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HANDBOOK OF CHEMISTRY

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AN APPENDIX OF MATHEMATICAL TABLES AND FORMULAS

by

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FIFTH EDITION REVISED AND ENLARGED

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Dedication

To those workers in science who through their labors determined the values recorded herein, this compilation is dedicated. Their devotion to the search for the constants of nature and the dissemination of this knowledge are the foundations upon which rest the achievements of applied science.

PREFACE

This book is the result of a number of years' experience in the compiling and editing of data useful to chemists. In it an effort has been made to select material to meet the needs of chemists who cannot command the unlimited time available to the research specialist, or who lack the facilities of a large technical library which so often is not conveniently located at many manufacturing centers. If the information contained herein serves this purpose, the compiler will feel that he has accomplished a worthy task. Even the worker with the facilities of a comprehensive library may find this volume of value as a time-saver because of the many tables of numerical data which have been especially computed for this purpose.

Every effort has been made to select the most reliable information and to record it with accuracy. Many years of occupation in this type of work bring a realization of the opportunities for the occurrence of errors, and while every endeavor has been made to prevent them, yet it would be remarkable if the attempts towards this end had always been successful. In this connection it is desired to express appreciation to those who in the past have called attention to errors and it will be greatly appreciated if this be done again with the present compilation for the publishers have given their assurance that no expense will be spared in making the necessary changes in subsequent printings.

It has been aimed to produce a compilation complete within the limits set by the economy of available space. One difficulty always at hand to the compiler of such a book is that he must decide what data are to be excluded in order to keep the volume from becoming unwieldy because of its size. He can hardly be expected to have an expert's knowledge of all branches of the science nor the intuition necessary to decide in all cases which particular value to record especially when many differing values are given in the literature for the same constant. If the expert in a particular field will judge the usefulness of this book by the data which it supplies to him from fields other than his specialty and not by the lack of highly specialized information in which only he and his coworkers are interested (and with which he is familiar and for which he

would never have occasion to consult this compilation), then an estimate of its value to him will be apparent. However, if such specialists will call attention to missing data with which they are familiar and which they believe others less specialized will also need, then works of this type can be improved in succeeding editions.

Many of the gaps in this volume are caused by the lack of such information in the literature. It is hoped that to one of the most important class of workers in chemistry, namely the teachers, the book will be of value not only as an aid in answering the most varied questions with which they are confronted by interested students, but also as an inspiration through what it suggests by the gaps and inconsistencies, challenging as they do the incentive to engage in the creative and experimental work necessary to supply the missing information.

While the principal value of the book is for the professional chemist or student of chemistry, it should also be of value to many people not especially educated as chemists. Workers in the natural sciences—physicists, mineralogists, biologists, pharmacists, engineers, patent attorneys, and librarians, are often called upon to solve problems dealing with the properties of chemical products or materials of construction. For such needs this compilation supplies helpful information and will serve not only as an economical substitute for the costly accumulation of a large library of monographs on specialized subjects, but also as a means of conserving the time required to search for information so widely scattered throughout the literature. For this reason especial care has been taken in compiling a comprehensive index and in furnishing cross references with many of the tables.

It is hoped that this book will be of the same usefulness to the worker in science as is the dictionary to the worker in literature, and that its resting place will be on the desk rather than on the book shelf.

N. A. Lange.

Cleveland, Ohio.
May 2, 1934.

PREFACE TO THE FIFTH EDITION

A number of new tables make their appearance in this *FIFTH EDITION.* These are listed below. All of the subject matter in the previous edition has been retained with the exception of the Table of Suffixes used in the nomenclature of organic compounds. The subject matter of this table has been augmented to include prefixes and symbols, and is now incorporated in the Glossary of Organic Chemistry Nomenclature. Much of the material in the previous edition has been completely rewritten and extended as listed below. The new tables and extensions of previous tables have necessitated the addition of 174 pages.

Perhaps the most important change in this edition is the complete revision of the table of Physical Constants of Organic Compounds. This table has been increased to include 6507 compounds with a corresponding list of more than 3500 synonyms. As in previous editions each compound, wherever it is possible, is given its Beilstein Reference. Many changes in standing matter throughout the work have been made to keep the information accurate and up-to-date. These changes, while less noticeable than additions of new subject matter, are just as important in providing a reference work of reliability.

The following is a list of the tables not in the previous edition and now offered for the first time:

PERIODIC TABLE (Deming)
FLAMMABLE LIQUIDS
FLAME TEMPERATURES
PLASTICS
FLUORESCENCE OF CHEMICALS, MINERALS, AND GEMS
WATER FOR INDUSTRIAL USE

The following tables in the previous edition have been extended or completely rewritten:

PHYSICAL CONSTANTS OF ORGANIC COMPOUNDS
FORMULA INDEX to the Table of Physical Constants of Organic Compounds
MELTING POINT INDEX to the Table of Physical Constants of Organic Compounds
NOMENCLATURE OF ORGANIC COMPOUNDS
ORGANIC REAGENTS FOR INORGANIC ANALYSIS
COMMON HAZARDOUS CHEMICALS
VITAMINS
DRINKING WATER STANDARDS
STANDARD CALIBRATION TABLE for the Chromel-Alumel Thermocouple
PROBABLE VALUES OF THE GENERAL PHYSICAL CONSTANTS
DENSITIES OF AQUEOUS SOLUTIONS OF HYDROCHLORIC, NITRIC, AND SULFURIC ACIDS to Include Corresponding Values of Normality
TRADE NAMES OF CHEMICALS
TWO HUNDRED YEAR CALENDAR increased to a *THREE HUNDRED YEAR CALENDAR*

The compiler, in presenting this *FIFTH EDITION*, wishes to express his indebtedness and appreciation to users of previous editions who have made suggestions for improvement or called attention to errors. Such suggestions have had much to do in improving this edition and making possible a compilation of maximum usefulness to its users. It is hoped that this coöperation will continue.

December, 1943. N. A. LANGE.

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FIRST AID MEASURES FOR ACCIDENTS AND ANTIDOTES OF POISONS

By W. F. von Oettingen, M. D., Ph. D.

The following directions are intended as first aid measures for accidents and different forms of poisoning. In laboratories connected with institutions or plants which have first aid stations or emergency hospitals, any injury should be reported immediately. If such facilities are not available, and whenever the case is of a more serious nature, a physician should be summoned at once and, in order to avoid any delay, the items in parentheses should be ready for his use upon his arrival.

Treatment of Burns

In any case of extensive burns of any degree, call physician.

1. From fire, steam and hot objects.

(*a*) *First degree* (*reddening*): Oil dressing or bland ointment; gauze saturated with pure vegetable or mineral oil.

(*b*) *Second degree* (*blisters*): Cover blister with sterile gauze saturated with a 5% solution of tannic acid and renew the dressing at intervals.

(*c*) *Third degree* (*destruction of tissue*): Cover wound with dressing of 5% tannic acid and call a physician. (Prepare sterile bandaging material; arrange facilities for sterilizing instruments with boiling water; in case of shock: caffeine sodio-benzoate or salicylate for hypodermic injection; normal saline solution.)

2. From acids (hydrochloric, nitric, phosphoric, and sulfuric acids, and chlorine or bromine). Wash with large quantities of water, then with 5% sodium bicarbonate solution, and apply oil dressing. (In case of extensive and severe burns prepare materials for physician as directed under 1, *c*.)

Burns from *hydrofluoric acid.* Wash burn immediately in cold running water until the white coagulated appearance of the area has been replaced by redness, or for a period of at least 4 to 6 hours. Then apply a freshly prepared 20% suspension of magnesium oxide in glycerol. (Prepare a 10% magnesium sulphate solution; material for oil dressing; facilities for the sterilization of instruments with boiling water.)

3. From alkalies: Wash the injury with large quantities of water, and cover the wound with an oil dressing or bland ointment. (In case of extensive burns prepare materials for physician as directed under 1, *c*.)

4. From phenols: Wash liberally with alcohol and then apply an

oil dressing. (In case of extensive burns prepare materials for physician as directed under 1, *c*.)

5. Burns of the eye should be flushed with large quantities of water, covered with sterile gauze, and medical aid should be summoned at once.

Treatment of Cuts

Clean the wound mechanically using *sterile* forceps or *sterile* gauze and paint the area *surrounding* the injury with 3.5% tincture of iodine.

If the cut is *small*, scrub with soap and water, cover with sterile gauze and bandage or adhesive tape.

If the cut is *severe* and bleeding freely apply a ligature between the site of the injury and the heart in case the blood is red and the flow intermittent; if the blood is dark and the flow continuous, apply the ligature between the injury and the periphery. Cover the wound with sterile gauze until arrival of the physician. (Prepare sterile bandaging material, facilities for sterilizing instruments with boiling water; and in case of severe hemorrhage several liters of sterilized physiological saline solution (0.9% solution of sodium chloride in water) and caffeine sodio-benzoate for hypodermic injection.)

Collapse

Lay the patient flat on the floor and let him inhale vapors of ammonia * or smelling salts; stimulate the skin by rubbing with stiff brushes. Administer whiskey or coffee *if patient is able to swallow*. In case the respiration is shallow or arrested, start artificial respiration preferably with simultaneous administration of oxygen-6% carbon dioxide mixture. (Prepare camphor oil, caffeine sodio-benzoate for hypodermic injection, sterilized physiological saline solution (0.9% solution of sodium chloride in water) and a cylinder of oxygen-6% carbon dioxide.)

Treatment of Poisonings

Call physician. If cause is known, follow immediately the directions given below.

Acids. When taken orally, rinse the mouth with water then with 5% sodium bicarbonate; give milk and a suspension of 10 grams of magnesium oxide (magnesia) in 150 cc of water; or limewater and oil; or a thin flour paste. (Prepare stomach tube, physiological saline solution prepared as directed under *collapse*, camphor oil and solution of caffeine sodio-benzoate.)

Alcohols. Give large quantities of warm water and if possible gastric

* Dilute.

lavage, emetics such as mustard water, and coffee. (Prepare caffeine sodio-benzoate, and oxygen-6% carbon dioxide mixture; stomach tube.)

Aldehydes. Give a tumbler full of 0.2% ammonia followed within a few minutes by milk. (Prepare stomach tube, caffeine sodio-benzoate, physiological saline as directed above, and oxygen-6% carbon dioxide mixture.)

Alkaloids. Immediately give one or two tablespoonfuls of purified charcoal in suspension in a glass of water; then give an emetic such as soap water. (Prepare caffeine sodio-benzoate, chloral hydrate, chloroform, and oxygen-6% carbon dioxide mixture.)

Ammonia. Administer large quantities of water containing vinegar or lemon juice and later give olive oil. (Prepare materials as given above for *acids* for use of the physician upon his arrival.)

Aniline. If taken by mouth, give large quantities of soap water, administer oxygen freely, combined with artificial respiration if necessary, saline cathartics, *give no alcohol or oils.* If inhaled, transfer patient to fresh air, let him have absolute rest and let him inhale oxygen. (Prepare materials as given under *acids.* Keep oxygen-6% carbon dioxide mixture ready.)

Arsenic or Antimony. Give an emetic such as soap water and a cathartic such as epsom salts; *do not rely upon chemical antidotes.* (Prepare stomach tube, physiological saline, and caffeine sodio-benzoate.)

Arsine. Absolute rest; free administration of oxygen-6% carbon dioxide mixture. (Prepare facilities for sterilizing instruments with boiling water, caffeine sodio-benzoate, and oxygen-6% carbon dioxide mixture.)

Barium salts. Give emetics such as soap water, and saline cathartics such as epsom or Glaubers salts. (Prepare stomach tube, and a 25% magnesium sulfate solution for hypodermic injection.)

Benzene. If taken by mouth, give emetics such as soap water or mustard water, cathartics, artificial respiration with simultaneous administration of oxygen, coffee. (Prepare stomach tube, caffeine sodio-benzoate, and oxygen-6% carbon dioxide mixture.) If inhaled, transfer patient to fresh air, prevent chilling, let him have absolute rest, if necessary let him inhale oxygen until physician arrives.

Carbolic acid. Give soap water as an emetic, large quantities of water, syrup of lime, or a solution of one part of potassium permanganate in 4000 parts of water. (Prepare stomach tube, caffeine sodio-benzoate, oxygen-6% carbon dioxide mixture.)

Carbon monoxide, Ethylene, Acetylene, Illuminating gas. Transfer patient to fresh air, prevent chilling, administer oxygen, if respiration is slow, irregular or intermittent, this should be combined with the administration of 6% carbon dioxide and artificial respiration in case the respiration has stopped. (Prepare caffeine sodio-benzoate, oxygen-6% carbon dioxide mixture.)

Chlorine, Bromine. If taken orally, rinse mouth with 3% sodium bicarbonate and magnesium oxide in water; give milk and suspension of 10 g. magnesium oxide in 150 cc of water. (Make preparations for the arrival of physician as directed under *acids.*) If inhaled, follow the treatment as given under *phosgene.*

Hydrocyanic acid, Cyanides. If taken orally, give a 1% solution of sodium thiosulfate or 0.025% solution of potassium permanganate alkalinized with sodium bicarbonate. Give an emetic such as mustard water or soap water and have patient inhale the contents of one pearl of amyl nitrite. Give artificial respiration with free administration of oxygen. (Prepare caffeine sodio-benzoate, oxygen-6% carbon dioxide mixture, stomach tube, several liters of an aqueous 0.05% potassium permanganate solution). If inhaled, start with inhalation of one pearl of amyl nitrite and artificial respiration with administration of oxygen.

Hydrogen sulfide. Artificial respiration with simultaneous administration of oxygen. (Prepare oxygen-6% carbon dioxide mixture.)

Iodine. Give an emetic such as soap water; a 1% aqueous solution of sodium thiosulfate (Hypo); starch paste; milk. (Prepare stomach tube and several liters of an aqueous 1% sodium thiosulfate solution.)

Lead compounds. Give large quantities of epsom salt. (Prepare stomach tube.)

Mercury compounds. Immediately give three raw eggs in a quart of milk and an emetic such as soap water. (Prepare stomach tube, hydrogen peroxide, and an hypophosphite-peroxide mixture composed of 1 gram sodium hypophosphite, 5 cc hydrogen peroxide, and 10 cc of water for each 0.1 gram of mercuric chloride in the stomach of the patient.)

Morphine alkaloids. Give strong coffee, hot bath and artificial respiration. (Prepare oxygen-6% carbon dioxide mixture, caffeine sodio-benzoate, 0.1% atropine sulfate solution for hypodermic use, stomach tube, and several liters of a 0.1% solution of potassium permanganate in water.)

Nitric vapors. *Absolute rest ! ! !* , even in moderate poisoning; inhalation of oxygen. (Prepare caffeine sodio-benzoate, facilities for sterilization of instruments with boiling water, and physiological saline solution as directed under *collapse.*)

Nitro compounds. Give emetic such as mustard water, and saline cathartics; *avoid alcohol, fats* and *oil.* (Prepare stomach tube, caffeine sodio-benzoate, and oxygen-6% carbon dioxide mixture.)

Oxalic acid. Give emetic such as mustard water; syrup of lime, lime water; castor oil. (Prepare stomach tube; sterile aqueous 3% solution of calcium lactate or calcium gluconate in ampoules for intravenous injection.)

Permanganate. Give water; emetic such as mustard water; starch paste. (Prepare stomach tube.)

Phosgene. *Absolute rest ! ! !*, even in moderate cases; inhalation of oxygen. (Prepare oxygen-6% carbon dioxide mixture, caffeine sodio-benzoate, and facilities for sterilization of instruments.

Phosphorus. Give 200 cc of a 0.2% aqueous solution of copper sulfate. *Avoid fats and oils.* (Prepare stomach tube, several liters of a 0.2% aqueous solution of copper sulfate, a 0.1% aqueous solution of potassium permanganate, liquid petrolatum.)

Pyridine. Give large quantities of tea or coffee; artificial respiration. (Prepare stomach tube, tannic acid, caffeine sodio-benzoate, and oxygen-6% carbon dioxide mixture.)

Sodium fluoride, Roach powder insecticide. Give lime water or weak solutions (2%) of calcium chloride. (Prepare for gastric lavage, keep lime water ready and 1% sterile solution of calcium chloride for intravenous injection, or calcium gluconate for intramuscular injection.)

Silver compounds. Give large quantities of common salt or sodium chloride solution. (Prepare stomach tube.)

Tin compounds. Give emetic such as soap water; milk of magnesia; oils. (Prepare stomach tube, caffeine sodio-benzoate.)

Zinc compounds. Give emetic such as soap water, and an egg in milk. (Prepare stomach tube, caffeine sodio-benzoate.)

ATOMIC WEIGHTS AND NUMBERS

(See also Table of Physical Constants of Inorganic Compounds)

Name	Symbol	Atomic Weight*	Logarithm of Atomic Weight	Atomic Number	Valence
Aluminum	Al	26.97	1.43088	13	3
Antimony	Sb	121.76	2.08551	51	3, 5
Argon	A	39.944	1.60145	18	0
Arsenic	As	74.91	1.87454	33	3, 5
Barium	Ba	137.36	2.13786	56	2
Beryllium	Be	9.02	0.95521	4	2
Bismuth	Bi	209.00	2.32015	83	3, 5
Boron	B	10.82	1.03423	5	3
Bromine	Br	79.916	1.90264	35	1, 3, 5, 7
Cadmium	Cd	112.41	2.05081	48	2
Calcium	Ca	40.08	1.60293	20	2
Carbon	C	12.010	1.07954	6	2, 3, 4
Cerium	Ce	140.13	2.14653	58	3, 4
Cesium	Cs	132.91	2.12355	55	1
Chlorine	Cl	35.457	1.54970	17	1, 3, 4, 5, 7
Chromium	Cr	52.01	1.71609	24	2, 3, 6
Cobalt	Co	58.94	1.77041	27	2, 3
Columbium	Cb	92.91	1.96806	41	3, 4, 5
Copper	Cu	63.57	1.80325	29	1, 2
Dysprosium	Dy	162.46	2.21075	66	3
Erbium	Er	167.2	2.22324	68	3
Europium	Eu	152.0	2.18184	63	3
Fluorine	F	19.00	1.27875	9	1
Gadolinium	Gd	156.9	2.19562	64	3
Gallium	Ga	69.72	1.84336	31	2, 3
Germanium	Ge	72.60	1.86094	32	2, 4
Gold	Au	197.2	2.29491	79	1, 3
Hafnium	Hf	178.6	2.25188	72	4
Helium	He	4.003	0.60239	2	0
Holmium	Ho	164.94	2.21352	67	3
Hydrogen	H	1.0080	0.0034605	1	1
Indium	In	114.76	2.05979	49	3
Iodine	I	126.92	2.10353	53	1, 3, 5, 7
Iridium	Ir	193.1	2.28578	77	3, 4
Iron	Fe	55.85	1.74695	26	2, 3
Krypton	Kr	83.7	1.92273	36	0
Lanthanum	La	138.92	2.14276	57	3
Lead	Pb	207.21	2.31641	82	2, 4
Lithium	Li	6.940	0.84136	3	1
Lutecium	Lu	174.99	2.24304	71	3
Magnesium	Mg	24.32	1.38596	12	2
Manganese	Mn	54.93	1.73981	25	2, 3, 4, 6, 7

*International Atomic Weights: Jour. Am. Chem. Soc. 63, 850 (1941).

ATOMIC WEIGHTS AND NUMBERS

Name	Symbol	Atomic Weight*	Logarithm of Atomic Weight	Atomic Number	Valence
Mercury	Hg	200.61	2.30235	80	1, 2
Molybdenum	Mo	95.95	1.98204	42	3, 4, 5, 6
Neodymium	Nd	144.27	2.15918	60	3
Neon	Ne	20.183	1.30499	10	0
Nickel	Ni	58.69	1.76856	28	2, 3
Nitrogen	N	14.008	1.14638	7	3, 5
Osmium	Os	190.2	2.27921	76	2, 3, 4, 6, 8
Oxygen	O	16.0000	1.20412	8	2
Palladium	Pd	106.7	2.02816	46	2, 3, 4
Phosphorus	P	30.98	1.49108	15	3, 5
Platinum	Pt	195.23	2.29055	78	2, 4
Potassium	K	39.096	1.59218	19	1
Praseodymium	Pr	140.92	2.14897	59	3
Protactinium	Pa	231	2.36361	91	5
Radium	Ra	226.05	2.35421	88	2
Radon	Rn	222	2.34635	86	.....
Rhenium	Re	186.31	2.27023	75	4, 6, 7
Rhodium	Rh	102.91	2.01246	45	2, 3
Rubidium	Rb	85.48	1.93186	37	1
Ruthenium	Ru	101.7	2.00732	44	2(?), 3, 4, 6, 8
Samarium	Sm	150.43	2.17734	62	3
Scandium	Sc	45.10	1.65418	21	3
Selenium	Se	78.96	1.89741	34	2, 4, 6
Silicon	Si	28.06	1.44809	14	4
Silver	Ag	107.880	2.03294	47	1
Sodium	Na	22.997	1.36167	11	1
Strontium	Sr	87.63	1.94265	38	2
Sulfur	S	32.06	1.50596	16	2, 4, 6
Tantalum	Ta	180.88	2.25739	73	3, 4, 5
Tellurium	Te	127.61	2.10588	52	2, 4, 6
Terbium	Tb	159.2	2.20194	65	3
Thallium	Tl	204.39	2.31046	81	1, 3
Thorium	Th	232.12	2.36572	90	4
Thulium	Tm	169.4	2.22891	69	3
Tin	Sn	118.70	2.07445	50	2, 4
Titanium	Ti	47.90	1.68034	22	3, 4
Tungsten	W	183.92	2.26463	74	2, 4, 6
Uranium	U	238.07	2.37671	92	4, 6
Vanadium	V	50.95	1.70714	23	2, 3, 4, 5
Xenon	Xe	131.3	2.11826	54	0
Ytterbium	Yb	173.04	2.23815	70	3
Yttrium	Y	88.92	1.94900	39	3
Zinc	Zn	65.38	1.81544	30	2
Zirconium	Zr	91.22	1.96009	40	4

*International Atomic Weights; Jour. Am. Chem. Soc. 63, 850 (1941).

A TABLE OF COMMON

Prepared by Committees of the National Fire Protection

Tentatively adopted 1928, *adopted* 1929,

These columns are informative only; it is not considered necessary that the material be kept or stored only in the containers as listed, nor that each package be labeled.

Usual Shipping Container	Life Hazard	Fire Fighting Phases
Acetic Acid (Glacial)		
Glass carboys and barrels. Expands on solidification and may burst container unless kept at a temperature above 16° C. (60.8° F.).	May cause painful burns of skin.	Extinguishing agent, water.
Acetone		
Carboys, steel drums, tank cars.	Toxicity of a comparatively low order.	Lighter than water. (Sp. gr. 0.792) but soluble in it in all proportions. Water, particularly in the form of spray, is the best extinguisher. Carbon di oxide may also be used. Automatic sprinkler systems or total-flooding carbon dioxide systems may be employed for protection in storage rooms.
Aluminum Dust		
Barrels or boxes.		Smother with sand, ashes, or rock dust. Do not use water, which may cause explosion.
Aluminum Resinate		
Wooden barrels.		
Ammonia (Anhydrous)		
Steel cylinders or steel tank cars.	Irritant. An outstanding serious effect produced by ammonia in concentrations of the order of ½% by volume for duration of exposure of the order of ½ hour is blindness. A concentration of 0.03% of ammonia in air for duration of exposure of the order of ½ to 1 hour, according to Lehmann, does not cause serious effects.	Soluble in water. Hose streams comparatively effective in removing the gas from the atmosphere.

HAZARDOUS CHEMICALS

Association and American Chemical Society.

amended 1931, 1935, 1938, 1939, 1941, 1942.

The requirements in the table on the storage of containers refer to chemicals in usual containers, and are not intended to apply to small bottles of chemicals such as are found in drug stores and chemical laboratories.

Fire Hazard	Storage
Dangerous in contact with chromic acid, sodium peroxide or nitric acid; yields moderately flammable vapors above flash point 104° F.	Safeguard against mechanical injury. Isolate from oxidizing materials as noted under Fire Hazard.
A volatile liquid. Gives off vapors which form with air flammable and explosive mixtures. Flash point −16° C. (3° F.). Explosive range 2.55% to 12.8% (upward propagation). The ignition temperature is comparatively high, being within the range 538° to 566° C. (1000° to 1050° F.). The vapors are heavier than air (vapor density 2). Fire hazard slightly less than that of gasoline.	Safeguard containers against mechanical injury. Only electrical equipment of the explosion-proof type, Group D classification, permitted in atmospheres containing acetone vapor in flammable proportions.
Forms flammable and explosive mixtures with air.	Keep in dry place. In case of fire do not use water; it may cause an explosion.
Combustible.	Storage should be ventilated and safeguarded as for oil storage building.
Gas density 0.60 (air = 1). Not flammable in air except in comparatively high concentration, which is seldom encountered under practical conditions, the low limit of the flammable or explosive range being about 15% to 16% and the upper limit about 25% to 26% by volume (horizontal propagation). The presence of oil will increase the fire hazard. Ammonia aqua does not burn.	Safeguard against mechanical injury and excessive heating of cylinders or tanks. Fire-resistive storage recommended. In combustible buildings or if near combustibles, sprinklered storage recommended. Isolate from other chemicals, particularly chlorine, bromine, iodine and mineral acids.

Usual Shipping Container	Life Hazard	Fire Fighting Phases
Ammonium Perchlorate		
Wooden barrels or kegs and glass bottles.		
Antimony Pentasulfide; (Golden Antimony Sulfide) Sb_2S_5		
Fiber drums or tins. Used in manufacture of matches, ammunition and fire works, and of certain rubber compounds.	Gaseous products of combustion contain sulfur dioxide and are irritating and corrosive.	Practically insoluble in water. Use water.
Barium Chlorate		
Wooden boxes, barrels or kegs.		See potassium chlorate.
Barium Nitrate		
Wooden boxes; barrels.	Soluble in water. Poisonous when taken internally.	See sodium nitrate.
Barium Peroxide		
Tightly closed metal containers packed in wooden boxes or barrels; or in bulk in metal barrels or drums.		Smother with sand, ashes, or rock dust. Do not use water.
Benzoyl Peroxide (Dry granular or powdered wet)		
Dry granular material in individual one-pound containers inside wooden boxes; finely powdered material shipped wet (30% water by weight) in glass containers placed inside tightly sealed metal containers in wooden boxes or in aluminum drums.	Dust irritating to eyes and lungs. Use goggles and dust respirator in dusty atmospheres.	Water, carbon dioxide, foam, sand, soda ash, or rock dust may be used as extinguishing agents.
Bleaching Powder; Calcium Hypochlorite; Chlorinated Lime; Chloride of Lime (incorrect name)		
Air-tight tin containers, wooden barrels, and steel drums. Encountered in paper, textile, disinfectant and alkali industries; also where water purification processes are employed.	Corrosive. Irritating to skin, eyes, and lungs. See chlorine.	Fires where the compound is present may be fought with water, preferably spray. Protect eyes and skin, using gas mask of a type approved by Bureau of Mines.

HAZARDOUS CHEMICALS

Fire Hazard	Storage
Oxidizing material. May explode in a fire. Hazard classes with potassium chlorate.	Safeguard against mechanical injury. Isolate from mineral acids, also from combustibles.
Combustible. Readily ignited by a small flame. Hazardous in contact with oxidizing material. Yields flammable hydrogen sulfide on contact with mineral acid.	Safeguard against mechanical injury. Isolate from acids, chlorates, nitrates, and other oxidizing agents.
Oxidizing material. Hazard classes with potassium chlorate.	Isolate.
Oxidizing material. Hazard in class with sodium nitrate.	Do not store with combustible materials.
Oxidizing material. Hazard in class with sodium peroxide.	Do not store with combustible materials.
Highly flammable in the dry state. Strong supporter of combustion. Do not subject dry material to heat of friction or grinding. Not miscible with water.	Store in a cool ventilated place. Powder should be stored with not less than 30% water by weight. Keep away from all sources of heat and separate from all combustible materials and acids.
Not combustible but evolves chlorine and at higher temperatures oxygen. With acids or moisture evolves chlorine freely at ordinary temperatures. See chlorine.	Store in cool, dry, well ventilated place away from combustibles. See chlorine. Rupture of drums containing bleaching powder, particularly if the chlorine content is high, may result from exposure to heat.

A TABLE OF COMMON

Usual Shipping Container	Life Hazard	Fire Fighting Phases
Borneol		
Barrels, kegs, boxes and tins.		See camphor.
Bromine		
Glass bottles; earthen jugs. Bottles should be surrounded by incombustible packing.	Corrosive; at ordinary temperatures gives off poisonous suffocating vapors.	
Bronze Dust		
Barrels or boxes.		Smother with sand or ashes.
Butane		
Steel cylinders.		
Calcium Carbide		
Iron drums and tin cans.	Serious under fire conditions.	Smother with sand or ashes. Do not use water.
Calcium Oxide; Quick Lime		
Wooden barrels and bags.		
Camphene		
Tins.		Smother with sand or ashes. Avoid water.
Camphor		
Tins and wooden kegs.		Smother with sand or ashes. Chemical streams. Avoid water.
Carbolic Acid—*See Phenol.*		
Carbon Disulfide		
Small glass, earthenware, or metal containers packed in outside barrels or boxes (See I. C. C. Regulations). Steel drums, steel tank cars. Carbon disulfide should never be transferred by means of air. Use inert gas, water, or pump. Use a wood measuring stick for	Toxic. 3200 to 3850 parts of vapor per million (0.32 to 0.385% by volume) may cause dangerous illness in ½ to 1 hour. Direct contact with the skin should be avoided. Products of combustion contain sulfur dioxide, which in concentrations of 0.2% by volume in air may cause serious injury in	Heavier than water (Sp. gr. 1.29) and sparingly soluble in it. Use sand, carbon dioxide, or other inert gas as extinguishing agents. Cooling and blanketing action of water may be utilized in case of fires in metal containers or tanks. Total-flooding carbon dioxide systems may be employed for protection in storage rooms. Foam not effective. Do not

HAZARDOUS CHEMICALS

Fire Hazard	Storage
Combustible. Hazard similar to camphor.	Store in well-ventilated compartment or building.
Causes oxidizing effect, resulting in heating and may cause fire when in contact with organic material.	Isolate; safeguard against mechanical injury.
When aluminum is present forms flammable and explosive mixtures with air. Composition usually free from aluminum.	Bronze dust free from aluminum not considered dangerous.
Flammable gas under pressure. Classes with gasoline vapor in fire hazard.	Safeguard against mechanical injury. Keep cool.
Gives off acetylene gas on contact with water or moisture.	Store in dry, well-ventilated place in accordance with N.F.P.A. Standards.
Heats upon contact with water or moisture and may cause ignition of organic material. Swells when moist and may burst container.	Isolate; store in dry place away from water or moisture.
When heated gives off flammable vapors. Classes with turpentine.	Isolate; keep in unheated compartment away from fire or heat.
Flammable; gives off flammable vapors when heated which may form explosive mixture with air. Flash point 180° F.	Detach from other storage. Keep in well-ventilated room remote from fire.
A highly volatile liquid with an offensive odor, giving off even at comparatively low temperatures vapors which form with air flammable and explosive mixtures. Flash point −30° C. (−22° F.). Flammable range 1% to 50% (upward propagation). The ignition temperature is dangerously low, being about 100° to 106° C. (212° to 223° F.). It is endothermic, and the vapor may be ignited by a heavy blow. The vapors are heavier than air (vapor density 2.62), and may travel a considerable distance to a source of ignition and flash back. More hazardous than gasoline.	Isolate and safe-guard containers against mechanical injury and metallic blows, and keep in unheated compartment away from sunlight and any source of ignition, including electric lighting fixtures and other electrical equipment. Storage tanks should be constructed over concrete basins containing water, and the carbon disulfide kept blanketed

Usual Shipping Container	Life Hazard	Fire Fighting Phases
Carbon Disulfide (*Continued*)		
measuring contents of storage tanks or tank cars. Tank cars when being loaded or unloaded should be well grounded. Do not dispose of carbon disulfide by pouring it on the ground. Provide a safe place for burning it.	½ hour or less. Often poisonous carbon monoxide is present in the products of combustion.	use carbon tetrachloride. Use of gas masks or oxygen helmets of the type approved for the purpose by U. S. Bureau of Mines recommended.
Charcoal (Wood)		
Boxes, barrels, bags, or bulk.	There is danger from carbon monoxide poisoning during burning unless adequate ventilation is provided.	Use water, completely extinguishing the fire, after which the storage pile should be moved.
Chinese Wax		
Burlap bags and wooden barrels.		
Chlorine		
Steel cylinders and tank cars.	Corrosive. Irritating to eyes and mucous membrane. Toxic. 0.004% to 0.006% by volume in air causes dangerous illness in ½ to 1 hour.	Use gas masks on entering atmospheres containing chlorine gas. If, however, concentration is high, or there is doubt as to the degree of concentration, use oxygen helmet of a type approved for such use by U. S. Bureau of Mines.
Chromium Trioxide or Chromium Anhydride CrO_3 (often called "Chromic Acid")		
Iron drums and glass bottles. It is used in chromium plating, in electric batteries, and in photography.	Irritating to skin. Poisonous.	Use water, completely extinguishing the fire, after which the storage pile should be removed.
Cobaltous Nitrate		
Wooden barrels.		
Colophony; Rosin		
Barrels.		
Copper Nitrate		
Wooden barrels and kegs.	Poisonous when taken internally. Soluble in water.	

HAZARDOUS CHEMICALS

Fire Hazard	Storage
	with water or inert gas at all times.
Spontaneously ignitable when freshly calcined and exposed to air, or when wet; hazardous when freshly ground and tightly packed.	Isolate; prevent dust accumulations; ventilate well; make daily inspections.
Combustible.	Detach from other storage.
Is not combustible in air but reacts chemically with many common substances and may cause fire or explosion when in contact with them. See remarks under "Storage." Dangerous to neutralize chlorine in a room with ammonia.	Isolate from turpentine, ether, ammonia gas, illuminating gas, hydrocarbons, hydrogen, and finely divided metals. Safeguard against mechanical injury of containers.
Oxidizing material; will ignite on contact with acetic acid and alcohol. Chars organic material such as wood, sawdust, paper, or cotton, and may cause ignition. Combustible material in presence of chromium trioxide when ignited burns with great intensity. May cause explosion in fire.	Isolate.
Oxidizing material. Classes with sodium nitrate.	See sodium nitrate.
Combustible; gives off flammable vapors when heated.	Ventilate storage; avoid dust; keep away from fire or heat.
Oxidizing material. Hazard classes with sodium nitrate.	Safeguard against mechanical injury; isolate. See sodium nitrate.

A TABLE OF COMMON

Usual Shipping Container	Life Hazard	Fire Fighting Phases
Cyclopropane Steel cylinders.	Anaesthetic.	Use water to cool cylinders not on fire. If gas is burning at valves or safety releases, usually the best course to follow is not to disturb or attempt to extinguish flame. To do so will cause the release of unburned gas and quickly create highly dangerous explosive atmospheres. If cylinder is mounted on an anaesthetic machine or truck, it may be possible to move it to a safe place. Carbon dioxide or carbon tetrachloride are best extinguishing agents.
Didymium Nitrate Wooden kegs.		
Dioxane Glass bottles, metal cans, and metal drums.	Irritant and toxic in high concentrations.	Water best extinguishing agent. Slightly heavier than and completely soluble in water (Sp. gr. 1.03).
Ethyl Ether Glass bottles or tin cans in boxes, steel drums.	Anaesthetic. See National Board of Fire Underwriters' Recommended Safeguards for the Installation and Operation of Anaesthetical Apparatus Employing Combustible Anaesthetics.	Lighter than water. (Sp. gr. 0.7135.) Soluble in about ten times its own volume of water. Water may be utilized only to cool metal containers. Best extinguishing agents are carbon dioxide and sand, also carbon tetrachloride in case of fires involving limited amounts of ether. Total-flooding carbon dioxide systems may be employed for protection in storage rooms.
Ethylene Steel cylinders.	Anaesthetic.	Use water to cool cylinders not on fire. If gas is burning at valves or safety releases, usually the best course to follow is not to disturb or attempt to extinguish flame. To do so

HAZARDOUS CHEMICALS

Fire Hazard	Storage
Highly flammable gas. Forms flammable and explosive mixtures with air or oxygen. Explosive range 2.40% to 10.4% (upward propagation). Only electrical equipment of the explosion-proof type, Group C classification tentative pending further tests, permitted in atmospheres containing cyclopropane in flammable proportions.	Isolate from oxygen cylinders and store in a cool, well ventilated storeroom.
Oxidizing material. Classes with sodium nitrate.	Isolate. See sodium nitrate.
Moderately volatile flammable liquid. Flash point 54° F. Explosive range 1.97% to 22.25% (upward propagation). Vapors are heavier than air (vapor density 3.03). Capable of forming peroxides under certain conditions, and there may be danger of explosion if redistilled, unless certain precautions are taken.	Isolate and safeguard against mechanical injury.
A highly volatile liquid, giving off even at comparatively low temperatures vapors which form with air or oxygen flammable and explosive mixtures. Explosive range 1.85% to 36.5% (upward propagation). The ignition temperature is comparatively low, being approximately 180° C. (356° F.). Spontaneously explosive peroxides sometimes form on long standing or exposure in bottles to sunlight. The vapors are heavier than air (vapor density 2.6) and may travel a considerable distance to a source of ignition and flash back. More hazardous than gasoline.	Safeguard containers against mechanical injury. Isolate and keep in unheated compartment away from sunlight and any source of ignition. Only electrical equipment of the explosion-proof type, Group C classification, permitted in atmospheres containing ether vapor in flammable proportions.
Highly flammable gas. Forms flammable and explosive mixtures with air or oxygen. Explosive range 2.75% to 28.6% (upward propagation). Ignition temperature about 450° C. (842° F.). Slightly lighter than air (density 0.97). The gas is spontaneously explosive in sunlight with chlorine.	Isolate from oxygen cylinders and store in a cool, well ventilated storeroom.

Usual Shipping Container	Life Hazard	Fire Fighting Phases
Ethylene (*Continued*)		will cause the release of unburned gas and quickly create highly dangerous explosive atmospheres. If cylinder is mounted on an anaesthetic machine or truck, it may be possible to move it to a safe place. In a closed storeroom carbon dioxide or carbon tetrachloride are best extinguishing agents.
Ferric Nitrate Wooden barrels.		
Formic Acid Barrels and carboys.	Corrosive; has caustic effect on the skin.	
Fulminate of Mercury		
Fulminate of Silver		
Hydrochloric Acid (Muriatic Acid) Tank cars (rubber-lined), carboys, and glass bottles.	Aqueous solution is corrosive, irritating, and poisonous. Fumes are corrosive and irritating to mucous membranes.	Use water or chemically basic substances such as soda ash or slaked lime.
Hydrocyanic Acid (Prussic Acid) Cylinders, or when completely absorbed in inert material in metal cans with outside wooden boxes.	Poisonous. Few breaths may cause unconsciousness and death. Avoid contact with the skin.	The gas is slightly lighter than air. Soluble in water. Water is the best extinguisher. When entering premises where used or stored during a fire, use oxygen helmet or gas mask equipped with canister of a type approved by the Bureau of Mines for hydrocyanic acid.
Hydrofluoric Acid (HF) Aqueous solution in lead carboys and wax or gutta percha bottles.	Acid and its vapors highly toxic and irritating to skin, eyes and respiratory tract. Fumes produced by contact with ammonia and many metals poisonous. May be neutralized with	Use water in case of fires involving hydrofluoric acid. Use oxygen helmet of a type approved for such use by the U. S. Bureau of Mines on entering atmospheres known to contain hydrofluoric acid vapors.

HAZARDOUS CHEMICALS

Fire Hazard	Storage
Only electrical equipment of the explosion-proof type, Group C classification, permitted in atmospheres containing ethylene in flammable proportions.	
Oxidizing material.	Isolate. Safeguard against mechanical injury.
Flammable; gives off flammable vapors which may form explosive mixtures with air.	Safeguard against mechanical injury.
High explosive.	Explosive restrictions.
High explosive.	Explosive restrictions.
Not combustible (in air) but if allowed to come in contact with common metals hydrogen is evolved, which may form explosive mixtures with air.	Safeguard containers against mechanical injury. Keep away from oxidizing agents, particularly nitric acid and chlorates. Avoid contact by leakage or otherwise with all common metals.
Forms flammable and explosive mixtures with air. Explosive range 6% to about 40% by volume (horizontal propagation). Concentrations of the gas ordinarily employed for fumigation (1% or less) are considerably below the lower limit of flammability (6% by volume). Some methods of fumigation, however, are employed which temporarily yield flammable mixtures even though the final concentration is low.	Isolate. Keep away from any source of heat. Safeguard containers against mechanical injury.
Colorless, volatile liquid. Not combustible but reacts with glass and most substances, platinum being an exception. Aqueous solution also attacks glass and several metals.	Isolate. Ventilate. Safeguard against mechanical injury. Encountered in glass works and chemical laboratories. Used to remove sand from castings and in the manufacture of filter paper. Vapors have been known to cause ser-

Usual Shipping Container	Life Hazard	Fire Fighting Phases
Hydrofluoric Acid (HF) (*Continued*)	chalk. Bicarbonate of soda solution may be immediately applied to burns as first-aid and used as gargle.	
Hydrofluosilicic Acid		
Lead carboys, hard rubber or paraffin bottles.	Corrosive.	
Hydrogen Peroxide (27.5 per cent by weight)		
Glass carboys, aluminum drums, aluminum tank cars (all containers must be vented).	Prolonged exposure to vapor irritating to eyes and lungs. Causes skin irritation. Use goggles to protect eyes from splash.	Use water.
Hydrogen Sulfide (Sulfuretted Hydrogen)		
Steel cylinders.	Toxic. 0.05 to 0.07 per cent by volume in air causes dangerous illness in ½ to 1 hr. Should be used under hoods in chemical laboratories to avoid danger of breathing dangerous concentrations.	Use gas masks in entering atmospheres containing hydrogen sulfide. If, however, concentration is high, use oxygen helmet of a type approved for such use by U. S. Bureau of Mines.
Lead Nitrate		
Wooden barrels.	Poisonous.	
Lime (unslaked)— *See Calcium Oxide.*		
Magnesium		
Shavings or powder in tightly closed metal or metal-lined containers. Ingots and bars in ordinary boxes.	Serious under fire conditions. Danger of explosion and from flying particles. Do not attempt to smother unless at a safe distance, or else protection is provided for eyes and face.	Smother with an excess of dry graphite. Dry sand may be used on small fires. Not advisable to use sand around machinery. Do not use water, foam, carbon tetrachloride, or carbon dioxide.
Magnesium Alloys (high percentage of magnesium)		
	Protect eyes and skin from flying particles in case of fire.	Smother with an excess of dry graphite. Dry sand may be used on small fires. Not advisable to use sand around machinery. Do not use water, foam, carbon tetrachloride, or carbon dioxide.

HAZARDOUS CHEMICALS

Fire Hazard	Storage
	ious corrosion of sprinkler piping and heads.
None.	Safeguard against mechanical injury.
Oxidizing liquid. May cause ignition of combustible material if left standing in contact with it. May decompose violently if contaminated with iron, copper, chromium, and most metals or their salts.	Store in a cool place in ventilated containers remote from combustible material and catalytic metals such as iron, copper, chromium.
Flammable gas. Forms flammable and explosive mixture with air or oxygen. Explosive range in air (upward propagation) 4.3 (low limit) to 46. Heavier than air. Specific gravity 1.19 (air = 1). Ignition temperature 346°-379° C. (655°-714° F.)	Store in ventilated place away from fuming nitric acid and oxidizing materials. Encountered in chemical laboratories, metallurgical and smelting works, gas works, sewers.
Oxidizing material. Classes with sodium nitrate.	Isolate; safeguard against mechanical injury.
Combustible, particularly in the form of powder, shavings, or thin sheets. When powder is disseminated in the air, explodes by spark. In finely divided form liberates hydrogen in contact with water. In massive form (ingots or blocks) comparatively difficult to ignite.	Store remote from water or moisture, oxidizing materials, chlorine, bromine, iodine, acids, and alkalies.
In compact or bulk form (castings, plates, etc.) difficult to ignite. Readily combustible in form of dust, turnings, and hazardous in such form with chlorine, bromine, iodine, oxidizing agents, acids, and alkalies.	Store dust, shavings, and turnings in metal containers in detached building or fire-resistive room. Detailed safety precautions for handling are usually supplied by manufacturers of magnesium alloys.

Usual Shipping Container	Life Hazard	Fire Fighting Phases
Magnesium Nitrate		
Wooden boxes.		See sodium nitrate.
Muriatic Acid — *See Hydrochloric Acid.*		
Naphthalene		
Tins, barrels, and burlap bags.	Irritant. Slight narcotic effect on the skin. The hot vapors produce itching, pain, and eczema.	Water is the best extinguishing agent. Foam or water applied to molten naphthalene at temperatures over 230° F. will cause foaming.
Nickel Nitrate		
Wooden kegs.	Poisonous when taken internally.	
Nitric Acid		
Carboys and glass bottles.	Corrosive; causes severe burns by contact; deadly if inhaled.	
Nitraniline or Nitro Aniline		
Wooden kegs.	Poisonous.	
Nitrochloro-Benzene		
Wooden kegs.	Serious under fire conditions.	
Phenol		
	Poisonous.	
Phosphorus, Red		
Hermetically sealed tin cans inside of wooden boxes.	Yields toxic fumes when burning.	Flood with water, and when fire is extinguished cover with wet sand or dirt. Under certain conditions at high temperatures reverts to white phosphorus.
Phosphorus, White, (or Yellow)		
Under water usually in hermetically sealed cans enclosed in other hermetically sealed cans with outside wooden boxes, or in drums or tank cars.	Poisonous. Serious under fire conditions. Yields highly toxic fumes when burning. Contact of phosphorus with the skin causes severe burns.	Deluge with water until fire is extinguished and phosphorus solidified; then cover with wet sand or dirt.

HAZARDOUS CHEMICALS

Fire Hazard	Storage
Oxidizing material. Classes with sodium nitrate.	See sodium nitrate.
Gives off flammable vapors when heated. Flash point 176° F. Naphthalene dust forms explosive mixtures with air. Ignition temperature 559° C. (1038° F.).	Isolate; keep away from fire or heat.
Oxidizing material. Classes with sodium nitrate.	Safeguard against mechanical injury.
May cause ignition when in contact with combustible materials; corrodes iron or steel; may cause explosion when in contact with hydrogen sulfide and certain other chemicals.	Safeguard against mechanical injury of containers; isolate from turpentine, combustible materials, carbides, metallic powders, fulminates, picrates or chlorates.
In presence of moisture causes nitration of organic materials and may result in spontaneous ignition.	Store in dry place; safeguard against mechanical injury.
Gives off flammable vapors when heated, which may form explosive mixtures with air.	Isolate, preferably in the open; if inside should be in unheated compartment or building.
When heated yields flammable vapors. Flash point 172.4° F.	Soluble in water. Never store with or above food products.
Flammable. Explosive when mixed with oxidizing materials. Not as dangerous to handle as white phosphorus, and when afire, more readily extinguished.	Isolate from other chemicals; safeguard against mechanical injury of container.
Highly flammable. Explosive in contact with oxidizing material. Ignites spontaneously on contact with air.	Isolate from chemicals. Store large quantities under water in underground iron or concrete tanks.

Usual Shipping Container	Life Hazard	Fire Fighting Phases
Phosphorus Sesquisulfide, P_2S_5		
Wooden boxes, iron drums, glass bottles.	Fumes in fire toxic.	
Picric Acid		
Wooden kegs, boxes, bottles.	Classes with high explosives in respect to life hazard.	
Potassium (Metallic Potassium)		
Hermetically sealed steel drums, tin cans, and tank cars.	Strong caustic reaction. Dangerous.	Smother with an excess of dry graphite or dry sand. Do not use water. It is difficult to extinguish fires in large quantities of potassium.
Potassium Chlorate		
Wooden barrels or kegs.	Dangerous under fire conditions.	Water is the best extinguishing agent.
Potassium Cyanide		
Tightly closed glass, earthenware, or metal containers; wooden boxes with inside metal containers, or with hermetically-sealed metal lining; metal barrels or drums.	Highly poisonous when taken internally. Evolves hydrocyanic acid gas (poisonous) on contact with acids or moisture.	
Potassium Hydroxide		
Wooden barrels, glass bottles.		
Potassium Nitrate		
Bags, tins and glass bottles.		See sodium nitrate.
Potassium Perchlorate		
Paper-lined metal containers.		Use water to prevent the spread of fire.
Potassium Permanganate		
Tins.		

HAZARDOUS CHEMICALS

Fire Hazard	Storage
Highly flammable. Ignites by friction.	Isolate from chemicals. Safeguard container against shock.
Flammable, explosive. Oxidizing material.	Isolate or store under water, keep away from other material, including metals, with which it forms sensitive and explosive picrates.
Oxidizes rapidly on exposure to atmosphere, igniting spontaneously if warm enough. Water is decomposed suddenly by contact with potassium, sufficient heat being generated to ignite spontaneously the evolved hydrogen (in the presence of air). Its reaction with water is more violent than that of sodium.	Do not tier if it can be avoided. Keep away from water, avoiding sprinkler systems. Safeguard against mechanical injury of containers.
Oxidizing material; explosive when in contact with combustible material.	Isolate from combustible material, acids, and sulfur.
Cyanides not flammable but evolve hydrocyanic acid (see) on contact with acids or moisture.	Isolate. Safeguard containers against mechanical injury.
Generates heat on contact with water. Classes with calcium oxide (lime) in hazard.	Store in dry place; keep remote from water or moisture.
In contact with organic materials causes violent combustion on ignition. Classes with sodium nitrate.	Store in dry place, prevent contact with organic material.
Oxidizing material. Combustible in contact with organic materials. More stable than chlorates. Explosive in contact with concentrated sulfuric acid.	Store in dry place away from acids and combustible material.
Oxidizing material. Explosive when treated with sulfuric acid, and in contact with alcohol, ether, flammable gases, and combustible materials.	Isolate from other chemicals, especially those noted under fire hazard.

Usual Shipping Container	Life Hazard	Fire Fighting Phases
Potassium Peroxide		
Tins and steel drums.	Strong caustic reaction and dangerous under fire conditions. Avoid breathing dust in handling, and wear goggles to protect eyes.	Smother with dry sand, soda ash, or rock dust. Do not use water.
Potassium Persulfate		
Glass bottles and stone jars.		
Potassium Sulfide		
Iron drums, cans, glass bottles.	Yields irritating and corrosive gases when burning.	
Salicylic Acid		
Bottles, cartons, kegs and barrels.	Used in manufacture of aspirin, salol, and methyl salicylate; also in manufacture of azo dyes. Preservative. There have been explosions in sublimation chambers.	Slightly soluble in water. Extinguish with water or smother with carbon dioxide or sand.
Saltpeter — *See Potassium Nitrate.*		
Silver Nitrate		
Amber or black glass bottles.	Corrosive and poisonous.	
Soda, Caustic — *See Sodium Hydroxide.*		
Sodium		
Hermetically sealed steel drums, tin cans, and tank cars.	Strong caustic reaction. Dangerous.	Smother with an excess of dry graphite or dry sand. Do not use water. It is difficult to extinguish fires in large quantities of sodium.
Sodium Chlorate		
Wooden barrels, glass bottles.	See potassium chlorate.	See potassium chlorate.
Sodium Chlorite ($NaClO_2$)		
Wooden boxes with inside containers which	Poisonous when taken internally. Dangerous	Soluble in water. Water is best extinguishing agent.

HAZARDOUS CHEMICALS

Fire Hazard	Storage
Does not burn or explode *per se* but mixtures of potassium peroxide and combustible substances are explosive and ignite easily even by friction or on contact with a small amount of water. Reacts vigorously with water and in large quantities this reaction may be explosive.	Store remote from organic substances and water. Do not expose to sprinkler systems.
Oxidizing material. May cause explosion in a fire.	Keep dry; safeguard against mechanical injury of containers.
Moderately flammable, yields flammable hydrogen sulfide on contact with mineral acids and sulfur dioxide when burning.	Safeguard against mechanical injury of containers.
Combustible solid. Flash point 157° C. (315° F.). Ignition temperature 545° C. (1013° F.). Salicylic dust forms explosive mixtures with air.	Store in dry place.
Oxidizing material.	Store in dark place; keep cool and away from combustible material.
Water is suddenly decomposed by contact with sodium with the evolution of hydrogen, which may ignite spontaneously (in the presence of air). Classes with potassium in respect to fire hazard but its reaction with water is less violent than that of potassium.	Do not tier if it can be avoided. Keep away from water, avoiding sprinkler systems. Safeguard against mechanical injury of containers.
Oxidizing material. Classes with potassium chlorate. See potassium chlorate.	See potassium chlorate.
Strong oxidizing material. Decomposes with evolution of heat at about 175° C. (347° F.). Ex-	Isolate from combustible material, sulfur, and acids.

Usual Shipping Container	Life Hazard	Fire Fighting Phases
Sodium Chlorite ($NaClO_2$) (*Continued*)		
must be glass or earthenware not over 2¼ lb. capacity, or metal not over 5 lb. capacity each.	under fire conditions. Used in bleaching textiles and paper.	
Sodium Cyanide— ***See Potassium Cyanide.***		
Sodium Hydrosulfite Wooden barrels, kegs, or boxes with inside glass bottles of capacity not exceeding 5 lb. each, or metal containers.	Bleaching agent for removing dyes.	Smother with sand or foam.
Sodium Hydroxide Iron drums.		
Sodium Nitrate Bags, tins and glass bottles.		Most fires involving sodium nitrate can safely be fought with water in the early stages; at such times it should be flooded with water. When large quantities are involved in the fire, the sodium nitrate may fuse or melt, in which condition application of water may result in extensive scattering of the molten material, and, therefore, care should be taken in applying water to the material after fire has been burning for some time.
Sodium Perchlorate Paper-lined metal containers.		See potassium perchlorate.
Sodium Peroxide — *See Potassium Peroxide.*		
Sodium Sulfide Iron drums and bottles.	See potassium sulfide.	

HAZARDOUS CHEMICALS

Fire Hazard	Storage
plosive in contact with combustible material. See potassium chlorate. In contact with strong acid liberates chlorine dioxide, an extra hazardous gas.	
Combustible. Heats spontaneously in contact with moisture and air, and may ignite nearby combustible material.	Store in dry place away from combustible materials.
Classes with potassium hydroxide and calcium oxide.	Isolate from heat and water. See calcium oxide and potassium hydroxide.
Oxidizing material. Bags or barrels may become impregnated with nitrate, in which condition they are readily ignitable. In contact with organic or other readily oxidizable (combustible) substances it will cause violent combustion on ignition.	Store in dry place; prevent contact with organic or combustible material. Fire hazard less if removed from bags and stored in noncombustible bins.
See potassium perchlorate.	See potassium perchlorate. Sodium perchlorate in anhydrous form is very hygroscopic and not used much in industries.
Moderately flammable. Classes with potassium sulfide.	See potassium sulfide.

Usual Shipping Container	Life Hazard	Fire Fighting Phases
Strontium Nitrate		
Barrels and boxes.		See sodium nitrate.
Strontium Peroxide (SrO_2)		
Metal cans.		Smother with sand, ashes, or rock dust. Do not use water.
Sulfur		
Sacks, boxes, barrels and box cars.	When burning forms sulfur dioxide, which in concentrations of 0.2% by volume in air may cause serious injury in ½ hour or less.	Water in form of spray best extinguisher. Small fires may be smothered with sand or additional sulfur. (Sulfur dioxide does not support combustion.) Avoid use of pressure hose (solid) streams, and do not scatter sulfur dust. If spray nozzle is not available, water may be allowed to flow out of hose (without nozzle) on to a burning pool of sulfur, or saturated steam may be used. See N. F. P. A. Code for the Prevention of Sulfur Dust Explosions and Fires.
Sulfuric Acid		
Carboys, iron drums, glass bottles and tank cars.	Corrosive; dangerous fumes under fire conditions.	Smother with sand, ashes, or rock dust, but avoid water.
Thorium Nitrate		
Wooden kegs.		See sodium nitrate.
Uranium Nitrate		
Glass bottles, boxes.		
Vinyl Ether		
Glass bottles and metal cans.	Anaesthetic.	Lighter than water (Sp. gr. 0.774). Not soluble in water. Water may be used only to cool metal containers. Best extinguishing agents are carbon dioxide, sand, and carbon tetrachloride.

HAZARDOUS CHEMICALS

Fire Hazard	Storage
Oxidizing material. Classes with sodium nitrate.	Safeguard against mechanical injury; keep away from other materials.
Oxidizing material. Hazards in class with barium peroxide.	Store in dry place away from combustible materials.
Flammable. Dust or vapor forms explosive mixtures with air. Hazardous in contact with oxidizing material.	Provide good ventilation. Isolate from chlorates, nitrates and other oxidizing materials.
May cause ignition by contact with combustible materials. Corrodes metal.	Safeguard against mechanical injury, isolate from saltpeter, metallic powders, carbides, picrates, fulminates, chlorates and combustible materials.
Oxidizing material. Classes with sodium nitrate.	Store in dry place, remote from water or moisture.
Oxidizing material. Classes with sodium nitrate.	See sodium nitrate.
Highly volatile flammable liquid. Flash point below −22° F. Gives off even at comparatively low temperatures vapors which form flammable mixtures with air or oxygen. Explosive range 1.70% to 27.0% (upward propagation). Hazard in a class with ethyl ether. Only electrical equipment of the explosion-proof type, Group C classification tentative pending further tests, permitted in atmospheres containing vinyl ether vapor in flammable proportions.	Isolate. Safeguard containers against mechanical injury. Store in a cool, well ventilated storeroom.

Usual Shipping Container	Life Hazard	Fire Fighting Phases
Zinc Chlorate		
Glass bottles, iron drums.	Serious under fire conditions.	
Zinc Powder or Dust		
Cartons, wooden barrels, or steel drums.	Zinc is comparatively volatile at elevated temperatures. Under fire conditions precautions should be taken to avoid breathing fumes, which may cause metal fume fever.	Smother with sand, ashes, or rock dust. Do not use water.

HAZARDOUS CHEMICALS

Fire Hazard	Storage
When in contact with organic material explodes by slight friction, percussion or shock. Classes with potassium chlorate.	Safeguard against mechanical injury; avoid tiering; isolate.
Hydrogen is evolved when commercial zinc is in contact with acids, sodium hydroxide, or potassium hydroxide. Hydrogen also evolved by acid-forming combinations containing zinc, such as zinc chloride and moisture. Dust may form explosive mixtures with air. Zinc dust in bulk in a damp state may heat and ignite spontaneously on exposure to the air.	Store in dry, ventilated place away from water or moisture. Isolate from acids.

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

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The following table gives pertinent data as to the fire hazard of liquids, gases, and solids found in industrial plants. It has been assembled from the results of tests made by the Factory Mutual Laboratories and from other data carefully chosen as the most reliable.

Abbreviations and Symbols

The following abbreviations are not used in the alphabetical listing but are shown with some names to identify the compound exactly.

o, ortho	*p*, para	
m, meta	*prim*, primary	*sym*, symmetrical
n, normal	*sec*, secondary	*ter*, tertiary

The numerical prefixes mono-, di-, tri-, and tetra- will be found in regular alphabetical order.

d., decomposes	sub., sublimes
>, greater than	<, less than

* An asterisk following the name of a metal indicates that hydrogen will be liberated when the metal is in contact with water. With the exception of potassium and sodium, hydrogen will be liberated in hazardous quantities only if the metal is in a finely divided form.

The properties of asphalts, naphthas, and oils vary over a large range as indicated. When it is necessary to know the exact hazard of a material, a sample should be sent to the Factory Mutual Laboratories at 184 High St., Boston, Mass., for test.

Flash Point. The approximate closed-cup flash points of hydrocarbons (organic compounds composed of only carbon and hydrogen) may be determined by the use of the following formula:

$$\textit{Closed cup flash point } °F. = 0.73 \times [\textit{initial}] \textit{ boiling point } °F. - 122$$

For petroleum and coal-tar distillates, the formula is applicable between initial boiling points of −150° F. and +550° F.

Explosive Limits. The data given for the lower and upper explosive limits are, with few exceptions, the values for upward flame propagation through a cylindrical tube.

Vapor Densities for the most part, have been calculated.

Suitable Extinguishing Agents. The code numbers in the last column indicate the following extinguishing agents.

1 Water (See note below)	4 Dry chemical
2 Foam	5 Powdered talc
3 Carbon dioxide	

Note: Water discharged from spray nozzles behaves much differently from water discharged from sprinklers or hose streams. The finely divided drops from a spray nozzle absorb much more heat than an equal volume of water from a sprinkler or hose stream and also partially smother the fire by excluding air. In general, water spray nozzles are suitable for use on fires in flammable liquids having a flash point over 150° F., but before purchasing new equipment, consult your Insurance Company or the Inspection Department.

If either water or foam is applied to a body of flammable liquid, all of which is heated above 250° F., the hot liquid may foam over and spread the fire.

I.C.C. Shipping Labels

Red —Flammable liquids with flash points at or below 80° F. and flammable compressed gases.

Yellow—Flammable solids (except explosives) and oxidizing materials (chlorates, permanganates, peroxides, nitrates).

White —Corrosive liquids (mineral acids).

Green —Non-flammable compressed gases.

Labels are required only for interstate shipments or for intrastate shipments by common carrier engaged in interstate or foreign commerce. Absence of a label does not necessarily mean that the material is non-hazardous.

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
Acetaldehyde	−17	....	4.0	57.0	365	No	0.783	1.52	−191	70	1, 3, 4
Acetanilide	345	345	....	....	....	..	1.21	4.65	237	581	1, 2, 3, 4
Acetic Acid (Glacial)	104	110	4.0	....	1050	No	1.05	2.07	62	245	1, 3, 4
Acetic Anhydride	121	130	....	....	752	No	1.08	3.52	−100	284	1, 3, 4
Acetic Ether, see ethyl acetate	....	....	....	....	....	..	....	....	....	....	.....
Acetoacetic Ester, see ethyl acetoacetate	....	....	....	....	....	..	....	....	....	....	.....
Acetone	0	15	2.15	13.0	1118	No	0.792	2.00	−137	134	3, 4
Acetophenone	221	....	....	....	....	No	1.03	4.14	68	396	1, 2, 3, 4
p-Acetotoluide	335	355	....	....	....	..	1.212	5.14	307	584	1, 2, 3, 4
Acetyl Chloride	40	....	....	....	....	No	1.105	2.70	−170	124	1, 3, 4
Acetylene	gas	....	2.5	80	635	No	....	0.91	....	−119	.....
Acetylene Dichloride, see dichloroethylene-1, 2	....	....	....	....	....	..	....	....	....	....	.....
Acetylene Tetrabromide	non-flammable		....	....	....	No	2.97	....	< −4	276	....
Acetylene Tetrachloride	non-flammable		....	....	....	No	1.58	5.73	−33	297	.....
Adipic Acid	385	....	....	....	....	..	....	5.04	303	700	1, 2, 3, 4
Aldol	181	....	....	....	....	No	1.11	3.04	....	380	1, 2, 3, 4
Allyl Alcohol	70	75	3.0	....	713	No	0.854	2.00	−200	206	3, 4
Allylene	gas	....	1.74	....	....	..	....	0.66	−156	−18	.....
Almond Oil (artificial), see benzaldehyde	....	....	....	....	....	..	....	....	....	....	.....
Aluminum (Powder) *	....	....	....	....	....	No	....	....	1218	3240	5
Amino Benzene, see aniline	....	....	....	....	....	..	....	....	....	....	.....
Ammonia (Anhydrous)	gas	....	16.0	27.0	1436	No	....	0.597	−107	−37	.....
Amyl Acetate-*n*	76	80	1.1	....	714	No	0.879	4.49	....	300	3, 4
Amyl Acetate-*iso*	92	100	....	....	715	No	0.876	4.49	....	290	3, 4
Amy Alcohol-*n*	91	120	1.2	....	621	No	0.817	3.04	−108	280	3, 4
Amyl Alcohol-*prim. iso*	109	115	....	....	667	No	0.813	3.04	−178	270	3, 4
Amyl Alcohol-*sec. n*	94	....	....	....	650-725	No	0.810	3.04	....	245	3, 4

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
Amyl Alcohol-*sec. iso*	103	....	....	....	....	No	0.819	3.04	....	235	3, 4
Amyl Chloride	....	....	1.4	....	....	No	0.878	3.67	....	223	2, 3, 4
Amylene-*n*	....	....	1.6	....	....	No	0.666	2.42	−191	98	2, 3, 4
Amyl Salicylate	270	....	....	....	....	..	1.065	7.17	....	512	1, 2, 3, 4
Aniline	168	....	....	....	1418	No	1.022	3.22	21	363	2, 3, 4
Aniline Hydrochloride	....	380	....	....	....	No	1.22	4.46	388	473	1, 3, 4
Anthracene	250	385	0.63	....	881 in O_2	No	1.25	1.15	424	644	1, 2, 3, 4
Anthraquinone	365	485	....	....	....	No	1.438	7.16	544	716	1, 2, 3, 4
Antifebrin, see acetanilide	....	....	....	....	....	..	....	....	....	....	.....
Asphalt (Typical)	400+	535+	....	....	905	No	0.95-1.1	....	180-220	>700	1, 2, 3, 4
Benzaldehyde	148	165	....	....	....	No	1.05	3.66	−15	355	1, 2, 3, 4
Benzene	12	....	1.4	8	1076	No	0.88	2.77	41	176	2, 3, 4
Benzine, see naphtha V.M. & P.	....	....	....	....	....	..	....	....	....	....	.....
Benzoic Acid	250	....	....	....	....	No	1.266	4.21	252	482	1, 3, 4
Benzol, see benzene	....	....	....	....	....	..	....	....	....	....	.....
Benzyl Acetate	216	....	....	....	862	No	1.06	5.17	−80	417	1, 2, 3, 4
Benzyl Alcohol	213	220	....	....	817	No	1.04	3.72	5	403	1, 2, 3, 4
Benzyl Benzoate	298	....	....	....	....	No	1.114	7.31	65	614	1, 2, 3, 4
Benzyl Cellosolve	....	265	....	....	....	No	1.07	....	....	493	1, 3, 4
Benzyl Chloride	140	....	1.1	....	....	No	1.103	4.36	−41	349	1, 2, 3, 4
Borneol	150	....	....	....	....	No	1.01	5.31	sub. 413	....	1, 2, 3, 4
Bromobenzene	149	....	....	....	....	No	1.497	5.41	−23	313	1, 2, 3, 4
Bromoethane, see ethyl bromide	....	....	....	....	....	..	....	....	....	....	.....
Bromomethane, see methyl bromide	....	....	....	....	....	..	....	....	....	....	.....
Bronze Dust (Aluminum Free)	No Hazard		....	....	....	No	....	....	....	....	.....
Butane-*n*	−76	gas	1.6	8.5	806	No	....	2.046	−211	33	.....
Butyl Acetate-*n*	72	90	1.7	15	790	No	0.88	4.00	−107	260	3, 4
Butyl Acetate-*iso*	64	....	....	....	....	No	0.871	4.00	−148	244	3, 4
Butyl Alcohol-*n*	84	110	1.7	....	693	No	0.806	2.55	−120	243	3, 4
Butyl Alcohol-*iso*	82	....	1.68	....	825	No	0.805	2.55	−162	225	3, 4

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
Butyl Alcohol-*ter.*	52	....	....	....	901	No	0.786	2.55	77	181	3, 4
Butyl Benzene-*sec.*	126	....	....	....	....	No	0.86	4.62	....	345	2, 3, 4
Butyl Carbinol, see amyl alcohol-*prim. iso*	....	....	....	....	....	..	....	....	....	....	.....
Butyl Carbitol	172	200	....	....	442	No	0.955	5.58	<−40	448	1, 3, 4
Butyl Carbitol Acetate	....	240	....	....	....	No	0.987	....	....	474	1, 2, 3, 4
Butyl Cellosolve	141	165	....	....	472	No	0.902	4.07	<−40	340	1, 3, 4
Butylene-*n*	gas	....	1.7	9.0	....	No	....	0.668	−202	23	.....
Butylene Glycol	104	....	....	....	....	No	1.019	3.10	....	379	3, 4
Butyl Formate-*n*	64	....	....	....	....	No	0.911	3.52	−130	225	2, 3, 4
Butyl Lactate	160	....	....	....	....	No	0.968	5.04	....	320	2, 3, 4
Butyl Phthallyl Butyl Glycollate	385	390	....	....	....	No	>1	....	....	....	1, 2, 3, 4
Butyl Propionate-*n*	90	110	....	....	800	No	0.875	5.00	....	295	2, 3, 4
Butyl Ricinoleate	230	....	....	....	....	..	0.906	....	....	790	1, 2, 3, 4
Butyl Stearate-*n*	320	385	....	....	....	..	0.855	....	61	650	1, 2, 3, 4
Butyraldehyde	20	....	....	....	....	No	0.817	2.48	−148	169	3, 4
Butyric Acid-*n*	170	....	....	....	....	No	0.960	3.04	18	327	1, 3, 4
Butyric Anhydride-*n*	190	....	....	....	....	..	0.978	5.38	−102	388	1, 3, 4
Butyrone	120	....	....	....	....	No	0.815	3.93	....	290	3, 4
Camphor	150	200	....	....	871	No	0.999	5.24	354	408	1, 2, 3, 4
Camphor Oil (Light)	117	125	....	....	....	No	0.88	....	....	347-392	2, 3, 4
Carbitol	201	215	....	....	....	No	0.99	4.62	....	396	1, 3, 4
Carbitol Acetate	225	230	....	....	....	No	1.013	6.07	....	424	1, 3, 4
Carbolic Acid, see phenol	....	....	....	....	....	..	....	....	....	....	.....
Carbon, see charcoal	....	....	....	....	....	..	....	....	....	....	.....
Carbon Disulfide	−22	....	1.0	50	257	No	1.256	2.64	−167	114	1, 3, 4
Carbon Monoxide	gas	....	12.5	74.2	1204	No	....	0.967	−339	−314	.....
Carbon Oxysulfide, see carbonyl sulfide	....	....	....	....	....	..	....	....	....	....	.....
Carbonyl Sulfide	....	....	11.9	28.5	....	..	1.24	2.10	−216	122	1, 3, 4

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
Carnauba Wax	540	595	....	....	....	..	....	....	185	....	1, 3, 4
Castor Oil	445	545	....	....	840	Yes	0.96	....	10	595	1, 2, 3, 4
Cellosolve	104	120	2.6	15.7	460	No	0.931	3.10	....	275	3, 4
Cellosolve Acetate	124	135	1.71	....	715	No	0.975	4.72	....	313	3, 4
Charcoal	....	....	....	....	....	Yes	3.51	....	>6300	7600	1
China Wood Oil, see tung oil	....	....	....	....	....	..	....	....	....	....	.....
Chlorobenzene	90	....	....	....	....	No	1.11	3.88	−49	270	2, 3, 4
Chloroethane, see ethyl chloride	....	....	....	....	....	..	....	....	....	....	.....
Chloroethyl Acetate	129	....	....	....	....	..	1.178	4.21	....	293	1, 2, 3, 4
Chloroform	non-flammable		....	....	....	No	1.489	4.13	−82	142	.....
Chloromethane, see methyl chloride	....	....	....	....	....	..	....	....	....	....	.....
Coal Tar Pitch	405	490	....	....	....	..	....	....	....	....	1, 2, 3, 4
Cocoanut Oil	420	510	....	....	....	Yes	0.91	....	72	....	1, 2, 3, 4
Colophony, see pine resin	....	....	....	....	....	..	....	....	....	....	.....
Corn Oil	490	....	....	....	....	Yes	0.92	....	14	....	1, 2, 3, 4
Cottonseed Oil	590	....	....	....	650	Yes	0.925	....	15-30	....	1, 2, 3, 4
Creosote Oil	165	185	....	....	637	No	>1	....	....	382-752	1, 2, 3, 4
o-Cresol	178	....	....	....	....	No	1.05	3.72	88	376	1, 2, 3, 4
p-Cresol	187	....	....	....	....	No	1.04	3.72	95	395	1, 3, 4
Cresylic Acid, see *p*-cresol	....	....	....	....	....	..	....	....	....	....	.....
Crotonaldehyde	55	....	2.95	15.5	....	No	0.853	2.41	−92	216	3, 4
Crotonylene	....	....	1.37	....	....	..	....	....	....	83	2, 3, 4
Cumene, see propylbenzene-*iso*	....	....	....	....	....	..	....	....	....	....	.....
Cyanamide	285	405	....	....	....	..	1.073	1.45	113	500	1, 3, 4
Cyclohexane	1	....	1.31	8.35	....	No	0.779	2.90	43	176	2, 3, 4
Cyclohexanol	154	....	....	....	....	No	0.962	3.45	75	322	1, 2, 3, 4
Cyclohexanone	147	....	....	....	....	No	0.947	3.38	−50	313	3, 4
Cyclohexanone delta	93	....	....	....	....	No	....	3.31	....	....	3, 4
Cyclohexyl Acetate	136	....	....	....	....	No	....	4.90	....	....	2, 3, 4
Cyclopropane	gas	....	2.41	10.3	....	No	....	1.45	−195	−29	.....

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
p-Cymene	117	145	....	....	921	No	0.86	4.62	−101	334	2, 3, 4
Decahydronaphthalene	136	....	....	....	504	No	0.895	4.76	−194	379	2, 3, 4
Decalin, see decahydronaphthalene	....	....	....	....	....	..	....	....	....	....	.....
Decane-*n*	115	....	0.67	2.6	>500	No	0.730	4.90	−26	344	2, 3, 4
Denatured Alcohol—95%	60	....	....	....	....	No	0.82	1.60	−60	175	3, 4
Diacetone Alcohol (comm'l)	48	55	....	....	....	No	0.931	4.00	....	329	3, 4
Diamyl Phthalate	245	340	....	....	....	..	....	....	....	648	1, 2, 3, 4
Dianisidine	403	....	....	....	....	..	....	....	269	....	1, 3, 4
Dibenzyl Ether	275	....	....	....	....	No	1.036	6.82	41	568	1, 2, 3, 4
Dibutyl Ether-*n*	77	....	....	....	....	No	0.769	4.48	....	286	3, 4
Dibutyl Oxalate-*n*	220	....	....	....	....	No	1.01	....	....	....	1, 2, 3, 4
Dibutyl Phthalate-*n*	315	335	....	....	....	No	1.045	9.58	....	690	1, 2, 3, 4
Dibutyl Phthalate-*iso*	322	....	....	....	....	No	....	9.58	....	....	1, 2, 3, 4
Dibutyl Tartrate-*n*	195	230	....	....	....	No	1.098	9.03	72	650	1, 2, 3, 4
Dicaproate, see triethylene glycol	....	....	....	....	....	..	....	....	....	....	....
o-Dichlorobenzene	151	165	....	....	....	No	1.325	5.07	2	354	1, 2, 3, 4
p-Dichlorobenzene	150	165	....	....	....	No	1.458	5.07	127	345	1, 3, 4
Dichlorodifluoromethane	non-flammable		....	....	....	No	....	....	....	−21.5	.....
Dichloro Ethane-1, 2, see ethylene dichloride	....	....	....	....	....	..	....	....	....	....	.....
Dichloroethene-1, 1, see dichloroethylene-1, 1	....	....	....	....	....	..	....	....	....	....	.....
Dichloro Ethylene-1, 1	57	....	5.6	13	856	No	1.250	3.35	....	98.6	1, 2, 3, 4
Dichoro Ethylene-1, 2	43	....	9.7	12.8	....	No	1.282	3.35	−113	141	1, 2, 3, 4
Dichloroethyl Ether-sym.	131	185	....	....	696	No	1.22	4.93	−58	352	1, 2, 3, 4
Dichloroisopropyl Ether	....	185	....	....	....	No	1.113	....	....	369	1, 2, 3, 4
Dichloromethane, see methylene chloride	....	....	....	....	....	..	....	....	....	....	.....
Dichloropropene-1, 2, see propylene dichloride	....	....	....	....	....	..	..	....	....	....	.....

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
Dichlorotetrafluoroethane	non-flammable		....	....	....	No	....	....	....	38.5	.....
Diethanolamine	....	280	....	....	1224	No	1.097	3.65	82	514	1, 3, 4
Diethylaminoethanol	....	140	....	....	....	No	0.885	....	....	322	3, 4
Diethyl Carbitol	....	180	....	....	....	No	0.908	....	....	367	1, 3, 4
Diethyl Carbonate	77	....	....	....	....	No	0.977	4.07	−45	259	2, 3, 4
Diethyl Cellosolve	....	95	....	....	....	No	0.842	....	....	251	3, 4
Diethyl Diphenyl Urea	302	....	....	....	....	..	....	....	....	....	1, 2, 3, 4
Diethylene Glycol	255	290	....	....	444	No	1.119	3.66	21	472	1, 3, 4
Diethylene Oxide	65	....	1.97	22.2	....	..	1.035	3.03	50	214	3, 4
Diethylene Triamine	....	215	....	....	....	..	0.954	3.48	....	404	1, 3, 4
Diethyl Ether	−20	....	1.7	48.0	366	No	0.71	2.55	−177	95	3, 4
Diethyl Glycophthalate	343	....	....	....	....	..	....	....	....	....	1, 3, 4
p-Diethyl Phthalate	243	305	....	....	....	..	1.110	7.66	112	576	1, 2, 3, 4
Diethyl Selenide	....	....	2.5	....	....	No	1.23	4.73	....	226	1, 2, 3, 4
Diethyl Sulfate	220	....	....	....	....	No	1.184	5.31	−12	406	1, 2, 3, 4
Diglycol Chlorohydrin	....	225	....	....	....	No	1.172	....	....	387	1, 3, 4
Dihexyl, see dodecane	....	....	....	....	....	..	....	....	....	....	.....
o-Dihydroxy Benzene, see pyrocatechol	....	....	....	....	....	..	....	....	....	....	.....
m-Dihydroxy Benzene, see resorcinol	....	....	....	....	....	..	....	....	....	....	.....
Dimethoxy Tetraglycol	....	285	....	....	....	No	1.013	....	....	528	1, 3, 4
Dimethyl Aniline	145	170	....	....	700	No	0.956	4.17	36	379	1, 2, 3, 4
Dimethyl Aniline, see also xylidine	....	....	....	....	....	..	....	....	....	....	.....
Dimethyl Carbinol, see propyl alcohol, *sec.*	....	....	....	....	....	..	....	....	....	....	.....
p-Dimethyl Cyclohexane	52	....	....	....	....	No	0.77	3.86	−123	248	2, 3, 4
Dimethyl Ether	−42	....	....	....	....	No	....	1.617	−216	−11	3, 4
Dimethyl Glycophthalate	369	....	....	....	....	No	....	9.72	....	....	1, 3, 4
Dimethyl Ketone, see acetone	....	....	....	....	....	..	....	....	....	....	.....
o-Dimethyl Phthalate	295	325	....	....	....	No	1.189	6.69	....	540	1, 2, 3, 4

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
Dimethyl Sulfate	182	240	....	....	....	No	1.332	4.35	−16	370	1, 2, 3, 4
Dinitro Aniline-2, 4	435	510	....	....	....	..	1.615	6.31	370	....	1, 3, 4
Dinitro Benzene	302	....	....	....	....	..	1.59	5.79	243	605	1, 3, 4
Dinitro Chlorobenzene	382	405	....	....	....	..	1.68	6.98	109	....	1, 3, 4
Dinitro Toluene-2, 4	....	....	....	....	....	No	1.52	6.27	158	572	1, 3, 4
Dioxane, see diethylene oxide	....	....	....	....	....	..	....	....	....	....	.....
Diphenyl	235	255	....	....	....	No	1.041	5.31	158	491	1, 3, 4
Diphenylamine	307	....	....	....	....	No	1.16	5.82	127	575	1, 3, 4
Diphenyl Ether, see diphenyl oxide	....	....	....	....	....	..	....	....	....	....	.....
Diphenyl Methane	266	....	....	....	....	No	1.006	5.79	79	508	1, 2, 3, 4
Diphenyl Oxide	239	....	....	....	....	No	1.073	5.86	81	500	1, 2, 3, 4
Dipropylene Glycol	....	280	....	....	....	No	1.040	....	....	372	1, 3, 4
Ditane, see diphenyl methane	....	....	....	....	....	..	....	....	....	....	.....
Divinyl Ether	< −22	....	1.7	27.0	680	No	0.774	....	....	102	3, 4
Dodecane	165	....	0.6	....	....	No	0.750	5.86	10	421	1, 2, 3, 4
Ester Gum	375	555	....	....	....	No	....	....	285	495	1, 3, 4
Ethane	gas	....	3.12	15.0	950	No	....	1.049	−278	−128	.....
Ethanol, see ethyl alcohol	....	....	....	....	....	..	....	....	....	....	.....
Ethanolamine	....	200	....	....	....	No	1.02	2.10	51	342	1, 3, 4
Ether, see diethyl ether	....	....	....	....	....	..	....	....	....	....	.....
Ethyl Acetanilide	126	....	....	....	....	..	0.942	4.72	....	400	2, 3, 4
Ethyl Acetate	24	30	2.18	11.5	907	No	0.899	3.04	−116	171	3, 4
Ethyl Acetoacetate	184	....	....	....	....	No	1.03	4.48	−48	356	1, 3, 4
Ethyl Alcohol	55	....	3.28	19	799	No	0.79	1.59	−178	173	3, 4
Ethyl Benzene	59	75	....	....	....	No	0.868	3.66	−134	277	2, 3, 4
Ethyl Bromide	....	....	6.75	11.25	952	No	1.430	3.76	−182	100	1. 3, 4
Ethyl Butyl Carbonate	122	....	....	....	....	No	....	5.03	....	....	2, 3, 4
Ethyl Butyrate	78	85	....	....	....	No	0.879	4.00	−135	248	3, 4
Ethyl Cellosolve, see cellosolve	....	....	....	....	....	..	....	....	....	....	.....
Ethyl Chloride	−58	−45	3.6	14.8	....	No	0.910	2.22	−220	54	3, 4

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
Ethylene	gas	....	3.02	34	1009	No	....	0.975	−272	−155	.....
Ethylene Chlorohydrin	....	140	....	....	....	No	1.213	2.78	−94	264	1, 3, 4
Ethylene Diamine	93	110	....	....	....	No	0.890	2.07	47	241	3, 4
Ethylene Dichloride	56	65	6.2	15.9	775	No	1.258	3.42	−33	183	1, 2, 3, 4
Ethylene Glycol	232	240	....	....	775	No	1.113	2.14	3	387	3, 4
Ethylene Oxide	....	....	3	80	804	No	0.887	1.52	−168	51	3, 4
Ethyl Formate	−4	10	3.5	16.5	....	No	0.922	2.55	−112	130	2, 3, 4
Ethyl Glycol Acetate	117	....	....	....	....	No	....	4.55	....	....	3, 4
Ethyl Lactate	115	....	....	....	....	No	1.03	4.41	....	309	3, 4
Ethyl Nitrate	50	50	3.8	....	....	No	1.105	3.14	−152	190	2, 3, 4
Ethyl Nitrite	−31	−30	3.01	>50	....	No	0.900	2.59	....	63	2, 3, 4
Ethyl Oxalate	....	....	....	....	....	No	1.080	5.04	−40	367	1, 3, 4
Ethyl Phthalyl Ethyl Glycollate	365	385	....	....	....	..	>1	....	....	....	1, 2, 3, 4
Ethyl Propionate	54	....	....	....	....	No	0.891	3.52	−99	210	2, 3, 4
Ethyl Propyl Carbinol Acetate	135	....	....	....	....	No	0.83	4.97	....	290	3, 4
Ethyl *p*-Toluene Sulfonamide	260	380	....	....	....	..	....	....	....	....	1, 3, 4
Ethyl *p*-Toluene Sulfonate	316	....	....	....	....	..	....	....	....	....	1, 2, 3, 4
F-11, see monofluorotrichloromethane	....	....	....	....	....	..	....	....	....	....	.....
F-12, see dichlorodifluoromethane	....	....	....	....	....	..	....	....	....	....	.....
F-114, see dichlorotetrafluoroethane	....	....	....	....	....	..	....	....	....	....	.....
Formaldehyde (soln. of gas in water)	130	200	....	....	806	No	....	1.03	−134	−6	3, 4
Freon, see dichlorodifluoromethane	....	....	....	....	....	..	....	....	....	....	.....
Fuel Oil No. 1	100-165	....	....	....	490	No	<1	....	....	....	2, 3, 4
Fuel Oil No. 2	110-190	....	....	....	494	No	<1	....	....	....	2, 3, 4
Fuel Oil No. 3	125-200	....	....	....	498	No	<1	....	....	....	2, 3, 4
Fuel Oil No. 4	150+	250	....	....	505	No	<1	....	....	....	1, 2, 3, 4
Fuel Oil No. 5	150+	....	....	....	....	No	<1	....	....	....	1, 2, 3, 4
Fuel Oil No. 6	150+	320	....	....	765	No	<1	....	....	....	1, 2, 3, 4
Furfural	140	155	2.1	....	739	No	1.159	3.31	−36	322	1, 2, 3, 4

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
Fusel oil, see *n*-amylalcohol	....	....	....	....	....	..	....	....	....	....	.....
Gas, Blast Furnace	....	....	35	74	....	No	....	....	....	....	.....
Gas, Coal Gas	....	....	5.3	31	1200	No	....	....	....	....	.....
Gas, Illuminating	....	....	5.3	31	1094	No	....	....	....	....	.....
Gas, Natural	....	....	4.8	13.5	....	No	....	....	....	....	.....
Gas, Oil Gas	....	....	6.0	13.5	637	No	....	....	....	....	.....
Gas, Producer	....	....	20.7	73.7	....	No	....	....	....	....	.....
Gas, Water	....	....	9.0	55.0	....	No	....	....	....	....	.....
Gas Oil	150+	....	....	....	640	No	<1	....	....	....	1, 2, 3, 4
Gasoline	−50	....	1.3	6	495	No	0.75	3-4	<−50	100-400	2, 3, 4
Glycerine	320	350	....	....	739	No	1.26	3.17	64	554	1, 3, 4
Glycerol, see glycerine	....	....	....	....	....	..	....	....	....	....	.....
Glyceryl Triacetate	280	295	....	....	....	No	1.161	7.52	−108	496	1, 2, 3, 4
Glyceryl Trinitrate, see nitroglycerin	....	....	....	....	....	..	....	....	....	....	.....
Glycol, see ethylene glycol	....	....	....	....	....	..	....	....	....	....	.....
Glycol Diacetate	....	220	....	....	....	No	1.100	4.53	−24	370	1, 2, 3, 4
Heptane-*n*	25	....	1	6	452	No	0.683	3.45	−130	208	2, 3, 4
Hexahydro-xylol, see *p*-dimethyl cyclohexane	....	....	....	....	....	..	....	....	....	....	.....
Hexalin, see cyclohexanol	....	....	....	....	....	..	....	....	....	....	.....
Hexalin Acetate, see cyclohexyl acetate	....	....	....	....	....	..	....	....	....	....	.....
Hexane-*n*	−7	....	1.25	6.90	477	No	0.661	2.97	−137	156	3, 4
Hexanol-1	145	....	....	....	....	No	0.82	3.52	−62	311	3, 4
Hexanol-3	137	....	....	....	....	No	0.818	3.52	....	275	3, 4
Hexanol-2	114	....	....	....	....	No	0.804	3.52	....	266	3, 4
Hexanone, see methyl butyl ketone	....	....	....	....	....	..	....	....	....	....	.....
Hexyl Acetate, see ethyl propyl carbinol acetate and methyl butyl carbinol acetate	....	....	....	....	....	..	....	....	....	....	.....

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
Hydrocyanic Acid	0	....	5.6	40	1000	No	0.697	0.9	10	79	.....
Hydrogen	gas	....	4.1	74.2	1076	No	....	0.069	−435	−422	.....
Hydrogen Sulfide	gas	....	4.3	45.5	....	No	....	1.189	−117	−76	.....
Hydroquinone	329	....	....	....	....	..	1.332	3.81	338	545	1, 3, 4
Kerosene, see fuel oil No. 1	....	....	....	....	....	..	....	....	....	....	.....
Lanolin	460	560	....	....	833	Yes	<1	....	100±	....	1, 2, 3, 4
Lard Oil (Commercial)	395	....	....	....	833	Yes	<1	....	28	....	1, 2, 3, 4
Lead Tetramethyl	....	....	1.8	....	....	..	1.995	9.20	−18	230	1, 2, 3, 4
Linseed Oil	435	535	....	....	820	Yes	0.93	....	−2	600+	1, 2, 3, 4
Lubricating Oil, Cylinder	....	535	....	....	783	No	<1	....	....	....	1, 2, 3, 4
Lubricating Oil, Light Machine	318	370	....	....	....	No	<1	....	....	....	1, 2, 3, 4
Lubricating Oil, Motor	....	450	....	....	....	No	<1	....	....	....	1, 2, 3, 4
Lubricating Oil, Spindle	169	200	....	....	....	No	<1	....	....	....	1, 2, 3, 4
Lubricating Oil, Turbine	....	400	....	....	700	No	<1	....	....	....	1, 2, 3, 4
Magnesium (Powder or Chips) *	....	....	....	....	....	No	....	....	1200	2048	5
Manganese (Powder) *	....	....	....	....	....	No	....	....	2300	3450	5
Marsh Gas, see methane	....	....	....	....	....	..	....	....	....	....	.....
Menhaden Oil	435	....	....	....	828	Yes	0.927	....	....	....	1, 2, 3, 4
Metaldehyde	97	135	....	....	....	No	....	6.06	475	....	1, 3, 4
Methanal, see formaldehyde	....	....	....	....	....	..	....	....	....	....	.....
Methane	gas	....	5.3	13.9	999	No	....	0.554	−300	−258	.....
Methanol, see methyl alcohol	....	....	....	....	....	..	....	....	....	....	1, 2, 3, 4
Methox, see methoxy ethyl phthalate	....	....	....	....	....	..	....	....	....	....	.....
Methoxy Ethyl Phthalate	275	370	....	....	....	No	....	....	....	....	1, 2, 3, 4
Methyl Acetate	15	20	4.1	13.9	935	No	0.925	2.56	−146	140	3, 4
Methyl Acetoacetate	180	....	....	....	....	No	1.077	4.00	82	338	1, 2, 3, 4
Methyl Alcohol	54	60	6.0	36.5	878	No	0.792	1.11	−144	147	3, 4
Methyl Amine	0	10	....	....	....	No	0.699	....	−134	19	3, 4
Methyl Aniline, see toluidine	....	....	....	....	....	..	....	....	....	....	.....

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
Methyl Bromide	practically non-flammable		13.5	14.5	....	No	1.732	3.27	−135	40	.....
Methyl Butyl Carbinol Acetate	113	....	....	....	....	No	0.855	4.97	....	285	3, 4
Methyl *n*-Butyl Ketone	....	95	1.22	8.0	....	No	0.830	3.45	−70	262	2, 3, 4
Methyl *iso*-Butyl Ketone	73	....	....	....	....	No	0.803	3.45	−121	244	2, 3, 4
Methyl Butyrate	57	....	....	....	....	No	0.898	3.52	< −142	215	2, 3, 4
Methyl Carbitol	....	200	....	....	....	No	1.035	4.14	....	379	1, 3, 4
Methyl Cellosolve	107	115	....	....	551	No	0.966	2.62	....	255	3, 4
Methyl Cellosolve Acetate	132	140	....	....	....	No	1.005	4.07	....	289	3, 4
Methyl Chloride	gas	....	8.2	19.7	....	No	0.92	1.78	−142	−11	.....
Methyl Cyclohexane	25	....	1.15	....	....	No	0.770	3.38	−195	214	2, 3, 4
Methyl Cyclohexanol	154	....	....	....	....	No	0.933	3.93	....	329	1, 2, 3, 4
Methyl Cyclohexanone	118	....	....	....	....	No	0.925	4.86	....	325	2, 3, 4
Methyl Cyclohexyl Acetate	147	....	....	....	....	No	....	5.37	....	...	2, 3, 4
Methylene Chloride	practically non-flammable		....	....	1224	No	1.336	2.93	−143	104	1, 2, 3, 4
Methyl Ether, see dimethyl ether	....	....	....	....	....	..	....	....	....	....	.....
Methyl Ethyl Ether	−35	....	2	10.1	374	No	0.697	2.07	....	50	3, 4
Methyl Ethyl Ketone	30	....	1.81	11.5	....	No	0.805	2.41	−123	176	3, 4
Methyl Formate	−2	....	5.0	22.7	840	No	0.975	2.07	−148	90	3, 4
Methyl Glycol	97	....	....	....	....	No	....	2.62	....	....	3, 4
Methyl Glycol Acetate	111	....	....	....	....	No	....	4.07	....	....	3, 4
Methyl Hexalin, see methyl cyclohexanol	....	....	....	....	....	..	....	....	....	....	.....
Methyl Phenol, see *o*-cresol	....	....	....	....	....	..	....	....	....	....	.....
Methyl Phthalyl Ethyl Glycollate	375	380	....	....	....	No	>1	....	....	....	1, 2, 3, 4
Methyl Propionate	28	....	....	....	....	No	0.915	3.03	−126	176	2, 3, 4
Methyl *iso*-Propyl Carbinol, see amyl alcohol, *sec. iso*	....	....	....	....	....	..	....	....	....	....	.....
Methyl *n*-Propyl Ketone	....	60	1.55	8.15	....	No	0.812	2.96	−108	216	3, 4

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
Methyl Salicylate	214	225	....	....	850	No	1.182	5.24	18	432	1, 2, 3, 4
Methyl Sulfate, see dimethyl sulfate	....	....	....	....	....	..	....	....	....	....	.....
Mineral Seal Oil (Typical)	170	255	....	....	....	No	....	....	....	....	1, 2, 3, 4
Mineral Spirits, see naphtha, safety solvent	....	....	....	....	....	..	....	....	....	....	.....
Monocresyl Diphenyl Phosphate	450	450	....	....	....	No	>1	....	....	....	1, 2, 3, 4
Monofluorotrichloromethane	non-flammable		....	....	....	No	....	....	....	76	.....
Mustard Oil	566	....	....	....	....	Yes	1.02	....	....	300	1, 2, 3, 4
Naphtha, Coal Tar	100-110	....	....	....	900-950	No	<1	....	<−50	300-400	2, 3, 4
Naptha, Safety Solvent	100-110	....	1.1	6.0	450-500	No	<1	....	<−50	300-400	2, 3, 4
Naphtha, V. M. & P.	20-45	....	1.2	6.0	450-500	No	<1	....	<−50	212-320	2, 3, 4
Naphtha (high flash), see naphtha, coal tar	....	....	....	....	....	..	....	....	....	....	.....
Naphthalene	174	190	0.9	....	1053	No	1.145	4.42	176	424	1, 3, 4
Naphthol (β)	307	340	....	....	....	No	1.22	4.97	252	547	1, 3, 4
Naphthylamine (α)	315	....	....	....	....	No	1.171	4.93	122	572	1, 3, 4
Neatsfoot Oil	470	....	....	....	828	Yes	0.92	....	84-106	....	1, 2, 3, 4
Nitric Ether, see ethyl nitrate	....	....	....	....	....	..	....	....	....	....	.....
p-Nitroaniline	390	390	....	....	....	..	1.437	....	295	>545	1, 3, 4
Nitrobenzene	190	....	....	....	924	..	1.2	4.25	42	412	1, 2, 3, 4
p-Nitrochlorobenzene	261	....	....	....	....	..	1.52	5.43	181	468	1, 3, 4
Nitroglycerin	Explodes	....	....	....	518	No	1.601	7.84	....	....	.....
Nitronaphthalene (α)	327	....	....	....	....	..	1.331	5.96	140	579	1, 3, 4
p-Nitrotoluene	223	....	....	....	....	..	1.286	4.72	126	460	1, 3, 4
m-Nitro *p*-Toluidine	315	345	....	....	....	..	1.312	5.24	241	....	1, 3, 4
Nitrous Ether, see ethyl nitrite	....	....	....	....	....	..	....	....	....	....	.....
Nonane-*n*	88	....	0.74	2.9	....	No	0.718	4.41	−60	302	3, 4
Octane-*n*	56	....	0.84	3.2	450	No	0.706	3.86	−69	257	3, 4
Octyl Acetate-*n*	180	....	....	....	....	No	0.885	5.93	−37	410	1, 2, 3, 4
Octyl Alcohol-*n*	178	....	....	....	....	No	0.827	4.48	3	381	2, 3, 4

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

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	Closed Cup	Open Cup	Lower	Upper							
Octyl Aldehyde	125	....	....	....	....	No	0.821	4.41	....	350	2, 3, 4
Oleic Acid	372	....	....	....	685	Yes	0.891	....	13	432	1, 2, 3, 4
Oleo Oil	....	....	....	....	....	Yes	0.915	....	2	464	1, 2, 3, 4
Olive Oil	437	....	....	....	826	Yes	0.910	....	21	....	1, 2, 3, 4
Ozokerite	236	315	....	....	....	No	0.95	....	136-230	....	1, 3, 4
Palm Oil	421	....	....	....	650	Yes	0.92	....	100	....	1, 2, 3, 4
Paraffin Wax	390	430	....	....	473	No	0.9	....	122	>700	1, 3, 4
Paraformaldehyde	158	200	....	....	....	No	....	....	sub. 248	....	1, 3, 4
Paranitraniline, see *p*-nitroaniline	....	....	....	....	....	..	....	....	....	....	.....
Peanut Oil	540	....	....	....	833	Yes	0.92	....	37	....	1, 2, 3, 4
Pentane-*n*	< −40	....	1.4	8.0	588	No	0.631	2.48	−206	97	2, 3, 4
Pentanone, see methyl propyl ketone	....	....	....	....	....	..	....	....	....	....	.....
Perchlorethylene, see tetrachloroethylene	....	....	....	....	....	..	....	....	....	....	.....
Perilla Oil	522	....	....	....	....	Yes	0.93	....	23	....	1, 2, 3, 4
Petroleum, Crude	20-90	....	....	....	....	No	<1	....	....	....	2, 3, 4
Petroleum Ether	−50	....	1.4	5.9	475	No	0.64	2.50	< −100	100-160	3, 4
Phenanthrene	....	....	....	....	....	No	1.063	6.14	212	644	.....
Phenol	175	185	....	....	1319	No	1.07	3.24	108	358	1, 3, 4
Phenyl Bromide, see bromobenzene	....	....	....	....	....	..	....	....	....	....	.....
Phenyl Carbinol, see benzyl alcohol	....	....	....	....	....	..	....	....	....	....	.....
Phenyl Cellosolve	....	250	....	....	....	No	1.109	....	....	473	3, 4
Phenyl Chloride, see chlorobenzene	....	....	....	....	....	..	....	....	....	....	.....
p-Phenylene Diamine	312	310	....	....	....	No	....	3.72	284	512	1, 3, 4
Phenyl Ethane, see ethyl benzene	....	....	....	....	....	..	....	....	....	....	.....
Phenyl Ethyl Alcohol	216	....	....	....	....	No	1.024	4.21	....	430	1, 2, 3, 4
Phenyl Methyl Ketone, see acetophenone	....	....	....	....	....	..	....	....	....	....	.....
Phosphorous (Red)	....	....	....	....	500	No	2.30	....	1337	....	1

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

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	Closed Cup	Open Cup	Lower	Upper							
Phosphorous (Yellow)	....	....	....	....	86	No	1.82	....	112	549	1
Phosphorous Sesquisulfide	....	....	....	....	212	No	2.03	....	342	765	1
Phthalic Anhydride	305	330	....	....	....	No	1.527	5.10	262	543	1, 3, 4
Picric Acid	Explodes	....	....	....	<572	No	1.763	7.90	250	....	1
Pine Oil	172	175	....	....	....	Yes	0.86	....	....	....	1, 2, 3, 4
Pine Pitch	285	....	....	....	....	Yes	....	....	148	490	1, 3, 4
Pine Resin	370	430	....	....	....	Yes	1.08	....	212-300	....	1, 3, 4
Pine Tar	130	255	....	....	671	Yes	....	....	....	208	2, 3, 4
Pine Tar Oil	144	....	....	....	....	Yes	0.862	....	....	....	3, 4
Potassium *	....	....	....	....	....	No	0.862	....	144	1396	5
Potassium Xanthate	205	....	....	9.5	....	No	1.558	....	d. >392	....	1, 3, 4
Propane	gas	....	2.37	9.5	871	No	....	1.56	−310	−45	.....
Propyl Acetate-*n*	58	....	2.0	....	....	No	0.886	3.52	−134	215	2, 3, 4
Propyl Acetate-*iso*	43	45	2.0	....	860	No	0.877	3.52	−99	194	2, 3, 4
Propyl Alcohol-*n*	59	85	2.5	....	812	No	0.804	2.07	−197	207	3, 4
Propyl Alcohol-*iso*	53	60	2.5	....	852	No	0.789	2.07	−122	181	3, 4
Propyl Alcohol-*sec*	67	....	....	....	....	No	0.79	2.07	−186	116	3, 4
Propyl Benzene-*n*	86	....	....	....	....	No	0.862	4.14	−152	316	2, 3, 4
Propyl Benzene-*iso*	102	....	....	....	....	No	0.864	4.14	−152	311	2, 3, 4
Propylene	gas	....	2.0	11.1	....	No	....	1.49	−301	−58	.....
Propylene Chlorohydrin	125	125	....	....	....	No	1.113	3.26	....	261	3, 4
Propylene Dichloride	59	65	3.4	14.5	1035	No	1.15	3.89	< −112	205	2, 3, 4
Propylene Glycol	210	225	....	....	....	No	1.040	2.52	....	370	1, 3, 4
Propylene Oxide	<20	....	....	....	....	No	0.859	2.00	....	95	3, 4
Propyl Ether-*iso*	−18	−15	....	....	830	No	0.73	3.52	< −76	156	2, 3, 4
Propyl Formate-*n*	27	....	....	....	....	No	0.909	3.03	−135	178	2, 3, 4
Propyl Formate-*iso*	22	....	....	....	....	No	0.873	3.03	....	153	2, 3, 4
Pyridine	68	....	1.8	12.4	1065	No	0.982	2.73	−44	239	3, 4
Pyrocatechol	261	....	....	....	....	No	1.344	3.79	221	474	1, 3, 4
Quenching Oil	365	405	....	....	....	No	0.9	....	....	....	1, 2, 3, 4

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
Racemic Acid, see tartaric acid	....	....	....	....	....	..	....	....	....	....	.....
Range Oil, see Fuel oil, No. 1	....	....	....	....	....	..	....	....	....	....	.....
Rape Seed Oil	325	550	....	....	836	Yes	0.915	....	63	....	1, 2, 3, 4
Red Oil, see oleic acid	....	....	....	....	....	..	....	....	....	....	.....
Resorcinol	261	....	....	....	....	No	1.272	3.79	230	529	1, 3, 4
Rosin Oil	266	....	....	....	648	Yes	0.98-1.1	....	....	....	1, 2, 3, 4
Sodium *	....	....	....	....	....	No	0.97	....	208	1612	5
Soya Bean Oil	540	....	....	....	833	Yes	0.925	....	72	....	1, 2, 3, 4
Sperm Oil, see whale oil	....	....	....	....	....	..	....	....	....	....	.....
Stearic Acid	385	425	....	....	743	Yes	0.847	9.80	157	726	1, 3, 4
Stoddard Solvent, see naphtha, safety solvent	....	....	....	....	....	..	....	....	....	....	.....
Sulfur	405	440	....	....	450	No	2.046	....	234	832	1
Sulfur Chloride	245	None	....	....	453	No	1.687	3.31	−112	280	1, 3, 4
Tallow	509	....	....	....	....	Yes	0.895	....	88-100	....	1, 3, 4
Tallow Oil	492	....	....	....	....	Yes	0.914	....	109	....	1, 3, 4
Tannic Acid	....	390	....	....	....	No	....	....	d.392	....	1
Tartaric Acid	....	410	....	....	....	No	1.667	....	284	....	1
Tetrabromoethane, see acetylene tetrabromide	....	....	....	....	....	..	....	....	....	....	.....
Tetrachloroethane, see acetylene tetrachloride	....	....	....	....	....	..	....	....	....	....	.....
Tetrachloroethylene	non-flammable		....	....	....	No	1.623	5.72	−8	248	.....
Tetradecane	212	....	0.5	....	....	No	0.765	6.83	41	486	1, 2, 3, 4
Tetraethylene Glycol	....	345	....	....	....	No	1.126	....	....	621	1, 3, 4
Tetralin, see tetrahydronaphthalene	....	....	....	....	....	..	....	....	....	....	.....
Tetrahydronaphthalene	171	180	....	....	....	No	0.973	4.55	−24	403	1, 2, 3, 4
Tin Tetramethyl	....	....	1.9	....	....	No	1.314	....	....	172	2, 3, 4
Toluene	40	45	1.27	7.0	1026	No	0.866	3.14	−134	232	2, 3, 4
o-Toluidine	185	....	....	....	900	No	0.999	3.90	3	392	1, 2, 3, 4

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
p-Toluidine	188	205	....	....	900	No	0.973	3.90	111	392	1, 3, 4
Toluol, see toluene	....	....	....	....	....	..	....	....	....	....	.....
Tolylacetamide, see *p*-acetoluide	....	....	....	....	....	..	....	....	....	....	.....
o-Tolyl *p*-Toluene Sulfonate	363	....	....	....	....	..	....	....	....	....	1, 3, 4
Transformer Oil, see transil oil	....	....	....	....	....	..	....	....	....	....	.....
Transil Oil	....	295	....	....	....	No	0.9	....	....	....	1, 2, 3, 4
Triacetin, see glyceryl triacetate	....	....	....	....	....	..	....	....	....	....	.....
Tributyl Phosphate	....	295	....	....	....	No	0.973	8.86	< −112	560	1, 2, 3, 4
Trichloroethylene	non-flammable		....	....	....	No	1.47	4.53	−99	189	.....
Trichloromethane, see chloroform	....	....	....	....	....	..	....	....	....	....	.....
o-Tricresyl Phosphate	460	504	....	....	....	No	....	....	....	d.770	1, 2, 3, 4
Triethanolamine	355	365	....	....	....	No	1.13	5.14	68	650	1, 3, 4
Triethylene Glycol	350	385	....	....	....	No	1.125	5.17	23	550	1, 3, 4
Triethylene Tetramine	....	260	....	....	....	No	0.982	....	....	532	1, 3, 4
Triglycol Dichloride	....	250	....	....	....	No	1.197	....	....	466	1, 3, 4
Triisopropanolamine	....	305	....	....	....	No	1.020	....	....	570	1, 3, 4
Trimethylene, see cyclopropane	....	....	....	....	....	..	....	....	....	....	.....
Trinitrophenol, see picric acid	....	....	....	....	....	..	....	....	....	....	.....
Triphenyl Phosphate	428	....	....	....	....	No	....	....	122	750	1, 3, 4
Tung Oil	552	....	....	....	855	Yes	0.94	....	88	....	1, 3, 4
Turkey Red Oil	476	....	....	....	833	No	....	....	....	....	1, 2, 3, 4
Turpentine	95	....	0.8	....	488	Yes	<1	....	....	300	2, 3, 4
Vinyl Acetate	18	30	....	....	800	No	....	....	....	....	2, 3, 4
Vinyl Chloride	....	....	4	22	....	No	0.97	2.15	−256	57	3, 4
Vinyl Ether, see divinyl ether	....	....	....	....	....	..	....	....	....	....	.....
Whale Oil	446	....	....	....	....	Yes	0.925	....	32	....	1, 2, 3, 4
Wintergreen oil, see methyl salicylate	....	....	....	....	....	..	....	....	....	....	.....
Wool Grease, see lanolin	....	....	....	....	....	..	....	....	....	....	.....
o-Xylene	63	75	1.0	....	924	No	0.88	3.66	−17	291	2, 3, 4

PROPERTIES OF FLAMMABLE LIQUIDS, GASES, AND SOLIDS

Name	Flash Point °F.		Explosive Limits % by Vol. in Air		Auto-ignition Temp. °F.	Susceptibility to Spontaneous Heating	Specific Gravity (Water = 1.00)	Vapor Density (Air = 1.00)	Melting Point °F.	Boiling Point °F.	Suitable Extinguishing Agents
	Closed Cup	Open Cup	Lower	Upper							
Xylol, see xylene	....	....	....	....	....	..	....	....	....	....	.....
o-Xylidine	206	....	....	....	....	No	0.99	4.17	<5	435	1, 2, 3, 4
Zinc (Dust or Powder) *	....	....	....	....	....	No	....	....	787	1706	5
Zirconium (Powder)	....	....	....	....	550	No	....	....	3092	>5250	5

AGRIC. RES. INST.

PERIODIC ARRANGEMENT OF

Series	Zero Group	Group I — R_2O	Group II — RO	Group III — R_2O_3	Group IV RH_4 RO_2
1		Hydrogen H = 1.0078 No. 1			
2	Helium He = 4.002 No. 2	Lithium Li = 6.940 No. 3	Beryllium Be = 9.02 No. 4	Boron B = 10.82 No. 5	Carbon C = 12.00 No. 6
3	Neon Ne = 20.183 No. 10	Sodium Na = 22.997 No. 11	Magnesium Mg = 24.32 No. 12	Aluminum Al = 26.97 No. 13	Silicon Si = 28.06 No. 14
4	Argon A = 39.944 No. 18	Potassium K = 39.10 No. 19	Calcium Ca = 40.08 No. 20	Scandium Sc = 45.10 No. 21	Titanium Ti = 47.90 No. 22
5		Copper Cu = 63.57 No. 29	Zinc Zn = 65.38 No. 30	Gallium Ga = 69.72 No. 31	Germanium Ge = 72.60 No. 32
6	Krypton Kr = 83.7 No. 36	Rubidium Rb = 85.44 No. 37	Strontium Sr = 87.63 No. 38	Yttrium Y = 88.92 No. 39	Zirconium Zr = 91.22 No. 40
7		Silver Ag = 107.880 No. 47	Cadmium Cd = 112.41 No. 48	Indium In = 114.8 No. 49	Tin Sn = 118.70 No. 50
8	Xenon Xe = 131.3 No. 54	Cesium Cs = 132.81 No. 55	Barium Ba = 137.36 No. 56	Rare Earths Nos. 57-71	Hafnium Hf = 178.6 No. 72
9		Gold Au = 197.2 No. 79	Mercury Hg = 200.61 No. 80	Thallium Tl = 204.39 No. 81	Lead Pb = 207.22 No. 82
10	Radon Rn = 222 No. 86	Virginium Vi = ? No. 87	Radium Ra = 225.97 No. 88	Actinium Ac = 227 No. 89	Thorium Th = 232.12 No. 90

Rare earth elements, Nos. 57-71, not classified in the table above:

Lanthanum	Cerium	Praseodymium	Neodymium	Illinium
La = 138.92	Ce = 140.13	Pr = 140.92	Nd = 144.27	Il = 146 (?)
No. 57	No. 58	No. 59	No. 60	No. 61

THE ELEMENTS (REVISED TO 1933)

Group V RH_3 R_2O_5	Group VI RH_2 RO_3	Group VII RH R_2O_7	Group VIII		
Nitrogen N = 14.008 No. 7	Oxygen O = 16.0000 No. 8	Fluorine F = 19.00 No. 9			
Phosphorus P = 31.02 No. 15	Sulfur S = 32.06 No. 16	Chlorine Cl = 35.457 No. 17			
Vanadium V = 50.95 No. 23	Chromium Cr = 52.01 No. 24	Manganese Mn = 54.93 No. 25	Iron Fe = 55.84 No. 26	Cobalt Co = 58.94 No. 27	Nickel Ni = 58.69 No. 28
Arsenic As = 74.93 No. 33	Selenium Se = 79.2 No. 34	Bromine Br = 79.916 No. 35			
Columbium Cb = 93.3 No. 41	Molybdenum Mo. = 96.0 No. 42	Masurium Ma = ? No. 43	Ruthenium Ru = 101.7 No. 44	Rhodium Rh = 102.91 No. 45	Palladium Pd = 106.7 No. 46
Antimony Sb = 121.76 No. 51	Tellurium Te = 127.5 No. 52	Iodine I = 126.92 No. 53			
Tantalum Ta = 181.4 No. 73	Tungsten W = 184.0 No. 74	Rhenium Re = 186.31 No. 75	Osmium Os = 190.8 No. 76	Iridium Ir = 193.1 No. 77	Platinum Pt = 195.23 No. 78
Bismuth Bi = 209.00 No. 83	Polonium Po = 210 No. 84	Alabamine Ab = ? No. 85			
Protoactinium Pa = 231 No. 91	Uranium U = 238.14 No. 92				

Samarium Sm = 150.43 No. 62	Europium Eu = 152.0 No. 63	Gadolinium Gd = 157.3 No. 64	Terbium Tb = 159.2 No. 65	Dysprosium Dy = 162.46 No. 66
Holmium Ho = 163.5 No. 67	Erbium Er = 167.64 No. 68	Thulium Tm = 169.4 No.69	Ytterbium Yb = 173.5 No. 70	Lutecium Lu = 175.0 No. 71

PERIODIC CHART

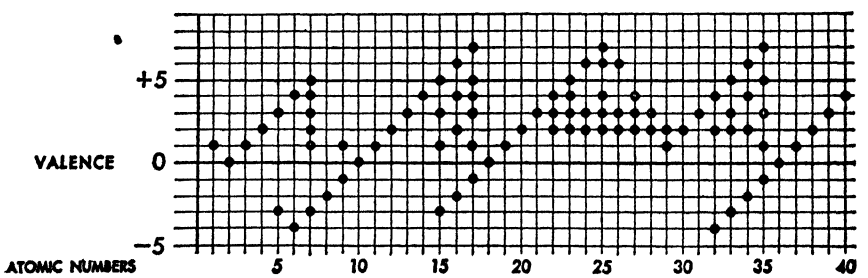
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LIGHT METALS (I A, II A) — HEAVY METALS (III B, IV B, V B, VI B, VII B, VIII)

																1	1 H 1.008
2 1	3 Li 6.940	2 2	4 Be 9.02														
2 8 1	11 Na 22.997	2 8 2	12 Mg 24.32														
2 8 8 1	19 K 39.096	2 8 8 2	20 Ca 40.08	2 8 9 2	21 Sc 45.10	2 8 10 2	22 Ti 47.90	2 8 11 2	23 V 50.95	2 8 13 1	24 Cr 52.01	2 8 13 2	25 Mn 54.93	2 8 14 2	26 Fe 55.85	2 8 15 2	27 Co 58.94
2 8 18 8 1	37 Rb 85.48	2 8 18 8 2	38 Sr 87.63	2 8 18 9 2	39 Y 88.92	2 8 18 10 2	40 Zr 91.22	2 8 18 12 1	41 Cb 92.91	2 8 18 13 1	42 Mo 95.95	2 8 18 14 1	43 Ma	2 8 18 15 1	44 Ru 101.7	2 8 18 16 1	45 Rh 102.91
2 8 18 18 8 1	55 Cs 132.91	2 8 18 18 8 2	56 Ba 137.36	2 8 18 18 9 2 138.92	57 La	58 to 71 See Below	2 8 18 32 10 2	72 Hf 178.6	2 8 18 32 11 2	73 Ta 180.88	2 8 18 32 12 2	74 W 183.92	2 8 18 32 13 2	75 Re 186.31	2 8 18 32 14 2	76 Os 190.2	2 8 18 32 15 2	77 Ir 193.1
2 8 18 32 18 8 1	87	2 8 18 32 18 8 2	88 Ra 226.05	2 8 18 32 18 9 2	89 Ac	2 8 18 32 18 10 2	90 Th 232.12	2 8 18 32 18 11 2	91 Pa 231	2 8 18 32 18 12 2	92 U 238.07						

RARE

2 8 18 19 9 2	58 Ce 140.13	2 8 18 20 9 2	59 Pr 140.92	2 8 18 21 9 2	60 Nd 144.27



OF THE ELEMENTS

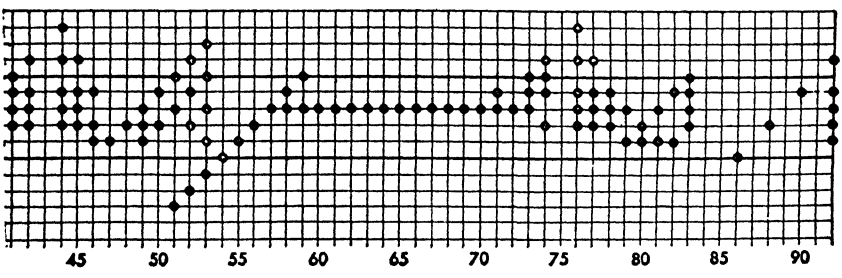
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NON METALS — INERT GASES

	I B	II B	III A	IV A	V A	VI A	VII A	INERT GASES
								2 He 4.003 (2)
			5 B 10.82 (2, 3)	6 C 12.010 (2, 4)	7 N 14.008 (2, 5)	8 O 16.000 (2, 6)	9 F 19.00 (2, 7)	10 Ne 20.183 (2, 8)
			13 Al 26.97 (2, 8, 3)	14 Si 28.06 (2, 8, 4)	15 P 30.98 (2, 8, 5)	16 S 32.06 (2, 8, 6)	17 Cl 35.457 (2, 8, 7)	18 A 39.944 (2, 8, 8)
28 Ni 58.69 (2, 8, 16, 2)	29 Cu 63.57 (2, 8, 18, 1)	30 Zn 65.38 (2, 8, 18, 2)	31 Ga 69.72 (2, 8, 18, 3)	32 Ge 72.60 (2, 8, 18, 4)	33 As 74.91 (2, 8, 18, 5)	34 Se 78.96 (2, 8, 18, 6)	35 Br 79.916 (2, 8, 18, 7)	36 Kr 83.7 (2, 8, 18, 8)
46 Pd 106.7 (2, 8, 18, 18)	47 Ag 107.880 (2, 8, 18, 18, 1)	48 Cd 112.41 (2, 8, 18, 18, 2)	49 In 114.76 (2, 8, 18, 18, 3)	50 Sn 118.70 (2, 8, 18, 18, 4)	51 Sb 121.76 (2, 8, 18, 18, 5)	52 Te 127.61 (2, 8, 18, 18, 6)	53 I 126.92 (2, 8, 18, 18, 7)	54 Xe 131.3 (2, 8, 18, 18, 8)
78 Pt 195.23 (2, 8, 18, 32, 16, 2)	79 Au 197.2 (2, 8, 18, 32, 18, 1)	80 Hg 200.61 (2, 8, 18, 32, 18, 2)	81 Tl 204.39 (2, 8, 18, 32, 18, 3)	82 Pb 207.21 (2, 8, 18, 32, 18, 4)	83 Bi 209.00 (2, 8, 18, 32, 18, 5)	84 Po (2, 8, 18, 32, 18, 6)	85 (2, 8, 18, 32, 18, 7)	86 Rn 222 (2, 8, 18, 32, 18, 8)

EARTH ELEMENTS

61	62	63	64	65	66	67	68	69	70	71
Il	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
	150.43	152.0	156.9	159.2	162.46	163.5	167.2	169.4	173.04	174.99
2, 8, 18, 22, 9, 2	2, 8, 18, 23, 9, 2	2, 8, 18, 24, 9, 2	2, 8, 18, 25, 9, 2	2, 8, 18, 26, 9, 2	2, 8, 18, 27, 9, 2	2, 8, 18, 28, 9, 2	2, 8, 18, 29, 9, 2	2, 8, 18, 30, 9, 2	2, 8, 18, 31, 9, 2	2, 8, 18, 32, 9, 2



THE ELEMENTS

ACTINIUM (Gr. *aktis*, ray) Ger. *Aktinium.* Fr. *actinium.* A radioactive element discovered in 1900 by Debierne in pitchblende. Actinium has not yet been isolated nor have any of its salts been prepared in a pure state, but always contaminated by thorium and the rare earths. Actinium is constantly breaking down into actinium-X, which in turn breaks down until actinium-D, the end product, is formed. Actinium is always associated with uranium and radium in nature and for every 1000 kilograms of uranium there are 0.34 grams of radium and only about 0.06 milligrams of actinium. It is very difficult to separate actinium from lanthanum, and, according to Mme. Curie, the preparation of pure actinium salts does not appear imminent. The half life is 13.5 years.

ALABAMINE (State of Alabama, and Alabama Polytechnic Institute.) Alabamine (ekaiodine) was discovered in 1931 by F. Allison and his co-workers Murphy, Bishop and Sommer. They digested one hundred pounds of monazite sand with aqua regia, extracted it with water, and examined the solution by means of their magneto-optic method of chemical analysis. They found the new halogen to be present in the form of peralabamic acid, $HAbO_4$. This compound was reduced to HAb, which was then converted into LiAb in which form they believe it to have been present to the extent of 2.5×10^{-6} gram of alabamine. Much research remains to be done on this element before many of its properties are known. The discovery of this element marks the end of the search for new elements from numbers 1 to 92 (hydrogen to uranium), although some investigators regard *neutron* to be an element of atomic number zero.

ALUMINUM (L. *alumen*, substance having an astringent taste) Ger. *Aluminium.* Fr. *aluminium.* Aluminum is a light, silvery metal, very malleable and ductile. Lavoisier predicted in 1782 that alumina was the oxide of a metal not then known. The first isolation of the metal is usually credited to Wöhler who in 1827 obtained the element by heating aluminum chloride with metallic potassium. Recent search of the early literature discloses, however, that the discovery should really be credited to Oerstedt, a Dane, who in 1825 heated aluminum chloride with a 1.5% potassium mercury amalgam and thus obtained the first metallic aluminum. The commercial method of isolation of the metal by electrolyzing a solution of the oxide in fused cryolite is based upon the work of Hall. Aluminum does not occur in the free state but its compounds are very widely distributed, aluminum being the most abundant metal, making up 7.85% of the known terrestrial matter. Cast aluminum is about as hard as silver. The metal takes a high polish but tends to become coated with a film of oxide. Although soluble in dilute HCl and H_2SO_4 and in solutions of KOH and NaOH, it is practically insoluble in HNO_3 or acetic acid even when hot. It is a very important metal being widely used in electrical transmission, since its conductivity per pound is greater than that of copper. Light alloys containing aluminum are used in making parts for automobiles, motorcycles and aircraft. It is also used in making cooking utensils, chemical apparatus, etc. In metallurgy aluminum is used as a degasifier, while aluminum powder is used in certain explosives, as a flashlight powder, in aluminum paints, and in the laboratory as a reducing agent. The thermite process is one that uses large amounts of aluminum. Cement, one of the most important building materials, is made up largely of aluminum silicate. Al_2O_3 or alumina, $Al_2(SO_4)_3$, $AlCl_3$ and $Al(NO_3)_3$ are typical aluminum compounds. The price is about 21¢ a pound.

ANTIMONY (Gr. *antimonos*, opposed to solitude, as antimony is always associated with other minerals) Ger. *Antimon.* Fr. *antimoine.* Antimony compounds have been known from ancient times, although the metal was probably confused with lead. Antimony was known to A. Libavius as early as 1615, and is said to have been discovered in about 1460 by Basil Valentine. Native antimony is known, but it is too rare to be commercially important. The ores of antimony are the sulfides and various antimonides and sulfantimonides of the heavy metals. The most important ore is stibnite, Sb_2S_3. The method of extraction used with this ore is the iron re-

duction process, which involves fusing the ore with iron turnings or shavings and slagging off the resulting iron sulfide with sodium chloride or sodium sulfate. The ordinary form of antimony is the metallic or gray variety. An unstable yellow antimony corresponding to yellow arsenic has been made. It ranks 52nd in order of abundance of elements in the lithosphere. Black antimony is amorphous and is more active and more easily volatilized than metallic antimony. Electrolytic antimony deposited by a weak current from an HCl solution of $SbCl_3$ is known as explosive antimony. This form has also been made in other ways; it explodes when scratched, when touched with a red-hot wire, or when heated to 125° C. Many antimony salts are poisonous but the metal is not. Antimony is used in making many important alloys such as bearing metal, type metal, hard lead, pewter, etc., chiefly for its property of hardening the softer metals. Its compounds are used in making pigments, in pharmaceutical preparations, as a mordant, in making percussion caps, fireworks and signal lights, and in the preparation of certain aniline dyes. A few common antimony compounds are $SbCl_3$, Sb_2O_3, SbH_3 or stibine, Sb_2O_5, and Sb_2S_3. The price of the metal is about 14¢ a pound.

ARGON (Gr. *argos*, neutral, inactive) Ger. *Argon*. Fr. *argon*. A colorless, odorless gas, somewhat heavier than air. It was discovered in 1894 by Lord Rayleigh and W. Ramsay, but over a century before Cavendish had found that air contained about 1/120th part of some gas other than oxygen, nitrogen and carbon dioxide. This small part was later proved to be mostly argon. It occurs in the atmosphere to the extent of about 0.93% by volume, or 1.29% by weight. Each square mile of the earth's surface supports about 800,000,000 pounds of argon. The gas is seldom prepared pure, it being sufficient in most cases to remove oxygen, nitrogen and carbon dioxide, leaving argon and traces of the rare inert gases. These can be removed by several fractional distillations of liquid air. Argon and the other inert gases are used to fill incandescent electric bulbs as well as various radio and rectifier tubes. A cylinder holding 2½ pounds or 19 cubic feet of argon can be refilled for $26.60.

ARSENIC (Gr. *arsenicos*, valiant or bold, from its action on other metals. L. *arsenicum*, yellow orpiment) Ger. *Arsen*. Fr. *arsenic*. Arsenic and its compounds have been known from ancient times, the metal being found in the free state as well as combined. Arsenic occurs as metallic arsenic, which is steel gray, opaque, and conducts electricity; as yellow arsenic, which is translucent and a non-conductor; as gray arsenic, which is gray to black, translucent and a non-conductor; and as brown arsenic, which is a pale reddish brown, opaque, amorphous, and a non-conductor of electricity. The yellow form is very unstable, it being necessary to keep it very cold and in the dark. Arsenic is 44th in abundance amongst the elements in the rocky crust of the earth. The ores of arsenic are the two sulfides As_2S_3 and As_2S_5, FeAsS, and various arsenides and arsenates. It is usually prepared by heating FeAsS or $FeAs_2$ in the absence of air, whereupon the arsenic sublimes. It is also obtained by treating ores from tin, copper, and tungsten mines. The compounds of arsenic in general are deadly poisons, but some are used in medicine, usually as a tonic. The natives of certain parts of Europe take large doses of As_2O_3, enough to be fatal to one not habituated, in the belief that their endurance is increased. Certain organic arsenic compounds such as salvarsan are important remedial agents, having specific power against blood parasites with little damage to the host when properly administered. The metal is used to harden lead in making shot, and in certain bronzes. Arsenic compounds, chiefly arsenious oxide or white arsenic, Paris green, $Cu(C_2H_3O_2)_2 \cdot 3CuAs_2O_4$, and lead arsenate are used as insecticides. As_2S_3 or orpiment is used as a pigment. As_2O_3, As_2O_5, As_2S_3, As_2S_5, AsH_3 or arsine, $KAsO_2$, $FeAsO_4$, and $AsCl_3$ are common arsenic compounds. The metal costs about 48¢ a pound, while white arsenic, As_2O_3, costs only 4¢ a pound.

BARIUM (Gr. *baros*, heavy) Ger. *Barium*. Fr. *barium*. A soft white metal of the alkaline earth group. It was first isolated by H. Davy in 1808. It never occurs native, but is fairly common as the sulfate, barite, and the carbonate, witherite. It ranks 16th among the elements in abundance. Barium is stable in

dry air but is readily oxidized by moist air or water at ordinary temperatures. It is malleable and ductile. The element has no important uses but several of its compounds have commercial applications. The carbonate, $BaCO_3$, is used in glass making and is recommended as a poison for destruction of rodents; the sulfate and carbonate are used in the manufacture of paints; $BaCl_2$ is used in purifying salt, in analytical chemistry, and in certain medicinal and photographic preparations; the nitrate and chlorate are used to produce a green color in signal lights and pyrotechny, and for certain explosive mixtures; barium peroxide, BaO_2, is used as a bleach. The porous monoxide is an excellent desiccant. Soluble barium compounds are poisonous. A pound of barium in the form of a chemically pure powder sells for about $30.

BERYLLIUM (L. *beryl*) Ger. *Beryllium* Fr. *béryllium*. Also known as GLUCINUM (Gr. *glykys*, sweet) Ger. *Glucinium*. Fr. *glycinium*. The symbols are Be and Gl. Beryllium is a dark gray metal lighter than aluminum. It was discovered by L. N. Vauquelin in 1797. It occurs in small amounts in many different minerals but its chief source is beryl, a beryllium aluminum silicate. It is the 41st element in order of abundance in the lithosphere. The metal is made commercially by converting the beryl to $BeCl_2$ and electrolyzing a fused mixture of $BeCl_2$ and an alkali chloride. Beryllium salts are generally white and do not color the non-luminous flame. The metal is used in making light alloys, hard copper, and brass which has remarkable resistance to fatigue. Beryllium salts are used in ceramics and in the manufacture of synthetic gems and incandescent mantles. BeO or beryllia, $BeCl_2$, $BeSO_4$, $BeSiO_4$, $Be(NO_3)_2$, and $Be(AlO_2)_2$ are a few of the most common beryllium salts. A copper alloy having 4% beryllium costs $15 per pound of contained beryllium.

BISMUTH (Ger. *weisse masse*, white mass. Called by miners *wismat*; changed to *bismat* when latinized) Ger. *Wismut*. Fr. *bismuth*. Bismuth is a tin-white metal with a high luster. It is thought to have been known to the ancients who confused it with tin and lead. Bismuth is not very abundant, it ranking 62nd in abundance amongst the elements found in the earth's rocky crust. Its chief source is native bismuth occurring either alone or with tin, gold, silver, etc. It can also be obtained commercially from sulfide or oxide ores. Bismuth is a soft, brittle metal which has the lowest heat conductivity of any metal. Bismuth melts at about 260° C. and its most important use is in the form of low-melting alloys with tin, cadmium, and lead. Some of these alloys melt at 75-80° C. and are used in automatic sprinklers, etc. The electrical resistance of bismuth increases in a magnetic field, which makes it useful in determining the strength of these fields. Certain salts of bismuth such as the salicylate and the subnitrate are used in medicine, while bismuth oxide is used in making an optical glass and an enamel for cast iron. Bi_2O_3, $BiOCl$, Bi_2O_5, $BiONO_3$, $Bi(NO_3)_3 \cdot 10H_2O$, and $Bi_2(SO_4)_3$ are typical bismuth salts. The metal of about 99.7% purity sells in ton lots for $1.25 a pound.

BORON (Ar. or Pers. *borak*, white) Ger. *Bor*. Fr. *bore*. Boron is a green or brown crystalline powder. It was first prepared in 1808 by J. L. Gay Lussac and L. J. Thenard. It occurs chiefly as borax in which form it is widely used as a cleaning powder. It is only 48th in abundance amongst the elements in the earth's crust, but nature has so concentrated it in a few places that it is a common and inexpensive element. It is essential to plant growth in very small amounts. Boron can be prepared by heating powdered magnesium with boric anhydride until an energetic reaction takes place. The resulting magnesium borate is leached out with water and HCl leaving the boron undissolved. It is seldom made for it has no important commercial uses. Boron is remarkable in that its electrical resistance at room temperature is about two million times its resistance at a red heat. Its most important compounds are borax, $Na_2B_4O_7 \cdot 10H_2O$, and boric acid, H_3BO_3, which is used as an antiseptic and in the plating industry. Borax and boric oxide, B_2O_3, are very important in the ceramic industries. The element costs about a dollar a gram, but borax sells for as little as 2½¢ a pound.

BROMINE (Gr. *bromos*, a stench) Ger. *Brom*. Fr. *brome*. Bromine, one of the

halogen elements, is a red, caustic, fuming liquid with a very strong, disagreeable odor. It was discovered in 1826 by A. J. Balard. It never occurs in the free state but its compounds are present in sea water and to a greater degree in certain saline springs, especially those of Stassfurt in Germany, and Ohio and Michigan in the United States. Bromine ranks 25th among the elements in order of abundance. Bromine will liberate iodine from its compounds and is in turn liberated from its compounds by chlorine, which is the basis of all technical processes for the production of bromine. Bromine and mercury are the only elements that are liquid at ordinary temperatures. The fumes of bromine are poisonous if inhaled in sufficient volume, and when the liquid is spilled on the skin it produces painful sores. Bromine is used in the preparation of various chemicals, in photography, as a disinfectant, in analytical chemistry, as a bleach, a military gas, and for gold extraction, but its largest use is in the production of ethylene bromide which is added to tetra-ethyl lead when the latter is used as an antiknock in internal combustion engines. The element is usually monovalent, but it exists with valencies of three, five, and seven as well. KBr, NaBr, AgBr, HBr, $CaBr_2$, BrCl, $AgBrO_3$, and $NaBrO_3$ are well known bromine compounds. The wholesale price of bromine is 30¢ a pound.

CADMIUM (Gr. *kadmia*, Cadmean (earth) or L. *cadmia*, calamine, a zinc ore) Ger. *Cadmium*. Fr. *cadmium*. Cadmium is a silver-white metal with a bluish tinge. It was discovered in 1817 by F. Stromeyer. It occurs chiefly as greenockite, CdS, which is found with zinc ores, usually in small quantities. Amongst the elements in the earth's crust it ranks 57th in abundance. The metal is generally obtained as a by-product in the distillation of zinc. The cadmium, being more volatile, distills off in the first fraction. This high cadmium fraction is then redistilled at a lower temperature, yielding cadmium up to 99.5% purity. Cadmium is malleable and ductile, about as hard as magnesium, and melts around 320° C. It is used in making low-melting alloys with bismuth, for making a dental amalgam, and as an alloy with silver in electroplating. Cadmium sulfide, when prepared artificially, is a bright yellow, and is used under the name of cadmium yellow in coloring white lead. CdO, CdS, $CdSO_4$, $CdCl_2$, $Cd(NO_3)_2$, and $Cd(OH)_2$ are typical cadmium compounds. The wholesale price of cadmium is about 85¢ a pound.

CALCIUM (L. *calx, calcis*, lime) Ger. *Calcium*. Fr. *calcium*. A soft silver-white metal of the alkaline earth group. The metal was first prepared by H. Davy in 1808. None of the alkaline earths occur free in nature, but calcium compounds are very abundant, calcium being fifth in order of abundance of all the elements, and making up 3.22% of the earth, air, and sea. Calcium is necessary for human nutrition, about half a gram a day being required by the average person. Animal skeletons owe their rigidity mainly to calcium phosphate, and the shells of mollusks and birds' eggs to the carbonate. Calcium is also essential to plant growth. The metal may be prepared by the electrolysis of $CaCl_2$ at a temperature slightly above its melting point. It is used as a reducing agent in the preparation of metals from their oxygen and halogen compounds; as a reagent in the purification of inert gases; as a scavenger and decarbonizer in metallurgy; as a means of fixing atmospheric nitrogen; and for making alloys, especially with aluminum. Calcium compounds are widely used in the manufacture of lime, mortar, bricks, cement, glass, glazes, sugar, paint, paper, and in tanning. Calcium hypochlorite is a common bleaching agent and deodorant, while calcium carbide is used to produce acetylene. CaO, $CaCl_2$, $CaCO_3$, $CaSO_4$, $Ca(NO_3)_2$, and $Ca(OH)_2$ are a few well known calcium salts. The retail price of calcium is about $5 a pound, but slaked lime, $Ca(OH)_2$, costs only about ½¢ a pound.

CARBON (L. *carbo*, coal) Ger. *Kohlenstoff*. Fr. *carbone*. Carbon occurs free in nature and has been known from ancient times. The element exists in two crystalline forms, diamond and graphite, as well as in the amorphous condition as exemplified by lampblack, boneblack, etc. The diamond is the hardest known substance, and has a very high melting point and index of refraction as well. Because of these properties it is much prized as a gem, but it is also used to cut

glass, drill rocks, and as bearings in watches and other precise instruments. The chief source of diamonds is the blue clay near Johannesburg, South Africa. Graphite occurs as nodules in granite, slate and other rocks, but it is sometimes found in large masses. It is gray with a metallic luster and is opaque even in the thinnest flakes. It is very soft and greasy to the touch. Graphite can, like the diamond, be burned to CO_2 at high temperatures. It is used in pencils, as crucibles for melting metals, in electrotyping, for protecting iron from rust, and as a lubricant. Amorphous carbon, of which there are several kinds, is made by burning various organic substances in an insufficient supply of air. It is soft, black, and slightly more active than graphite, probably because it is in a more finely divided state. Special forms of carbon (activated) are used for their absorptive properties in removing odors, tastes, colors, etc. Carbon is the basic substance around which all organic life revolves. It is found in all plants and animals in the combined state, while great deposits of coal are known which consist mainly of carbon either free or combined. Carbon dioxide is present in air to the extent of .035% by volume, and is the sole source of carbon for life. Carbon amounts to 0.18% of all known terrestrial matter, and is 11th amongst the elements in order of abundance. The number of known carbon compounds is around a quarter of a million, while the number of possible compounds is almost unlimited. $CaCO_3$, CO_2, CO, CS_2, CCl_4, $CHCl_3$, C_2H_5OH, CH_3COOH, $(COOH)_2$, and $C_2H_5OC_2H_5$ are a few of the most important carbon compounds. The wholesale price of graphite is about 6¢ a pound, while that of carbon black is about 3¢ a pound.

CERIUM (Named from the asteroid, *Ceres*, which was discovered three years before the element) Ger. *Cerium*. Fr. *cérium*. A steel-like appearing metal of the rare earth group, which is malleable and ductile and can be cut with a knife. It was discovered by Berzelius and Hisinger in 1804. Cerium is the most abundant of the rare earths, and is 24th in order of abundance amongst the elements in the earth's crust. It is usually found in monazite sand, cerite, gadolinite and samarskite. The metal can be prepared by the electrolysis of the chloride. Cerium is separated from mixtures with the other rare earths by oxidation to the ceric state and subsequent removal. Iron-cerium alloys are pyrophoric and are used in automatic lighters. An alloy of cerium with lanthanum and the other rare earths, known as *mischmetall*, is a valuable reducing agent. Gas mantles contain about one percent CeO_2; cerium salts, especially the fluoride are introduced into arc-lamp electrodes which makes them burn more brightly, quietly, and evenly. Ceria is used to make glass of good heat protecting properties. Cerous salts (valence 3) are colorless; ceric salts (valence 4) are yellow, orange or red. Cerium is used in certain photoelectric cells. Ceric oxalate is used in medicine, and the sulfate is being used in titrimetric analysis in place of $KMnO_4$ or $K_2Cr_2O_7$, it having the advantage of yielding colorless reaction products. Ce_2O_3 or ceria, CeO_2, $Ce_2(CO_3)_3$, and $CeCl_3$ are a few of the better known cerium compounds. A technical grade of the element costs $36 a pound, but some of its compounds are relatively cheap.

CESIUM (L. *coesius*, sky-blue) Ger. *Cäsium*. Fr. *césium*. Cesium is a silvery white alkali metal resembling rubidium and potassium. It was discovered with the aid of the spectroscope in 1860 by Bunsen and Kirchhoff. Cesium is the heaviest of the known members of the alkali series of metals, and is the most electropositive of all metals. It is the softest of all solid metals, being softer than beeswax and must be kept out of contact with air or water. Its chief source is the mother liquors from the production of KCl from carnallite. Cesium is the 37th element in abundance in the earth's crust, but it is never found in large quantities. It is used in certain photoelectric cells, and in vacuum tubes to remove traces of gases. Cesium compounds color the non-luminous flame violet. CsOH, CsCl, CsCN, and $CsHC_4H_4O_6$, the acid tartrate, are some common cesium salts. The price is about $14 a gram.

CHLORINE (Gr. *chloros*, grass green) Ger. *Chlor*. Fr. *chlore*. Chlorine is a greenish-yellow gas with a disagreeable odor. It is a member of the halogen group of elements and was first proved to be an element by H. Davy in 1810. Chlorine does not occur free in nature, but

chlorides and other chlorine-containing compounds are quite common, chlorine ranking 12th among the elements in order of abundance. Sodium chloride is the most important source for both chlorine and sodium, it being found in huge deposits as well as being present in sea water and in most brines. Chlorine is generally made by the electrolysis of sodium chloride, it being a secondary product in the manufacture of sodium hydroxide. Chlorine is non-combustible, but it will support the combustion of certain compounds. A candle will burn in chlorine with a smoky flame, the hydrogen in the paraffin combining with the chlorine while the carbon is liberated. Chlorine is used as a bleaching agent, a water disinfectant, a war gas, and as an intermediate in the preparation of other compounds, one of the most important of which is calcium hypochlorite or bleaching powder. Sodium chloride is a necessary constituent of animal diets. Chlorine can act with a valence of 1, 3, 4, 5, and 7 as illustrated by the compounds NaCl, $KClO_2$, ClO_2, $KClO_3$, and $KClO_4$. Hydrochloric acid, HCl, is one of the three common mineral acids. The wholesale price is 5½¢ a pound in carloads or a 100 pound cylinder can be refilled for $12.00.

CHROMIUM (Gr. *chroma*, color) Ger. *Chrom*. Fr. *chrome*. A hard, bright, silvery metal capable of taking a high polish. It was discovered in 1797 by L. N. Vauquelin, whose work was confirmed by M. H. Klaproth. The principal ore of chromium is chromite, $FeO \cdot Cr_2O_3$. Most of the chromium comes from New Caledonia, the United States, India, and Canada. Chromium ranks 18th in abundance amongst the elements in the earth's crust. The metal is generally prepared by the reduction of Cr_2O_3 with hydrogen or some other reducing agent, the chromic oxide being made from chromite by heating the refined ore with an alkali, acidifying to form the alkali dichromate, and reducing this to the insoluble Cr_2O_3 and a soluble alkali salt, the latter being leached out with water. The metal which has been electrically deposited has a hardness of 9 on the scale where diamond is 10 and is much harder than metal prepared in other ways. Objects electroplated with chromium have a beautiful silvery finish that is very resistant to all kinds of corrosion. There are many important chromium alloys such as steel with about two percent chromium, as well as different nickel-chromium and chrom-vanadium steels. The addition of chromium to an alloy generally adds to its toughness, hardness, strength, and resistance to corrosion. Perhaps the largest use of chromium is in the form of chromite as a refractory lining in open-hearth and other furnaces. Chromium compounds are highly colored, and are much used as pigments. They are also used in tanning, in making safety matches, as antiseptics, as components in certain galvanic cells, and for many other purposes. K_2CrO_4, $Cr(OH)_3$, Cr_2O_3, CrO_3, and $PbCrO_4$ are typical chromium compounds. The price is 85¢ per pound.

COBALT (Gr. *kobolos*, a goblin) Ger. *Kobalt*. Fr. *cobalt*. Cobalt is a bright silvery metal and is a member of the iron-cobalt-nickel triad. It was first prepared by Georg Brandt in 1735; cobalt compounds, however, were first studied by Thenard in 1802. It is not very widely distributed; among the more important ores are cobaltite (CoAsS), smaltite ($CoAs_2$), erythrite ($Co_3(AsO_4)_2 \cdot 8H_2O$), and wad ($Co_3S_4$). The most important deposit of cobalt ores is the one at Cobalt, Ontario, where the cobalt arsenide is mixed with nickel and silver. These ores are ground, smelted, roasted, and washed in a series of steps that results in the recovery of nickel and cobalt oxides, silver, and arsenious oxide. The Co_3O_4 which is the form usually sent to the refinery is reduced to the metal with carbon, hydrogen or aluminum. Cobalt is 25th in abundance amongst the elements in the earth's crust. Cobalt is not quite as magnetic as iron, but is harder than iron or nickel; like iron, its hardness and tensile strength are much improved by the addition of small amounts of carbon, usually to the extent of 0.25% or less. Too much carbon makes cobalt brittle. Unlike iron, cobalt is not attacked by air and water at ordinary temperatures, but it is superficially oxidized at a red heat. Cobalt may be electroplated, depositing a coating with properties superior to that obtained by nickel plating. Many valuable cobalt alloys are known such as stellite and cochrome, the latter being the same as nichrome with the nickel replaced by

cobalt. This alloy, which is used for electrical heating units, melts at a higher temperature and is more resistant to corrosion than the corresponding nickel alloy. Combined with nickel and aluminum, cobalt is used in making the very powerful Alnico magnets. A cobalt amalgam is used in dentistry. Certain cobalt salts are used to impart a beautiful blue color to glass, pottery, enamels and paints. Several organic cobalt salts such as the oleate, acetate, linoleate, etc. are used as dryers in the paint and varnish industry. Cobalt forms divalent and trivalent compounds, but the latter are generally unstable except in the double salts. $CoCl_2$, $Co(ClO_3)_2$, $Co(OH)_2$, Co_3O_4 or cobalto-cobaltic oxide, $CoSO_4$, and $Co(NO_3)_2$ are common cobalt salts. The cost of cobalt is about $2.00 a pound.

COLUMBIUM (from *Columbia*, America, as the original ore came from the United States). Also called **NIOBIUM** (Gr. myth. Niobe daughter of Tantalus, as it is found associated with tantalum) Ger, *Columbium* or *Niobium*. Fr. *columbium* or *niobium*. Columbium is steel-gray in color and has a bright metallic luster. It was discovered in 1801 by C. Hatchett. Columbium does not occur in the free state, and its minerals are relatively rare, the element being 33rd in order of abundance in the earth's crust. It is generally found with tantalum as the columbates and tantalates of calcium, iron, uranium, manganese, and the rare earths. The two metals are separated by taking advantage of the different solubilities of potassium fluotantalate and potassium fluocolumbate. Columbium is malleable and ductile, and very resistant to corrosion. Like its companion metal, tantalum, a columbium electrode acts as an electrolytic valve allowing an alternating current to pass only in one direction through an electrolytic cell. Columbium has been used in lamp filaments and in jewelry, it being capable of being colored by an electrolytic process. Columbium forms the oxides Cb_2O_3, CbO_2, and Cb_2O_5, the pentoxide giving rise to salts known as columbates or niobates. CbF_5, $CbCl_3$, $CbCl_5$, and $CbOCl_3$ are other compounds. The retail price is about $4.50 a gram.

COPPER (L. *cuprum*, copper) Ger. *Kupfer*. Fr. *cuivre*. Copper is a reddish-brown ductile metal. It is found native in large masses, and has been known from the earliest times. The metal is also obtained from ores such as covellite (CuS), tenorite (CuO), cuprite (Cu_2O), chalcocite (Cu_2S) and azurite ($Cu_3(OH)_2(CO_3)_2$). Copper ores are found in many countries, but the United States is the largest producer. Counting only the elements in the earth's crust, copper is 22nd in abundance. The metal is usually prepared by roasting and smelting the ore and then making the final purification by electrolysis. Copper is one of the best conductors of heat and electricity, and consequently is widely used in making boilers, steam pipes, cooking utensils, chemical apparatus, and wires for telephones and telegraphs as well as for the distribution of current. Copper rollers are used in calico printing. Its alloys are very important, including brass, bronze, gun-metal, coins, etc. Copper salts are used in medicine, for combatting pests, and as antiseptics. CuO, Cu_2O, $CuSO_4 \cdot 5H_2O$, CuOH, CuCl, and $Cu(NO_3)_2$ are well known copper salts. In large quantities the price of copper is 11½ to 12¢ a pound.

DYSPROSIUM (Gr. *dysprositos*, hard to get at) Ger. *Dysprosium*. Fr. *dysprosium*. Dysprosium is a rare earth metal of the yttrium group and has not yet been described. It was discovered in 1886 by Lecoq de Boisbaudran. The compounds of dysprosium are found in very small quantities in the minerals blomstrandine, euxenite, fergusonite, gadolinite, and polycrase, together with the other rare earths. It is widely distributed, being 45th in abundance amongst the elements in the earth's crust. Dysprosium salts are yellow or greenish-yellow in color. Dy_2O_3 or dysprosia, $DyCl_3$, $Dy_2(SO_4)_3$, $Dy(NO_3)_3 \cdot 6H_2O$, $Dy_2(CO_3)_3 \cdot 4H_2O$ and a few others have been described. They have no commercial application.

ERBIUM (*Ytterby*, a town in Sweden) Ger. *Erbium*. Fr. *erbium*. Erbium has been isolated as a dark gray metallic powder which was probably impure. It was discovered in 1843 by C. G. Mosander. Erbium occurs with other rare earths in minerals such as gadolinite, blomstrandine, euxenite and a few others. It ranks 50th in abundance amongst the elements in the rocky crust of the earth. Its compounds are pink or rose colored, and have a sweet, astringent

taste. A few compounds of erbium including Er_2O_3 or erbia, $Er_2(SO_4)_3$, $Er(NO_3)_3 \cdot 5H_2O$ and others have been prepared. They are not used commercially.

EUROPIUM (*Europe*) Ger. *Europium.* Fr. *europium.* Europium is one of the least abundant of the rare earth elements, ranking 53rd amongst the elements in the earth's crust. The metal has not yet been prepared, and few of its salts are known. Europia (Eu_2O_3) was isolated in 1900 by Demarcay, and prepared in a state of purity by Urbain and Lacombe in 1904. Europium compounds are pale pink in color. $EuCl_3$, $EuCl_2$, Eu_2O_3, $Eu_2(SO_4)_3$ and a few organic salts have been isolated.

FLUORINE (L. *fluere*, to flow) Ger. *Fluor.* Fr. *fluor.* Fluorine is a pale, greenish-yellow gas of the halogen family and is very pungent and corrosive. The gas was isolated in 1886 by H. Moissan after a period of more than 75 years of labor on the part of many experimenters. Fluorine is the most chemically active of the elements. It occurs in the combined form in fairly large quantities being the 20th element in order of abundance in all known terrestrial matter, or 17th counting only the elements in the earth's crust. The moist gas will attack glass, but dry fluorine is without action. It is prepared by electrolyzing a solution of potassium fluoride in liquid HF or molten KHF_2. The chief ores of fluorine are fluorspar (CaF_2), and cryolite (Na_3AlF_6). Fluorine will combine with all elements except the inert gases. It is so active that solid fluorine and liquid hydrogen explode when brought together at −252° C. The free element is difficult to prepare and is seldom used. Hydrogen fluoride is used for etching glass; in the fermentation industries for checking the growth of wild yeasts; to coagulate rubber latex; in the laboratory for analytical purposes, especially the estimation of silica; and for opening boring holes in gas and petroleum wells, the acid being used to dissolve the siliceous material. Soluble fluorides are poisonous; NaF, for example, being a common insecticide. Boron trifluoride is finding some use as a catalyst. A very small amount of fluorine in the water supply causes a defect in children known as "mottled teeth." This small amount of fluorine can be removed easily and economically from public or private water supplies. A few typical fluorine compounds are NaF, CaF_2, KF, AgF, and AlF_3.

GADOLINIUM (Named for J. Gadolin, the Finnish chemist) Ger. *Gadolinium.* Fr. *gadolinium.* The element has not been prepared, but several of its salts are known. Gadolinium was discovered in 1886 by Marignac. It is generally found with other rare earths, especially those of the terbium family, of which it is a member. It is the 40th element in abundance in the earth's crust. The gadolinium ion is colorless. Among the salts of this element which have been prepared are Gd_2O_3 or gadolinia, $GdCl_3$, GdF_3, Gd_2S_3, $Gd_2(SO_4)_3$, $Gd(NO_3)_3 \cdot 6H_2O$, and several organic salts.

GALLIUM (L. *Gallia*, France) Ger. *Gallium.* Fr. *gallium.* Gallium is a steel-gray metal. It was discovered in 1875 by L. de Boisbaudran. The element is 32nd in order of abundance in the earth's crust and, though widely distributed, occurs in very small quantities. It is obtained from certain zinc blendes in which it occurs as a very slight impurity. Gallium is unique in that it melts at 30° C. and yet is not very volatile at a red heat. These properties make the metal valuable for use in thermometers for high temperatures. It is also capable of being greatly supercooled; and, when solid, is much harder than other low-melting metals. Gallium has a valence of three, and forms salts resembling those of aluminum, such as $GaCl_3$, Ga_2O_3, Ga_2S_3, and $Ga_2(SO_4)_3$. It also forms divalent salts such as $GaCl_2$, etc. The price is about $8 a gram.

GERMANIUM (L. *Germania*, Germany) Ger. *Germanium.* Fr. *germanium.* Germanium is a grayish-white metal of the silicon family, appearing in the periodic table between silicon and tin. It was discovered in 1886 by C. Winkler, but it had been predicted before this by Mendeleeff, who called it eka-silicon. The element is rather scarce, ranking 36th in abundance, in the earth's crust. It is found in small quantities in the ores of silver, copper, zinc, and a few other metals. It can be separated from most of its associates by precipitation from acid solution with H_2S. The metal

may be prepared by reducing the sulfide with hydrogen or carbon. Germanium compounds are plant stimulants in very low concentrations, toxic in higher. Germanium resembles silicon in forming a gaseous hydride GeH_4, while K_2GeF_6 is like K_2SiF_6. GeO_2, GeS_2, GeO, GeS are typical compounds. The retail price is about $16 a gram.

GOLD (Anglo-Saxon, *gold*. Sanskrit, *juel*, to shine) Ger. *Gold*. Fr. *aurum*. Like most metals that are found in the free state, gold has been known from ancient times. It is bright yellow in color, is very soft and heavy, is the most malleable and ductile of all metals, is a good conductor of heat and electricity, and is not acted upon by air, water, or most reagents. The metal is generally found native in rocky or sandy deposits. After concentrating the ores, the gold is extracted by the amalgamation process or the cyanide method. In abundance, it ranks 58th amongst the elements in the earth's crust. Gold is widely used in coinage, it being the standard for monetary value in most countries. The metal is generally alloyed with copper or silver to make it hard enough to stand wear; such alloys are used in jewelry and other ornaments. Gold forms compounds in which it is either tri- or mono-valent. Gilding is often accomplished electrolytically, usually with sodium gold cyanide or chloroauric acid, $HAuCl_4$. Many gold compounds are used in medicine, and several, notably $AuCl_3$, are of use in photography. The United States Government sets the price of gold at $510.42 per pound avoirdupois.

HAFNIUM (L. *Hafnia*, Copenhagen) Ger. *Hafnium*. Fr. *hafnium*. Hafnium is a metal resembling zirconium, and is found in nearly all ores of that metal. It was discovered in 1922 by D. Coster and G. Hevesy. The average hafnium content of all zirconium ores is about three percent of the amount of zirconium in the ore, but the minerals alvite, cyrtolite, and thortveitite are much richer than this in hafnium. This element is number 72 in the periodic table. Urbain thought he had discovered number 72 in Marignac's ytterbium and named his new element "celtium," but this is now believed to have been a concentrated sample of lutecium. It is very difficult to separate hafnium from zirconium. This is generally accomplished by many fractional crystallizations of the mixed potassium hexafluorides, K_2HfF_6 and K_2ZrF_6. The metal is prepared by reducing K_2HfF_6 with sodium. The probable concentration of hafnium in the earth's crust is one part in 100,000, it ranking 47th amongst the elements in abundance.

HELIUM (Gr. *helios*, the sun) Ger. *Helium*. Fr. *hélium*. Helium is a very light, colorless, odorless, inert, atmospheric gas. It was found spectroscopically in the atmosphere of the sun by Lockyear in 1868. The gas was first isolated by Ramsay in 1895. Helium is present to a very slight degree in air, and to a much larger extent in certain mine gases and dissolved in spring water. Helium is a disintegration product of radioactive substances, so it is generally found in the ores of uranium, radium, etc. and from which it may be obtained by heating the mineral and pumping off the resulting gases. The chief source of helium is certain gas wells in the Texas-Panhandle containing 1 to 2% of the element; a more recently discovered supply has been found in wells of southeastern Colorado yielding as high as 7%. The helium-bearing gases in Germany vary from 0.001% to 0.19%; in the "blue" rock salt, in whose origin radioactive processes seem to play a very important part, it occurs to the extent of 0.13 cubic milliliters per 100 grams of the salt. The element has been found in the thermal waters of the Black Forest, in Baden-Baden, and also in Heidelberg. Helium ranks 63rd in abundance amongst the elements in the earth's crust, but the atmosphere above 13 miles is probably chiefly helium and hydrogen. Helium forms no compounds, so it is probably present in an occluded condition or perhaps trapped in tiny holes within the rocks. The chief use for helium is to inflate lighter-than-air machines; although heavier than hydrogen, it will neither burn nor support combustion. It has been used for the production of the lowest temperatures ever obtained; i.e., below −271° C. The most important use of helium is to replace the nitrogen in the air in caissons and for administration in asthmatic conditions. For the former it is less soluble in blood than is nitrogen; for the latter it is lighter and more penetrative

in the narrowed passages. A cylinder containing 146 cubic feet of helium when at atmospheric pressure can be refilled for $16.

HOLMIUM (from *Holmia*, latinized form of Stockholm, near which the rare earth minerals are found) Ger. *Holmium.* Fr. *holmium.* Holmium is one of the least abundant of the rare earth metals, ranking 43rd in abundance amongst the elements in the earth's crust. It has never been isolated, the oxide holmia, Ho_2O_3, being very difficult to obtain in a pure state. The element was discovered in 1879 by P. T. Cleve. Holmium salts, a few of which have been prepared, are yellow with an orange tinge.

HYDROGEN (Gr. *hydro genes*, water former) Ger. *Wasserstoff.* Fr. *hydrogéne.* Hydrogen is a colorless, odorless, combustible gas. Although it was known to the alchemists, hydrogen was first recognized as a distant substance by Cavendish in 1766. Hydrogen occurs in the free state in certain natural gases and in volcanic exhalations. It is thought by some to be the major constituent of the atmosphere in the upper regions. Hydrogen makes up 0.95% of all known terrestrial matter. It combines with oxygen to form water from which the element can be prepared by electrolysis. It is also obtained by the action of acids on metals and by the action of steam on certain metals such as iron at a red heat. Hydrogen is element number one in the periodic table; it has the lowest atomic weight of any element and is the lightest gas; the hydrogen molecule diffuses faster than any other. The gas is used in the oxy-hydrogen flame in welding, in hydrogenating oils, fats and other substances, for filling balloons, and as a reducing agent. Hydrogen is a necessary constituent in hundreds of important compounds. All acids owe their acidity to the presence of the hydrogen ion in their solutions. All hydrocarbons, carbohydrates, proteins, fats, in fact nearly all organic compounds contain hydrogen. A cylinder holding 180 cubic feet of hydrogen when at atmospheric pressure can be refilled for $5.

ILLINIUM (Named from the University and State of Illinois, U. S. A.) Ger. *Illinium.* Illinium, element number 61, was the last of the rare earths to be discovered. It was found in 1926 by Harris, Yntema, and Hopkins, as the result of work carried on at the University of Illinois. The metal has never been isolated, nor have any of its pure salts been prepared, the element being detected by means of absorption, arc, and X-ray emission spectra. Illinium is a member of the cerium group of rare earths. It appears in the periodic table between neodymium and samarium.

INDIUM (From its indigo-blue spectrum line) Ger. *Indium.* Fr. *indium.* Indium is a soft, silvery white metal of the aluminum family. It is very malleable and ductile, and is even softer than lead. The element was first isolated in 1863 by F. Reich and T. Richter. It occurs as a very slight impurity in certain zinc blendes. Indium never occurs native, but is generally found as the sulfide, In_2S_3. It is very rare, being 64th in abundance amongst all elements, in the earth's crust. The metal is not affected by air or water, but can be ignited to the oxide In_2O_3. Indium has no important commercial applications, due partly to its high price of about $12.50 per ounce.

IODINE (Gr. *iodes*, violet) Ger. *Jod.* Fr. *iode.* The German symbol of J for iodine, and the French symbol of Az for nitrogen are the only instances of different national usage in this respect. Iodine, one of the halogen elements, is a bluish-black crystalline solid which is converted into a violet vapor on heating. It was discovered in 1811 by B. Courtois, while Gay Lussac aided him in investigating the new substance in proving the fact that it was an element. Iodine does not occur free in nature, but its compounds are found in sea water as well as in sea plants and animals. Certain kinds of kelp seem to absorb it from the water in preference to bromine which occurs in much larger quantities. Iodine ranks 28th amongst the elements in abundance, but counting only those in the rocky crust of the earth it drops to 59th place. Iodine was formerly obtained from the ashes of seaweeds, but most of it is now made from the mother liquors after the extraction of sodium nitrate from the caliche of Chile, in which iodine is present in the form of iodates. The iodine is obtained from iodates by heating them

with sodium bisulfite. Iodine plays an important part in animal economy, it being present in small quantities in all the organs, especially the thyroid gland. The element is used in medicine, both as a tincture (the free element dissolved in alcohol) and in compounds, mostly for external use as antiseptics. Iodine is important in analytical chemistry as are several of its compounds, notably KI and KIO_3. Some iodides are used in photography while a considerable amount is used in the aniline dye industry. It acts as a powerful poison. Iodine usually has a valence of one, forming iodides such as NaI, KI, AgI, BiI_3, CaI_2, etc. It also forms iodates (salts of iodic acid, HIO_3) and periodates (salts of periodic acid, HIO_4). Tri-valent iodine is known in compounds like ICl_3. The wholesale price of crude iodine is about $1.30 a pound, while the resublimed grade costs around $2.00.

IRIDIUM (So named from the iridescent color of its salts) Ger. *Iridium.* Fr. *iridium.* Iridium is a metal of the platinum family. It is hard, brittle, nonductile, and in appearance lies between silver and tin. Iridium was first identified as a new metal by Tennant in 1804. It is found in alluvial deposits alloyed with platinum as platiniridium, or with osmium as osmiridium. Iridium is very rare, ranking 61st in abundance amongst the elements in the earth's crust. The metal is generally obtained by precipitation from solution as $(NH_4)_2IrCl_6$; this is then heated in a current of hydrogen, leaving the impure iridium, which must further undergo a complicated process to remove traces of rhodium, ruthenium and iron. Iridium, when alloyed with platinum, forms a hard, resistant metal that is used to make scientific apparatus, surgical tools, standard weights and lengths, and pen points. Because of its hardness the element itself is used to make pivots, etc. Iridium black, made by the action of light on alcoholic sulfate solutions, is used as a catalytic agent. Acids, even aqua regia, do not act on iridium, while fluorine and chlorine do not act until a red heat is reached. Fusion with KOH and KNO_3 results in the formation of K_2IrO_4. $IrCl_4$, $IrCl_3$, $K_3IrCl_6 \cdot 3H_2O$, Ir_2O_3, IrO_2, and $K_3Ir(CN)_6$ are some typical iridium compounds. The wholesale price of the metal is about $5,000 a pound.

IRON (Anglo-Saxon, *iren,* or *isern.* Latin, *ferrum,* from which is derived the symbol Fe) Ger. *Eisen.* Fr. *fer.* Iron is a bright, silvery white metal which tarnishes in air or water. Perfectly dry air does not affect it, but under normal atmospheric conditions an unprotected sample will, in time, rust away completely. Next to aluminum, iron is the most abundant of all metals, and has been known from very early times. It ranks fourth in abundance amongst all the elements in the earth's crust. It is sometimes found native in meteors, in which it is alloyed with from 1 to 10% of nickel. The usual source of the metal is magnetite (Fe_3O_4) and hematite (Fe_2O_3), which are the ores that are mined in vast quantities in the Lake Superior district. The iron is obtained by reducing the ores with carbon in a blast furnace. The fusible carbide, cast iron, can be purified by "puddling" in a reverberatory furnace with ore, limestone, etc. to remove C, S, P and Si with mechanical working to produce wrought iron; or completely fused at a higher temperature for steel, to which alloying additions may be made. Pure iron is rather soft, malleable and ductile. Small amounts of carbon greatly change these properties, making the iron harder and of higher tensile strength; too much carbon makes iron brittle. Iron is very strongly magnetic. It is readily attacked by dilute mineral acids, but can be rendered passive by concentrated nitric acid. Pure iron is seldom used except in medicine for treatment of anemia, and in analytical work as a reducing agent, but the so-called "ingot iron" and electrolytic iron are nearly pure, as are certain low carbon steels. The quality of steel is greatly improved by the addition of small amounts of nickel, cobalt, chromium, vanadium, or tungsten. FeO, Fe_2O_3, $FeSO_4$, FeS, $FeCl_3$ and $Fe(NO_3)_3$ are typical iron compounds. Crude pig iron sells for about $28 a ton, but U. S. P. powdered iron costs about 80¢ a pound.

KRYPTON (Gr. *kryptos,* hidden) Ger. *Krypton.* Fr. *crypton.* Krypton is one of the rare, inert atmospheric gases. It was first isolated by W. Ramsay and M. W. Travers in 1898 by fractionally distilling liquid argon which contained the other inert gases. Krypton is present in air to the extent of one part in

20,000,000 by volume, or one part in 7,000,000 by weight. It is seldom prepared pure, but is allowed to remain with the other inert gases in filling incandescent bulbs. The cost of 250 cc in glass is $17.50.

LANTHANUM (Gr. *lanthano*, to be concealed) Ger. *Lanthan*. Fr. *lanthane*. Lanthanum, a tin-white metal which is malleable but not ductile, was discovered in 1839 by C. G. Mosander. It burns in air at 440-460°C. to form the oxide La_2O_3, and generally occurs with the other rare earth elements in the combined form in such minerals as scheelite, monazite, apatite, cerite, orthite, as well as in certain kinds of calcite, fluorspar, etc. The element is fairly common, ranking 30th in abundance in the earth's crust. Lanthanum salts are colorless unless derived from a colored acid. Most of the usual salts of lanthanum have been prepared, such as the chloride, $LaCl_3$, from which the metal is made by reduction with sodium, the sulfate, $La_2(SO_4)_3$, etc. It has no important commercial applications. The price is about $9 a gram.

LEAD (Medieval *led*, *leed*, *lead*. Anglo-Saxon *léad*, akin to Danish *lood*. L. *plumbum*, from which we get the symbol Pb) Ger. *Blei*. Fr. *plomb*. Lead is a dull, gray, heavy metal with little tenacity. It is very soft and easily fused, and has been known from ancient times. Lead is seldom found native, its most common ore being galena (PbS). Cerussite ($PbCO_3$), and anglesite ($PbSO_4$) occur in sufficient quantities to be mined, and a rare mineral plumbojarosite is used as an ore in Utah. Although lead is a common and very useful metal, it ranks only 31st in abundance amongst the elements in the earth's crust. The ores are roasted in some cases to form the sulfate, sulfide and oxide in such proportions that when the temperature is raised they react to form lead and sulfur dioxide. In the iron reduction process the ore is heated with iron, and the lead is set free. It is used in making pipes, sulfuric acid chambers, and other containers for corrosive liquids. Vast quantities are used in the lead plate type of storage battery, as well as in many valuable alloys such as Babbitt and type metal, shot, solder and pewter. Lead compounds are very important in the paint industry, white lead ($2PbCO_3 \cdot Pb(OH)_2$), red lead (Pb_3O_4), and lead chromates such as $PbCrO_4$ being common pigments while lead linoleate and other lead salts of fatty acids are well-known paint driers. Lead compounds are used in the manufacture of flint glass and enamels; lead oxide is used in vulcanizing rubber; the ethide, $Pb(C_2H_5)_4$ is a popular gasoline antiknock; and sodium plumbite (Na_2PbO_2) is used to sweeten gasoline by removing the sulfides as PbS. Lead is the stable end product of all natural radio-active elements. Radium D is one of the radio-active isotopes of lead. The nature of these isotopes as shown by the molecular weight of the lead found in a certain region is taken as an indication of its geological age. Lead and its soluble compounds are cumulative poisons, repeated small doses being as dangerous as a single large dose. Exposure to dust containing lead is a common cause of poisoning, "painters' colic" being an example. PbO, PbO_2, $Pb(NO_3)_2$, $Pb(C_2H_3O_2)_2$, and K_2PbO_3 are typical lead compounds. The wholesale price is about 5¢ a pound.

LITHIUM (Gr. *lithos*, stony) Ger. *Lithium*. Fr. *lithium*. Lithium is an alkali metal which is silvery white in color but tarnishes so quickly in air that it is seldom seen in this condition. It should be preserved in a well-stoppered bottle under a liquid which contains as little oxygen as possible. Lithia, Li_2O, was discovered in 1817 by A. Arfvedson in the mineral petalite, while H. Davy, somewhat later, succeeded in isolating a little of the element by electrolyzing LiCl. Lithium never occurs free, but its compounds are found in soil, spring water, and in various minerals such as lepidolite, petalite, spodumene, etc. The element ranks 38th in abundance in the earth's crust. Lithium comes first in the group of alkali metals. It is the lightest of all metals, has the highest specific heat of any element, and is the hardest of the alkali metals, being about as hard as lead. Lithium and its compounds impart a brilliant crimson color to the flame. The element has a limited application in hardening bearing alloys, but the carbonate is widely used in ceramic glazes, and several salts, notably the carbonate and citrate are important

medicinally. LiCl, Li_2CO_3, Li_2SO_4, Li_2O and $LiNO_3$ are common lithium salts. The metal retails for about 18¢ a gram, but the carbonate costs only about $1 a pound.

LUTECIUM (From *Lutecia*, ancient name of Paris) Ger. *Lutetium*. Fr. *lutetium*. Lutecium is the last of the rare earth elements in the periodic table. It was discovered in 1905 by G. Urbain and is found in various rare earth minerals, especially those containing yttrium. Lutecium is 55th in abundance amongst the elements in the earth's crust. The metal has not been prepared in the pure state, but a few salts are known, including lutecia, Lu_2O_3, and the sulfate, $Lu_2(SO_4)_3$.

MAGNESIUM (L. *Magnesia*, a district in Asia Minor) Ger. *Magnesium*. Fr. *magnésium*. Magnesium is a very light, silvery white metal that tarnishes slightly in air. In 1808 H. Davy proved that magnesia was the oxide of a metal which he called magnium. This name was later changed to magnesium. The metal was isolated by Bussy in 1829. It does not occur free in nature, but its compounds are quite common, magnesium being 8th amongst the elements in order of abundance. Magnesite ($MgCO_3$), dolomite (Mg, Ca, CO_3), carnalite (KCl, $MgCl_2$), and Epsom salt ($MgSO_4 \cdot 7H_2O$) are common magnesium minerals. The metal is generally made by electrolyzing the fused chloride. In this country the chief sources of magnesium are the Michigan brines and sea water. Magnesium as a powder or a ribbon will burn in air with a brilliant, white flame, and in these forms is used as a "flashlight powder" and for pyrotechnics. It is the easiest of all metals to machine, and can also be cast, rolled, or forged. An alloy of about 90% magnesium and 10% aluminum is widely used because of its high strength per pound. Magnesium is also used to dehydrate oils, to form the Grighard reagent so important in organic chemistry, and as a deoxidizer in making certain alloys. The element is essential to both animal and vegetable life. MgO and $MgCO_3$ are used in ceramics, while several magnesium compounds are important medicinally. The wholesale price of magnesium is about 30¢ a pound.

MANGANESE (L. *magnes*, magnet, as pyrolusite was formerly confused with iron ores which are magnetic) Ger. *Mangan*. Fr. *manganèse*. Manganese is a hard, brittle metal with a brilliant luster and a reddish tinge. In 1740 Pott showed that pyrolusite (MnO_2), contained no iron, and formed a series of well-defined salts. In 1774 Scheele proved that it contained a new element. Gahn was the first to isolate the metal. Manganese is quite widely distributed in the combined state in such ores as pyrolusite (MnO_2), braunite (Mn_2O_3), and hausmannite (Mn_3O_4), as well as in the form of the sulfide, sulfate, carbonate, silicate, tungstate, etc. It ranks 10th in abundance amongst the elements in the earth's crust. The metal can be prepared by reducing the oxides with carbon or aluminum; by reducing the halogen salts with sodium, magnesium, or aluminum; by reducing a manganese solution with various metals; and by electrolysis. The most important use of manganese is in the alloys ferromanganese and spiegeleisen in which form it is added to steel to impart toughness and hardness without brittleness. Manganese is essential to plant and animal life and to reproduction in animals. The oxide MnO_2 is used in the manufacture of chlorine and iodine, in making a black enamel for pottery, as a drier for oils, and as a depolarizer in dry cells; $MnCl_2$ is used in dyeing cotton; $MnSO_4$ is employed in calico printing; and $KMnO_4$ and $NaMnO_4$ are used as disinfectants. The wholesale price of manganese is about 45¢ a pound.

MASURIUM (From Masurian province belonging to Germany) Ger. *Masurium*. Masurium is a metal of the manganese family. It was discovered in 1924 by Noddack, Tacke, and Berg. It is found together with rhenium in the minerals gadolinite, molybdenite, sperryite, and in platinum ores. Its properties are not as well known as those of rhenium, as the latter element is much more abundant. The metal is thought to have a high melting point, and to form masurates such as Na_2MaO_4. The relative occurrence of masurium in the earth's crust is estimated at 10^{-13}.

MERCURY (L. *Mercurius*, the god and planet. Symbol Hg from L. *hydrargyrum*) Ger. *Quecksilber*. Fr. *mercure*.

Mercury which is the only metal that is liquid at ordinary temperatures is silvery white and heavier than lead. It was known in ancient times as liquid silver, and was much investigated by the alchemists. G. Agricola called it a metal, and Lavoisier showed its elemental nature. Mercury is neither abundantly nor widely distributed in nature, it being 58th in abundance amongst the elements in the earth's crust. It sometimes occurs native in small amounts, or as a silver amalgam, but it is most often found as cinnabar (HgS). It is prepared from the sulfide by combining the sulfur with oxygen or lime and distilling the liberated mercury into condensers. Mercury is a shining, mobile liquid with little tendency to adhere to glass and is widely used in thermometers, barometers, and manometers. Gases inert to mercury do not penetrate it and hence they are often collected over it. The soluble salts of mercury are poisonous. Mercury alloys, which are called amalgams, are much used in dentistry. Mercurous chloride or calomel (HgCl) is used as a purgative. Mercuric chloride or corrosive sublimate ($HgCl_2$), a very poisonous substance, is used as an external antiseptic, as are some other mercury salts. These poisonous compounds are not very toxic to plants, and are often used in combatting plant diseases and insect pests. The metal is used in the extraction of gold and silver; in the mercury arc lamp; as the cathode in certain standard cells; in electric rectifiers and switches; in fluorescent lamps; and in the manufacture of mercury salts. Sodium amalgam is a valuable reducing agent. The sulfide HgS is known as vermilion and is used as a pigment. The price of mercury changes very rapidly, it being known to double in a few months. A 76 pound flask costs from $160 to $190.

MOLYBDENUM (Gr. *molybdos*, lead. Or L. *molybdoena*, galena) Ger. *Molybdenum* or *Molybdän*. Fr. *molybdène*. Molybdenum is a silvery white metal of the chromium group and is very hard and tough. It was discovered in 1778 by Scheele, and first prepared in 1782 by P. J. Hjelm. It does not occur free in nature, and its compounds are among the scarcer constituents of the earth's crust, it ranking 34th amongst the elements in abundance. The two most important ores of molybdenum are molybdenite, MoS_2, and wulfenite, $PbMoO_4$. The concentrated ores are reduced with aluminum, carbon, or other reducing agents. The metal is chiefly used in making ferro-molybdenum for hardening tool steel, boiler plate, gun barrels, etc. Certain molybdenum compounds are used in coloring pottery and fabrics, while ammonium molybdate is used in analytical chemistry to detect and determine phosphates. Molybdenum forms salts in which it has valencies of 3, 4, or 6, but the hexavalent salts are the most stable. MoO_3, $(NH_4)_2MoO_4$, MoO_2Cl_2, MoO_2, $CaMoO_4$, $PbMoO_4$, and MoS_3 are common compounds. The wholesale price of the metal is $2.60 a pound.

NEODYMIUM (Gr. *neos*, new, and *didymos*, twin) Ger. *Neodym*. Fr. *néodyme*. Neodymium is a metal with a slight yellow tinge. It was discovered in 1885 by C. A. von Welsbach and is one of the most abundant of the rare earth elements, ranking 29th in abundance amongst all the elements in the earth's crust. It is about twice as common as praseodymium, along with which it constitutes *didymium*; the latter was once thought to be an element. It is found in minerals which contain the other rare earths, such as cerite, monazite sand, gadolinite, etc. The compounds of neodymium are rose-red or reddish violet in color. The usual salts of this element have been prepared including Nd_2O_3 or neodymia, $NdCl_3$, $Nd(OH)_3$, $Nd_2(SO_4)_3$, $Nd(NO_3)_3 \cdot 6H_2O$ and others. Neodymium and its salts have no important applications.

NEON (Gr. *neos*, new) Ger. *Neon*. Fr. *néon*. Neon is one of the inert atmospheric gases. It was first isolated in 1898 by W. Ramsay and M. W. Travers who fractionally distilled liquid argon which contained the other inert gases, neon making up 0.16% of crude argon. Neon is in the first fraction of this distillation, it being the most volatile as well as the lightest of the inert gases with the exception of helium. Neon is slightly lower in density than oxygen and is being used to a large extent in the so-called neon lights which involve passing an electric discharge through an evacuated tube into which a little neon has been admitted. A brilliant orange-red glow is produced

which has excellent fog-penetrating power, and which is quite efficient from the standpoint of light produced for current consumed. Neon is present in the atmosphere to the extent of 0.00123% by volume or 0.00086% by weight. It sells for $5.00 a liter in glass flasks at normal pressure.

NICKEL (Ger. *Nickel*, a goblin or devil) Ger. *Nickel*. Fr. *nickel*. Nickel is a bright, silvery metal of the iron-cobalt-nickel triad. It is hard, malleable, ductile, and has high tensile strength. The metal was used in nickel-copper alloys for coinage for several thousand years, but it was first recognized as a new metal by Cronstedt in 1750, who succeeded in isolating the metal in an impure form and named it nickel from *Kupfernickel*, an ore that appeared to contain copper yet yielded none. The element ranks 21st in abundance in the earth's crust. Nickel is found native in meteors alloyed with iron, but the commercial sources are such ores as are found in Ontario, New Caledonia, and Norway. These ores include $NiAs_2$, Ni_4As_3, $Ni_3(AsO_4)_2 \cdot 8H_2O$, Ni_2O_3, (NiMg) $SiO_3 \cdot xH_2O$ and NiS · 2FeS. Each of these ores is treated in a different manner depending on the amount and character of the impurities. Sometimes copper and nickel are refined together, the resulting product being a natural alloy of nickel and copper known as *monel metal*. Nickel is always found associated with cobalt from which it is separated with difficulty. This can be done by forming the insoluble nickel dimethylglyoxime, or by fractional distillation of the mixed carbonyls which are then decomposed by heating. Nickel is magnetic at ordinary temperatures, but not at 360°C. Air and sea water have very little effect on nickel, nor do hydrochloric or sulfuric acids corrode it at ordinary temperatures. At a red heat, nickel slowly decomposes steam. The addition of up to 18% of tungsten greatly increases the resistance of nickel to corrosion. Nickel is widely used as a catalyst, since in the finely divided state it speeds up many reactions such as the hydrogenation of oils, the reduction of nitrogen oxides to ammonia, the decomposition of acetylene, etc. Nickel plated objects are very common, as are alloys of nickel such as invar, German silver, constantin, chromel, monel metal, etc. Nickel steels are much used because of their toughness. Nickel and nickel bronze or other nickel alloys are used as coinage in several countries. Edison cells use nickel oxide or hydroxide for depolarizing electrodes. Nickel usually behaves as a divalent element, the trivalent salts being unstable as a rule. NiO, Ni_2O_3, $NiCl_2$, $Ni(OH)_2$, NiS, $NiSO_4$, and $Ni(NO_3)_2$ are common nickel salts. The wholesale price of nickel is about 35¢ a pound.

NITROGEN (L. *nitro*, native soda; *gen*, forming) Ger. *Stickstoff*. Fr. *nitrogéne*, formerly *azote*, symbol Az, this symbol and J for iodine being the only instances of differences in national usage of chemical symbols. The compound PbN_6 is called lead azide even in this country, an example of the persistence of the old French name. Nitrogen is a colorless, odorless gas present in the atmosphere to the extent of 75.5% by weight, and 78.06% by volume. D. Rutherford, in 1772 is credited with its discovery, but Cavendish, Lavoisier and others investigated "phlogisticated air," as air minus oxygen was called. Nitrogen is a vital constituent of animal and plant diets, and forms a part of all living bodies. Certain legumes, notably beans, have the power of absorbing nitrogen from the air and transforming it into proteins which is in turn food for animals. This nitrogen cycle in the soil is essential to life. Fixed or combined nitrogen is present in many mineral deposits as saltpeter, KNO_3, or soda niter, $NaNO_3$. Because of its slight solubility in water, nitrogen is contained in many natural waters and has been found in the gases from springs, geysers, and volcanos. It is prepared by removing the oxygen and carbon dioxide from the air with hot copper and lime. This, of course, leaves the nitrogen contaminated with the inert gases. It may be prepared in the laboratory by heating an aqueous solution of a mixture of 1 mole $NaNO_2$ and ½ mole $(NH_4)_2SO_4$. Nitrogen has been made by the fractional distillation of liquid air, and by reactions with substances containing nitrogen of which the following equation is an example: $2NH_3 + 3Cl_2 = 6HCl + N_2$. Gaseous nitrogen is often used to form an inert atmosphere for the preservation of materials, and to fill incandescent bulbs, although the gas is not entirely inert since it combines directly with

lithium, calcium, and magnesium when it is heated with these metals. Nitrogen is also used in the manufacture of ammonia, which may in turn be oxidized to nitric acid. Nitrogen compounds are very numerous, all nitrates, nitrites, nitrides, cyanides, cyanates, and all nitro, amino, and ammonium compounds being included in this category. Many nitrogen compounds are explosive, some, like picric acid, being comparatively stable, while others, like nitrogen iodide, can be exploded by touching them with a feather. Nitrogen forms five oxides; N_2O, NO, N_2O_3, NO_2, and N_2O_5. Ammonia, NH_3, nitric acid, HNO_3, and urea are perhaps the most important nitrogen compounds. A cylinder containing 14½ pounds of nitrogen (200 cubic feet at atmospheric pressure) can be refilled for $5.

OSMIUM (Gr. *osme*, a smell, from the odor of its volatile tetroxide) Ger. *Osmium*. Fr. *osmium*. Osmium is a brilliant metal of the platinum family, bluish in color and resembling zinc in appearance. It was discovered in 1804 by Tennant. It is found in nature alloyed with iridium in osmiridium, and in platinum sands in North and South America and the Urals. It may be precipitated from solution by H_2S as OsS_4, which on heating deposits osmium on the upper part of the crucible, and may also be prepared by reducing OsO_4 with carbon monoxide or dioxide in a red hot porcelain tube. Osmium tetroxide melts at 45° and boils at 100°, yielding a very poisonous vapor which causes pathological disturbances even to the extent of blindness. Osmium has a specific gravity of 21.3 to 24 and has the greatest density of any known substance. It is harder than glass and is very brittle. The metal is readily dissolved by fuming nitric acid, aqua regia, or fused sodium or barium nitrate; it is also attacked by hot fluorine or chlorine. In the finely divided form osmium is a very effective catalyst, causing hydrogen and oxygen to explode at 40 to 50°. With an osmium catalyst ammonia can be made from its elements at 185 atmospheres and a temperature of 880 to 1000°. Its chief use is in the alloy osmiridium which is used to make pen points. Osmium is the only element which forms definite compounds with a valence of eight. It also forms salts in which it has valencies of 2, 3, 4, 6, 8. $OsCl_2$, $OsCl_3$, $OsCl_4$, H_2OsO_4 are typical compounds. The price is about $2,040 a pound, or $140 per troy ounce.

OXYGEN (Gr. *oxys*, sharp; *gen*, born) Ger. *Sauerstoff*. Fr. *oxygène*. Oxygen is a colorless, odorless, active gas. The liquid and solid forms have a pale blue color. It was discovered independently by Priestley and Scheele in 1774, and was known to the chemists of the 18th century as "dephlogisticated air." Oxygen is the most abundant element, making up 88.8% of the waters of the earth, 50% of the rocks and soils, and one-fourth of the atmosphere by weight or one-fifth by volume. The best commercial method of preparing oxygen is by the fractional distillation of liquid air, but it can also be obtained by the electrolysis of water containing dissolved electrolyte, or by heating HgO, BaO_2, $KClO_3$ or other oxygen-containing compounds. Oxygen is not combustible but supports combustion, and combines with all the elements except the inert gases of the argon group. All plant and animal life as we know it depends on oxygen either free or combined for its existence. The gas is used in the oxy-hydrogen and oxy-acetylene flames for welding; for ventilating submarines; for medical purposes; for oxidizing oils, etc.; for bleaching; and in determining the carbon content of steel and organic compounds. The element exists in two forms, the usual state being O_2, while ozone, a less common form is O_3. The name *ozone* was derived from a Greek word meaning "I smell," since the characteristic odor of the substance is often noticed around electrical machines. It is formed whenever an electric spark is produced, and can often be observed during thunder storms. Ozone is a very active oxidizing agent especially towards organic matter, and is used as a bactericide in sterilizing water. A cylinder of oxygen holding 220 cubic feet at atmospheric pressure can be refilled for $5.

PALLADIUM (Named from the planetoid Pallas) Ger. *Palladium*. Fr. *palladium*. Palladium is a silvery white metal, less ductile but harder than platinum. It was discovered by Wollaston in 1804 and occurs native alloyed with platinum or gold, and as the selenide. It is present as an impurity in the nickeliferous ores of Sudbury, Ontario, from the matte of which it is sometimes

isolated. Palladium ranks 65th in abundance amongst the elements in the earth's crust. Palladium may be separated from the platinum group through precipitation as the iodide by adding potassium iodide to the solution. The metal is obtained by reduction of its salts with hydrogen, or by deposition from its solutions in the presence of zinc. Palladium occludes gases to a remarkable degree, especially hydrogen, and like other members of the platinum family, it is a very good catalyst, particularly when in a finely divided state. It is attacked by hot, concentrated acids and by fluorine and chlorine at high temperatures. Alloys of palladium and gold are useful as platinum substitutes, and because of their resistance to atmospheric corrosion are used for astronomical and dental purposes and for coating the reflectors of searchlights. Palladium salts are used in photography. Palladium functions as a di-, tri-, and tetravalent element. $PdCl_2$, K_2PdCl_4, $PdCl_3$, PdO, $Pd_2O_3 \cdot xH_2O$, and $PdO_2 \cdot xH_2O$ are typical palladium compounds. The metal sells for about $380 a pound, or $26 a troy ounce in which unit the precious metals are always sold.

PHOSPHORUS (Gr. *phosphoros*, light-bringer) Ger. *Phosphor*. Fr. *phosphore*. Phosphorus is a non-metallic element occurring in several different forms. White or colorless phosphorus, the ordinary form, turns yellow on exposure to light. Red phosphorus can be made by heating the white variety or exposing it to a bright light. When a solution of yellow phosphorus in phosphorous tribromide is held at 180°, a bright red precipitate separates. This is called scarlet phosphorus. Metallic or violet phosphorus is obtained by heating the red variety in contact with lead for ten hours at about 500°C., the phosphorus dissolves in the lead and, on cooling, separates in this crystalline modification. Only the red and yellow forms are commercially available. When pure the red form is not poisonous, while the yellow variety is extremely toxic. Phosphorus, first isolated from urine by H. Brandt in 1669 is the first element whose discoverer is known. Phosphorus does not occur native but its compounds are very widely distributed, phosphorus ranking 11th in abundance amongst the elements. The chief source of the element is phosphate rock, generally $Ca_3(PO_4)_2$, which is treated with sulfuric acid to convert it to phosphoric acid which is then heated with carbon, the crude phosphorus being removed by distillation. It occurs in all fertile soils, being a necessary factor in plant and animal economy. It is an essential constituent in protoplasm, nervous tissue and bones, occurring in the latter as calcium phosphate. Phosphorus is used in making bronzes, in gas analysis, in medicine, and in making matches. The element is very poisonous but many of its compounds are harmless. PH_3, PCl_3, PCl_5, $POCl_3$, Na_3PO_4, P_2O_3, and P_2O_5 are typical compounds. In large quantities the red and yellow varieties sell for 40¢ and 18¢ a pound respectively.

PLATINUM (Spanish *plata*, silver) Ger. *Platin*. Fr. *platine*. Platinum is a tin-white metal, malleable, ductile, and harder than silver; it does not tarnish in air or dissolve in any single acid. It was first brought to Europe from South America in 1735. The metal occurs native, either in a fairly pure state or alloyed with other metals and nuggets weighing up to 21 pounds have been found. It ranks 57th in abundance amongst the elements in the earth's crust. In refining crude platinum, the metal is precipitated as $(NH_4)_2PtCl_6$ which on being heated yields spongy platinum. This is then rolled or hammered into the desired condition. Platinum is a very noble metal being dissolved only by aqua regia, but it is corroded by the halogens and caustic alkalies. Like all the metals in this group, platinum possesses considerable catalytic activity, a property most pronounced when the metal is in a finely divided state. Platinum black, in which form it is generally used as a catalyst, is a fine, soft, black powder which is thought to be $PtO \cdot H_2O$. A platinum catalyst is used in the contact process for manufacturing sulfuric acid and other commercial reactions. Platinum is used for jewelry, and for electrical and dental purposes, as well as making crucibles, tongs, pyrometers, electrical contact points, pins, foil and plate. Another use in recent years is in decorating glassware, in which a platinum resin is applied and fired, leaving a bright and very thin coating of platinum. $PtCl_2$, H_2PtCl_4, $PtCl_4$, K_2PtCl_6, and $PtO \cdot 2H_2O$, are

typical platinum compounds. The price of the metal is about $560 a pound, or $38 per troy ounce.

POTASSIUM (Eng. *potash*. Symbol K from *kalium*) Ger. *Kalium*. Fr. *potassium*. Potassium is a light, silver-white alkali metal, first isolated in 1807 by H. Davy. It is found in nature in large quantities, but only in the combined form. It occurs in sylvite (KCl), saltpeter (KNO_3), and many other minerals. It is the 7th element in order of abundance in the earth's crust. Potassium salts are necessary to plant life, and are therefore found in all fertile soils. Plants preferentially absorb these salts which are then found in the ash they leave on ignition. The metal is produced by the electrolysis of fused potassium hydroxide but it is seldom made as it has few uses. Like all of the alkali metals it tarnishes in air, combines with water at ordinary temperatures, and hence must be preserved under kerosene. An alloy of sodium and potassium which is a liquid at ordinary temperatures is used in high reading thermometers. Potassium is used in certain photoelectric cells, and in analysis for the determination of oxygen. Potassium has a valence of one in all of its compounds. KOH, KCN, KCl, KBr, KI, K_2SO_4, KNO_3, K_2SiO_3, K_2CO_3, K_2CrO_4, and $K_2Cr_2O_7$ are some of the more important potassium compounds. The metal retails for $12.50 a pound, but many of its salts are comparatively cheap.

PRASEODYMIUM (Gr. *praseos*, leek-green, and *didymos*, a twin) Ger. *Praseodym*. Fr. *praséodyme*. Praseodymium is a rare earth metal that has a yellow tinge and is strongly paramagnetic. It was discovered in 1885 by C. A. von Welsbach. The element is widely distributed, ranking 42nd in abundance in the earth's crust. A mixture of praseodymium and neodymium was for a long time considered to be an element, and was called *didymium*. The ratio of praseodymium to neodymium in most minerals is about 1 to 2, both metals being found in cerite and other rare earth minerals. A little didymia is used to impart a brown color to printed matter on gas mantles. Praseodymium salts are leek-green in color. Compounds of this metal are Pr_2O_3, PrO_2, $PrCl_3$, $Pr_2(SO_4)_3$.

PROTACTINIUM (Gr. *protos*, first) Ger. *Protaktinium*. Fr. *protactinium*. Protactinium is one of the four radioactive atomic species representing element 91 and is the only one that can be isolated in weighable quantities. The first isotope, UX_2 or brevium (half life 1.14 minutes), was discovered by Fajans in 1913. Protactinium itself was discovered in 1917 by Hahn and Meitner and independently and at about the same time by Soddy and Cranston. It is the mother substance of actinium and its series of natural radioactive elements, being itself derived from an isotope of uranium (actino-uranium). One ton of uranium in any natural ore contains about 0.27 grams protactinium. The oxide Pa_2O_5 was first isolated in 1927, the metal itself in 1934. The atomic weight of the element was listed for the first time in the International Atomic Weight Table of 1936. The half life of protactinium is about 3.2×10^4 years.

RADIUM (L. *radius*. ray) Ger. *Radium*. Fr. *radium*. Radium is a radio-active element. It has been prepared as a white metal which immediately becomes black on exposure to air. The metal will decompose water in the cold, and blackens organic matter such as paper on contact. It was discovered in 1898 by P. Curie and his wife, M. S. Curie. Radium is a decomposition product of uranium, and is always found with that metal, generally to the extent of about one part in three million. The most important source is the pitchblende found at Great Bear Lake in northern Canada, where more than 100 grams of radium are extracted annually. Another important source of radium is the carnotite sand of Colorado. The element is constantly giving off heat, the temperature of radium and its salts being about a degree and a half higher than that of its surroundings. During its 2300 years of life a gram of radium gives off 250,000 times as much energy as the burning of a gram of coal. Each gram of radium produces about a tenth of a cubic millimeter of emanation each day. This gas is pumped off and sealed in tiny tubes which are applied to the diseased tissue when radium is used to combat cancerous growths, and skin diseases. Radium and its salts are extremely poisonous to all life; the unskillful application of the radiation is very dangerous. The radium of commerce

is generally in the form of the chloride or bromide. The final decomposition product of radium is an isotope of lead. The carbonate and sulfate are used in luminous paints. The price of radium has recently dropped from $70,000 to $25,000 a gram.

RADON, NITON or RADIUM EMANATION (The name *radon* was chosen because it comes from radium. The name *niton* is from L. *nitens*, shining). Ger. *Niton*. Fr. *niton*. Radon is a gaseous substance emanating from radium and having radioactive properties of its own. It was observed by the Curies, Gray, Ramsay, Rutherford and others. The gas appears to be inert and a member of the argon family and has been liquefied and solidified by Rutherford, Ramsay and others. It decomposes into a radioactive solid and alpha particles, each of which is an atom of helium carrying two unit positive charges. The half life of radon is 3.83 days. For the method of using radon, see RADIUM.

RHENIUM (Named from the Rhine province belonging to Germany) Ger. *Rhenium*. Rhenium is a member of the manganese family of metals, and was once called dwimanganese. It was discovered by Noddack, Tacke, and Berg in 1924, at the same time that they discovered masurium or ekamanganese. Both of these metals are found in the combined state in platinum ores, gadolinite, molybdenite, and sperryite. Rhenium is 60th in abundance amongst the elements in the earth's crust. Rhenium is stable in air and possesses a very high melting point and boiling point. The most stable rhenium compounds are those in which the element has a valence of six or seven. Re_2O_7, $HReO_4$ (a strong acid), $KReO_4$, $ReCl_6$, Re_2S_7, ReS_3, ReS_2, ReO_2, and ReO_3 are known. The metal is being prepared in Germany to the extent of about 150 kilograms a year. Platinum-rhenium thermocouples have been made, and the metal may find some use as a catalyst. The price is about $4 per gram.

RHODIUM (Gr. *rhodon*, a rose, from the color of the aqueous solutions of its salts) Ger. *Rhodium*. Fr. *rhodium*. Rhodium, a silvery white metal of the platinum family, was discovered in 1804 by Wollaston. It occurs as an alloy in platinum ores, in osmiridium, and in the gold-rhodium alloys known as rhodite, which are from 30 to 43% rhodium. Amongst the elements in the earth's crust, it ranks 59th in order of abundance. The metal is insoluble in acids or aqua regia, but when fused with potassium acid sulfate it yields the sulfate. An alloy of 95% platinum and 5% rhodium is superior to platinum for making crucibles and other laboratory equipment. Rhodium is used in conjunction with platinum to make thermocouples. Rhodium black, a finely divided substance containing some oxide or hydride, is used as a catalyst and for producing a black color in decorating porcelain. A new use for rhodium is in plating standard weights. $RhCl_3$, $RhCl_3 \cdot xH_2O$, $Na_3RhCl_6 \cdot 18H_2O$, Rh_2O_3, RhO_2, Na_2RhO_4 are typical compounds. The price is about $1,800 a pound, or $125 a troy ounce in which unit it is always sold.

RUBIDIUM (L. *rubidus*, red) Ger. *Rubidium*. Fr. *rubidium*. Rubidium is a silvery-white alkali metal resembling potassium. It inflames spontaneously in air, and must be preserved out of contact with air and water. Rubidium is the second most electropositive metal, being exceeded only by cesium in this respect. It was discovered spectroscopically in 1860 by Bunson and Kirchhoff and is present in several rare minerals, the chief source being the mother-liquors from carnotite refineries. There are no rich deposits, but the element is widely distributed, ranking 16th in abundance amongst the elements in the earth's crust. Its salts impart to the non-luminous flame a very brilliant red color. The metal is softer than any metal except cesium and forms a series of salts such as RbCl, $RbNO_3$, Rb_2SO_4, Rb_2O, etc. Rubidium and its salts have no important uses, although the metal has been used in photoelectric cells. The price is about $15 a gram.

RUTHENIUM (*Ruthenia*, Russia) Ger. *Ruthenium*. Fr. *ruthénium*. Ruthenium is a hard, brittle metal of the platinum family, resembling platinum in luster and appearance. The element was named by Osann who discovered it in 1828. It was first made in the pure state by Klaus in 1845. Ruthenium is very scarce, ranking 66th in abundance amongst the

elements in the earth's crust. It occurs in the rare mineral laurite, Ru_2S_3, but it is obtained from osmiridium, in which it occurs as an impurity to the extent of 6% or less. Ruthenium has several different valencies in its various compounds, $RuCl_2$, $RuCl_3$, K_2RuCl_5, K_2RuCl_6, Ru_2O_3, RuO_2, and $K_2RuO_4 \cdot H_2O$ being typical ruthenium salts. The metal occludes gases, and is sometimes used to catalyze oxidation reactions. Ruthenium is of little commercial importance. It costs about $550 a pound, or $38 per troy ounce, the unit in which precious metals are quoted.

SAMARIUM (Named after *Samarski*, a Russian engineer) Ger. *Samarium*. Fr. *samarium*. Samarium is a hard, brittle, yellowish-gray, lustrous metal which quickly tarnishes in air. It was discovered in 1879 by Lecoq de Boisbaudran, and like the other rare earths, is found in small quantities in such minerals as cerite, gadolinite, samarskite and others. In abundance it is 39th amongst the elements in the earth's crust. Samarium may be separated from lanthanum, praseodymium, and neodymium by converting the mixed oxides to the anhydrous chlorides and passing in a stream of dry hydrogen at a red heat, thus converting the samarium to $SmCl_2$. This is insoluble in alcohol, whereas the chlorides of the others are soluble. Samarium salts are pale yellow in color and, like the metal, are unimportant commercially. The usual compounds of samarium have been prepared, including Sm_2O_3 or samaria, Sm_2S_3, $Sm_2(SO_4)_3$, $SmCl_3$, $Sm(NO_3)_3 \cdot 6H_2O$ and others.

SCANDIUM (Named after the Scandinavian peninsula by its Swedish discoverer) Ger. *Scandium*. Fr. *scandium*. Scandium itself has not been isolated, but the properties of its salts prove it to be identical with the ekaboron predicted by Mendeleeff. It was discovered in 1879 by L. F. Nilson and is found in a few rare minerals such as wolframite, wiikite, euxenite, etc. to the extent of one or two percent Sc_2O_3. It is the 43rd element in abundance in the earth's crust. $ScCl_3$, $ScBr_3 \cdot 6H_2O$, Sc_2O_3 or scandia, Sc_2S_3, $Sc(OH)_3$, $Sc_2(SO_4)_3$ and many other scandium salts have been prepared.

SELENIUM (Gr. *selene*, the moon) Ger. *Selen*. Fr. *sélénium*. Selenium is a non-metallic element which exists in several allotropic forms. It was discovered in 1817 by J. J. Berzelius and J. G. Gahn. Selenium is found in many sulfide ores generally in the form of selenides but sometimes native. The most common ore is clausthalite, PbSe, but the element is usually obtained from the flue dust of pyrites burners. Amongst the elements in the earth's crust it ranks 56th in abundance. Selenium is said to be contained in teeth and bones and in most vegetables, especially spinach. It is precipitated from its solutions by sulfur dioxide, which is the method generally used to obtain the element from its refined ores. Selenium exists as red amorphous, red crystalline, gray metallic, and black selenium, the black form being thought by some to be the metallic variety in the finely divided condition. Metallic selenium conducts electricity; its electrical resistance decreasing while the element is being exposed to light, furnishes the basis for its use in photo-electric cells. These cells are of rapidly increasing importance in controlling automatic equipment of many kinds. A recent application of the element is in rectifiers, which exhibit remarkable stability under high overloads. Selenium is used in preparing a scarlet-red color for glass, glazes and enamels; for making flame-proof insulated wires, paper, etc.; in the colloidal form as a germicide and fungicide; and as di-ethyl selenide, a gasoline antiknock. Selenium itself is not poisonous but the alkali selenites and selenates are very toxic. When warmed, selenium emits an odor resembling that of rotten radishes. Selenium and its compounds impart a blue color to the Bunsen flame. The element resembles sulfur and has valencies of 2, 4, and 6. SeO_2, Na_2SeO_3, Na_2SeO_4, and Na_2Se are typical selenium compounds. The price is $1.75 a pound.

SILICON (L. *silex*, flint) Ger. *Silicium*. Fr. *silicium*. Silicon is a non-metallic element which is dark steel-gray when crystalline, and a dark brown mass when amorphous. It was first isolated in 1823 by J. J. Berzelius. Silicon is never found native, but its compounds are so common that silicon ranks second only to oxygen in abundance, composing 25.8% of the known land, sea and air. It occurs

in all silicate minerals as well as in quartz (SiO_2), sandstone, and others. The silicates include clay, granite, feldspar, mica, and many other very common minerals. Silicon is made by reducing SiO_2 with magnesium or sodium. It is employed as a deoxidizer in metallurgy, where many silicon alloys are used, the silicon being added as a rule in the form of ferrosilicon. High silicon alloys are very hard and chemically resistant, but are so brittle they cannot be machined. Silica, or SiO_2, is used in making glass, mortar, and Portland cement; and sodium silicate under the name of waterglass is used as a medium for preserving eggs and as an adhesive. Silicon is very resistant to acid corrosion, a property which is also manifested by the high-silicon alloys. SiO_2, SiH_4, Na_2SiO_3, K_2SiO_3 are well known silicon compounds. The price of silicon is about 16¢ a pound.

SILVER (Assyrian, *sarpu*. Anglo-Saxon *soelfor*. Symbol Ag from L. *argentum*) Ger. *Silber*. Fr. *argent*. Silver is the whitest of metals, and one of the best conductors of heat and electricity. It is strong and is excelled only by gold in malleability and ductility. Silver is sometimes found free in nature and has been known from the earliest times. Most silver ores contain only about one percent of silver, but such ores are fairly common. Mexico and the United States produce most of the world's silver, a great deal being a by-product in the refining of lead and copper. It is the 63rd element in order of abundance in the earth's crust. The silver ion is very poisonous, and like lead is cumulative in action. Silver is stable in air and water but blackens on exposure to vapors of sulfur compounds especially hydrogen sulfide which form the sulfide, Ag_2S. The metal is used in making table ware, coinage, jewelry, and in silvering mirrors. Certain of its salts, particularly the halides, are sensitive to light and are much used in photography. Silver nitrate is used in analytical chemistry, in medicine, and, with the cyanide, in plating. In recent years steels containing silver have been widely used in making pistons for gasoline engines. The price of silver is $5.10 a pound.

SODIUM (Eng. *soda*) Ger. *Natrium*. Fr. *sodium*. Sodium is a waxy, silvery white alkali metal. It was first isolated in 1807 by H. Davy. Sodium always occurs in the combined form, and is present as the chloride in vast quantities in sea water and rock salt deposits. In Chile and Peru there are deposits of $NaNO_3$, and on the sites of dried-up lakes there are found carbonates, sulfates, and borates of sodium, Sodium salts are present in nearly all brines, in animal fluids, and in most plants. It is the 6th element in order of abundance in the earth's crust. Metallic sodium is attacked by air and water, hence it is usually preserved under kerosene or imbedded in vaseline. It is prepared commercially by the electrolysis of fused sodium hydroxide and is used in making the peroxide and cyanide, as well as in the manufacture of some aniline dyes and a number of other organic compounds where a very strong reducing agent is required. It is sometimes used in the preparation of other metals. Sodium and its salts impart a brilliant yellow color to the flame. Many sodium compounds are extremely important, often being sold by the carload. A few of the most important are the chloride, NaCl, which is a necessary constituent of animal diets; caustic soda, NaOH; soaps, which are sodium or potassium salts of one or more fatty acids such as stearic, oleic or palmitic; borax, $Na_2B_4O_7 \cdot 10H_2O$; trisodium phosphate, $Na_3PO_4 \cdot 12H_2O$; hypo, $Na_2S_2O_3 \cdot 5H_2O$; soda ash, Na_2CO_3, and sal soda, $Na_2CO_3 \cdot 10H_2O$; Glauber's salt, $Na_2SO_4 \cdot 10H_2O$; baking soda, $NaHCO_3$; $NaNO_3$; $NaNO_2$; Na_2O_2; the various silicates which are different ratios of Na_2O, SiO_2 and H_2O; and the sulfite Na_2SO_3. The wholesale price of metallic sodium is about 16¢ a pound.

STRONTIUM (Named from the town of Strontian, Scotland) Ger. *Strontium*. Fr. *strontium*. Strontium is a brass-yellow metal of the alkaline earth group and was first isolated in 1808 by H. Davy, although the oxide was known to Crawford in 1790. It is never found native, and occurs chiefly as strontianite ($SrCO_3$), and celestite ($SrSO_4$) being 18th amongst the elements in the order of abundance, or 14th counting only those in the earth's crust. The metal has no uses, but like the other metals of the

alkaline earths it can be prepared by the electrolysis of the fused chloride. Strontium salts impart a brilliant red color to a flame, and are used in making fireworks and red signal lights; they are also used to a small extent in medicine. Strontia (SrO) is used in the recovery of sugar from beet-sugar molasses. Strontium has a valence of two, and forms compounds such as $SrCl_2$, $SrBr_2$. The metal retails for about $5 an ounce.

SULFUR (Sanskrit, *solvere*. L. *sulphurum*) Ger. *Schwefel*. Fr. *soufre*. Sulfur, a non-metallic element that is found native as well as combined, has been known from very early times. It exists in several allotropic forms, of which the most common is rhombic sulfur, the variety which is found native and is mined in vast quantities in Texas, Louisiana and Sicily. Sulfur compounds such as the metallic sulfides and sulfates are also very common. Sulfur ranks 12th in abundance amongst the elements in the earth's crust. Rhombic sulfur is a yellow powder which changes in shade with different temperatures. When molten sulfur is allowed to cool slowly, wax-yellow needles of monoclinic sulfur are formed and these change to rhombic sulfur at ordinary temperatures. Another form sometimes encountered is nacreous sulfur which forms yellowish-white needles with a pearly luster. There are also other less common metastable varieties known, as well as certain amorphous types. Flowers of sulfur is the name given to a finely divided form prepared by sublimation. In the United States, sulfur is mined by the very unusual method of drilling to the sulfur stratum and sinking three concentric pipes down to the deposit. Superheated steam is then forced down the outside pipe and melts the sulfur; hot water is pumped down the other outside pipe at high pressure, whereby the molten sulfur is forced up through the middle pipe and is collected at the surface. Sulfur is used in the manufacture of matches, gunpowder, and pharmaceutical preparations, as well as in the vulcanization of rubber, and as a fungicide. Most of the sulfur produced is burned to sulfur dioxide, which is the intermediate in the preparation of sulfuric acid, sodium thiosulfate, calcium bisulfite, and other sulfur compounds. Sulfur is one of the elements essential to plant and animal life. It is a constituent of some proteins. An important sulfur compound is hydrogen sulfide, a common laboratory precipitant which is very poisonous. Sulfur has valencies of 2, 4, and 6. FeS, $BaSO_4$, $CaSO_3$, BaS, SO_2, SO_3, S_2Cl_2, and $Na_2S_2O_3 \cdot 5H_2O$ are typical sulfur compounds. Crude sulfur in bulk sells for about $16 a long ton, but the flowers sell for 3¢ and the commercial flour for 1.6¢ a pound.

TANTALUM (Gr. myth. *Tantalus*, because the metal was hard to isolate, therefore tantalizing) Ger. *Tantal*. Fr. *tantale*. Tantalum is a white metal with a grayish tinge and a bright luster, and is little affected by exposure to air. The element was discovered in 1802 by A. G. Ekeberg. It is never found in the free state, but occurs with columbium as the tantalates and columbates of iron, calcium, manganese, uranium, and the rare earths. Tantalum is impervious to any single acid, and even resists aqua regia, but it will dissolve in the fused alkalis, and in a mixture of nitric and hydrofluoric acids. Tantalum has high melting and boiling points, is hard, malleable, and very ductile. It was once used in making filaments for incandescent lamps, but in this capacity it has been generally replaced by tungsten. Tantalum is used to make pen nibs, dental, surgical, and laboratory equipment, normal weights, and parts for delicate instruments which are subjected to the action of corrosive gases. It is also used as a rectifier for alternating current, since a tantalum electrode in a single cell will permit the current to flow only one direction, thus changing an alternating current to a pulsating direct current. Tantalum usually has a valence of five. Ta_2O_5, TaO_2, $FeTa_2O_6$, $TaCl_3$, $TaOF_3$, $CaTa_2O_6$, $TaCl_5$, and K_2TaF_7 are typical tantalum compounds. Tantalum (C.P.) costs about $70.00 per pound.

TELLURIUM (L. *tellus*, the earth) Ger. *Tellurium*. Fr. *tellure*. Tellurium is a non-metallic element of the sulfur selenium family. It was discovered in 1782 by F. J. Müller, and later confirmed by M. H. Klaproth who actually isolated the new element. When cooled from the molten state, tellurium is a tin-white crystalline mass which is brittle and easily powdered, and has

a metallic luster. It also exists as a brownish-black amorphous powder. Tellurium is the least abundant of the sulfur family, rarely occurring native but usually as tellurides and in a few oxidized ores. It is about as abundant as gold. Tellurium is used in the glass industry, in the manufacture of electrical equipment, and in making dyestuffs. Some of its alloys have valuable properties, that with tin being very hard and of high tensile strength, while its alloy with aluminum is very ductile. Colloidal tellurium is used as an insecticide, germicide, and wood preservative. Certain tellurium salts are used in staining metals, while one tellurium compound has been found to possess anti-knock properties when used as a component of motor fuels. Tellurium is poisonous and is readily absorbed from gold-tellurium dental fillings. The very offensive "tellurium breath" is caused by the inhalation of the vapors of tellurium, or by the absorption of the element in the body by other means. The element has valencies of 2, 4, and 6. H_2Te, H_2TeO_4, H_2TeO_3, $AuTe_2$, TeO_2, and $BaTeO_4$ are typical tellurium compounds. The wholesale price is $1.75 a pound.

TERBIUM (From *Ytterby*, a town in Sweden) Ger. *Terbium.* Fr. *terbium.* Terbium is a rare earth metal which has not yet been isolated. It was discovered in 1843 by C. G. Mosander and is one of the least abundant of the rare earths, being found in small quantities in gadolinite, cerite, and other rare earth minerals. The element ranks 54th in abundance amongst the elements in the earth's crust. Terbium salts are colorless or white and have no important uses. Tb_2O_3 or terbia, Tb_4O_7, $TbCl_3$, $Tb_2(SO_4)_3$, $Tb(NO_3)_3 \cdot 6H_2O$, and a few other terbium salts have been prepared.

THALLIUM (L. *thallus*, a budding twig) Ger. *Thallium.* Fr. *thallium.* Thallium is a gray metal, softer than lead, and having high malleability and low tenacity. In 1861 Crookes discovered a new green line in the spectrum which he attributed to a new element which he called thallium. The metal was first isolated in 1862 by A. Lamy. The ores of thallium are so scarce that it is easier to obtain the metal from the mud of the lead chambers or the flue dust of sulfuric acid works. Thallium is the 61st element in abundance in the earth's crust. Thallium salts are poisonous and color the non-luminous flame a bright green. Thallium acetate, which is poisonous, when taken internally causes a falling out of the hair. Depilatory preparations containing up to 5½% have been prepared and sold but their use is attended by considerable danger. Thallium itself has no important uses, but its salts, especially the sulfate, are widely used in rat poisons, as well as some small application in medicine, analytical chemistry, and in making green signal lights. The element has valencies of one and three. Tl_2O, Tl_2O_3, $TlOH$, $TlCl$, $TlO(OH)$, and Tl_2S are typical salts. Thallium costs about $5 a pound.

THORIUM (Scandinavian myth. *Thor.*) Ger. *Thorium.* Fr. *thorium.* Thorium is a metal resembling platinum in color, and having a high specific gravity and melting point. It was discovered in 1819 by J. J. Berzelius. Thorium is widely distributed but in small quantities, thorite, orangite, and thorianite containing from 50 to 78% ThO_2. The chief ore is monazite sand in which thorium is present to the extent of about 5 to 7% in the concentrated ore. Amongst the elements in the earth's crust thorium ranks 35th in abundance. The most important use of thorium is as the nitrate which is combined with about one percent of cerium nitrate to make Welsbach gas mantles. These nitrates are burned to oxides the first time the mantles are used; beryllium and magnesium nitrates are also present to strengthen the ash skeleton. Certain thorium salts have some small use in medicine, analysis, and roentgenography. Thorium is radioactive, its average life being 2.5×10^{10} years. It is a member of the tin group, and has a valence of four. ThO_2, $ThCl_4$, $Th(NO_3)_4$, $Th(OH)_4$, are typical compounds. The price is about $3 a gram.

THULIUM (L. *Thule*, the most northerly part of the habitable world) Ger. *Thulium.* Fr. *thulium.* Thulium is a rare earth metal of the erbium group and has never been isolated. It was discovered in 1879 by P. T. Cleve and is found in small amounts in euxenite, gadolinite, blomstrandine, and other rare earth minerals. Amongst the elements in the earth's crust, thulium ranks

60th in abundance. It is very difficult to separate thulium from the other metals of its group, especially erbium. Thulium salts are pale green in color. Tm_2O_3 or thulia, $TmCl_3 \cdot 7H_2O$, $Tm(NO_3)_3 \cdot 4H_2O$, $Tm_2(SO_4)_3$ and other thulium salts have been prepared.

TIN (Anglo-Saxon, Danish, and Icelandic, *tin*. Actual origin unknown) Ger. *Zinn*. Fr. *étain*. Tin is a white metal with a slight bluish tinge. Below 18°C. the stable form is *gray tin*, which is a powdery material and long exposure to cold will cause metallic tin to change to the gray form. When tin is so affected it is said to have the tin disease. When a piece of tin is bent it emits a high-pitched crackling noise known as the "cry" of tin. The metal was known in ancient times, for, although the ancients did not find it native, the smelting of tin is a comparatively simple process. Tin, though a common metal, is quite scarce, few workable deposits being known. It ranks 27th in abundance amongst the elements in the earth's crust, being less common than cerium, vanadium, tungsten, zirconium and other metals that are usually considered rare. The most important ore is cassiterite, SnO_2. The ore is first concentrated, then roasted, and then impurities such as tungsten and iron are removed chemically. The chief source of tin at present is the Maylayan peninsula. It is widely used in lining vessels for domestic and industrial use, but tin foil has been almost completely replaced by aluminum foil in the wrapping of tobacco, candy, etc. Tin forms a part of many valuable alloys such as brass, bronze, pewter, solder, and white bearing metal. The so-called "tin" cans are made of sheet iron coated with a thin layer of tin. The metal is also used as a reducing agent. Tin oxide (SnO_2) is used as a polishing powder and as an opacifying agent in glasses, glazes, and enamels. Tin sulfide is used as a bronzing powder and the two chlorides, $SnCl_2$ and $SnCl_4$, are used as mordants, in weighting silk, and in dyeing. Tin has valencies of two and four, and forms compounds such as SnO, SnO_2, $Sn(OH)_2$, H_2SnO_3, and $SnSO_4$. The price of tin is about 48¢ a pound.

TITANIUM (L. myth. *Titans*, the first sons of the earth) Ger. *Titanium*. Fr. *titanium*. Titanium is a metal of the tin group which resembles iron and takes a high polish. It was discovered in 1791 by W. Gregor, and rediscovered in 1794 by M. H. Klaproth who named it titanium. The metal does not occur free in nature and its compounds are not found in very concentrated form, yet it is more abundant than copper, lead, and zinc. Titanium is the 9th element in abundance in the earth's crust. Its most important ores are rutile, TiO_2, and ilmenite, $FeTiO_3$. The metal is hard, and so brittle that in the cold it can be powdered in an agate mortar, but at a red heat it can be forged. It burns in oxygen at 610°C. to form the oxide, TiO_2, and in nitrogen at 800°C. to form the nitride, TiN. This is the only known vigorous combustion in nitrogen gas. Titanium is chiefly used in metallurgy as a deoxidizer and denitrogenizer, and to add desirable qualities such as toughness to alloys. The oxide (TiO_2) is a brilliant white pigment that is used in the ceramic, rubber and other industries. Certain titanium compounds are used as incandescent media in illumination, while others are used as dyes and mordants for wool, cotton, and paper. Other than those previously mentioned, Ti_2O_3, TiF_4, $TiCl_4$, and K_2TiF_6 are the most common titanium compounds. The price of the metal is about $5 a pound, but the more common titanium dioxide costs only about 13¢ a pound.

TUNGSTEN (Danish *tung sten*, heavy stone) Ger. *Wolfram*. Fr. *tungstène*. Symbol W (Wolframium). Tungsten is a metal of the chromium group. It is steel-gray in color, with a high metallic luster and good tensile strength, and has the highest melting point of any metal. It was discovered by Scheele in 1783 with the assistance of two laboratory helpers, the Spanish brothers J. J. and Don F. de Elhuyar. Many historians credit the de Elhuyars with the discovery of the metal. Tungsten does not occur native and its compounds are rather rare, the element ranking 23rd in abundance in the earth's crust. The most important ores are the wolfram group (the iron and manganese tungstates) and the scheelite group (the calcium tungstates). The ores are first refined to a content of about 65% WO_3 and are then given different chemical

treatments depending on whether the oxide, the tungstates or the metal are wanted. Tungsten filaments are used in nearly all incandescent lamps, as well as in the wiring of electric furnaces; the metal is also used for targets in X-ray tubes, in contact points, and in phonograph needles. Tungsten alloys are used in tool steel and in other places where great strength and high heat-resisting qualities are needed. When tungsten is combined with carbon in the alloy *Carbaloy*. it forms a very hard material that holds a cutting edge under very severe conditions. Tungsten exhibits valencies of from two to six, but its most stable derivatives are those containing hexavalent tungsten. Some of its better known compounds are WO_3, WF_6, WCl_4, $WOCl_4$, H_2WO_4, $CaWO_4$, and Na_2WO_4. The price varies from $2.25 a pound for powder of 98 to 99% purity to $6.50 a pound for the 99.9% material.

URANIUM (Named from the planet Uranus) Ger. *Uranium*. Fr. *uranium*. Uranium is a radioactive metal of the chromium series and was discovered in 1789 by M. H. Klaproth in the mineral pitchblende. It occurs in small quantities, generally as an unnecessary constituent in several ores such as carnotite, pitchblende, and cleveite; the most important deposits being the pitchblende deposits at Great Bear Lake in Canada, and the carnotite mines in Colorado and Utah. Uranium is the 46th ranking element in abundance in the earth's crust. It is radioactive and is constantly breaking down; the radioactivity of uranium is not very strong, its average life being 6.43×10^9 years. Its *half life* is 4.45×10^9 years, it breaking down to uranium X_1, uranium X_2, uranium II, ionium, and finally to radium. Radium is, therefore, always found associated with uranium, and this is the chief reason for the treatment of uranium ores in radium extraction, the uranium itself being obtained as a by-product. Uranium is a lustrous, white metal, malleable and ductile and capable of taking a high polish. It is not hard enough to scratch glass, and has a density of 18.685 at 13°C. The metal burns briskly in air at 170°C. to form UO_2. It displaces hydrogen from mineral acids, and displaces mercury, silver, copper, tin, platinum, and gold from solutions of their salts. Uranium salts are poisonous to the animal system. Uranium has a valence of six or four. UO_3, UO_2, UCl_6, $UO_2(IO_3)_2$, and UO_2Cl_2 are a few typical uranium compounds. The last two mentioned are *uranyl* compounds. Uranium is sometimes used to harden and strengthen steel, while some uranium compounds are widely employed in ceramics, analytical chemistry and photography.

VANADIUM (Scand. myth. goddess, *Vanadin*) Ger. *Vanadin*. Fr. *vanadium*. Vanadium is a steel-gray metal capable of taking a very high polish and is the hardest of all metals. It was discovered in 1830 by N. G. Sefstrom in iron ores found near Taberg, Sweden. It does not occur free in nature, but is quite common in the combined form, being more abundant than zinc, lead, nickel, nitrogen, or copper, and ranking 20th in abundance amongst all the elements in the earth's crust. The metal occurs in sufficient concentration to be extracted commercially in several different forms. It has been obtained commercially from the ash of oil burning furnaces. It is usually associated with other ores such as titaniferous magnetites, gold tellurides, and in patronite found in Peru. The extraction varies with the type of ore used, but the separation is usually a chemical one. It is very difficult to obtain the metal pure, but fairly easy to make alloys such as ferrovanadium and nickelvanadium. Vanadium is used, frequently with chromium, in the making of special alloy steels, its presence increasing the toughness of the alloy and adding to the resistance to shock. The metal is also used as a contact catalyst in the manufacture of SO_3, as a reducing agent, as a dryer for linseed oil paints, and as a photographic developer and sensitizer. Vanadium compounds are poisonous when taken internally. Vanadium has valencies of from two to five, and forms four oxides, VO, V_2O_3, VO_2, and V_2O_5. Other common vanadium compounds are V_2S_5, $VOCl_3$, VCl_2, and NH_4VO_3. Ferrovanadium having a 45 to 55% vanadium content can be bought for about $2.80 per pound of contained vanadium.

VIRGINIUM (State of Virginia). Virginium (ekacesium) is the alkali metal below cesium in the periodic table. It was discovered in 1929 by Allison

and Murphy who examined specimens of lepidolite, a lithium ore, and pollucite, a cesium mineral, with their magneto-optic method of analysis. They consistently found minima on their arbitrary scale corresponding to those predicted for ekacesium. (Cf. *Physical Review* 35, 285.) The chloride, nitrate, sulfate and hydroxide all gave minima at the proper points. In 1931, Papish and Wainer found spectroscopic evidence of the existence of this element in the least soluble alums prepared from a sample of samarskite which was rich in uranium and its disintegration products, and which also contained rubidium and cesium. They were, however, unable to verify the magneto-optic observations of Allison and Murphy.

XENON (Gr. *xenos*, a stranger) Ger. *Xenon*. Fr. *xénon*. Xenon is a rare, inert, atmospheric gas. It was isolated in 1898 by W. Ramsay and M. W. Travers by distilling liquid argon which also contained the other inert gases. Xenon is the rarest atmospheric gas, it being present to the extent of one volume in 170,000,000 volumes of air, or one part in 40,000,000 parts by weight. It is the least volatile constituent in liquid air, and is one of the heaviest gases known. One liter of xenon weighs 5.842 grams, and its vapor density is 65 compared to oxygen as 16. Liquid xenon at −102°C. has a specific gravity of 3.52. Like the other elements in the zero group, it forms no compounds. The gas is seldom prepared pure. The cost of 100 cc. in glass is $21.

YTTERBIUM (From *Ytterby*, a town in Sweden) Ger. *Ytterbium*. Fr. *ytterbium*. Ytterbium is a rare earth metal which has not been isolated. It was discovered in 1905 by G. Urbain as a constituent of Marignac's ytterbium which was found to contain two elements that were called lutecium and neo-ytterbium. The latter name has since been shortened to ytterbium. It is found in very small amounts in minerals which contain other rare earths, particularly yttrium. These minerals include gadolinite, polycrase, blomstrandine and others. In the earth's crust, ytterbium is the 49th element in order of abundance. A few ytterbium compounds are known, among them being Yb_2O_3 or ytterbia and $Yb_2(SO_4)_3 \cdot 8H_2O$.

YTTRIUM (From *Ytterby*, a town in Sweden) Ger. *Yttrium*. Fr. *yttrium*. Yttrium, a metal of the rare earth group, has not yet been prepared in massive form, but has been isolated as a gray, metallic powder. It was first separated in the form of yttria by Mosander in 1843, and was named by Ekeberg. It has the lowest molecular weight of the rare earths, and, being Element 39, is sometimes considered "out of place" in the periodic table, the other rare earths being numbers 57 to 71 inclusive. Yttrium is the second most abundant rare earth, it ranking 28th amongst all the elements in the earth's crust in this respect. It is found in company with the other rare earths in monazite sand, gadolinite, blomstrandine, samarskite, xenotime, euxenite and polycrase. The salts of yttrium are colorless. Y_2O_3, or yttria, YCl_3, $Y(OH)_3$, $Y_2(SO_4)_3$, $Y(NO_3)_3 \cdot 6H_2O$ and others have been prepared. There is a small demand for yttria in the manufacture of Nernst lamps.

ZINC (Ger. *Zink*, akin to *Zinn*, tin) Ger. *Zink*. Fr. *zinc*. Zinc is a bluish-white metal which when pure is malleable and ductile at ordinary temperatures. Commercial zinc must be heated to certain temperatures before it may be worked. Zinc and its compounds have been known since the middle ages especially in India and China. It has had dozens of different names, one of them, *spelter*, being applied today to commercial zinc. Paracelsus, an alchemist of about 1570, seems to have been the first to call it "zinckum." Zinc is never found native, its chief ore being sphalerite or ZnS. It is also found as the oxide, zincite, and the carbonate, smithsonite. The metal is generally prepared by roasting the ore and then reducing it with carbon in a distillation furnace above 907°C., the boiling point of zinc. It is the 26th ranking element in abundance in the earth's crust, being 200 times more abundant than cadmium with which it is nearly always associated. It is widely used in making galvanized iron, which is sheet iron covered with a thin film of zinc. Another important use is as the negative plate in the so-called dry cells. The metal is also used as a precipitant in the cyanide process of refining gold and silver. Impure zinc generally contaminated with arsenic is

often used to prepare hydrogen in the laboratory. Large amounts of zinc are used annually in making brass and other alloys. In the pure form it is widely used as a reducing agent in analytical chemistry. Precipitated zinc sulfide is the only white sulfide. Zinc has a valence of two, forming compounds like ZnO, ZnS, $ZnSO_4$, $ZnCl_2$, and $Zn(NO_3)_2$, as well as the zincates like Na_2ZnO_2, and K_2ZnO_2. The wholesale price of zinc is about 5½ to 6¢ a pound.

ZIRCONIUM (Arabian *Zerk*, a precious stone) Ger. *Zirkonium*. Fr. *zirconium*. Zirconium exists in two forms, one of which is crystalline, white, metallic, and takes a high luster like nickel, while the other is a bluish-black amorphous powder. The oxide was discovered in 1789 by M. H. Klaproth, and the metal was first isolated by J. J. Berzelius in 1824. Zirconium does not occur free in nature, being commonly found as the silicate or oxide. It is widely distributed, ranking 19th in abundance amongst the elements in the earth's crust, but large, workable deposits are rare. The metal which can be prepared by the action of sodium on K_2ZrF_6, has been used as a scavenger in steel. The oxide has been used to replace lime in carbide lamps, to make highly refractory ware such as crucibles and muffles, and as an opacifying agent in glazes. The silicate, zircon, has been used for balance knife-edges and planes because of its hardness. Zirconium has a valence of four in all of its compounds. ZrO_2, ZrF_4, ZrS_2, $ZrCl_4$, and H_2ZrO_3 are some typical compounds. The price is about $7 a pound.

CHANGES IN ATOMIC WEIGHTS 1894 TO 1941

The Dates Below Are Inclusive

Aluminum 27 (*1894-1895*); 27.11 (*1896-1899*); 27.1 (*1900-1921*); 27.0 (*1922*); 26.97 (*1925-1941*).

Antimony 120 (*1894-1895*); 120.43 (*1896-1899*); 120.4 (*1900-1902*); 120.2 (*1903-1922*); 121.77 (*1925*); 121.76 (*1931-1941*).

Argon 39.96 (*1902*); 39.9 (*1903-1910*); 39.88 (*1911-1917*); 39.9 (*1920-1922*); 39.91 (*1925*); 39.944 (*1931-1941*).

Arsenic 75 (*1894-1895*); 75.09 (*1896*); 75.01 (*1897-1899*); 75.0 (*1900-1909*); 74.96 (*1910-1925*); 74.93 (*1931-1933*); 74.91 (*1934-1941*).

Barium 137.43 (*1894-1899*); 137.40 (*1900-1902*); 137.4 (*1903-1908*); 137.37 (*1909-1925*); 137.36 (*1931-1941*).

Beryllium (glucinum) 9 (*1894-1895*); 9.08 (*1896-1899*); 9.1 (*1900-1922*); 9.02 (*1925-1941*).

Bismuth 208.9 (*1894*); 208 (*1895*); 208.11 (*1896-1899*); 208.1 (*1900-1902*); 208.5 (*1903-1906*); 208.0 (*1907-1921*); 209.00 (*1921-1941*).

Boron 11 (*1894-1895*); 10.95 (*1896-1899*); 11.0 (*1900*); 11 (*1901-1902*); 11.0 (*1903-1905*); 11 (*1906*); 11.0 (*1907-1917*); 10.9 (*1920-1922*); 10.82 (*1925-1941*).

Bromine 79.95 (*1894-1902*); 79.96 (*1903-1908*); 79.92 (*1909-1922*); 79.916 (*1925-1941*).

Cadmium 112 (*1894-1895*); 111.93 (*1896*); 111.95 (*1897-1898*); 112.38 (*1899*); 112.4 (*1900-1908*); 112.40 (*1909-1922*); 112.41 (*1925-1941*).

Calcium 40 (*1894-1895*); 40.08 (*1896*); 40.07 (*1897-1899*); 40.1 (*1900-1908*); 40.09 (*1909-1911*); 40.07 (*1912-1925*); 40.08 (*1931-1941*).

Carbon 12 (*1894-1895*); 12.01 (*1896-1897*); 12.00 (*1898-1899*); 12.0 (*1900-1902*); 12.00 (*1903-1915*); 12.005 (*1916-1922*); 12.000 (*1925*); 12.00 (*1931-1936*); 12.01 (*1937*); 12.010 (*1938-1941*).

Cerium 140.2 (*1894-1896*); 140.20 (*1897*); 139.35 (*1898-1899*); 139.0 (*1900-1901*); 139 (*1902*); 140 (*1903*); 140.25 (*1904-1925*); 140.13 (*1931-1941*).

Cesium 132.9 (*1894-1895*); 132.89 (*1896-1899*); 132.9 (*1900-1902*); 133 (*1903*); 132.9 (*1904-1908*); 132.81 (*1909-1933*); 132.91 (*1934-1941*).

Chlorine 35.45 (*1894-1908*); 35.46 (*1909-1922*); 35.457 (*1925-1941*).

Chromium 52.1 (*1894-1895*); 52.14 (*1896-1899*); 52.1 (*1900-1909*); 52.0 (*1910-1922*); 52.01 (*1925-1941*).

Cobalt 59 (*1894*); 59.5 (*1895*); 58.93 (*1896-1897*); 58.99 (*1898-1899*); 59.00 (*1900-1902*); 59.0 (*1903-1908*); 58.97 (*1909-1922*); 58.94 (*1925-1941*).

Columbium (niobium) 94 (*1894-1895*); 94.0 (*1896*); 93.73 (*1897-1899*); 93.7 (*1900-1902*); 94 (*1903-1908*); 93.5 (*1909-1916*); 93.1 (*1917-1925*); 93.3 (*1931-1934*); 92.91 (*1935-1941*).

Copper 63.6 (*1894-1895*); 63.60 (*1896-1899*); 63.6 (*1900-1901*); 63.60 (*1902*); 63.6 (*1903-1908*); 63.57 (*1909-1941*).

Dysprosium 162.5 (*1908-1922*); 162.52 (*1925*); 162.46 (*1931-1941*).

Erbium 166.3 (*1894-1896*); 166.32 (*1897-1899*); 166.0 (*1900*); 166 (*1901-1908*); 167.4 (*1909-1911*); 167.7 (*1912-1925*); 167.64 (*1931-1933*); 165.20 (*1934*); 167.64 (*1935-1937*); 167.2 (*1938-1941*).

Europium 152.0 (*1907*); 152 (*1908*); 152.0 (*1909-1941*).

Fluorine 19 (*1894-1895*); 19.03 (*1896*); 19.06 (*1897-1899*); 19.05 (*1900-1902*); 19 (*1903-1906*); 19.0 (*1907-1922*); 19.00 (*1925-1935*); 19.00 (*1936-1941*).

Gadolinium 156.1 (*1894-1896*); 156.76 (*1897-1899*); 157.0 (*1900-1901*); 156.4 (*1902*); 156 (*1903-1908*); 157.3 (*1909-1922*); 157.26 (*1925*); 157.3 (*1931-1936*); 156.9 (*1941*).

Gallium 69 (*1894-1895*); 69.0 (*1896*); 69.91 (*1897-1899*); 70.0 (*1900*); 70 (*1901-1906*); 70.0 (*1907-1908*); 69.9 (*1909-1917*); 70.1 (*1920-1922*); 69.72 (*1925-1941*).

Germanium 72.3 (*1894-1896*); 72.48 (*1897-1899*); 72.5 (*1900-1922*); 72.60 (*1925-1941*).

Gold 197.3 (*1894-1895*); 197.24 (*1896*); 197.23 (*1897-1899*); 197.2 (*1900-1941*).

Hafnium 178.6 (*1931-1941*).

Helium 3.96 (*1902*); 4 (*1903-1906*); 4.0 (*1907-1910*); 3.99 (*1911-1915*); 4.00 (*1916-1925*); 4.002 (*1931-1937*); 4.003 (*1938-1941*).

Holmium 163.5 (*1913-1922*); 163.4 (*1925*); 163.5 (*1931-1940*); 164.94 (*1941*).

Hydrogen 1.008 (*1894-1925*); 1.0078 (*1931-1937*); 1.0081 (*1938-1939*); 1.0080 (*1940-1941*).

Indium 113.7 (*1894-1896*); 113.85 (*1897-1899*); 114.0 (*1900-1902*); 114 (*1903-1904*); 115 (*1905-1908*); 114.8 (*1909-1933*); 114.76 (*1934-1941*).

Iodine 126.85 (*1894-1904*); 126.97 (*1905-1908*); 126.92 (*1909-1922*); 126.932 (*1925-1931*); 126.92 (*1933-1941*).

Iridium 193.1 (*1894-1895*); 193.12 (*1896-1899*); 193.1 (*1900-1902*); 193.0 (*1903-1908*); 193.1 (*1909-1941*).

Iron 56 (*1894-1895*); 56.02 (*1896-1899*); 56.0 (*1900*); 55.91 (*1901-1908*); 55.85 (*1909-1911*); 55.84 (*1912-1939*); 55.85 (*1940-1941*).

Krypton 81.76 (*1902*); 81.8 (*1903-1909*); 83.0 (*1910*); 82.92 (*1911-1922*); 82.9 (*1925-1931*); 83.7 (*1933-1941*).

Lanthanum 138.2 (*1894-1895*); 138.6 (*1896*); 138.64 (*1897-1899*); 138.6 (*1900-1902*); 138.9 (*1903-1908*); 139.0 (*1909-1922*); 138.90 (*1925-1931*); 138.92 (*1933-1941*).

Lead 206.95 (*1894-1895*); 206.92 (*1896-1902*); 206.9 (*1903-1908*); 207.10 (*1909-1915*); 207.20 (*1916-1925*); 207.22 (*1931-1936*); 207.21 (*1939-1941*).

Lithium 7.02 (*1894-1895*); 7.03 (*1896-1908*); 7.00 (*1909-1910*); 6.94 (*1911-1922*); 6.940 (*1925-1941*).

Lutecium (cassiopeium) 174.0 (*1909-1915*); 175.0 (*1916-1939*); 174.99 (*1940-1941*).

Magnesium 24.3 (*1894-1895*); 24.29 (*1896*); 24.28 (*1897-1899*); 24.3 (*1900-1902*); 24.36 (*1903-1908*); 24.32 (*1909-1941*).

Manganese 55 (*1894-1895*); 54.99 (*1896-1899*); 55.0 (*1900-1908*); 54.93 (*1909-1941*).

Mercury 200 (*1894-1895*); 200.0 (*1896*); 200.00 (*1897-1898*); 200.0 (*1899-1911*); 200.6 (*1912-1922*); 200.61 (*1925-1941*).

Molybdenum 96 (*1894-1895*); 95.98 (*1896*); 95.99 (*1897-1899*); 96.0 (*1900-1902*); 96 (*1903*); 96.0 (*1904-1937*); 95.95 (*1938-1941*).

Neodymium 140.5 (*1894-1896*); 140.80 (*1897-1898*); 143.60 (*1899*); 143.6 (*1900-1908*); 144.3 (*1909-1922*); 144.27 (*1925-1941*).

Neon 19.94 (*1902*); 20 (*1903-1908*); 20.0 (*1909*); 20.2 (*1910-1925*); 20.183 (*1931-1941*).

Nickel 58.7 (*1894-1895*); 58.69 (*1896-1899*); 58.70 (*1900-1902*); 58.7 (*1903-1908*); 58.68 (*1909-1922*); 58.69 (*1925-1941*).

Nitrogen 14.03 (*1894-1895*); 14.04 (*1896-1906*); 14.01 (*1907-1917*); 14.008 (*1920-1941*).

Osmium 190.8 (*1894-1895*); 190.99 (*1896-1899*); 191.0 (*1900-1903*); 191 (*1904-1905*); 191.0 (*1906-1908*); 190.9 (*1909-1922*); 190.8 (*1925-1933*); 191.5 (*1934-1937*); 190.2 (*1938-1941*).

Oxygen 16.0 (*1894*); 16 (*1895*); 16.00 (*1896-1899*); 16.000 (*1900-1902*); 16.00 (*1903-1922*); 16.000 (*1925*); 16.0000 (*1931-1941*).

Palladium 106.6 (*1894*); 106.5 (*1895*); 106.36 (*1896-1899*); 107.0 (*1900-1902*); **106.5** (*1903-1908*); 106.7 (*1909-1941*).

Phosphorus 31 (*1894-1895*); 31.02 (*1896-1899*); 31.0 (*1900-1910*); **31.04** (*1911-1922*); 32.027 (*1925*); 31.02 (*1931-1938*); 30.98 (*1939-1941*).

Platinum 195 (*1894-1895*); 194.89 (*1896-1899*); 194.9 (*1900-1902*); **194.8** (*1903-1908*); 195.0 (*1909-1910*); 195.2 (*1911-1922*); 195.23 (*1925-1941*).

Potassium 39.11 (*1894-1902*); 39.15 (*1903-1908*); 39.10 (*1909-1922*); 39.096 (*1925*); 39.10 (*1931-1933*); 39.096 (*1934-1941*).

Praseodymium 143.5 (*1894-1896*); 143.60 (*1897-1898*); 140.46 (*1899*); **140.5** (*1900-1908*); 140.6 (*1909-1915*); 140.9 (*1916-1922*); 140.92 (*1925-1941*).

Protactinium 231 (*1936-1941*).

Radium 225 (*1903-1905*); 225.0 (*1906-1907*); 225 (*1908*); 226.4 (*1909-1915*); **226.0** (*1916-1922*); 225.95 (*1925*); 225.97 (*1931-1935*); 226.05 (*1936-1941*).

Radon (niton) 222.4 (*1912-1922*); 222 (*1925-1941*).

Rhenium 186.31 (*1931-1941*).

Rhodium 103 (*1894-1895*); 103.01 (*1896-1899*); 103.0 (*1900-1908*); 102.9 (*1909-1922*); 102.91 (*1925-1941*).

Rubidium 85.5 (*1894-1895*); 85.43 (*1896-1899*); 85.4 (*1900-1904*); **85.5** (*1905-1908*); 85.45 (*1909-1922*); 85.44 (*1925-1936*); 85.48 (*1937-1941*).

Ruthenium 101.6 (*1894-1895*); 101.68 (*1896-1899*); 101.7 (*1900-1941*).

Samarium 150 (*1894-1895*); 150.0 (*1896*); 150.26 (*1897-1899*); 150.3 (*1900-1901*); 150.3 ? (*1902*); 150 (*1903-1904*); 150.3 (*1905-1908*); 150.4 (*1909-1922*); **150.43** (*1900-1941*).

Scandium 44 (*1894-1895*); 44.0 (*1896*); 44.12 (*1897-1899*); 44.1 (*1900-1920*); **45.1** (*1921-1922*); 45.10 (*1925-1941*).

Selenium 79 (*1894-1895*); 79.0 (*1896*); 79.02 (*1897-1898*); 79.17 (*1899*); 79.2 (*1900-1933*); 78.96 (*1934-1941*).

Silicon 28.4 (*1894-1895*); 28.40 (*1896-1899*); 28.4 (*1900-1908*); 28.3 (*1909-1921*); 28.1 (*1922*); 28.06 (*1925-1941*).

Silver 107.92 (*1894-1902*); 107.93 (*1903-1908*); 107.88 (*1909-1922*); 107.880 (*1925-1941*).

Sodium 23.05 (*1894-1908*); 23.00 (*1909-1922*); 22.997 (*1925-1941*).

Strontium 87.60 (*1894*); 87.66 (*1895*); 87.61 (*1896-1899*); 87.60 (*1900-1902*); 87.6 (*1903-1908*); 87.62 (*1909-1910*); 87.63 (*1911-1941*).

Sulfur 32.06 (*1894-1895*); 32.07 (*1896-1902*); 32.06 (*1903-1908*); 32.07 (*1909-1915*); 32.06 (*1916-1922*); 32.064 (*1925*); 32.06 (*1931-1941*).

Tantalum 182.6 (*1894-1896*); 182.84 (*1897-1899*); 182.8 (*1900-1902*); 183 (*1903-1906*); 181 (*1907-1908*); 181.0 (*1909-1911*); 181.5 (*1912-1925*); 181.4 (*1931-1935*); 180.88 (*1936-1941*).

Tellurium 125 (*1894-1895*); 127.0 ? (*1896*); 127.49 (*1897-1899*); 127.5 (*1900*); 127.5 ? (*1901*); 127.7 (*1902*); 127.6 (*1903-1908*); 127.5 (*1909-1933*); 127.61 (*1934-1941*).

Terbium 160 (*1894-1895*); 160.0 (*1896*); 160.00 (*1897-1899*); 160 (*1900-1906*); 159.2 (*1907-1941*).

Thallium 204.18 (*1894-1895*); 204.15 (*1896-1902*); 204.1 (*1903-1908*); 204.0 (*1909-1922*); 204.39 (*1925-1941*).

Thorium 232.6 (*1894-1895*); **232.63** (*1896-1899*); 232.6 (*1900-1901*); 232.6 ? (*1902*); **232.5** (*1903-1908*); 232.42 (*1909-1910*); 232.4 (*1911-1917*); 232.15 (*1920-1925*); **232.12** (*1933-1941*).

Thulium 170.7 (*1894-1896*); 170.70 (*1897-1899*); 170.7 (*1900-1902*); 171 (*1903-1908*); 168.5 (*1909-1921*); 169.9 (*1922*); 169.4 (*1925-1941*).

Tin 119 (*1894-1895*); 119.05 (*1896-1899*); 119.0 (*1900-1915*); 118.7 (*1916-1922*); 118.70 (*1925-1941*).

Titanium 48 (*1894-1895*); 48.15 (*1896-1902*); 48.1 (*1903-1925*); 47.90 (*1931-1941*).

Tungsten 184 (*1894*); 184.9 (*1895*); 184.84 (*1896*); 184.83 (*1897-1899*); 184 (*1900-1906*); 184.0 (*1907-1937*); 183.92 (*1938-1941*).

Uranium 239.6 (*1894-1895*); 239.59 (*1896-1899*); 239.6 (*1900-1902*); 238.5 (*1903-1915*); 238.2 (*1916-1922*); 238.17 (*1925*); 238.14 (*1931-1936*); 238.07 (*1937-1941*).

Vanadium 51.4 (*1894-1895*); 51.38 (*1896-1899*); 51.4 (*1900-1902*); 51.2 (*1903-1910*); 51.06 (*1911*); 51.0 (*1912-1922*); 50.96 (*1925*); 50.95 (*1931-1941*).

Xenon 128.0 (*1902*); 128 (*1903-1908*); 128.0 (*1909*); 130.1 (*1910*); 130.2 (*1911-1932*); 131.3 (*1933-1941*).

Ytterbium 173 (*1894-1895*); 173.0 (*1896*); 173.19 (*1897-1899*); 173.2 (*1900-1902*); 173 (*1903-1904*); 173.0 (*1905-1908*); 172.0 (*1909-1915*); 173.5 (*1916-1922*); 173.6 (*1925*); 173.5 (*1931-1933*); 173.04 (*1934-1941*).

Yttrium 89.1 (*1894-1895*); 88.95 (*1896*); 89.02 (*1897-1899*); 89.0 (*1900-1915*); 88.7 (*1916-1917*); 89.33 (*1920-1922*); 88.9 (*1925*); 88.92 (*1931-1941*).

Zinc 65.3 (*1894-1895*); 65.41 (*1896-1899*); 65.4 (*1900-1908*); 65.7 (*1909*); 65.37 (*1910-1922*); 65.38 (*1925-1941*).

Zirconium 90.6 (*1894-1896*); 90.40 (*1897-1899*); 90.4 (*1900-1902*); 90.6 (*1903-1922*); 91 (*1925*); 91.22 (*1931-1941*).

The references for this table are given below in which the date is preceded by the volume number and then the page number of the Journal of the American Chemical Society: 16, 192 (1894); 17, 212 (1895); 18, 213 (1896); 19, 368 (1897); 20, 171 (1898); 21, 213 (1899); 22, 79 (1900); 23, 94 (1901); 24, 213 (1902); 25, 1 (1903); 26, 1 (1904); 27, 1 (1905); 28, 1 (1906); 29, 107 (1907); 30, 1 (1908); 31, 1 (1909); 32, 1 (1910); 33, 1639 (1911); 34, 1437 (1912); 35, 1807 (1913); 36, 1585 (1914); 37, 2449 (1915); 38, 2219 (1916); 39, 2517 (1917); 41, 1881 (1919); 42, 1761 (1920); 43, 1751 (1921); 47, 600 (1925); 53, 1637 (1931); 55, 451 (1933); 56, 763 (1934); 57, 793 (1935); 58, 547 (1936); 59, 225 (1937); 60, 744 (1938); 61, 227 (1939); 62, 672 (1940); 63, 850 (1941).

SYNONYMS OF THE ELEMENTS

Aldebaranium—ytterbium.
Argentum—silver.
Aurum—gold.
Austrium—impure gallium.
Cassiopeium—lutecium.
Celtium—lutecium.
Demonium—dysprosium.
Didymium—neodymium and praseodymium.
Dwi-manganese—rhenium.
Eka-aluminum—gallium.
Eka-boron—scandium.
Eka-cesium—virginium.
Eka-iodine—alabamine.
Eka-manganese—masurium.
Eka-silicon—germanium.
Eka-tantalum—protoactinium.
Erythronium—vanadium.
Ferrum—iron.
Florentium—illinium.
Glucinum—beryllium.
Hydrargyrum—mercury.
Kalium—potassium.
Natrium—sodium.
Neoytterbium—ytterbium.
Niobium—columbium.
Niton—radon.
Plumbum—lead.
Radium emanation—radon.
Stannum—tin.
Stibium—antimony.
Wolframium—tungsten.

INTERNATIONAL TABLE OF STABLE ISOTOPES FOR 1938

The table below was compiled from the third international table to be issued (*Ber.* 71, p. 160, Abt. A, Oct. 1938). The values given in italics do not form a part of the international table but are taken from a review of isotope investigations during the year 1936 (*Ber.* 70, p. 10, Abt. A, Jan. 1937). Values followed by a question mark (?) are doubtful; those followed by an asterisk (*) are approximate; those followed by a double asterisk (**) are estimated.

At. No.	Element	Sym.	Mass No.	Abundance in %	Packing Fraction	Atomic Weight (O = 16.0000)	
						Physical Individual	Chemical from Isotope Research
0	*Neutron*	*n*	*1*	.....	*+90*	*1.0090*	.....
1	Hydrogen	H	1	99.98	*+81*	*1.0081*	
	" (Deuterium)	D	2	0.02	*+73*	*2.0147*	*1.00805*†
	" (Tritium)	T	3	7×10^{-8}?	*+57*	*3.0171*	
2	Helium	*He*	*3*	.....	*+57*	*3.0171*	*4.0030*
	"	He	4	100	*+9.8*	*4.0039*	
3	Lithium	Li	6	7.9	*+27.8*	*6.0167*	*6.9374*
	"	Li	7	92.1	*+25.7*	*7.0180*	
4	Beryllium	Be	8?	0.05?	*+9.8*	*8.0078*	
	"	Be	9	100	*+16.6*	*9.0149*	*9.0129*
	"	*Be*	*10?*	?	*+16.4*	*10.0164*	
5	Boron	B	10	20	*+16.1*	*10.0161*	*10.811*
	"	B	11	80	*+11.6*	*11.0128*	
6	Carbon	C	12	99.3	*+3*	*12.0036*	*12.008*
	"	C	13	0.7	*+5.6*	*13.0073*	
7	Nitrogen	N	14	99.62	*+5.2*	*14.0073*	*14.008*
	"	N	15	0.38	*+3.2*	*15.0048*	
8	Oxygen	O	16	99.76	*±0*	*16.0000*	
	"	O	17	0.04	*+2.7*	*17.0046*	*16.0000*
	"	O	18	0.20	*+2.1*	*18.0038*	
9	Fluorine	F	19	100	*+2.6*	*19.0049*	*19.000*
10	Neon	Ne	20	90.00	*−0.7*	*19.9986*	
	"	Ne	21	0.27	.....	.....	*20.191*
	"	Ne	22	9.73	*−0.6*	*21.9985*	
11	Sodium	Na	23	100	.....	.....	.....
12	Magnesium	Mg	24	77.4	*−2.6*	*23.9938*	
	"	Mg	25	11.5	.....	.....	*24.33*
	"	Mg	26	11.1	.....	.....	
13	Aluminum	Al	27	100	*−3.3*	*26.9911*	*26.985*
14	Silicon	Si	28	89.6	*−5.0*	*27.9860*	
	"	Si	29	6.2	*−4.7*	*28.9864*	*28.126*
	"	Si	30	4.2	*−5.2*	*29.9845*	
15	Phosphorus	P	31	100	*−5.0*	*30.9844*	*30.978*
16	Sulfur	S	32	96*	*−5.9*	*31.9812*	
	"	S	33	1*	.....	.....	*32.05*
	"	S	34	3*	*−5.9*	*33.9799*	
17	Chlorine	Cl	35	76	*−5.8*	*34.9796*	.....
	"	Cl	37	24	*−6.0*	*36.9777*	.....
18	Argon	A	36	0.31	*−6.7*	*35.976*	
	"	A	38	0.06	*−6.5*	*37.9753*	*39.953*
	"	A	40	99.63	*−6.15*	*39.9754*	
19	Potassium	K	39	93.4		.....	
	"	K	40	0.01	*−7***	.....	*39.096*
	"	K	41	6.6		.....	

†If the D:H = 1:30,000 (as in electrolytic hydrogen) then the atomic weight is 1.00788.

INTERNATIONAL TABLE OF STABLE ISOTOPES FOR 1938

At. No.	Element	Sym.	Mass No.	Abundance in %	Packing Fraction	Atomic Weight (O = 16.0000)	
						Physical Individual	Chemical from Isotope Research
20	Calcium	Ca	40	96.76		.....	
	"	Ca	42	0.77	−7.2**	.....	40.076
	"	Ca	43	0.17		.....	
	"	Ca	44	2.30		.....	
21	Scandium	Sc	45	100	−7**	.....	44.96
22	Titanium	Ti	46	8.5		.....	
	"	Ti	47	7.8		.....	
	"	Ti	48	71.3	−8**	.....	47.91
	"	Ti	49	5.5		.....	
	"	Ti	50	6.9		.....	
23	Vanadium	V	51	100	.....	.....	.....
24	Chromium	Cr	50	4.9	.....	.....	
	"	Cr	52	81.6	−10	51.948	52.005
	"	Cr	53	10.4	.....	.....	
	"	Cr	54	3.1	.....	.....	
25	Manganese	Mn	55	100	.....	.....	.....
26	Iron	Fe	54	6.5		.....	
	"	Fe	56	90.2	−10**	.....	55.84
	"	Fe	57	2.8		.....	
	"	Fe	58	0.5		.....	
27	Cobalt	Co	57	0.2	.....	.....	.....
	"	Co	59	99.8	.....	.....	.....
28	Nickel	Ni	58	66.4	−10	57.942	
	"	Ni	60	26.7	.....	.....	
	"	Ni	61	1.6	.....	.....	58.71
	"	Ni	62	3.7	.....	.....	
	"	Ni	64	1.6	.....	.....	
29	Copper	Cu	63	68*	.....	.....	.....
	"	Cu	65	32*	.....	.....	.....
30	Zinc	Zn	64	50.4	−9.9	63.937	
	"	Zn	66	27.2	.....	.....	
	"	Zn	67	4.2	.....	.....	65.333
	"	Zn	68	17.8	.....	.....	
	"	Zn	70	0.4	.....	.....	
31	Gallium	Ga	69	61.2	−9.8**	.....	69.71
	"	Ga	71	38.8		.....	
32	Germanium	Ge	70	21.2		.....	
	"	Ge	72	27.3		.....	
	"	Ge	73	7.9	−7.7**	.....	72.57
	"	Ge	74	37.1		.....	
	"	Ge	76	6.5		.....	
33	Arsenic	As	75	100	−8.8	74.934	74.92
34	Selenium	Se	74	0.9	.....	.....	
	"	Se	76	9.5	.....	.....	
	"	Se	77	8.3	.....	.....	78.95
	"	Se	78	24.0	−8.0?	77.938?	
	"	Se	80	48.0	−7.3	79.941	
	"	Se	82	9.3	.....	.....	
35	Bromine	Br	79	50.6	−9.0	78.929	79.916
	"	Br	81	49.4	−8.6	80.926	
36	Krypton	Kr	78	0.35	−9.4	77.926	
	"	Kr	80	2.01	−9.1	79.926	
	"	Kr	82	11.53	−8.8	81.927	83.76
	"	Kr	83	11.53	−8.7	82.927	

INTERNATIONAL TABLE OF STABLE ISOTOPES FOR 1938

At. No.	Element	Sym.	Mass No.	Abundance in %	Packing Fraction	Atomic Weight (O = 16.0000)	
						Physical Individual	Chemical from Isotope Research
36	Krypton	Kr	84	57.11	−8.6	83.928	
	"	Kr	86	17.47	−8.2	85.929	
37	Rubidium	Rb	85	72.8	−8.2**	.....	85.45
	"	Rb	87	27.2		.....	
38	Strontium	Sr	84	0.5		.....	
	"	Sr	86	9.6	−8.2**	.....	87.62
	"	Sr	87	7.5		.....	
	"	Sr	88	82.4		.....	
39	Yttrium	Y	89	100	−8.1**	.....	88.91
40	Zirconium	Zr	90	48		.....	
	"	Zr	91	11.5		.....	
	"	Zr	92	22	−7**	.....	91.24
	"	Zr	94	17		.....	
	"	Zr	96	1.5		.....	
41	Columbium	Cb	93	100	−8	92.926	92.90
42	Molybdenum	Mo	92	14.2	.....	.....	
	"	Mo	94	10.0	.....	.....	
	"	Mo	95	15.5	.....	.....	
	"	Mo	96	17.8	.....	.....	95.96
	"	Mo	97	9.6	.....	.....	
	"	Mo	98	23.0	−5.5?	97.946?	
	"	Mo	100	9.8	−5.5	99.945	
44	Ruthenium	Ru	96	5*		.....	
	"	Ru	98?	.....		.....	
	"	Ru	99	12*		.....	
	"	Ru	100	14*	−6**	.....	101.1
	"	Ru	101	22*		.....	
	"	Ru	102	30*		.....	
	"	Ru	104	17*		.....	
45	Rhodium	Rh	101	0.1	−5.7**	.....	102.92
	"	Rh	103	99.9		.....	
46	Palladium	Pd	102	0.8		.....	
	"	Pd	104	9.3		.....	
	"	Pd	105	22.6	−6**	.....	106.54
	"	Pd	106	27.2		.....	
	"	Pd	108	26.8		.....	
	"	Pd	110	13.5		.....	
47	Silver	Ag	107	52.5	−5.3**	.....	107.87
	"	Ag	109	47.5		.....	
48	Cadmium	Cd	106	1.5		.....	
	"	Cd	108	1.0		.....	
	"	Cd	110	15.6		.....	
	"	Cd	111	15.2		.....	
	"	Cd	112	22.0	−6.5**	.....	112.18
	"	Cd	113	14.7		.....	
	"	Cd	114	24.0		.....	
	"	Cd	116	6.0		.....	
	"	Cd	118?	.....		.....	
49	Indium	In	113	4.5	−7.4**	.....	114.80
	"	In	115	95.5		.....	
50	Tin	Sn	112	1.1	.....	.....	
	"	Sn	114	0.8	.....	.....	
	"	Sn	115	0.4	.....	.....	
	"	Sn	116	15.5	.....	.....	

INTERNATIONAL TABLE OF STABLE ISOTOPES FOR 1938

At. No.	Element	Sym.	Mass No.	Abundance in %	Packing Fraction	Atomic Weight (O = 16.0000)	
						Physical Individual	Chemical from Isotope Research
50	Tin	Sn	117	9.1	.....	.....	*118.67*
	"	Sn	118	22.5	.....	.....	
	"	Sn	119	9.8	.....	.....	
	"	Sn	120	28.5	−7.3**	.....	
	"	Sn	122	5.5	.....	.....	
	"	Sn	124	6.8	.....	.....	
51	Antimony	Sb	121	56	*−6.3***	.....	*121.8*
	"	Sb	123	44		.....	
52	Tellurium	Te	120	v. small		.....	
	"	Te	122	2.9		.....	
	"	Te	123	1.6		.....	
	"	Te	124	4.5	*−5***	.....	*127.58*
	"	Te	125	6.0		.....	
	"	Te	126	19.0		.....	
	"	Te	128	32.8		.....	
	"	Te	130	33.1		.....	
53	Iodine	I	127	100	*−5.3*	*126.932*	*126.904*
54	Xenon	Xe	124	0.094	.....	.....	
	"	Xe	126	0.088	.....	.....	
	"	Xe	128	1.90	.....	.....	
	"	Xe	129	26.23	.....	.....	
	"	Xe	130	4.07	.....	.....	*131.12*
	"	Xe	131	21.17	.....	.....	
	"	Xe	132	26.96	.....	.....	
	"	Xe	134	10.54	*−5.3*	*133.929*	
	"	Xe	136	8.95	.....	.....	
55	Cesium	Cs	133	100	*−5*	*132.933*	*132.90*
56	Barium	Ba	130	0.16	.....	.....	
	"	Ba	132	0.015	.....	.....	
	"	Ba	134	1.72	.....	.....	
	"	Ba	135	5.7	.....	.....	*137.35*
	"	Ba	136	8.5	.....	.....	
	"	Ba	137	10.8	.....	.....	
	"	Ba	138	73.1	*−6.1*	*137.916*	
57	Lanthanum	La	139	100	.....	.....	*138.91*
58	Cerium	Ce	136	v. small		.....	
	"	Ce	138	v. small		.....	*140.13*
	"	Ce	140	89		.....	
	"	Ce	142	11		.....	
59	Praseodymium	Pr	141	100		.....	*140.91*
60	Neodymium	Nd	142	25.95		.....	
	"	Nd	143	13.0		.....	
	"	Nd	144	22.6		.....	
	"	Nd	145	9.2		.....	*143.5*
	"	Nd	146	16.5		.....	
	"	Nd	148	6.8		.....	
	"	Nd	150	5.95		.....	
62	Samarium	Sm	144	3		.....	
	"	Sm	147	17		.....	
	"	Sm	148	14		.....	
	"	Sm	149	15		.....	*150.1*
	"	Sm	150	5		.....	
	"	Sm	152	26		.....	
	"	Sm	154	20		.....	

estimated at −5 for the light earths, at −3 for the heavy earths

INTERNATIONAL TABLE OF STABLE ISOTOPES FOR 1938

At. No.	Element	Sym.	Mass No.	Abundance in %	Packing Fraction	Atomic Weight (O = 16.0000)	
						Physical Individual	Chemical from Isotope Research
63	Europium	Eu	151	50.6		.....	*151.90*
	"	Eu	153	49.4		.....	
64	Gadolinium	Gd	155	21		.....	
	"	Gd	156	23		.....	
	"	Gd	157	17		.....	*156.9*
	"	Gd	158	23		.....	
	"	Gd	160	16		.....	
65	Terbium	Tb	159	100		.....	*158.19*
66	Dysprosium	Dy	161	22		.....	
	"	Dy	162	25		.....	*162.5*
	"	Dy	163	25		.....	
	"	Dy	164	28		.....	
67	Holmium	Ho	165	100		.....	*164.91*
68	Erbium	Er	166	36		.....	
	"	Er	167	24		.....	*167.15*
	"	Er	168	30		.....	
	"	Er	170	10		.....	
69	Thulium	Tm	169	100		.....	*168.91*
70	Ytterbium	Yb	171	9		.....	
	"	Yb	172	24		.....	
	"	Yb	173	17		.....	*173.2*
	"	Yb	174	38		.....	
	"	Yb	176	12		.....	
71	Lutecium	Lu	175	100		.....	*174.91*
72	Hafnium	Hf	176	5		.....	
	"	Hf	177	19		.....	
	"	Hf	178	28	*−3***	.....	*178.4*
	"	Hf	179	18		.....	
	"	Hf	180	30		.....	
73	Tantalum	Ta	181	100	*−4*	*180.928*	*180.89*
74	Tungsten	W	180	0.2	.....	.....	
	"	W	182	22.6	.....	.....	
	"	W	183	17.3	.....	.....	*183.94*
	"	W	184	30.1	*0?*	*184.0?*	
	"	W	186	29.8	.....	.....	
75	Rhenium	Re	185	38.2	.....	.....	*186.2*
	"	Re	187	61.8	*−1*	*186.981*	
76	Osmium	Os	184	0.018	.....	.....	
	"	Os	186	1.58	.....	.....	
	"	Os	187	1.64	.....	.....	
	"	Os	188	13.3	.....	.....	*190.30*
	"	Os	189	16.2	.....	.....	
	"	Os	190	26.4	*−1*	*189.98*	
	"	Os	192	40.9	*−1*	*191.98*	
77	Iridium	Ir	191	38.5	*0***	.....	*192.2*
	"	Ir	193	61.5		.....	
78	Platinum	Pt	192	0.8		.....	
	"	Pt	194	30.2		.....	
	"	Pt	195	35.3	*+0.5***	.....	*195.13*
	"	Pt	196	26.6		.....	
	"	Pt	198	7.2		.....	
79	Gold	Au	197	100	.....	.....	*<197.2*
80	Mercury	Hg	196	0.15	.....	.....	
	"	Hg	198	10.11	.....	.....	

INTERNATIONAL TABLE OF STABLE ISOTOPES FOR 1938

At. No.	Element	Sym.	Mass No.	Abundance in %	Packing Fraction	Atomic Weight (O = 16.0000)	
						Physical Individual	Chemical from Isotope Research
80	Mercury	Hg	199	17.03	.....	.....	
	"	Hg	200	23.26	*+0.8*	*200.016*	*200.61*
	"	Hg	201	13.17	.....	.....	
	"	Hg	202	29.56	.....	.....	
	"	Hg	204	6.72	.....	.....	
81	Thallium	Tl	203	29.4	*+1.8*	*203.037*	*204.41*
	"	Tl	205	70.6	*+1.8*	*205.037*	
82	Lead	Pb	204	1.5		.....	
	"	Pb	206	23.5	*+1***	.....	*207.15*
	"	Pb	207	22.7		.....	
	"	Pb	208	52.3		.....	
83	Bismuth	Bi	209	100	.....	.....	.....
90	Thorium	Th	232	100?	*+3.0*	*232.070*	*232.02*
92	Uranium	U	235	<1	*+3.6*	*235.084*	*238.02*
	"	U	238	>99	*+3.7*	*238.088*	

EFFECTIVE RADII OF ATOMS AND IONS

Compiled by Charles W. Stillwell, Ph. D.

The values are given in angstrom units. The atomic radii are from Neuburger, *Zeit. Krist. 93, 1 (1936)*. To give some idea of the degree of accuracy with which values for ionic radii are known, three sets of values are given; viz., **G**, empirical data from crystal structure by Goldschmidt, *Ber. 60, 1263 (1927)*; and calculated values **P** and **Z** by Pauling, *J. Am. Chem. Soc. 49, 765 (1927)*, and Zachariasen, *Zeit. Krist. 80, 137 (1931)*.

Element	Atomic Radius	Ion	Ionic Radii			Interatomic Distances
			G	P	Z	
H	0.37	H^-	1.27	2.08	1.36	....
Ne	1.60	.....	....	....	....	....
A	1.91	.....	....	....	....	....
Kr	2.0	.....	....	....	....	....
Xe	2.2	.....	....	....	....	....
Li	1.50	Li^+	0.78	0.60	0.68	....
Be	1.1112	Be^{2+}	0.34	0.31	0.39	....
B	(*ca.* 0.7)	B^{3+}	....	0.20	0.24	....
C	0.77	C-O (CO_3)	....	....	....	1.31*
N	0.53	N-O (NO_3)	....	....	....	1.23*
		N^{3-}	....	1.71	....	....
O	.....	O^{2-}	1.32	1.40	1.40	....
		O^{6+}	....	0.09	....	....
F	0.68	F^{7+}	....	0.07	....	....
		F^-	1.33	1.36	1.33	....
Na	1.86	Na^+	0.98	0.95	0.98	....
Mg	1.595	Mg^{2+}	0.78	0.65	0.71	....
Al	1.48	Al^{3+}	0.57	0.50	0.55	....
Si	1.172	Si^{4+}	0.39	0.41	0.44	....
		Si-O (SiO_3)	....	....	....	1.63†

* Zachariasen, *J. Am. Chem. Soc. 53, 2123 (1931)*.

† Zachariasen, private communication.

EFFECTIVE RADII OF ATOMS AND IONS

Element	Atomic Radius	Ion	Ionic Radii G	Ionic Radii P	Ionic Radii Z	Interatomic Distances
P (black)	1.08	P-O (PO_4)	....	....	....	1.56†
		P^{3-}	....	2.12	....	....
S (rhombic)	1.06	S-O (SO_4)	....	....	....	1.49†
		S^{2-}	1.74	1.84	1.85	....
Cl	0.97	Cl-O (ClO_3)	....	....	....	1.45†
		Cl^-	1.81	1.81	1.81	....
K	2.27	K^+	1.33	1.33	1.33	....
Ca	1.97	Ca^{2+}	1.06	0.99	0.98	....
Sc	.....	Sc^{3+}	0.83	0.81	0.78	....
Ti	1.45	Ti^{4+}	0.64	0.68	0.62	....
V	1.313	V^{4+}	0.61	....	....	....
		V^{5+}	....	0.59	....	....
Cr (α)	1.246	Cr^{3+}	0.65	....	....	....
(β)	1.35	Cr^{6+}	....	0.52	....	....
Mn (α)	1.24	Mn^{2+}	0.91	....	....	....
(β)	1.26	Mn^{4+}	0.52	....	....	....
(γ)	1.29	Mn^{7+}	....	0.46	....	....
Fe (α)	1.238	Fe^{2+}	0.83	....	....	....
(β)	1.26	Fe^{3+}	0.67	....	....	....
Co	1.25	Co^{2+}	0.82	....	....	....
Ni	1.243	Ni^{2+}	0.78	....	....	....
Cu	1.275	Cu^+	(*ca.* 1.0)	0.96	....	....
Zn	1.329	Zn^{2+}	0.83	0.74	....	....
Ga	1.22	Ga^{3+}	0.62	0.62	....	....
Ge	1.22	Ge^{4+}	0.44	0.53	....	....
As	1.25	As^{5+}	....	0.47	....	....
		As-O (AsO_3)	....	....	....	2.01*
		As^{3}	....	2.22	....	....
Se	1.16	Se^{6+}	0.3 to .4	0.42	....	....
		Se^{2-}	1.91	1.98	1.96	....
Br	1.13	Br-O (BrO_3)	....	....	....	1.68*
		Br^-	1.96	1.95	1.96	....
Rb	2.43	Rb^+	1.49	1.48	1.48	....
Sr	2.14	Sr^{2+}	1.27	1.13	1.15	....
Zr	1.58	Zr^{4+}	0.87	0.80	0.79	....
Mo	1.36	Mo^{4+}	0.68	....	....	....
		Mo^{6+}	....	0.62	....	....
Ru	1.322	Ru^{4+}	0.65	....	....	....
Rh	1.342	Rh^{3+}	0.69	....	....	....
Pd	1.372	.....	....	....	....	....
Ag	1.441	Ag^+	1.13	1.26	....	....
Cd	1.486	Cd^{2+}	1.03	0.97	....	....
Sn (white)	1.508	Sn^{4+}	0.74	0.71	....	....
Sb	1.439	Sb^{5+}	....	0.62	....	....
		Sb-O (SbO_3)	....	....	....	2.22*
		Sb^{3-}	....	2.45	....	....
Te	1.44	Te^{4+}	0.89	....	....	....
		Te^{6+}	....	0.56	....	....
		Te^{2-}	2.11	2.21	2.18	....
I	1.35	I^{7+}	....	0.50	....	....
		I^-	2.20	2.16	2.19	....
Cs	2.62	Cs^+	1.65	1.69	1.67	....
Ba	2.17	Ba^{2+}	1.43	1.35	1.31	....
La	1.86	La^{3+}	1.22	1.15	1.06	....
Ce	1.81	Ce^{4+}	1.02	1.01	0.89	....

PHYSICAL CONSTANTS

In this table the density of gases is given as the weight in grams of one liter of the gas at 760 mm of mercury pressure (one atmosphere) and 0° C.; densities of liquids and solids are expressed in grams per one cubic centimeter; values in parentheses are estimated values.

Name	Symbol	Form and Color at Room Temp.	Density	Melting Point °C.	Boiling Point °C.	Specific Heat g-cal/g atom
Alabamine	Ab	Element No.	85; atomic weight	(221); mel	ting point (	470°).
Aluminum	Al	silv. met.	(l) $2.46^{658°}$	.....	1800	(l) $6.76^{660°}$
			(s) $2.702^{20°}$	660	.....	(s) $5.78^{20°}$
Antimony	Sb	silv. met.	(l) $6.55^{631°}$	.....	1380	$6.76^{30°}$
			(s) $6.684^{25°}$	630.5	.....	$6.0^{20°}$
Argon	A	colorl. gas	(g) 1.7824	.....	.....	$4.83^{15°}$
			(l) $1.402^{-185.7°}$	.....	−185.7	$5.35^{-100°}$
			(s) $1.65^{-223°}$	−189.2	.....	$6.19^{-223°}$
Arsenic	As	gray met.	(s) 5.7	814 36at.	subl. 615	$6.16^{0-100°}$
		black	(s) $4.7^{20°}$	.....	.....	$6.45^{0-100°}$
		yel.	(s) $2.0^{20°}$	.....	.....	.....
Barium	Ba	yel. met.	(s) $3.5^{20°}$	850	1140	.....
Beryllium	Be	gray met.	(s) $1.8^{20°}$	1350	(1500)	$3.85^{0-100°}$
Bismuth	Bi	wh. met.	(l) $10.12^{270°}$	.....	1450	(l) $7.41^{400°}$
			(s) $9.8^{20°}$	271	.....	(s) $6.12^{20°}$
Boron	B	gray	2.5	2300	2550	$3.30^{0-100°}$
Bromine	Br	red liq.	(l) $3.119^{20°}$	.....	58.78	(l) $8.61^{3-45°}$
			(s) (3.4)	−7.2	.....	(s) 5.62^{-192} to $^{-108°}$
Cadmium	Cd	silv. met.	(l) $8.03^{320°}$	.....	767	(l) $8.62^{61°}$
			(s) $8.6^{20°}$	320.9	.....	(s) $6.17^{20°}$
Calcium	Ca	silv. met.	(s) $1.55^{20°}$	810	1200 ± 30	$6.21^{20°}$
Carbon	C	diamond	(s) $3.51^{20°}$	.....	4200	$1.5^{20°}$
		graphite	(s) $2.26^{20°}$	3500	.....	$2.0^{20°}$
Cerium	Ce	gray met.	6.90(6.7)	640	1400	.....
Cesium	Cs	silv. yel. met.	(l) $1.84^{26°}$	.....	670	.....
			(s) $1.90^{20°}$	26	.....	$6.9^{20°}$
Chlorine	Cl	yel.-grn. gas	(g) 3.214	.....	.....	(g) 4.11
			(l) $1.557^{-33.6°}$	.....	−34.6	(l) 8.0
			(s) (1.9)	−101.6	.....	(s) $6.7^{-113°}$
Chromium	Cr	gray	(s) 7.1	1615	2200	$5.5^{20°}$
Cobalt	Co	silv. met.	(s) $8.9^{20°}$	1480	2900	$5.93^{20°}$
Columbium	Cb	gray	(s) $8.4^{20°}$	1950	(>3300)	.....
Copper	Cu	red met.	(l) $8.31^{1083°}$	1083	.....	(l) $6.5^{1084°}$
			(s) $8.92^{20°}$	.....	2300	(s) $5.85^{20°}$
Dysprosium	Dy	.....	.....	.....	.....	.....
Erbium	Er	.....	.....	.....	.....	.....
Europium	Eu	.....	.....	.....	.....	.....
Fluorine	F	pa. yel. gas	(g) 1.695	.....	.....	.....
			(l) $1.11^{-187°}$	.....	−187	.....
			(s) 1.3	−223	.....	.....
Gadolinium	Gd	.....	.....	.....	.....	.....
Gallium	Ga	gray-wh. met.	(l) $6.095^{29.7°}$	.....	>1600	$5.5^{1119°}$
			(s) $5.91^{20°}$	29.75	.....	$5.5^{12-23°}$
Germanium	Ge	gray-wh. met.	$5.36^{20°}$	958.5	2700	$5.33^{0-100°}$
Gold	Au	yel. met.	(l) $17^{1063°}$	.....	2600	(l) $6.5^{1100°}$
			(s) $19.3^{20°}$	1063.0	.....	(s) $6.14^{18°}$
Hafnium	Hf	.....	.....	(1700)	(>3200)	.....
Helium	He	colorl. gas	(g) 0.1785	.....	.....	(g) 4.99
			(l) $0.126^{-268.9°}$	<−272.2	−268.9	.....
Holmium	Ho	.....	.....	.....	.....	.....

OF THE ELEMENTS

The following abbreviations are employed:—at., atmosphere; bl., blue; c., cubic; colorl., colorless; g., gas; grn., green; h., hexagonal; l., liq., liquid; m., monoclinic; met., metal or metallic; pa., pale; powd., powder; r., rhombic; s., solid; silv., silvery; subl., sublimes; t., tetragonal; tr., trigonal; wh., white; yel., yellow or yellowish.

Symbol	Latent Heat of (in kg-cal/g atom)		Resistivity ohm-cm $R \times 10^{-6}$	Surface Tension dyne/cm	Thermal Expansion $E \times 10^{-6}$	Solid Cryst form
	Vaporization at B. P.	Fusion	R		E	
Ab	.....	.....	.....	.....	.....	....
Al	53.8	.....	.....	$520^{750°}$	.....	....
	.....	2.55	$2.62^{20°}$	.....	$23.03^{20°}$	c
Sb	45.4	.....	(l) $12^{860°}$	.....	.....	....
	.....	4.77	(s) $39^{20°}$	.....	$11.4^{20°}$	h
A	.....	.....	.....	.....	.....	....
	1.5	.....	.....	.....	.....	
	.....	0.268	.....	.....	.....	c
As	subl. 33.2	1.65	$35^{0°}$	.....	$4.7^{20°}$	h
	.....	.....	.....	.....	.....	....
	.....	.....	.....	.....	.....	c
Ba	86.3	1.40	.....	.....	.....	....
Be	.....	2.9	$18.5^{20°}$	.....	.....	h
Bi	46.1	2.50	.....	$376^{300°}$	.....	....
	.....	2.60	$115^{20°}$	.....	.....	h
B	.....	.....	1.8×10^{12}, 0°	.....	.....	m(?)
Br	3.58	.....	.....	$36^{58.6°}$	$1100^{0-30°}$	r
	.....	1.3	(s) $>10^{14}$	.....	.....	....
Cd	25.6	1.45	.....	$628^{350°}$	.....	....
	.....	.....	$7.5^{20°}$	.....	$29.8^{20°}$	h
Ca	95.3	2.23	$4.6^{20°}$	.....	$25^{0-21°}$	c
C	143	.....	5×10^{20}, 15°	.....	$0.9^{20°}$	c
	.....	.....	1400, 20°	.....	$3^{20°}$	c
Ce	.....	.....	$78^{20°}$	.....	.....	c(h)
Cs	17	.....	.....	.....	.....	....
	.....	0.50	$20^{20°}$	.....	$97^{0-26°}$	....
Cl	.....	.....	.....	.....	.....	....
	2.39	.....	$>10 \times 10^{15}$, -70°	$27^{-34.6°}$	$1500^{-34°}$	r
	.....	0.812	.....	.....	.....	....
Cr	76.5	3.93	$2.6^{0°}$	.....	$8.2^{20°}$	c
Co	90.8	3.67	$9.7^{20°}$	.....	$12.3^{20°}$	c
Cb	.....	.....	.....	.....	.....	....
Cu	112	.....	.....	.....	(l) $190^{1083°}$	....
	.....	3.11	$1.69^{20°}$	.....	(s) $16.6^{20°}$	c
Dy	.....	.....	.....	.....	.....	....
Er	.....	.....	.....	.....	.....	....
Eu	.....	.....	.....	.....	.....	....
F	.....	.....	.....	.....	.....	....
	1.4	.....	.....	.....	(l) $3000^{-200°}$	.....
	.....	0.19	.....	.....	.....	....
Gd	.....	.....	.....	.....	.....	....
Ga	.....	.....	(l) 27 $\times 10^{-6}$, 30°	$358^{300°}$	.....	....
	.....	1.33	(s) 53°	.....	$18^{0-30°}$	t
Ge	119	.....	89 $\times 10^{3}$, 0°	.....	.....	c
Au	87.9	.....	(l) 30.8 $\times 10^{-6}$, 1063°	.....	.....	....
	.....	3.03	(s) $2.4^{20°}$	.....	$14.2^{20°}$	c
Hf	.....	.....	.....	.....	.....	....
He	.....	.....	.....	.....	.....	....
	0.024	.....	.....	.....	.....	....
Ho	.....	.....	.....	.....	.....	....

Name	Symbol	Form and Color at Room Temp.	Density	Melting Point °C	Boiling Point °C	Specific Heat g-cal/g atom
Hydrogen	H	colorl. gas	(g) 0.08987	.....	.....	(g) 3.477
			(l) $0.0709^{-252.7°}$	.....	−252.7	(l) $0.233^{-252°}$
			(s) $0.0808^{-262°}$	−259.14	.....	(s) $0.57^{-260.6°}$
Indium	In	silv. met.	$7.3^{20°}$	155	>1450	$6.52^{0-100°}$
Iodine	I	blk. solid	(l) $4.00^{107°}$	.....	184.35	(l) $1.91^{114-185°}$
			(s) $4.93^{20°}$	113.5	.....	(s) $6.64^{20°}$
Iridium	Ir	silv. met.	$22.4^{20°}$	2350	(>4800)	$6.24^{0-100°}$
Iron	Fe	silv. met.	(l) $6.91^{1530°}$	.....	3000	.....
			(s) $7.86^{20°}$	1535	.....	$5.95^{20°}$
Krypton	Kr	colorl. gas	(g) 3.708	.....	.....	.....
			(l) $2.6^{-146°}$	.....	−151.8	.....
			(s) (2)	−169	.....	.....
Lanthanum	La	silv. met.	(s) $6.15^{20°}$	826	1800	$6.20^{0-100°}$
Lead	Pb	silv. met.	(l) $10.3^{327°}$	.....	1620	.....
			(s) $11.34^{20°}$	327.5	.....	$4.61^{20°}$
Lithium	Li	silv. met.	$0.53^{20°}$	186	>1200	$5.5^{0°}$
Lutecium	Lu	.....	.....	.....	.....	.....
Magnesium	Mg	silv. met.	(l) $1.57^{650°}$	.....	1110	.....
			(s) $1.74^{20°}$	651	.....	$6.0^{20°}$
Manganese	Mn	silv. met.	$7.2^{20°}$	1260	1900	$5.88^{0°}$
Masurium	Ma	.....	.....	(2300)	.....	.....
Mercury	Hg	silv. liq.	(l) $13.546^{20°}$	.....	356.90	(l) $6.67^{20°}$
			(s) $14.19^{-38.9°}$	−38.87	.....	(s) $6.69^{-40°}$
Molybdenum	Mo	silv. met.	10.2	2625	3700	$6.2^{20-100°}$
Neodymium	Nd	silv. met.	$6.9^{20°}$	840	.....	$6.5^{0-100°}$
Neon	Ne	colorl. gas	(g) 0.9002	.....	.....	.....
			(l) $1.204^{-245.9°}$	.....	−245.9	.....
			(s) (1.0)	−248.67	.....	.....
Nickel	Ni	silv. met.	$8.90^{20°}$	1452	2900	(l) $7.9^{1452°}$
			.....	.....	.....	(s) $6.16^{20°}$
Nitrogen	N	colorl. gas	(g) 1.2506	.....	.....	(g) 3.479
			(l) $0.808^{-195.8°}$	.....	−195.8	(l) $6.64^{-200°}$
			(s) $1.026^{-252.5°}$	−209.86	.....	(s) $5.5^{-212°}$
Osmium	Os	bl.-wh. met.	$22.48^{20°}$	2700	(>5300)	$6.0^{20-100°}$
Oxygen	O	colorl. gas	(g) 1.4290	.....	.....	(g) 3.489
			(l) $1.14^{-183°}$	.....	−183.0	(l) $6.31^{-200°}$
			(s) $1.426^{-252.5°}$	−218.4	.....	(s) $5.37^{-221.8}$
Ozone	O_3	colorl. gas	(g) $3.03^{-80°}$	.....	.....	.....
			(l) $1.71^{-183°}$	−251	−112	.....
Palladium	Pd	silv. met.	(l) $11^{1550°}$	.....	2200	.....
			(s) $12^{20°}$	1555	.....	$6.26^{18°}$
Phosphorus	P	yel. solid	(s) $1.82^{20°}$	44.1	.....	5.5
		red solid	(s) $2.20^{20°}$	$590^{43 atm.}$	.....	5.7^{-21} to $^{+7°}$
			(l) $1.745^{44.5°}$	.....	280	.....
Platinum	Pt	silv. met.	(s) $21.45^{20°}$	1755	.....	$6.33^{20°}$
			(l) $19^{1755°}$	.....	4300	.....
Polonium	Po	.....	.....	(1800)	.....	.....
Potassium	K	silv. met.	(l) $0.83^{62°}$	.....	760	(l) $7.2^{63°}$
			(s) $0.86^{20°}$	62.3	.....	(s) $6.9^{14°}$
Praseodymium	Pr	met.	$6.5^{20°}$	940	.....	$6.5^{0-100°}$
Radium	Ra	silv. met.	(5)	960	1140	.....
Radon	Rn	colorl. gas	(g) 9.73	.....	.....	.....
			(l) $4.4^{-62°}$	.....	−61.8	.....
			(s) (4)	−71	.....	.....

Symbol	Latent heat of (in kg-cal/g atom) Vaporization at B.P.	Latent heat of (in kg-cal/g atom) Fusion	Resistivity ohm-cm $R \times 10^{-6}$ R	Surface Tension dyne/cm	Thermal Expansion $E \times 10^{-6}$ E	Solid Cryst form
H	.....	.....	.....	.....	.....	....
	0.108	.....	.....	$1.91^{-252 \cdot 7^{\circ}}$	$1300^{-255^{\circ}}$	....
	.....	0.014	.....	.....	.....	o
In	.....	.....	(l) 29 × 10^{-6}, 155°	.....	.....	....
			(s) 9^{200}	.....	33^{200}	t
I	5.26	.....	(l) 78 × 10^{6}, 110.5°	.....	(l) $800^{107-150^{\circ}}$	....
	.....	2.00	(s) 1.3 × 10^{15}, 20°	.....	(s) $93^{20-100^{\circ}}$	r
Ir	.....	5.04	6^{200}	.....	6.5^{200}	o
Fe	90.8	.....	.....	.....	.....	....
	.....	2.68	10.0^{200}	.....	11.7^{200}	o
Kr	.....	.....	.....	.....	.....	....
	2.2	.....	.....	.....	.....	....
	.....	0.36	.....	.....	.....	....
La	.....	.....	59^{180}	.....	.....	....
Pb	46.12	.....	(l) 98 × 10^{-6}, 400°	$442^{350^{\circ}}$	(l) $120^{327-825^{\circ}}$	....
	.....	1.24	(s) 21.9^{200}	.....	(s) 29.1^{200}	c
Li	40.6	1.10	(s) 9.3^{200}	.....	(s) 56^{200}	....
			(l) 45 × 10^{-6}, 230°	.....	(l) $180^{186-230^{\circ}}$	c
Lu	.....	.....	.....	.....	.....	....
Mg	62.6	.....	.....	.....	(l) $380^{650-800^{\circ}}$	....
	.....	2.16	4.46^{200}	.....	(s) 25.6^{200}	h
Mn	57.3	3.45	5	.....	23^{200}	....
Ma	.....	.....	.....	.....	.....	....
Hg	14.2	.....	(l) 95.8 × 10^{-6}, 20°	.....	(l) 182^{200}	....
	.....	0.557	(s) $21.3^{-50^{\circ}}$	476^{200}	(s) $90^{-190 \text{ to } -40^{\circ}}$	h(?)
Mo	170	5.66	4.77^{200}	.....	4^{200}	c
Nd	.....	.....	79^{200}	.....	.....	....
Ne	.....	.....	.....	.....	.....	....
	0.416	.....	.....	.....	.....	....
	.....	0.057	.....	.....	.....	....
Ni	90.8	4.20	.....	.....	.....	....
	.....	.....	6.9^{200}	.....	12.8^{200}	c
N	.....	.....	.....	.....	.....	....
	0.669	.....	.....	$8.85^{-195 \cdot 8^{\circ}}$	$600^{-195^{\circ}}$	....
	.....	0.0851	.....	.....	.....	c
Os	.....	.....	9^{200}	.....	6.1^{200}	h
O	.....	.....	.....	.....	.....	....
	0.8179	.....	.....	$13.2^{-183^{\circ}}$	$4100^{-195^{\circ}}$	....
	.....	0.053	.....	.....	.....	h
O_3	.....	.....	.....	.....	$2000^{-183^{\circ}}$	....
	.....	.....	.....	.....	.....	....
Pd	.....	.....	.....	.....	.....	....
	.....	4.12	10.8^{200}	.....	11.8^{200}	c
P	.....	0.156	10^{17}, 11°	.....	(s) $125^{0-40^{\circ}}$	h
	.....	.....	.....	.....	.....	c
	.....	.....	(l) 2.3 × 10^{6}, 25°	.....	(l) $520^{50-60^{\circ}}$	....
Pt	.....	4.70	10.5^{200}	.....	8.9^{200}	c
	124	.....	.....	.....	.....	....
Po	.....	.....	.....	.....	.....	....
K	20	.....	(l) 13 × 10^{-6}, 62°	.....	(l) $290^{62-150^{\circ}}$	....
	.....	0.574	(s) 7.0^{200}	.....	(s) 83^{200}	c
Pr	.....	.....	88^{180}	.....	.....	....
Ra	.....	.....	.....	.....	.....	....
Rn	.....	.....	.....	.....	.....	....
	4.32	.....	.....	.....	.....	....
	.....	0.777	.....	.....	.....	....

Name	Symbol	Form and Color at Room Temp.	Density	Melting Point °C	Boiling Point °C	Specific Heat g-cal/g atom
Rhenium	Re	hard, silv. met.	21.40	3440 ± 60	.....	6.44
Rhodium	Rh	silv. met.	$12.5^{20°}$	1955	(>2500)	$6.0^{0-100°}$
Rubidium	Rb	silv. met.	(l) $1.475^{38.5°}$	.....	700	(l) $7.6^{500°}$
			(s) $1.53^{20°}$	38.5	.....	(s) $6.86^{0°}$
Ruthenium	Ru	gray met.	$12.2^{20°}$	2450	(>2700)	$6.20^{-100°}$
Samarium	Sa	met.	7.7	>1300	.....	.....
Scandium	Sc	.....	(2.5)	1200	(2400)	.....
Selenium	Se	gray solid	$4.80^{25°}$	220	688	$6.70^{-41°}$
		red solid	$4.50^{25°}$	.....	.....	.....
Silicon	Si	black solid	$2.4^{20°}$	1420	2600	$4.95^{20°}$
Silver	Ag	silv. met.	(l) $9.49^{60°}$	.....	1950	(l) $33.8^{907-1100°}$
			(s) $10.5^{20°}$	960.5	.....	(s) $6.16^{20°}$
Sodium	Na	silv. met.	(l) $0.93^{97.5°}$	.....	880	(l) $7.65^{100°}$
			(s) $0.97^{20°}$	97.5	.....	(s) $6.79^{20°}$
Strontium	Sr	yel. met.	2.6	800	1150	.....
Sulfur	S	yel. solid	(l) $1.808^{115°}$	.....	444.6	(l) $7.26^{100°}$
			(s) $2.07^{20°}$	112.8	.....	(s) $5.5^{0-30°}$
			(s) $1.96^{20°}$	119.0	.....	(s) $5.7^{0-30°}$
Tantalum	Ta	silv. met.	16.6	2850	(>4100)	$6.5^{20°}$
Tellurium	Te	gray-wh.powd.	(s) (α) $6.24^{20°}$	452	1390	$6.0^{20°}$
			(s) (β) $6.00^{20°}$	.....	.....	.....
Terbium	Tb	.....	.....	.....	.....	.....
Thallium	Tl	silv. met.	(l) $11.0^{300°}$	.....	1650	.....
			(s) $11.85^{20°}$	303.5	.....	$6.36^{20°}$
Thorium	Th	met.	11.2	1845	(>3000)	$6.40^{0-100°}$
Thulium	Tm	.....	.....	.....	.....	.....
Tin	Sn	silv. met.	(l) $6.98^{232°}$	.....	2260	(l) $7.4^{232°}$
		wh.	(s) $7.31^{20°}$	231.85	.....	(s) $6.43^{18°}$
		gray	(s) $5.750^{20°}$	.....	.....	(s) $6.12^{20°}$
Titanium	Ti	silv. met.	$4.5^{20°}$	1800	(>3000)	$6.9^{0-100°}$
Tungsten	W	met.	19.3	3370	5900	$6.2^{20-100°}$
Uranium	U	wh. met.	18.7	<1850	.....	$6.7^{0-100°}$
Vanadium	V	gray met.	5.96	1710	(3000)	$5.8^{20-100°}$
Virginium	Vi	.....	.....	(23)	Element	No. 87.
Xenon	Xe	colorl. gas	(g) 5.851	.....	.....	.....
			(l) $3.06^{-109.1°}$	.....	−109.1	.....
			(s) (2.7)	−140	.....	.....
Ytterbium	Yb	.....	.....	.....	.....	.....
Yttrium	Y	gray met.	5.51	1490	(2500)	.....
Zinc	Zn	bl.-wh. met.	(l) $6.7^{463°}$	.....	907	.....
			(s) $7.140^{20°}$	419.43	.....	$6.05^{20°}$
Zirconium	Zr	gray met.	(s) $6.4^{20°}$	1700	(>2900)	$6.02^{0-100°}$

Symbol	Latent Heat of (in kg-cal/g atom) Vaporization at B. P.	Fusion	Resistivity ohm-cm $R \times 10^{-6}$ R	Surface Tension dyne/cm	Thermal Expansion $E \times 10^{-6}$ E	Solid Cryst form
Re	200	.....	$19.8^{0°}$	.....	12.45*	h
Rh	... .	.....	$5.1^{20°}$	.....	$8.4^{20°}$	c
Rb	18	.....	(l) 23.5×10^{-6}, 50°	.....	(l) $340^{40-100°}$	....
	.....	0.516	(s) $12.5^{20°}$	.....	(s) $90^{20°}$	....
Ru	.....	.....	$10^{20°}$	.....	$9.1^{20°}$	h
Sa	.....	.....	.....	.....	.....	....
Sc	.....	.....	.....	.....	.....	....
Se	7.4	0.53	$12^{20°}$	$72^{217°}$	$37^{40°}$	tr
	.....	.....	.....	.....	.....	(h?)
Si	40.6	9.47	85×10^3, 20°	.....	$2.8\text{-}7.3^{20°}$	c
Ag	59.5	.....	(l) 17×10^{-6}, 1000°	.....	(l) $110^{960-1200°}$	....
	.....	2.70	(s) $1.62^{20°}$	.....	(s) $18.9^{20°}$	c
Na	25.1	.....	(l) 9.7×10^{-6}, 100°	.....	(l) $280^{100-200°}$	....
	.....	0.633	(s) $4.6^{20°}$	.....	(s) $71^{20°}$	c
Sr	91.5	2.19	.....	.....	$23^{20°}$	....
S	2.15	.....	.....	.....	(l) $430^{115°}$	....
	.....	0.300	2×10^{23}, 20°	.....	(s) $64^{40°}$	r
	.....	0.333	.....	.....	.....	m
Ta	.....	.....	$15^{20°}$	.....	$7^{20°}$	c
Te	20	0.9(3.2?)	[5.8-33] $\times 10^3$	.....	$16.8^{40°}$	h(?)
	.....	.....	.....	.....	.....	....
Tb	.....	.....	.....	.....	.....	....
Tl	28.7(?); 61.2(?).	.....	(l) 74×10^{-6}, 300°	.....	(l) $140^{300-350°}$	....
	.....	1.03	(s) $18.1^{20°}$	.....	(s) $28^{20°}$	t
Th	.....	.....	$18^{20°}$	.....	.....	c
Tm	.....	.....	.....	.....	.....	....
Sn	77.7	.....	(l) 49×10^{-6}, 300°	.....	$100^{232-1600°}$	....
	.....	1.78	(s) $11.4^{20°}$	.....	$20^{20°}$	t
	.....	.....	.....	.....	5^{-163} to $^{-18°}$	c(?)
Ti	.....	.....	$3^{20°}$	.....	.....	c
W	217	8.40	$5.48^{20°}$	.....	$4^{20°}$	c
U	.....	.....	$60^{20°}$	.....	.....	....
V	.....	.....	.....	.....	.....	c
Vi	.....	.....	.....	.....	.....	....
Xe	.....	.....	.....	.....	.....	....
	(3.20)	.....	.....	.....	.....	....
	.....	(0.490)	.....	.....	.....	....
Yb	.....	.....	.....	.....	.....	....
Y	.....	.....	.....	.....	.....	....
Zn	23.7	.....	(l) 43×10^{-6}, 440°	.....	(l) $150^{419-543°}$	....
	.....	1.6	(s) $6^{20°}$	.....	(s) $33^{20°}$	h
Zr	.....	.....	.....	.....	$170^{0°}$	c

*β for 001 cryst. plane; β for 100 cryst. plane = 4.67

INTERNATIONAL TABLE OF THE NATURAL RADIOACTIVE ELEMENTS AND THEIR CONSTANTS

*J. Am. Chem. Soc. 53, 2437 (1931)**

Name	Symbol	Number P.	Number At.	Isotope	Half Period T	Average Life τ	λ/sec.	Radiation ( ) = weak rad.	Penetration of α rays in cm.
URANIUM FAMILY									
Uranium I	UI	238	92	U	4.45×10^{9} yrs.	6.43×10^{9} yrs.	5.0×10^{-18}	α	2.37
Uranium X_1	UX_1	234	90	Th	24.5 days	35.4 days	3.28×10^{-7}	β	.....
Uranium X_2 (Brevium)	UX_2	234	91	Pa	1.14 min.	1.64 min.	1.01×10^{-2}	β (α)	.....
Uranium Z	UZ	234	91	Pa	6.7 hrs.	9.7 hrs.	2.87×10^{-5}	β	.....
Uranium II	UII	234	92	U	3×10^{5} yrs.	4.3×10^{5} yrs.	7.4×10^{-14}	α	2.75
IONIUM-RADIUM FAMILY									
Ionium	Io	230	90	Th	8.3×10^{4} yrs.	1.2×10^{5} yrs.	2.6×10^{-13}	α	2.85
Radium	Ra	226	88	Ra	1590 yrs.	2295 yrs.	1.38×10^{-11}	$\alpha(\beta\times\gamma)$	3.13
Radon (Niton, Radium emanation)	Rn	222	86	Rn	3.825 days	5.518 days	2.097×10^{-6}	α	3.94
Radium A	RaA	218	84	Po	3.05 min.	4.40 min.	3.78×10^{-3}	α	4.50
Radium B	RaB	214	82	Pb	26.8 min.	38.7 min.	4.31×10^{-4}	$\beta(\gamma)$	.....
Radium C	RaC	214	83	Bi	19.7 min.	28.5 min.	5.86×10^{-4}	99.97% β and γ	.....
Radium C'	RaC'	214	84	Po	*ca.* 10^{-6} sec.	10^{-6} sec.	10^{6}	α	6.57
Radium C''	RaC''	210	81	Tl	1.32 min.	1.9 min.	8.7×10^{-3}	β	.....
Radium D (Radiolead)	RaD	210	82	Pb	19 yrs.	27.4 yrs.	1.15×10^{-9}	(β and γ)	.....
Radium E	RaE	210	83	Bi	4.9 days	7.07 days	1.63×10^{-6}	β	.....
Radium F (Polonium)	RaF	210	84	RaA	140 days	202 days	5.73×10^{-8}	$\alpha(\gamma)$	3.58
Radium G	RaG	206	82	Pb	.....	.....	.....	.....	.....
ACTINIUM FAMILY									
Actino-Uranium	AcU	235	92	U	4.0×10^{8} yrs.	5.77×10^{8} yrs.	5.5×10^{-17}	α	.....
Uranium Y	UY	231	90	Th	24.6 hrs.	35.5 hrs.	7.81×10^{-6}	β	.....
Protactinium (Eka-tantalum)	Pa	231	91	Pa	3.2×10^{4} yrs.	4.6×10^{4} yrs.	6.86×10^{-13}	α (β and γ)	3.314
Actinium	Ac	227	89	Ac	13.5 yrs.	19.4 yrs.	1.63×10^{-9}	β	.....
Radioactinium	RdAc	227	90	Th	18.9 days	27.3 days	4.24×10^{-7}	$\alpha(\beta)$	4.36
Actinium X	AcX	223	88	Ra	11.2 days	16.2 days	7.14×10^{-7}	α	4.17

* With revision as of 1935.

Name	Symbol	Number P.	Number At.	Isotope	Half Period T	Average Life τ	λ/sec.	Radiation ( ) = weak rad.	Penetration of α rays in cm.
ACTINIUM FAMILY (Continued)									
Actinon (Actinium emanation)	An	219	86	Rn	3.92 sec.	5.66 sec.	0.177	α	5.40
Actinium A	AcA	215	84	Po	2×10^{-3} sec.	2.88×10^{-3} sec.	347	α	6.16
Actinium B	AcB	211	82	Pb	36.0 min.	52 min.	3.21×10^{-4}	(β and γ)	.....
Actinium C	AcC	211	83	Bi	2.16 min.	3.12 min.	5.35×10^{-3}	α and β	5.12
Actinium C′	AcC′	211	84	Po	*ca.* 5×10^{-3} sec.	*ca.* 7×10^{-3} sec.	*ca.* 140	α	?
Actinium C″	AcC″	207	81	Tl	4.76 min.	6.87 min.	2.43×10^{-3}	β and γ	.....
Actinium D (Actinium lead)	AcD	207	82	Pb	.....	.....	.....	.....	.....
THORIUM FAMILY									
Thorium	Th	232	90	Th	1.8×10^{10} yrs.	2.5×10^{10} yrs.	1.2×10^{-18}	α	2.58
Mesothorium 1	MsTh_1	228	88	Ra	6.7 yrs.	9.7 yrs.	3.26×10^{-9}	.....	.....
Mesothorium 2	MsTh_2	228	89	Ac	6.13 hrs.	8.84 hrs.	3.14×10^{-5}	β and γ	.....
Radiothorium	RdTh	228	90	Th	1.90 yrs.	2.74 yrs.	1.16×10^{-8}	α(β)	3.67
Thorium X	ThX	224	88	Ra	3.64 days	5.25 days	2.20×10^{-6}	α	4.08
Thoron (Thorium emanation)	Tn	220	86	Rn	54.5 sec.	78.7 sec.	1.27×10^{-2}	α	4.74
Thorium A	ThA	216	84	Po	0.14 sec.	0.20 sec.	4.95	α	5.40
Thorium B	ThB	212	82	Pb	10.6 hrs.	15.3 hrs.	1.82×10^{-5}	β and γ	.....
Thorium C	ThC	212	83	Bi	60.5 min.	87.3 min.	1.91×10^{-4}	65% β	.....
Thorium C′	ThC′	212	84	Po	1×10^{-9} sec.	1×10^{-9} sec. (?)	1×10^{9} (?)	α	8.16
Thorium C″	ThC″	208	81	Tl	3.1 min.	4.47 min.	3.73×10^{-3}	β and γ	.....
Thorium D (Thorium lead)	ThD	208	82	Pb	.....	.....	.....	.....	.....
Potassium	K	40	19	K	1×10^{9} yrs.	.....	.....	β	.....
Rubidium	Rb	86	37	Rb	1×10^{8} yrs.	.....	.....	β	.....
Samarium	Sa	(?)	62	Sa	.....	.....	.....	α	.....

PROPERTIES OF MINERALS

Compiled by ***Clarence E. Miller, M. Sc.***

For more detailed information concerning the minerals listed or not listed in these tables, the reader is referred to the following sources which have been freely used in compiling these tables:

DANA, E. S., **Dana's System of Mineralogy.** 6th Edition and Appendices to date.

HINTZE, C., **Handbuch der Mineralogie.** Band I to May 1933; Band II. Published by Walter D. Grüyter and Co., Berlin and Leipzig, Germany.

WINCHELL, A. N., **Elements of Optical Mineralogy.** Part II. 3d Edition, 1933. Published by John Wiley and Sons, New York.

FORD, W. E., **Dana's Textbook of Mineralogy.** 4th Edition, 1932. Published by

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Moh's Scale Of Hardness:

1, talc; 2, gypsum; 3, calcite; 4, fluorite; 5, apatite; 6, orthoclase; 7, quartz; 8, topaz; 9, corundum, 10, diamond.

"Working Scale Of Hardness:"

1, very easily scratched by finger nail, and have greasy feel to the hand; 2, easily scratched by finger nail; 3, scratched by brass pin or copper coin; 4, easily scratched by knife; 5, scratched with difficulty with knife; 6, easily scratched by file; 7, are but little touched by file, but will scratch window glass. All harder than 7 will scratch window glass.

Abbreviations

In compiling the data in Table of Minerals, the following aobreviations have been used:

***—under* Name:**

Ra., radioactive; ?, questioned or doubtful.

***—under* Crystal System:**

C, Isometric; Tet., tetragonal; H, hexagonal; R, orthorhombic; M, monoclinic; Tri., triclinic; Am., amorphous; Crypt., cryptocrystalline; iso., isotropic; ?, doubtful.

***—under* Index of Refraction:**

All values, unless noted, are those of the mean value or β; η, index of refraction for all isotropic minerals, and when used with biaxial or uniaxial minerals denotes that no definite directional value has been determined; ω is the index of refraction value for the ordinary ray and is used in giving the index of uniaxial minerals; α and γ, where used denote, respectively the values of minimum and maximum indices of refraction of biaxial minerals; ϵ is used to denote the value of index of the extraordinary ray in uniaxial minerals.

***—under* Color:**

W, white; R, red; Reds, various shades of red; Bl., blue; Blk., black; Br., brown; O, orange; Y, yellow; Grn., green; Greens, various shades of green; Gr., gray; V, violet; Pr., purple; Pk., pink; — or colorl., colorless; d, deep shade; all of the abbreviations above when in lower case type (as grn. for greenish) indicate the ending of the word with "ish".

TABLE A

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Acanthite	Ag_2S	R	2-2.5	7.2-7.3	.....	Bl, Gr
2	Adamite	$Zn_3(AsO_3)_2{\cdot}H_2O$	R	3.5	4.3	1.733	Y, R,Gr, colorl.
3	Aeschynite (Ra)	$Ce_2(Ca,Fe)_2(Ti,Th)_8O_{39}$	R	5-6	4.9-5.1	2.20—2.26η	Blk, Br, Y
4	Aguilarite	$Ag_2S{\cdot}Ag_2Se$	C	2.5	7.586	.....	iron Blk.
5	Aikenite	$2PbS{\cdot}Cu_2S{\cdot}Bi_2S_5$	R	2-2.5	6.1-6.8	.....	lead Gr
6	Alabandite	MnS	C	3.5-4	3.9-4.1	$2.70_{Li\eta}$	iron Blk
7	Allanite	$HCaFe''(Al, Ce, Fe''')_3Si_3O_{13}$	M	5.5-6	3.0-4.2	1.64-1.80	Blk, BrBlk
8	Allophane	$Al_2SiO_5{\cdot}nH_2O$	Am	3	1.85-1.89	1.47-1.49η	Y, Gr, Br, O, Grn, Pk
9	Altaite	PbTe	C	3-3.5	8.16	.....	blR

PROPERTIES OF MINERALS

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LARSEN, E. S., **The Microscopic Determination of the Nonopaque Minerals.** U. S. Geolog. Surv. Bul. 679, 1921; Washington.
SHORT, M. N., **Microscopic Determination of the Ore Minerals.** U. S. Geolog. Surv. Bul. 825, 1931; Washington.
The American Mineralogist. Vols. 1 to 18 (1933). Published by the Mineralogical Society of America.
Mineralogical Magazine and Abstracts. Magazine 1876 to 1933; Abstracts 1920 to 1933. Published by the British Mineralogical Society; London.

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Von Kobell's Scale Of Fusibility:
1, stibnite; 2, natrolite; 3, garnet, lime-alumina variety; 4, hornblende; 5, orthoclase; 6, bronzite; 7, infusible.

Penfield's Scale Of Fusibility:
1, stibnite, fuses readily in candle flame; 2, chalcopyrite, fuses in the luminous flame, but with difficulty in closed tube; 3, almandite, fuses readily in the blowpipe; 4, actinolite, edges are readily rounded in the blowpipe flame; 5, edges are fused with difficulty in the blowpipe flame; 6, bronzite, only the thinnest splinters are rounded by fusion in the blowpipe flame; 7, infusible.

—*under* Luster:
M, metallic; V, vitreous; A, adamantine; G, greasy, W, waxy; R, resinous; D, dull; E, earthy; Pl. pearly; Sk., silky; Sn., satiny; Sp., splendent; s, sub.

—*under* Fusibility:
Numbers 1, 2, 3.... 6 degrees of fusibility; see **Scale of Fusibility.** if, infusible; f, fusible; df., difficultly fusible; ef., easily fusible; vol., volatile.

—*under* Solubility:
i., insoluble; s., soluble; sl., slightly or partly; dec., decomposes or decomposed; aq. reg., aqua regia; gel., gelatinizes; turp., turpentine; alc., alcohol; a., acid.

—*under* Special Properties:
Photoluminescence includes phosphorescence or fluorescence caused by X-ray, or ultra violet light, or argon lamp, abbreviated (A), or exposure to radium (R).
Cer., cerium metals; Yttr., yttrium metals; E, rare earths; mole unit cell, moles per unit cell; B. B., before blow pipe.

—*under* Localities:
Only the important localities of fine specimens, or crystallized material is given in case of the more common minerals.
A., abundant; C., common; Unc., uncommon; R., raro; V. R., very rare.

TABLE A

Luster	Fusibility	Solubility	Special Properties	Locality	
M	1.5	s. HNO_3	sectile; changes (reversibly) to isometric form at 179°C, photoelectric	V.R Bohemia; Mexico; Colorado (?)	1
V	3	s. HCl	may contain Ga	R. Zinc deposits: Greece; Germany; Utah; Nevada; Japan; Chili; France	2
R-sM	if.	i.	19-24% Cer., 1-3% Yttr., 16-18% ThO_2	V.R. Imen Mts.; Urals; Norway	3
M sp.	....	.....	sectile; thermoelectric	V.R. Guanajuato, Mexico	4
M	f.	dec. HNO_3	.....	R. Urals; Georgia; No. Carolina; Germany; Austria.	5
sM	3	s. HCl	streak-green	R. Asia Minor; Europe; Mexico; Arizona; Colorado.	6
sM, R	2.5	gel. HCl	3.6-51% Cer., 0-8% Yttr., 0-3.5% ThO_2	Unc. E. Greenland; New York; New Jersey; Madagascar; Virginia; Texas	7
W-R	if.	gel. HCl	.....	R. Pennsylvania; Thuringia; England.	8
M	f.	s. HNO_3	effervesces with HNO_3	R. Altai Mts., Siberia; Chile; N. Carolina; N. Mexico; Colorado; California.	9

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Aluminite	$Al_2O_3 \cdot SO_3 \cdot 9H_2O$	R?	1-2	1.66	1.464	W
2	Alunite	$K_2Al_6(OH)_{12}(SO_4)_4$	H	3.5-4	2.58-2.75	1.572ω	W
3	Alugenite	$Al_2(SO_4)_3 \cdot 18H_2O$	M or Tri	1.5-2	1.65-1.8	1.474	W
4	Alvite	Silicate Zr, Ce, Y, Ca, Mg, Be, Cu, Zn, H_2O	Tet.	5-6	3.3-4.3	.....	y Br
5	Amalgam	Ag_2Hg_3 - $Ag_{36}Hg$	C	3-3.5	13.75-14.1	.....	silver W
6	Ambatoarinite	$5SrCO_3 \cdot 4E_2CO_3$, E_2O_3 E = Ce, La, Di	R	4.5	3.95	>1.66η	Pk, Blk
7	Amblygonite	$Li(Al,F)PO_4$	Tri	6	3-3.1	1.595	W-grn, bl, y
8	Amethyst	SiO_2 + Mn	H	7	2.65-2.66	.....	Pr, bV
9	Ammonioborite	$(NH_4)_2B_{10}O_{16} \cdot 5H_2O$	.....	....	.....	1.487	.....
10	Ammoniojarosite	$(NH_4)_2Fe_6(OH)_{12}(SO_4)_4$	H?	....	.....	1.750-1.800	pY
11	Ammonium nitrate	NH_4NO_3	R	1	1.73	.....	—, W
12	Ampangabeite (Ra)	Columbate and titanate of Fe, U, rare earths	R	4	3.97-4.29	2.13η	Br R
13	Amphibole Group:	.....	.....	....	.....	.. ..	.....
14	(a) Actinolite	$Ca(Mg, Fe)_3(SiO_3)_4$	M	5-6	3-3.2	1.627	Grn-grGrn
15	(b) Anthophyllite	$(Mg, Fe)SiO_3$	R	5.5-6	2.85-3.2	1.642	br Grn, br Gr
16	(c) Arfvedsonite	$Na_3Fe_4Al(OH)_2Si_8O_{22}$	M	6	3.44-3.45	1.707	pure Blk
17	(d) Hornblende	Complex silicate of Ca, Al, Mg, Fe'', Fe'''	M	5-6	2.9-3.4	1.642-1.673	Bl-W
18	(e) Glaucophane	$Na(Al,Fe)(SiO_3)_2$ with $(Mg,Fe)SiO_3$	M	6-6.5	3-3.15	1.638	azure Bl, BlkBl-gr
19	(f) Riebeckite	$NaFe'''(SiO_3)_2$ with $FeSiO_3$	M	4	3.4	1.695	dBl-Blk
20	(g) Tremolite	$CaMg_3(SiO_3)_4$	M	5-6	2.9-3.2	1.623	W-dGr
21	Analcime	$Al_2O_3 \cdot 4SiO_2 \cdot Na_2O \cdot 2H_2O$	C	5-5.5	2.2-2.3	1.4874η	W
22	Ancylite	$4Ce(OH)CO_3 \cdot 3SrCO_3 \cdot 3H_2O$	R	4.5	3.95	1.865$\pm\omega$	y, O, Br, Gr
23	Andalusite	$Al_2O_3 \cdot SiO_2$	R	7.5	3.1-3.2	1.639	rBr, V, Gr, R, Grn
24	Angiesite	$PbSO_4$	R	2.8-3	6.3-6.4	1.882	W
25	Anhydrite	$CaSO_4$	R	3-3.5	2.8-3	1.576	W
26	Ankerite	$2CaCO_3 \cdot MgCO_3 \cdot FeCO_3$	H	3.5-4	2.9-3.2	1.727ω	W, Gr, r
27	Antimony	Sb	H	3-3.5	6.6-6.7	.....	tin W
28	Apatite	$(CaF)Ca_4(PO_4)_3 \pm Cl$	H	4.5-5	3.17-3.23	1.632-1.648 ω	sea Grn, blGrn, VGrn, VBl, W
29	Apophyllite	$K_2O \cdot 8CaO \cdot 16SiO_2 \cdot 16H_2O$	Tet.	4.5-5	2.3-2.4	1.703	W, gr
30	Aragonite	$CaCO_3$	R	3.5-4	2.93	1.680	W, Gr, V, Y, Grn
31	Argentite	Ag_2S	C	2-2.5	7.2-7.4	.....	blk, lead Gr
32	Argyrodite	Ag_8GeS_6	C	2-3	6.1-6.3	.....	Blk, Gr
33	Arizonite	$Fe_2O_3 \cdot 3TiO_2$	M?	5.5	4.25	2.62_{Li}	d steel Gr

Luster	Fusibility	Solubility	Special Properties	Locality	
E	if.	s. acid	.....	R. In clay: Saxony; France; England; Missouri	1
D-V	if.	s. H_2SO_4	decrepitates; photoluminescent	Unc. Europe; Utah	2
V-S	if.	s. H_2O	.....	Unc. Bohemia; Italy; Chile; Colorado; Arizona; New Mexico.	3
G	if.	i.	4% Cer., 22% Yttr., 4.6% Hf	V.R. Ytterby, Sweden; Arendal, Norway; No. America	4
M	vol.	s. HNO_3	.....	R. Bavaria; So. America; British Columbia	5
.....	....	s. HCl	.....	V.R. Ambatoarina, Madagascar	6
V-G	2	s. H_2SO_4, HCl	thermoluminescent	C. Pegmatites: Europe; Australia; Maine; California	7
V	as quartz		.....	C. Urals; India; Ceylon; Madagascar; United States; Canada	8
.....	....	.....	.....	R. Tuscan lagoons, Italy	9
V	....	s. HCl	.....	R. Southern Utah	10
V	....	s. H_2O	deflagrates	R. Tennessee	11
G	f.	s. HCl	.....	V.R. Madagascar; Brazil	12
.....	....	.....	.....	A. World wide in igneous and metamorphic rocks	13
V	4	i. HCl	.....	C. Widespread	14
V	df.	i.	.....	R. Norway; Greenland; Pennsylvania; No. Carolina	15
V	2	i.	intumesces	R. Greenland; Norway; Red Hill, New Hampshire; Colorado	16
V	3-4	i. a.	.....	A. Widespread	17
V	3-3.5	i.a.	.....	R. Switzerland; Italy; Japan; California	18
V	3(?)	i.a.	.....	R. Socotra Island; Nigeria; Massachusetts; Colorado	19
V	4	i.a.	thermoluminescent, yellow	C. Tremola, Switzerland; widespread	20
V	2.5	gel. HCl	no intumescence	Unc. With zeolites: Europe; New Jersey; Colorado	21
.....	if.	s. a.	46.3% Ce	V.R. Narsarsuk, Greenland	22
V	if.	i.	sections normal to optic axis are idiophanous; var. Chiastolite shows black and white crosses	C. Ural Mts.; Spain; Germany; Maine; Massachusetts; Pennsylvania; California	23
A-V	1.5	sl. s. HNO_3	decrepitates; very brittle; (A) photoluminescent	C. Common in lead deposits	24
V-Pl	3	s. HCl	diamagnetic; radium changes color	A. Common with gypsum deposits	25
V	if.	s. a.	.....	Unc. Austria; Italy; Novia Scotia; New York	26
M	1	s. h. HCl $SbCl_3$ppt.	.....	R. Germany; France; Quebec; California	27
V-sR	4.5-5	s.HCl, HNO_3	(Ba); (A)(C) photoluminescent; thermoelectric; pyro- and piezo- electric	C. Widely distributed; Renfew County, Quebec	28
V-Pl	1.5	dec. HCl	pyroelectric.	C. With zeolites	29
V	if.	s. HCl	(A) photoluminescent	A. Czechoslovakia; Germany; Italy; Sicily; Colorado; Missouri	30
M	f.	s. HNO_3	sectile, X-ray has cubic structure only above 180°C, is orthorhombic below; photoelectric	Unc. Saxony; Harz Mts.; So. America; Montana; Colorado; Nevada	31
M	ef.	dec. HNO_3	6.5% Ge	V.R. Freiberg, Saxony; Bolivia	32
M-sM	....	dec. h. H_2SO_4	streak-brown	V.R. Mohave County, Arizona	33

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Arrhenite	Silico-tantalate of Y, Ce, Zr, Al, Fe, Ca, Be, etc.	Am.	....	3.68	.....	R
2	Arsenic	As	H	3.5	5.7	.....	tin W
3	Arsenoferrite	$FeAs_2$	C	5.5	6.42	.....	dBr
4	Arsenolite	As_2O_3	C	1.5	3.7-3.86	1.755η	W, colorl.
5	Arsenopyrite	$FeS_2 \cdot FeAs_2$	R	5.5-6	5.9-6.2	.....	silver W
6	Astrophyllite	$(K,Na)_4(Fe,Mn)_4(Si,Ti,Zr)_5O_{16}$	R	3-4	3.3-3.4	1.703	bronze Y, gold Y
7	Atacamite	$CuCl_2 \cdot 3Cu(OH)_2$	R	3-3.5	3.76-3.78	1.861	bright Grn, blk Grn
8	Auerbachite	Impure hydrated $ZrSiO_4$	Tet.	6	4.06	.....	brGr
9	Auerlite (Ra)	Silico-phosphate of Th; $3ThO_2(3SiO_2 \cdot P_2O_5)6H_2O$	Tet.	2.5-3	4.1-4.8	1.67ω	Y, OR
10	Autunite (Ra)	$CaO \cdot 2UO_3 \cdot P_2O_5 \cdot 8H_2O$	R	2-2.5	3.1-3.2	1.575	lemon-sulfur Y
11	Avogadrite	$(K,Cs)BF_4$	R	....	2.62	1.3245	.....
12	Axinite	$H(Fe,Mn)Ca_2Al_2BSi_4O_{16}$	Tri.	6.5-7	3.3	1.685	Br, Bl, Y
13	Azurite	$2CuCO_3 \cdot Cu(OH)_2$	M	3.5-4.3	3.4-3.8	1.758	azure Bl
14	Baddeleyite	ZrO_2 plus small amount of hafnium oxide	M	6.5	4.4-6.0	2.19	—, Y, Blk, Br
15	Bagrationite	var. allanite	M	5.5-6	3-4.2	.....	Blk
16	Barite	$BaSO_4$	R	2.5-3.5	4.3-4.6	1.637	W
17	Barylite	$Be_2BaSi_2O_7$	R	6-7	4.0	1.70	—, W
18	Bassetite (Ra)	Nearly that of autunite	M	....	3.10	1.574	Y
19	Basnäsite	(Ce, La, Di) FCO_3	H	4-4.5	4.9-5.2	1.717ω	Y-r Br
20	Bauxite	$Al_2O_3 \cdot 2H_2O$	Am.	soft	2.55	.....	W, Br, R
21	Bazzite	Silicate, Sc, rare earths, Fe, Na	H	6.5	2.8	1.626ω	azure Bl
22	Beckelite	$Ca_3(Ce,La,Di)_4Si_3O_{15}$	C	5	4.15	1.812η	Y
23	Becquerelite (Ra)	$UO_3 \cdot 2H_2O$	R	....	.....	1.87	br Y
24	Befanamite	Similar to thortveite; no Y; hign Zr, Al	.....	6-7	3.49	.....	.....
25	Benitoite	$BaTiSi_3O_9$	H	6.2-6.5	3.6	1.757ω	Bl-p Bl,—
26	Bertrandite	$4BeO \cdot 2SiO_2 \cdot H_2O$	R	6-7	2.59-2.6	1.605	—, p Y
27	Beryl	$3BeO \cdot Al_2O_3 \cdot 6SiO_2$	H	7.5-8	2.6-2.8	1.582ω	Grn, Bl, Y, W
28	Berylonite	$NaBePO_4$	R	5.5-6	2.8	1.55ω	—, W, p Y
29	Berzelianite	Cu_2Se	C	soft	6.71	.....	silver W
30	Betafite (Ra)	Hydrous columbate, titanate of U, Ca, etc.	C	5	4	1.92	grn Blk
31	Biotite	See under Mica	.....	....	.....	.....	.....
32	Bismuth	Bi	H	2-2.5	9.7-9.8	.....	r silver
33	Bismutatantalite	$Bi_2O_3(Ta,Cb)_2O_5$	R	5	8.15	2.2η	Blk
34	Bismuthinite	Bi_2S_3	R	2	6.4-6.5	.....	lead Gr, tin W
35	Blödite	$Na_2SO_4 \cdot MgSO_4 \cdot 4H_2O$	M	3	2.23	1.488	—, grn, y R
36	Blomstrandine (Ra)	Columbate, titanate of Y, Er, Ce, U (Nb_2O_5: TiO_2 = 1:6)	R	5.5	4.8-4.9	2.142η	br Blk.

Luster	Fusibility	Solubility	Special Properties	Locality	
.....	....	.....	33.2% Yttr.; 2.6% Cer.	V.R. Ytterby, Sweden	1
M	vol.	s. HCl	B. B. garlic odor	R. Saxony; Roumania; Japan; Arizona; Canada	2
.....	....	.....	.....	R. Switzerland; Czechoslovakia	3
V	1, vol.	sl. s. H_2O	.....	R. California; Bohemia; Germany; France	4
M	2	dec. HNO_3	thermoelectric	C. Germany; Switzerland; Norway; New Hampshire; Colorado; Ontario	5
sM-Pl	2.5-3	dec. HCl	.....	V.R. Norway; Greenland; French Guinea; Colorado	6
A-V	3-4	v. s. a.	.....	Unc. So. America; rare in U.S.A.: Arizona; Wyoming; Utah	7
E	if.	powder s. H_2SO_4	.....	V.R. Alexandrovsk, Russia	8
.....	if.	.....	69-73% ThO_2	V.R. Henderson County, No. Carolina	9
sA-Pl	2.5	s. HNO_3	(A) photoluminescent	V.R. Saxony; France; Portugal; England; Connecticut; No. Carolina; So. Dakota	10
.....	....	.....	.....	V.R. As sublimate at Vesuvius	11
V	2	not dec.	ignited, gel. HCl; pyroelectric	Unc. Germany; Switzerland; France; Japan; New Jersey; Pennsylvania; California	12
V-A	3	s.a.	thermoluminescent	C. Siberia; Australia; Bisbee and Morenci, Arizona; New Mexico	13
Sk-G	6	dec. H_2SO_4	1.2% Hf; B. B. glows	V.R. Ceylon; Brazil; Montana	14
R-sM	....	.....	.....	V.R. Ural Mts.	15
V, R Pl	3	i.	decrepitates; (A) photoluminescent; diamagnetic	C. England; Roumania; Germany; Michigan; Missouri; Colorado; Utah	16
G	if.	i.	.....	V.R. Sweden; New Jersey	17
.....	....	.....	.....	V.R. Cornwall, England	18
V	if.	sl. s. H_2SO_4	64-93% Cer.; 0-10% ThO_2	R. Sweden; Urals; Madagascar; Colorado	19
E	if.	.....	nonplastic	C. France; Alabama; Georgia; Arkansas	20
.....	if.	i.	.....	V.R. Baveno, Italy	21
.....	if.	s. a.	59.7% Cer.; 2.8% Yttr.	V.R. Ukraine, Russia	22
R	....	.....	.....	V.R. Belgian Congo	23
.....	....	.....	1.0% Hf	V.R. Befanamo, Madagascar	24
A, V.	3	s. HF	.....	V.R. San Benito County, California	25
V-Pl	if.	i. a.	pyroelectric	R. Siberia; France; Bohemia; Norway; Maine; Virginia; Colorado	26
V-R	5.5	i.	weakly pyroelectric; paramagnetic	C. Urals; S. W. Africa; Brazil; Colombia; Maine; No. Carolina; Colorado	27
V	3-5	s.a.	decrepitates	R. Maine; Norway	28
M	f.	s. HNO_3	.....	V.R. Sweden; Harz Mts.	29
G	....	.....	.....	V.R. Madagascar	30
.....	....	.....	.....	....	31
M	v. vol.	s. HNO_3	.....	V.R. Saxony; Norway; Sweden; Australia	32
sM	....	i. a.	streak-black; 40% Ta_2O_3, 6.6% Cb_2O_3. No U.	V.R. Pegmatite: Uganda	33
M	1	s. h. HNO_3	sectile, streak-Gr thermo-and photoelectric	R. Saxony; Norway; Bolivia; Connecticut; Montana	34
V	1.5	s. H_2O	.....	R. Salsburg; Stassfurt; Russia; Chile; California; New Mexico	35
.....	df.	.....	.....	V.R. Pegmatite: Norway	36

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Bodenbenderite	Titano-silicate of Y, Al, Mn, etc.	C	6-6.5	3.5	>1.77η	flesh R
2	Bodenite	var. allanite (rich in Al, Ca; no Be)	M	....	.....	.....	.....
3	Boracite	$6MgO \cdot MgCl_2 \cdot 8B_2O_3$	C	7	2.9	1.667η	W,gr,y, grn
4	Borax	$Na_2O \cdot 2B_2O_3 \cdot 10H_2O$	M	2-2.5	1.7	1.470	W,gr,bl, grn
5	Bornite	Cu_5FeS_4	C	3	4.9-5.4	.....	copper R, br
6	Boulangerite	$5PbS \cdot 2Sb_2S_3$	R	2.5-3	5.3-6.2	.....	bl lead Gr
7	Bournonite	$3(Pb,Cu_2)S \cdot Sb_2S_3$	R	2.5-3	5.7-5.9	.....	steel Gr, iron Blk
8	Brannerite (Ra)	$(UO,TiO,UO_2)TiO_3$	R	4.5	4.5-5.4	2.3η	Blk
9	Braunite	$3MnMnO_3 \cdot MnSiO_3$	Tet.	6-6.5	4.7-4.8	>2.72$_{Li\omega}$	d brBlk, steel Gr
10	Brazilite	var. baddeleyite	.....	....	.....	.....	.....
11	Brewsterite	$(Ba,Sr)O \cdot Al_2O_3 \cdot 6SiO_2 + 5H_2O$	M	5	2.1-2.5	1.512	W,Y,Gr
12	Britholite	Basic phospho-silicate of Ce metals, Fe, Ca, Mg, Na, F	R	5.5	4.4	1.775	Br
13	Brochantite	$CuSO_4 \cdot 3Cu(OH)_2$	R	3.5-4	3.8-3.9	1.773	emerald Grn
14	Bröggerite (Ra)	$(U,Th,Pb_2)O_6 \cdot 2UO_3$	C	5.5	8.7-9.1	.. ..	Blk
15	Bromellite	BeO	H	9	3.017	1.719ω	W
16	Bromyrite	AgBr	C	2-3	5.8-6.47	2.25η	Y
17	Brookite	TiO_2	R	5.5-6	3.8-4.1	2.586	Br,y,r, iron Blk
18	Brucite	$MgO \cdot H_2O$	H	2.5	2.3-2.4	1.5617ω	W
19	Buszite	Cb, Pr, Er, Eu silicate	H	5.5	5	1.72η	yR
20	Buttgenbachite	Hydrous chloro-Cu $(NO_3)_2$	H	....	3.33	1.747η	azure Bl
21	Calamine	$2ZnO \cdot SiO_2 \cdot H_2O$	R	4.5-5	3.4-3.5	1.617	W
22	Calaverite	$AuTe_2$	M	2.5	9.0	.....	steel Gr, y
23	Calcio-samarskite (Ra)	samarskite, Ca rich	.....	6.5	4.48-4.73	.....	grBr, Blk
24	Calcio-thorite (Ra)	var. thorite + Ca $5ThSiO_4 \cdot 2Ca_2SiO_4 \cdot 10H_2O$	Am.	4.5	4.114	.....	dR
25	Calcite	$CaCO_3$	H	3	2.6-2.71	1.65849ω	, W,R,Bl, V, Grn, Y, Gr
26	Calcium-larsenite	$(Pb,Ca)ZnSiO_4$	R?	3	4.421	1.769	W
27	Caldasite	Mixture of baddeleyite with silicates	.....	....	.....	.....	.....
28	Caledonite	$2(Pb,Cu)O \cdot SO_3 \cdot H_2O$	R	2.5-3	6.4	1.866	verdigris Grn blGrn
29	Calomel	HgCl	Tet.	1-2	6.5	1.9733ω	W,yGr, yW, Br
30	Cancrinite	$4Na_2O \cdot CaO \cdot 4Al_2O_3 \cdot 9SiO_2 \cdot 2CO_2 \cdot 3H_2O$	H	5-6	2.4-2.5	1.524ω	W,Y,Gr, Grn,Bl,r
31	Canfieldite	$Ag_8(Sn,Ge)S_6$	C	2-3	6.276	.....	Blk
32	Cappelenite	Boro-silicate of Y and Ba	H	6	4.4	1.76ω	grnBr
33	Carnallite	$MgCl_2 \cdot KCl \cdot 6H_2O$	R	1	1.6	1.475	W-r
34	Carnotite (Ra)	$K_2O \cdot 2U_2O_3 \cdot V_2O_5 \cdot 2H_2O$	R	4	.....	1.895-1.925	Y
35	Caryocerite (Ra)	Near melanocerite + ThO_2	H	5-6	4.29	1.74 $\pm\eta$	Br

Luster	Fusibility	Solubility	Special Properties	Locality	
.....	....	.....	.....	V.R. Sierra Chica, Argentina	1
.....	....	.....	17% Yttr.; 18% Cer.	V.R. Boden, Saxony	2
V, A	2	s. HCl	intumescence, strongly pyroelectric	Unc. Germany	3
V-E	1-1.5	s. H_2O	decrepitates; diamagnetic	C. Kashmir; Tibet; California; Nevada	4
M	2	s. HNO_3	streak: pale gr-Br	C. Common, widespread, in copper regions	5
M	ef.	s. h. HCl	streak: RBr; decrepitates; photoelectric	Unc. Germany; France; Washington; Nevada	6
M	ef.	dec. HNO_3	decrepitates; photoelectric	Unc. Germany; France; England; Peru; Bolivia; Arizona; Utah; Nevada	7
sM	....	s. a.	streak: d grn Br	V.R. Stanley Basin, Idaho	8
sM	if.	s. HCl	streak. as color	R. Harz Mts.; Sweden; India; Brazil	9
.....	....	.....	0.5% Hf ?	V.R. Brazil	10
V-Pl	3	dec. HCl	B.B. swells; pyroelectric	R. Scotland; Ireland; Germany; France	11
.....	....	.....	60.5-60.9% Cer.	V.R. South Greenland	12
V	3.5	s. HNO_3	.....	Unc. Algeria; S. W. Africa; Chile; Arizona; Utah; California	13
sM	if	d. HNO_3	0.4% Cer.; 1.4-4.3% Yttr.; 4.7-6.1% ThO_2	V.R. Annerod, Norway	14
.....	....	.....	.....	V.R. Vermland, Sweden	15
A-G	1, 422°C	s. NH_4OH	diathermanous	V.R. Mexico; Chile	16
A-sM	if.	i.	.....	R. Europe; Massachusetts; New York; Arkansas	17
V,P,W	if.	s.	pyroelectric; (A) photoluminescent	C. Italy; Sweden; New York; Pennsylvania; California; Texas	18
.....	....	.....	.....	V.R. Kahn, S. W. Africa	19
.....	....	.....	.....	V. R. Lihasi, Belgian Congo	20
V	6	gel. a.	decrepitates, strongly pyroelectric; triboluminescent	C. Siberia; Germany; England New Jersey; Nevada; Montana; Colorado	21
M	ef.	dec. HNO_3	.....	R. Roumania; W. Australia; California; Colorado	22
.....	....	.....	.....	V.R. Hybla and Parry Sounds, Ontario	23
V	if.	gel. a.	59.3% ThO_2	V.R. Islands of Lävon and Arö, Norway	24
V-E	if.	s. HCl	glows under B. B. some var. fluoresce red, pink; photoluminescent	A. World-wide; Optical, Pedro Mts., N. Mex.	25
G	....	.....	photoluminescent; vivid lemon. Diamagnetic	V.R. Franklin, New Jersey	26
.....	....	.....	.....	V.R. Caldas district, Minas Geraes, Brazil	27
W	1.5	sl.s. HNO_3	.....	R. Atacama Desert, Chile; Europe; California; New Mexico; Utah	28
A	vol.	s. aq. reg.	cathode phosphorescent and colored	R. Bavaria; Bohemia; Italy; Texas	29
sV-G	2	s. HCl	intumesces, X-ray shows similarity to sodalite group	Unc. In rocks, i.e., nephelino syenites; Norway; Maine	30
M	ef.	dec. HNO_3	1.82% Ge	V.R. Bolivia	31
.....	if.	s. HCl	4.2% Cer.; 52.5% Yttr.	V.R. Langesundfiord, Norway	32
G	?	s. H_2O	strongly phosphorescent	Unc. Stassfurt; Upper Silesia	33
E	if.	.....	.....	V.R. Colorado; Utah; Pennsylvania; S. Australia; Belgian Congo	34
V,R	if.	dec. HCl	swells; 41.8% Cer.; 2.2% Yttr.; 13.6% ThO_2	V.R. Langesundfiord, Norway	35

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Cassiterite	SnO_2	Tet.	6-7	6.8-7.1	1.9966ω	Br, Blk, R
2	Castelnaudite	var. xenotime with Zr	Tet.	4-5	4.5	.....	.....
3	Catapleiite	$H_4(Na_2,Ca)ZrSi_3O_{11}$	M	6	2.75	1.592	pY, yBr
4	Celestite	$SrSO_4$	R	3-3.5	3.95	1.624	W, bl, r
5	Cenosite	$2CaO\cdot(Ce,Y)_2O_3\cdot CO_2\cdot 4SiO_2\cdot H_2O$	R	5-6	3.4-3.6	1.689	yBr
6	Cerargyrite	AgCl	C	1-1.5	5.552	2.0611	pearl Gr, gr.Grn, W, —
7	Cerite	$H_3(Ca,Fe)Ce_3Si_3O_{13}$	R	5.5	4.8-4.9	1.818	clove Br, cherry R
8	Cerussite	$PbCO_3$	R	3-3.5	6.46-6.574	2.076	W, Gr
9	Ceylonite	$(Mg,Fe)O\cdot(Al,Fe)_2O_3$	C	8	3.5-3.6	.....	dGrn, Br, Blk
10	Chabazite	$(Ca,Na_2)Al_2Si_4O_{12}\cdot 6H_2O$	H	4-5	2.1-2.2	1.480ω 1.4855	W, flesh R
11	Chalcanthite	$CuSO_4\cdot 5H_2O$	Tri.	2-2.5	2.2	1.539	Berlin Bl, sky Bl
12	Chalcedony	SiO_2	Crypt.	7	2.6-2.64	1.537η	varied
13	Chalcocite	Cu_2S	R	2.5-3	5.5-5.8	.....	blk lead Gr
14	Chalcolamprite	$Na_4(CaF)_2Cb_2SiO_9$?	C	5.5	3.8	1.87η	dGr Br
15	Chalcomenite	$CuSeO_3\cdot 2H_2O$	M	2.5-3	3.76	1.731	Bl
16	Chalcopyrite	$CuFeS_2$	Tet.	3.5-4	4.1-4.3	.....	grn brass Y
17	Chillagite	$3PbWO_4\cdot PbMoO_4$	Tet.	3.5	7.5	.....	Y, br
18	Chiviatite	$2PbS\cdot 3Bi_2S_6$	.....	....	.....	.....	lead Gr
19	Chlorite	.....	.....	....	.....	.....	.....
20	(a) Clinochlore	$1H_4Mg_3Si_2O_9\cdot 1H_4Mg_2Al_2SiO_9 >$	M	2-2.5	2.65-2.78	1.57-1.59	l grass Grn to y, W, R
21	(b Penninite	$H_4Mg_3Si_2O_9 > H_4Mg_2Al_2SiO_9$	M	2-2.5	2.6-2.85	1.576-1.60	"
22	(c) Prochlorite	$H_4Mg_3Si_2O_9 < H_4Mg_2Al_2SiO_9$	M	1-2	2.78-2.9	1.53-1.67	"
23	Chloritoid	$H_2(Fe,Mg)Al_2SiO_7$	M or T	6.5	3.4-3.6	1.72	dGr, grn Gr, gr Blk, Grn
24	Chlormagnesite	$MgCl_2$	H	soft	2.325	1.675ω	.....
25	Chondrodite	$2Mg_2SiO_4\cdot Mg(F,OH)_2$	M	6-6.5	3.1-3.3	1.610-1.636	W, pY, Br, R
26	Chromite	$FeO\cdot Cr_2O_3$	C	5.5	4.3-4.6	2.1η	iron Blk, bl Blk
27	Chrysoberyl	$BeO\cdot Al_2O_3$	R	8.5	3.5-3.8	1.748	various Grns to Y
28	Chrysocolla	$CuSiO_3\cdot 2H_2O$	Crypt.	2.4	2-2.24	1.597	Grn, bl Grn, Bl
29	Chrysolite	$2(Mg,Fe)O\cdot SiO_2$	R	6-7	3.3-3.6	1.65-1.68	olive Grn, Grn, bl, gr Grn
30	Churchite	$(Ce,Ca)PO_4\cdot 2H_2O$	R?	3-3.5	3.14	1.62	pGr
31	Cinnabar	HgS	H	2-2.5	8-8.2	2.913ω	R, brR, lead Gr
32	Clarkeite (Ra)	$(Na_2,Pb)O\cdot 3UO_3\cdot 3H_2O$	.....	4-4.5	6.39	2.098	v. dBr
33	Clausthalite	PbSe	C	2.5-3	7.6-8.8	.....	lead Gr
34	Cleveite (Ra)	Related to uraninite; rich in rare earths, He	C	5.5	7.49	.....	Blk
35	Clinohedrite	$H_2CaZnSiO_5$	M	5.5	3.33	1.67η	—, W

Luster	Fusibility	Solubility	Special Properties	Locality	
A	if.	sl. s.	.....	Unc. England; Malay States; Bolivia	1
.....	....	.....	.....	V.R. Diamantinos, and Bahia, Brazil	2
DV	3	s. HCl	becomes hexagonal at 140°C; 0.3% Hf	V.R. Langesundfiord, Norway; S. Greenland; Arkansas	3
V-Pl	3	i.	frequently decrepitates; Ra luminescent	R. Put-in-Bay, Ohio; Pennsylvania; New York; Colorado; Europe	4
GV	5	s. HCl	little exfoliation	V.R. Norway; Sweden; Ontario	5
R-A	1	i. HNO_3, s. NH_4OH	highly sectile; X-ray: atomic structure similar to halite	R. Harz Mts.; N. S. Wales; Chile; Colorado; Idaho	6
D, A, R	if.	gel. HCl	51-72% Ce	V.R. Sweden	7
A-V	1	s. HNO_3	decrepitates; pyroelectric; (A) photoluminescent	C. Common lead ore; Europe; N.S. Wales; Missouri; Idaho	8
V	2135°C	sl. s. H_2SO_4	.....	R. Ceylon; Franklin, New Jersey	9
V	3	dec. HCl	intumesces	C. Common zeolite; Germany; New Jersey; Nova Scotia	10
V	3	s. H_2O	.....	Unc. Desert regions; copper mine waters	11
W	if.	i.	thermophosphorescent; (A) photoluminescent	A. Widespread	12
M	1130°C	s. HNO_3	above 91°C changes to isometric	C. Important copper ore, widespread	13
M ?	....	.....	3.41% E	V.R. Narsarsuk, S. Greenland	14
V	1.5	s.a.	.....	R. Mendoza, LaRioja, Argentina	15
M	2	dec. HNO_3	X-ray: structure similar to sphalerite. Cu, Fe replacing Zn	A. Common copper ore, widespread	16
V	ef.	dec. a.	.....	V.R. Chillagoe, N. S. Wales	17
M	....	.....	microscopic study shows this to be a mixt. of bismuthinite and Cu minerals	R. Chivaiato, Peru	18
.....	....	.....	.....	A. Very common and widespread	19
Pl	6	dec. H_2SO_4	.....	.. Most common of chlorite minerals; Urals; New York	20
Pl, V	5-6 sl. dec. HCl; dec. H_2SO_4		exfoliates	.. Crystals; Switzerland; Utah	21
sPl	5	dec. h. H_2SO_4	.....	.. Crystals: common in Alps; N. Carolina	22
Pl	6	dec. H_2SO_4	.....	C. Crystals: Urals; France; Rhode Island; Michigan; common	23
V	1	s. H_2O	deliquescent	V.R. Near volcanoes	24
V-R	if.	gel.	h. H_2SO_4 gives F_2	Unc. Mt. Somma; Sweden; New York	25
sM-M	if.	i.	sometimes feebly magnetic	Unc. S. Rhodesia; New Caledonia; N. Carolina; Pennsylvania; California	26
V	if.	i.	X-ray: atomic structure similar to chrysolite; heating discolors; ultraviolet recolors	Unc. Maine; Connecticut; New York; Brazil; Urals; S. Rhodesia	27
V, E	if.	dec. a.	decrepitates, rather sectile	Unc. Minor copper ore	28
V	if.	s. HCl	pale yellowish green, transparent is gem variety	C. Basic igneous rocks; meteorstones	29
V, P	if.	s.a.	51.87% Ce	V.R. Cornwall, England	30
A	vol.	d. aq. reg.	strong circular polarization about 15 times quartz	Unc. Almaden, Spain; California; Texas; Nevada; Italy	31
W	.....	s. HCl	.....	V.R. Spruce Pine, N. Carolina	32
M	vol.	s.a.	decrepitates	R. Harz Mts.; Argentina	33
D	if.	s. H_2SO_4	very rich in He. 2-3% Cer.; 10% Yttr., 4-5% ThO_2	V.R. Arendal, Norway	34
Pl	4	gel. HCl	exfoliates; photoluminescent orange	V.R. Franklin, New Jersey	35

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Cobaltite	$CoS_2 \cdot CoAs_2$	C	5.5	6-6.3	.....	silver W + r tint
2	Codazzite	$(Ca,Mg,Fe,Ce)CO_3$	H	4	2.5	.....	ashy Br
3	Columbite	$(Fe,Mn)(Cb, Ta)_2O_6$	R	6	5.3-7.3	2.2-2.4	iron Blk, grn, br Bl
3.1	Colemanite	$Ca_2B_6O_{11} \cdot 5H_2O$	M	4.0-4.5	2.43	1.592	YW
4	Cookeite	$(HO)_6LiAl_3Si_2O_6$	M	2.5	2.67	1.579	W,y,Grn, Br, p.Pk
5	Cooperite	PtS	Tet.	4-5.5	9	.....	steel Gr
6	Copper	Cu	C	2.5-3	8.8-8.92	$0.64 In_a$	copper R
7	Cordierite	$Mg_2Al_4Si_5O_{18}$	R	7-7.5	2.6-2.7	1.534 to 1.599η	various Bl
8	Cordylite	parisite with Ba (Cer. 49.4%)	H	4.5	4.31	1.760ω	wax Y
9	Corundum	Al_2O_3	H	9	3.9-4.1	1.7676 to 1.7682ω	Bl, R, V, Gr, Br, W
10	Covellite	CuS	H	1.5-2	4.6	$1.45 Na\ \omega$; 2.688	indigo Bl
11	Crocidolite	$Na_2O \cdot Fe_2O_3 \cdot 2FeO \cdot 6SiO_2$	M	4	3.2-3.3	1.699	lavender Bl, leek Grn
12	Crocoite	$PbO \cdot CrO_3$	M	2.5-3	5.9-6.1	2.37 to 2.42	hyacinth R
13	Cryolite	$3NaF \cdot AlF_3$	M	2.5	2.9-3.0	1.3389	snow W, r, br, Bl
14	Cryolithionite	$3NaF \cdot 3LiF \cdot 2AlF_3$	C	2.5	2.78	1.339η	—,W
15	Cuprite	Cu_2O	C	3.5-4	5.8-6.2	2.849η	Reds
16	Cuprotungstite	$CuWO_4$	Crypt.	4.5	.....	2.15η	Grn
17	Curite (Ra)	$2PbO \cdot 5UO_3 \cdot 4H_2O$	R	4-5	7.192	2.11	rBr, dY,
18	Cyrtolite	Related to alvite; pseudomorph after zircon	Tet.	5-6	3.3-4.3	.....	brR
19	Danalite	$3(Fe,Zn,Mn)BeSiO_4 \cdot ZnS$	C	5.5	3.4	1.754η	flesh R, Gr
20	Danburite	$CaO \cdot B_2O_3 \cdot 2SiO_2$	R	7	3	1.633	pY,yW, yBr,—
21	Darapskite	$NaNO_3 \cdot Na_2SO_4 \cdot H_2O$	M	2-3	2.2	1.481	colorl.
22	Datolite	$2CaO \cdot B_2O_3 \cdot 2SiO_2 \cdot H_2O$	M	5-5.5	2.9-3.0	1.654	W,pGrn, Y, R
23	Davidite (Ra)	titanate of Fe, U, V, Cr, rare earths	C	....	4	.....	Blk
24	Delorenzite (Ra)	$2FeO, UO_2, 2Y_2O_3 \cdot 24TiO_2$?	R	5-5.5	4.7	$1.70(?)\eta$	Blk
25	Descloizite	$4(Pb,Zn)O \cdot V_2O_5 \cdot H_2O$	R	3.5	5.9-6.1	2.265	R, Br, Blk
26	Dewindtite (Ra)	$3PbO \cdot 5UO_3 \cdot 2P_2O_5 \cdot 12H_2O$	R	....	4.08	1.763	canary Y
27	Diamond	C	C	10	3.516-3.525	2.4195η	—,W,y,r, o, grn, bl, Blk
28	Diaspore	$Al_2O_3 \cdot H_2O$	R	6.5-7	3.3-3.5	1.722	w,gr,Y,—, Br
29	Dickinsonite	$(Mn,Fe,Ca,H,Na)_3 \cdot P_2O_8$	M	3.5-4	3.4	1.655 to 1.662	olive Grn to grass Grn
30	Dioptase	$CuO \cdot SiO_2 + H_2O$	H	5	3.2-3.4	1.644 to 1.658ω	emerald Grn

Luster	Fusibility	Solubility	Special Properties	Locality	
M	f.	s. h. HNO_3	thermoelectric; X-ray: isometric lattice; evidences of tetartohedral symmetry rare in crystals	Unc. Trans-Caucasia; Norway; Sweden; Cobalt, Ontario	1
sV	....	.....	Ce due to included parisite	V.R. Colombia emerald mine	2
M-A	if.	sl. dec. h. HCl, H_2SO_4	X-ray: structure closely resembles brookite	R. Ilmen Mts.; Finland; Norway; Madagascar; Greenland; Me.; Colo.; N. Car.; S. D.	3
....	....	.....	.....	Unc. Death Valley, Calif.	3.1
Pl, V	6	dec. H_2SO_4	exfoliates	R. With tourmaline: Maine; Connecticut	4
....	....	.....	.....	V.R. Transvaal and Lydenburg, S. Africa	5
M	1087° C	s. HNO_3	.....	Unc. Russia; England; N. S. Wales; Bolivia, Michigan	6
V	5-5.5	sl. dec.	Ceylon gives intense blue transparent "saphir d'eau"	Unc. Igneous rocks; Bavaria; Ceylon, Connecticut	7
W	if.	s. HCl decrepitates	X-ray: structure different from parisite	V.R. Narsarsuk, S. Greenland	8
V-A	if.	i.	X-ray: shows complex structure; likened to deformed halite structure	Unc. Urals; N. Carolina; Georgia; gems: India; Siam; Burma	9
sM-R	2.5	s. HNO_3	.....	R. Serbia; Saxony; Peru; Chile; Bolivia; Colorado; Montana	10
Sk, D	3(?)	i.	fibrous = "Blue Asbestos"; silicified = "Tiger's eye."	Unc. S. Africa; Austria; France; Massachusetts; Rhode Island	11
A-V	1.5	s. a.	streak: orange-yellow; decrepitates	R. Urals; Tasmania; Brazil; Philippine Islands; Arizona	12
V-G	1	s. H_2SO_4	X-ray: atomic structure similar to garnet. Cubic form at 570°C.; colored by cathode rays	Unc. Ivigtut, Arksukfiord, Greenland; Colorado; Russia	13
V	1.5	s. a.	X-ray: body centered cubic similar to garnet	V.R. With cryolite	14
A-sM	f.	s. conc. HCl	X-ray: structure of normal symmetry; photoelectric	Unc. Perm, Russia; N. S. Wales; Rhone, France; Arizona	15
V	3(?)	dec. HCl	.....	V.R. Santiago, Chile; Mexico; Spain; N. S. Wales; Utah	16
.....	.....	s. a.	strongly radioactive	V.R. Katanga, Belgian Congo	17
sA	.....		5.5% Hf	V.R. Ytterby, Sweden	18
V-R	3	gel. HCl	.....	R. Cape Ann, Massachusetts; New Hampshire; Colorado; Cornwall, England	19
V-G	3.5	sl. dec. HCl	thermophosphorescent	R. Connecticut; New York; Japan; Switzerland; Madagascar	20
V	1(?)	s. H_2O	.....	R. Taltal, Chile	21
V	2	gel. HCl	X-ray: shows close relation structurally between datolite and euclase	Unc. New Jersey; Massachusetts; Michigan; Hartz Mts.; Norway	22
Sp	....	.....	5-10% E_2O_3	V.R. Olary, S. Australia	23
R	if.	dec. H_2SO_4	14.6% Y	V.R. In pegmatite: Piedmont, Italy	24
G	1.5	s. d. HNO_3	decrepitates	Unc. Austria; Africa; Argentina; New Mexico; Arizona	25
A	.....	s. HNO_3	.....	V.R. Katanga, Belgian Congo	26
A-G	if.	i. out of contact with air, changes to graphite at 1900°C.	transparent to X-rays; triboluminescent; phosphoresces; triboelectric and photoluminescent	Unc. S. Africa; Brazil; India; Arkansas; N. Carolina; Wisconsin; Virginia; Colorado; California; Georgia	27
V-P	if.	i.; s. h. NaOH	decrepitates	Unc. Urals; Greece	28
V	2.5-3	s.a.	.....	V.R. Connecticut; Maine	29
V	if.	gel. HCl	decrepitates; paramagnetic; pyroelectric	R. French Congo; Katanga, Belgian Congo; Chile; Arizona	30

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Dolomite	$CaCO_3 \cdot MgCO_3$	H	3.5-4	2.8-2.9	1.68174ω	W,r,Grn, Br,Gr, Blk
2	Dumontite (Ra)	$2PbO \cdot 3UO_3 \cdot P_2O_5 \cdot 5H_2O$	R?	....	.....	1.77-1.89η	dark Y
3	Dumortierite	$8Al_2O_3 \cdot B_2O_3 \cdot 6SiO_2 \cdot H_2O$?	R	7	3.3-3.4	1.686	smalt Bl, grn Bl
4	Dysanalyte	$(Ca, Fe)_7Cb_2Ti_6O_{24}$?	C	5-6	4.13	2.33η	iron Blk
5	Dyscrasite	Ag_3Sb	R	3.5-4	9.4-9.8	.....	silver W
6	Edingtonite	$BaO \cdot Al_2O_3 \cdot 3SiO_2 \cdot 3H_2O$	R	4-4.5	2.7-2.8	1.549	W,grnW, Pk
7	Eglestonite	Hg_4Cl_2O	C	2-3	8.3	2.49η	bl Y, Blk
8	Elbrussite	Hydrous silicate Al, Fe‴, Fe″, Mg, Ca, K	Uniaxial	2	2.281	1.56	d Br
9	Electrum	Au + 36-18% Ag	C?	2.5-3	15.5-12.5	.....	p Y, y W
10	Eliasite (Ra)	var. gummite	Am.	3.5-4.5	4.0-5.0	.....	hyacinth R, Blk
11	Ellsworthite (Ra)	$CaO \cdot Cb_2O_5 \cdot 2H_2O$ approx. plus U oxides, Ti, etc.	C	4	3.608-3.758	1.89η	amber Y, d Br
12	Elpidite	$H_6Na_2Zr(SiO_3)_6$	R	7	2.54	1.565	W—, brick R
13	Embolite	Ag(Cl, Br)	C	1.5	5.8	2.15η	gr,Grn, yGrn, Y
14	Emmonsite	$FeTeO_3$	M	2	5	2.09	yGrn
15	Enargite	$3Cu_2S \cdot As_2S_5$	R	3	4.3-4.5	.....	gr Blk, iron Blk
16	Endeiolite	Near chalcolamprite with F replaced by (OH)	C	4	3.44	.....	d Br
17	Epididymite	$HNaBeSi_3O_8$	R	5.5	2.55	1.544 Larsen: 1.569β	colorl.
18	Epidote	$4CaO \cdot 3(Al, Fe)_2O_3 \cdot 6SiO_2 \cdot H_2O$	M	6-7	3.2-3.5	1.754	pistachio Grn, y Grn, br Grn, Blk
19	Epistilbite	$CaO \cdot Al_2O_3 \cdot 6SiO_2 \cdot 5H_2O$	M	3.5-4	2.25	1.510	W
20	Epistolite	$H_7Na_6Cb_3TiSi_5O_{26}$?	M	1-1.5	2.9	1.650	W,gr,br
21	Epsomite	$MgSO_4 \cdot 7H_2O$	R	2-2.5	1.75	1.455	W
22	Erdmannite (Ra)	Silicate, Ce, Y, Th, Zr, Be, Ca, Al, Fe, H_2O	Am.	4.5	3.01-3.39	.....	Br, leek Grn
23	Erikite (Ra)	Phospho-silicate, Ca, Ce, Al, K, Na, Th, H_2O	R	5.5	3.5	.....	p Y Br, d gr Br
24	Erythrite	$3CoO \cdot As_2O_5 \cdot 8H_2O$	M	1.5-2.5	3.0	1.663	crimson, peach R
25	Eschwegite	Hydrous titanate, columbate, tantalate of Y, Er	.....	5.5	5.87	2.15-2.20η	d r Gr
26	Eschynite (Ra)	$(Ca,Fe)_2Ce_4Cb_6(Ti,Th)_8O_{39}$?	R	5.5	4.9-5.1	2.205η	Br Blk
27	Eucairite	$Cu_2Se \cdot Ag_2Se$	C	1	7.50	.....	silver W, lead Gr
28	Euclase	$2BeO \cdot Al_2O_3 \cdot 2SiO_2 \cdot H_2O$	M	7.5	3.1	1.655	—, p Grn, Bl
29	Eucolite	Similar to eudialyte	H	5	3.1	1.621ω	—, Br, R
30	Eucrasite (Ra)	Altered thorite with Ce, Y, Th, Zr, Ti, Ca, Mn, Fe, Na	R	4.5-5	4.4	.....	br Blk
31	Eucryptite	$LiAlSiO_4$	H	....	2.667	1.545ω	—, W
32	Eudialyte	$(Na,Ca,Fe)_6Zr(OH,Cl)(SiO_3)_6$ with Ce	H	5-6	2.8-3.1	1.606 to 1.610ω	R, Br, Pk
33	Eudidymite	$HNaBeSi_3O_8$	M	6	2.553	1.546	W
34	Eulytite	$Bi_4(SiO_4)_3$	C	4-6	6.1	2.05	Br, gr,—, straw Y

Luster	Fusibility	Solubility	Special Properties	Locality	
V,Pl, D	if.	s. h. HCl	X-ray: lower symmetry than calcite. ⅓ replacement of Mg by Fe, no change; paramagnetic	A. Saxony; Switzerland; Missouri; Vermont; New Jersey; New York	1
E	....	.....	.....	V.R. Belgian Congo	2
V	lf.	i. HF	exhibits idiophanous figures analogous to andalusite	Unc. Rhone, France; California; New York; Nevada; Ontario	3
A-sM	lf.	dec. HCl	0-5% Cer.	V.R. Kaiserstuhl, Baden, Germany; Vesuvius	4
M	1.5	s. HNO_3	X-ray: identical to artificial Ag_3Sb	Unc. Chief ore, Baden; Harz Mts.; N. S. Wales; Chile	5
V	5	gel. a.	.....	V.R. Glasgow, Scotland; Sweden	6
A, R	vol.	dec. a.	decrepitates	R. Terlingua, Texas	7
G	3	.....	streak: dark lemon yellow; adheres to tongue	R. Karatschaev, N. Caucasus	8
M	ef. at 1100°C	s. aq. reg.	.....	R. Verespatak, Hungary; Peru; Colombia; Altai Mts.; Bodie, Calif.; Virginia	9
R	....	.....	as gummite	V.R. Bohemia	10
A	....	.....	.....	V.R. In pegmatite: Hasting County, Haliburton County, Ontario	11
.....	....	.....	0.2% Hf	V.R. Narsarsuk, S. Greenland	12
A	ef.	s. NH_4OH	diathermanous	R. Chile; N. S. Wales; Nevada; Colorado; Arizona; New Mexico	13
....	f.	s. HCl	.....	V.R. Tombstone, Arizona	14
M	1	s. aq. reg., s. HNO_3	decrepitates	C. Peru; important ore Butte, Montana	15
.....	....	.....	4.43% E_2O_3	V.R. Narsarsuk, Greenland	16
V	3	v. sl. s. a.	.....	V.R. Narsarsuk, Greenland; Langesundfiord, Norway	17
V	3-3.5	sl. dec. HCl	intumesces	A. Widespread; France; Italy; Colorado; Alaska	18
V-Pl	3	dec. HCl	intumesces	R. Iceland; Scotland; India	19
.....	....	.....	.....	V.R. Julianehaab, Greenland; in pegmatite	20
V-E	1	s. H_2O	found in mineral waters; efflorescence on mine walls	Unc. Epsom, England; Italy; Stassfurt; Kentucky; Tennessee; Indiana	21
V	2.5	gel. HCl	18-35% Cer., 1.5-2% Yttr., 0-12% $ThO_2 + ZrO_2$	V.R. Brevig, Norway	22
.....	....	.....	40.5% Cer., 3.3% ThO_2	V.R. Julianehaab, Greenland	23
A, V, Pl, D	2	s. HCl	sectile	R. Saxony; Sweden; Ontario; rare in United States	24
.....	....	.....	.....	V.R. Pebbles at Minas Geraes, Brazil	25
.....	if.	i.	.....	R. Ilmen Mts., Siberia; Hitterö, Norway	26
M	ef.	s. h. HNO_3	.....	R. Sweden; Chile; Argentina	27
V	5.5	i.	tribo- and pyro-electric	R. Ural Mts.; Salzburg, Bavaria; Brazil	28
.....	2.5	gel. HCl	0.2% Hf	V.R. S. Norway; Madagascar; Magnet Cove, Arkansas	29
W G	4	s. H_2SO_4	streak: brown	V.R. Brevig, Norway	30
.....	ef..	gel. HCl	.....	V.R Branchville, Connecticut	31
V	2.5	gel. HCl	0.1, 0.2, 0.17% Hf	V.R. Julianehaab, Greenland; Russia; Russian Lapland	32
V, Pl	3	s. HF	.....	V.R. Narsarsuk, Greenland; Langesundfiord, Norway	33
A	2	gel. HCl	.....	V.R. Saxony	34

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Euxenite (Ra)	Columbate, titanate of Y, Ce, Er, U, Th, Zr	R	6.5	4.7-5.0	2.06-2.26η	brBlk
2	Fairfieldite	$Ca_2MnP_2O_8 \cdot 2H_2O$	Tri.	3.5	3.1	1.644	W,gr,Y
3	Fayalite	$2FeO \cdot SiO_2$	R	6.5	4.1-4.3	1.877	p,grnY, Br,Blk
4	Feldspar	.....	.....	....	.....	.....	.....
5	(a) Albite	Ab. = $NaAlSi_3O_8$	Tri.	6-6.5	2.60-2.62	1.529	W,grn, blk,r
6	(b) Andesine	$Ab_{70}An_{30}$-$Ab_{50}An_{50}$	Tri.	6	2.676	1.553	W,grn,—
7	(c) Anorthite	An. = $CaAl_2Si_2O_8$	Tri.	6-6.5	2.74-2.76	1.584	W
8	(d) Anorthoclase	$(Na,K)AlSi_3O_8$	Tri.	6	2.57-2.60	1.529	W
9	(e) Bytownite	$Ab_{70}An_{30}$-$Ab_{10}An_{90}$	Tri.	6	2.73	1.572	colorl.
10	(f) Celsian	$BaAl_2Si_2O_8$	M	6-6.5	3.37	1.589	colorl.
11	(g) Hyalophane	$(K_2,Ba)Al_2Si_4O_{12}$	M	6-6.5	2.805	1.545	—,W,Pk, grn
12	(h) Labradorite	$Ab_{50}An_{50}$-$Ab_{30}An_{70}$	Tri.	6	2.68-2.72	1.563	W,Gr,Br, grn,—
13	(i) Microcline	$KAlSi_3O_8$	Tri.	6-6.5	2.54-2.57	1.522	W,R,Grn, pY
14	(j) Oligoclase	$Ab_{90}An_{10}$-$Ab_{70}An_{30}$	Tri.	6	2.62-2.65	1.543	W, Gr, grn, r
15	(k) Orthoclase	$KAlSi_3O_8$	M	6	2.56-2.58	1.524	W, Pk,—
16	Ferberite	$FeWO_4$	M	5-5.5	7.1	2.4_{Li}	brR,Blk, Br
17	Ferghanite (Ra)	$U_3(VO_4)_2 \cdot 6H_2O$	R	2	3.3	.....	sulfur Y
18	Fergusonite (Ra)	Y(Cb,Ta)O_4 with Er, Ce, U, Fe, Ca, etc.	Tet. ?	5.5-6	5.8	2.115 2.175η	brBlk
19	Ferritungstite	$Fe_2O_3 \cdot WO_3 \cdot 6H_2O$	H	....	.....	1.80ω	pY-BrY
20	Fersmannite	$2Na_2(O,F_2) \cdot 4CaO \cdot 4TiO_2 \cdot 3SiO_2$	M	5.5	3.44	1.930	Br
21	Fischerite	$AlPO_4 \cdot Al(OH)_3 \cdot 2\frac{1}{2}H_2O$	R	5	2.5	1.55η	Grn
22	Florencite	$3Al_2O_3 \cdot Ce_2O_3 \cdot 2P_2O_5 \cdot 6H_2O$	H	5	3.58	1.680ω	pY
23	Fluellite	$AlF_3 \cdot H_2O$	R	3	2.17	1.490	—,W
24	Fluocerite	(Ce,La,Di)F_3	H	4.5-5	5.7-6.13	1.614η	p wax Y, y, r, Br
25	Fluorite	CaF_2	C	4	3-3.3	1.4339η	—, all colors
26	Forsterite	$2MgO \cdot SiO_2$	R	6-7	3.2-3.3	1.651	W,grnY
27	Fourmarierite (Ra)	Hydrous Pb uranate	R	3-4	6.046	1.92	R
28	Fowlerite	$Ca(Mn,Fe,Zn)_5(SiO_3)_6$	M	6	3.67	.....	.....
29	Franklinite	$(Fe,Mn,Zn)O \cdot Fe_2O_3$	C	5.5-6.5	5-5.2	$2.36_{Li}\eta$	iron Blk
30	Freieslebenite	$2Ag_2S \cdot 3PbS \cdot 2Sb_2S_3$	M	2	6.2-6.4	.....	steel Gr, silver W
31	Fremontite	(Na,Li)Al(OH,F)PO_4	Tri. ?	5.5	3.04	1.603	grW,W
32	Freyalite	Silicate of Th, rare earths, with Al, Fe, Mn, Na, H_2O	Am.	6	4.06-4.17	.....	Br
33	Fuchsite	Muscovite + Cr	M	2-2.25	2.6-2.8	1.594	bright Grn, yGrn
34	Gadolinite	$Be_2Fe(YO)_2(SiO_4)_2$	M	6.5-7	4.0-4.5	1.77-1.82η	Blk, grn Blk, Br

Luster	Fusibility	Solubility	Special Properties	Locality	
G	if.	i.	2-8 % Cer.; 13-35 % Yttr.	R. Madagascar; Brazil; Norway; Finland; N. Carolina	1
V	4	s.a.	.....	R. Branchville, Connecticut; Buckfield, Poland, Maine	2
sM, R	4	gel. HCl	turns to brown or black on exposure	R. Lipari Islands, Fayal, Azores; France; Ireland	3
.....	....	.....	.....	A. World-wide in igneous, metamorphic rocks	4
V, Pl	4	i.	pyroelectric	A. Switzerland; France; Virginia; Colorado.	5
V	4-4.5	i.	.....	.. Small crysts.: Japan	6
V	5	dec. HCl	.....	.. Mte. Somma. Vesuvius, Italy; Japan; New Jersey; in meteorites	7
V	if.	i.	.....	.. Pantelleria, Italy; S. Norway; New York	8
V	5	gel. h. HCl	.....	R. Rarest of feldspars; found in some meteorites	9
V	if.	s. HCl	.....	V.R. Sweden	10
V	6	i.	.....	R. Switzerland; Sweden; Franklin, N. J.	11
V	1280 to 1500°C sl. s. h. HCl		play of colors	A. Labrador	12
V	1450°C	i.	green type = "Amazon stone"	A. Ilmen Mts.; Urals; Italy; Virginia; Colorado	13
V	1120 to 1380°C	i.	.....	A. Norway; Sweden; New York; Pennsylvania; N. Carolina	14
V	1450°C	i.	pyroelectric	A. Most common silicate; Ceylon; Italy; Colorado; California	15
G, M	2	dec. a.	.....	R. Spain; Boulder County, Colorado	16
.....	....	.....	.....	V.R. Fergahana, Russian Turkestan	17
sM-V	if.	dec. H_2SO_4	X-ray: shows normally no cryst. atomic structure, but at 400°C crystalline tetr. 0.5-14 % Ce.; 28-47 % Y.; 0-7 % ThO_2 + ZrO_2	V.R. Greenland; Sweden; Norway; N. Carolina; S. Carolina; Texas	18
E	....	dec. a.	.....	V.R. Germania tungsten mine, Washington	19
V	....	.....	.....	R. Chibines Mts., Russia	20
V	....	s. H_2SO_4	.....	V.R. Ural Mts.	21
R	if.	sl. s. HCl	28 % Ce	V.R. Minas Geraes, Brazil	22
V	if.	i.	.....	V.R. St. Austell, Cornwall	23
W	if.	s. H_2SO_4	81.4-82.6 % Cer.; 1.1-4.3 % Yttr.; decrepitates	V.R. Sweden; variety tysonite, Colorado	24
V	1.5	s. a.	decrepitates; color changed by heat, pressure; tribo-, thermo-, photoluminescent diathermanous	C. Cumberland, England; Illinois; Kentucky; Pennsylvania; Ontario	25
V	if.	s. ±	.....	R. Italy; Norway; Urals	26
A	....	.....	.....	V.R. Katanga, Belgian Congo	27
V	....	.....	.....	V.R. Franklin and Sterling Hill, N. J.	28
M	if.	s. HCl	slightly magnetic	Unc. Franklin Furnace, N. J.; Hessen-Nassau	29
M	ef.	sl.s. HCl	.....	R. Roumania; Saxony; Spain; Colorado	30
V-G	ef.	sl.s. H_2SO_4	.....	R. Fremont County, Colorado	31
R	....	.....	31.3 % Cer.; 28.4 % ThO_2	V.R. Brevig, Norway	32
V-R	5	i.	.....	R. Georgia; Vermont; Maryland; Zillerthal, Germany; Transvaal, S. Africa	33
V, G	if.	gel.	3.4-51.5 % Cer. (usual 6-20 %); 5-60 % Yttr. (usual 35-48 %); thermoluminescent	R. Sweden; Norway; Texas; Arizona; Colorado	34

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Gahnite	$ZnAl_2O_4$	C	7.5-8	4-4.6	1.80±η	dGrn, Grn,bl Blk,ygr
2	Galena	PbS	C	2.5-2.7	7.4-7.7	3.912	lead Gr
3	Garnet	.....	.....	....	.....	.....	.....
4	(a) Almandite	$Fe_3Al_2(SiO_4)_3$	C	6.5-7	4.25	1.801 impure 1.830pure	dR,brR, Blk
5	(b) Andradite	$Ca_3Fe_2(SiO_4)_3$	C	6.5-7	3.75	1.895	Y,Grn, Br,Blk
6	(c) Grossularite	$Ca_3Al_2(SiO_4)_3$	C	6.5-7	3.53	1.735η	varies Br
7	(d) Pyrope	$Mg_3Al_2(SiO_4)_3$	C	6.5-7	3.51	1.705η	R
8	(e) Spessarite	$Mn_3Al_2(SiO_4)_3$	C	6.5-7	4.18	1.800η	—, r
9	(f) Uarovite	$Ca_3Cr_2(SiO_4)_3$	C	6.5-7.5	3.41-3.52	1.838η	emerald Grn
10	Garnierite	$(Mg,Ni)O{\cdot}SiO_2+xH_2O$	Am.	1-3	2.3-2.9	1.59η	apple Grn
11	Gay-Lussite	$Na_2CO_3{\cdot}CaCO_3{\cdot}5H_2O$	M	2-3	1.9	1.516	W,yW
12	Gehlenite	$CaO{\cdot}MgO{\cdot}Al_2O_3{\cdot}SiO_2$	Tet.	5.5-6	3.04	1.666-1.691ω	grGrn, liver Br
13	Geikielite	$(Mg,Fe)TiO_3$	H	6	4	2.31ω	Bl-BrBlk
14	Genthite	$Mg_2Ni_2O_3{\cdot}3SiO_2{\cdot}6H_2O$	Am.	3-4	2.409	1.59(?)η	p apple Grn, y
15	Geocronite	$5PbS{\cdot}Sb_2S_3$	R	2-3	6.3-6.5	.....	lead Gr
16	Gerhardite	$Cu(NO_3)_2{\cdot}3H_2O$	R	2	3.43	1.713	emerald Grn
17	Gersdoffite	$NiS_2{\cdot}NiAs_2$	C	5.5	5.6-6.2	.....	silver W, steel Gr
18	Gibbsite	$Al_2O_3{\cdot}3H_2O$	M	2.5-3.5	2.3-2.4	1.566	W,gr,grn, rW
19	Gismondite	$(Ca,K_2)Al_2Si_2O_8{\cdot}4H_2O$	M	4.5	2.265	1.539	—,W,r,gr
20	Glauberite	$CaSO_4{\cdot}Na_2SO_4$	M	2.5-3	2.7-2.8	1.535	pY,Gr, brick R
21	Glaucodot	$(Fe,Co)S_2{\cdot}(Fe,Co)As_2$	R	5	5.9-6.0	.....	gr tin W
22	Glauconite	Silicate Al,Ca,Fe,K,Mg $+H_2O$	M	2	2.2-2.8	1.628	dull Grn
23	Gmelinite	$(Ca,Na_2)O{\cdot}Al_2O_3{\cdot}3SiO_2{\cdot}6H_2O$	H	4.5	2-2.1	1.465 to 1.481ω	yW,grr,W, rW, R
24	Goethite	$Fe_2O_3{\cdot}H_2O$	R	5-5.5	4.28	2.39	y,r,blkBr
25	Gold	Au	C	2.5-3	15.6-19.33	$0.366_{Na}\eta$	gold
26	Gorceixite	$2BaO{\cdot}3Al_2O_3{\cdot}2P_2O_5{\cdot}7H_2O$	Micro.	6	3.1	1.6253ω	W
27	Goslarite	$ZnSO_4{\cdot}7H_2O$	R	2	1.75-2	1.480	W r,y
28	Graphite	C	H	1-2	2-2.3	.....	Iron Blk
29	Greenockite	CdS	H	3-3.5	4.5-5.0	2.506ω; 2.688	honey to orange Y
30	Guanovulite	$3(SO_4)_2(K,NH_4)_3H{\cdot}4H_2O$?	.....	2	2.3-2.6	.....	—,W
31	Guarinite	$(Na_2,Ca)(Si,Zr)O_3+F$	Tri.	5.5	3.31	1.716±0.003	Y,Br
32	Guitermannite	$3PbS{\cdot}As_2S_3$?	.....	3	5.94	.....	dlGr
33	Gummite (Ra)	Alteration product of uraninite. Composition?	Am.?	2.5	3.9-4.2	1.61η	rY,oR, rBr
34	Gypsum	$CaSO_4{\cdot}2H_2O$	M	1.5-2	2.32	1.523	W,Gr,y,Bl
35	Haldingerite	$HCaAsO_4{\cdot}H_2O$	R	2-2.5	2.85	1.602	W
36	Hainite	Tantalo-silicate, titanate of Zr, Ca, Na	Tri.	5	3.2	1.7±	Y, —

Luster	Fusibility	Solubility	Special Properties	Locality	
V-G	if.	i.	may contain Ga	R. Bavaria; Sweden; New Jersey; N. Carolina; Georgia; Maryland; Colorado	1
M	2	dec. HNO_3	may decrepitate; photoelectric	C. Saxony; Harz Mts.; England; Missouri; Colorado; Idaho	2
.....	....	.....	.....	.. ..	3
V	3	i.	.....	A. Most common of garnets	4
V	3.5	i.	.....	Unc. Franklin, New Jersey	5
V	3	i.	.....	C. Siberia; Urals; Italy; Mexico; Lower California	6
V	3.5	i.	.....	Unc. Bohemia	7
V	3	i.	.....	Unc. Bavaria; Urals; Italy; Norway; Madagascar	8
V	if.	i.	.....	R. Urals: Siberia	9
D-E	if.	dec. HCl	.....	Unc. New Caledonia; N. Carolina	10
V	1.5	s.a.	decrepitates	Unc. Venezuela; Utah; Nevada; Wyoming	11
R, V	6(1450°C.)	gel. HCl	.....	R. Italy; Roumania; Mexico	12
M-A	if.	s. HCl	.....	R. Rakwana, Ceylon	13
R	if.	dec. HCl	.....	R. Pennsylvania; Spain; Ontario	14
M	ef.	s. h. HCl	decrepitates	R. Sweden; Spain; Tuscany	15
M	2	s. dil. a.	.....	R. Jerome, Arizona; Katanga, Belgian Congo	16
M	f.	dec. h. HNO_3	decrepitates	R. Ontario; Austria; Hessen-Nassau	17
V	if.	s. conc. H_2SO_4	.....	Unc. Urals; Norway; Brazil; Arkansas; Massachusetts; Pennsylvania	18
V, Pl	3	gel. HCl	intumesces	R. Italy; Bohemia; Westphalia	19
V	1.5	s. HCl	decrepitates; photoluminescent	Unc. Austria; Saxony; India; Spain; Chile; Arizona; California	20
M	f.	....	thermoelectric	R. Norway; Chile; Ontario; Arizona	21
D	ef.	may dec. HCl	.....	Unc. In marine sediments	22
V	2.5-3	dec. HCl	intumesces	Unc. Ireland; Scotland; Nova Scotia; New Jersey	23
sA	if.	s. HCl	streak: yellow	C. Crystals: Cornwall; common iron ore	24
M	1100°C	s.aq.reg	.....	Unc. Africa; Australia; S. America; Canada; Alaska; United States	25
.....	....	.....	0-3% Cer.	V.R. Brazil	26
V	if.	s. H_2O	dehydrates in air; diamagnetic	R. Schemnitz; Harz Mts.; France; Sweden; Montana; Utah	27
M, D, E	if.	i.	.....	C. Siberia; Finland; Ceylon; Mexico; New York	28
A-R	sublimes	s. HCl	.....	R. Scotland; New Jersey; Missouri; Arkansas; California	29
Sk	dec.	s.H_2O	.....	V.R. Peru	30
A-R	3(?)	gel. HCl	.....	V.R. Mte. Somma, Italy	31
M	....	.....	.....	R. Silverton, Colorado	32
G	if.	s. a.	.....	R. Saxony; Katanga, Belgian Congo; N. Carolina	33
Pl, sV, Sn	2.5-3	s. HCl	athermanous; (A) photoluminescent; colored by Ra	A. Switzerland; Mexico; Ohio; Utah; Michigan; California	34
V, Pl	2.5	s. HNO_3	.....	V. R. Bohemia; Baden	35
.....	4±	dec. HCl	.....	V.R. Found in the rock phonolite	36

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Halite	$NaCl$	C	2.5	2.1-2.6	1.5442η	—, W, pk, y, bl, r
2	Halloysite	$Al_2O_3 \cdot 2SiO_2 \cdot H_2O$	Am.	1-2	2.0-2.20	$1.47\text{-}1.52\eta$	W, gr, grn, y, bl, r
3	Halotrichite	$Al_2O_3 \cdot FeO \cdot 4SO_3 \cdot 22H_2O$	M	2	1.9	1.49	y
4	Hambergite	$Be_2(OH)BO_3$	R	7.5	2.347	1.588	GrW
5	Hanksite	$9Na_2SO_4 \cdot 2Na_2CO_3 \cdot KCl$	H	3-3.5	2.56	1.481ω	W
6	Hannayite	$H_4(NH_4)_2Mg(PO_4)_2 \cdot 8H_2O$	Tri. or M	soft	1.9	1.572	W, y
7	Hardystonite	$Ca_2ZnSi_2O_7$	Tet.	3-4	3.4	1.672ω	W
8	Harmotome	$(K_2, Ba)Al_2Si_5O_{14} \cdot 5H_2O$	M	4.5	2.44-2.50	1.505	W, Gr, Y, R, Br
9	Hatchettolite (Ra)	$U(Cb, Ta)O_3 \cdot H_2O$	C	5	4.8	1.98η	yBr
10	Hauerite	MnS_2	C	4	3.46	$2.69_{Li}\eta$	BrBlk
11	Hausmannite	Mn_3O_4	Tet.	5-5.5	4.71-4.85	$2.46_{Li}\omega$	brBlk
12	Haüynite	$3NaAlSiO_4 \cdot CaSO_4$	C	5.5-6	2.4-2.5	1.4961η	Bl, sky Bl, Gr, R Y, Br
13	Hedyphane	Ca variety of mimetite (5-15% CaO)	M?	4.5	5.404	1.948ω	YW
14	Hellandite	$Ca(Al, Y, Er, Fe \cdot OH)_3 Si_2O_8$	M	5.5	3.7	1.65	Br
15	Helvite	$3(Mn, Fe)BeSiO_4 \cdot MnS$	C	6-6.5	3.1-3.3	1.739η	honey Y, yBr, Grn, rBr
16	Hematite	Fe_2O_3	H	5.5-6.5	4.9-5.3	$3.042_{Li}\omega$	R, steel Gr, iron Blk
17	Hercynite	$FeO \cdot Al_2O_3$	C	7.5-8	3.95	1.800η	Blk
18	Herderite	$Be(OH, F) \cdot CaPO_4$	M	5	3	1.612	y, grnW
19	Hessite	Ag_2Te	C	2.5-3	8.3-8.5	.....	lead or steel Gr
20	Hielmite (Ra)	Stanno-tantalate, (columbate) of Y, U, Fe, Ca, Mn, H	R ?	5	5.82	$2.30_{Li}\omega$	Blk
21	Heulandite	$(Ca, Na_2)O \cdot Al_2O_3 \cdot 6SiO_2 \cdot 5H_2O$	M	3.5-4	2.1-2.2	1.499	W, R, Gr, Br
22	Högbomite	Chiefly $Al_2O_3 \cdot Fe_2O_3 \cdot MgO, TiO_2$	H	6.5	3.81	1.853ω	Blk
23	Homilite	$(Ca, Fe)_3(BO)_2(SiO_4)_2$	M	5.5	3.38	1.725	Blk, blk Br
24	Hopeite-α -β	$Zn_3P_2O_8 \cdot 4H_2O$	R	3.2	3.03	1.591 1.582	grW .....
25	Hübnerite	$MnWO_4$	M	5-5.5	7-7.5	2.22	brR
26	Huntilite	Ag_2As ?	Am.	2.5-3.5	7.5	.....	dGr, Blk
27	Hutchinsonite	$PbS \cdot (Tl, Ag)_2S \cdot 2As_2S_3$	R	1.5-2	4.6	3.176_{Na}	scarlet R
28	Hydromagnesite	$3MgCO_3 \cdot Mg(OH)_2 \cdot 3H_2O$	M	3.5	2.16	1.530	colorless
29	Hydrothorite (Ra)	Hydrous silicate of Th, alteration of mackintoshite	.....	1-2	.....	1.638η	p, pk, buff
30	Ianthinite (Ra)	$2UO_2 \cdot 7H_2O$ perhaps	R	....	.....	1.90	V, Blk
31	Ice	H_2O	H	1.5	0.918	1.309ω	—, W
32	Ilmenite	$FeO \cdot TiO_2$	H	5-6	4.5-5.1	.....	iron Blk
33	Ilvaite	$H_2O \cdot CaO \cdot 4FeO \cdot Fe_2O_3 \cdot 4SiO_2$	R	5.5-6	3.99-4.05	1.91	iron Blk, d.gr Blk
34	Iridium	Ir (Fe, Pt)	C	6-7	22.6-22.8	.....	silver W
35	Iridosmine	IrOs (Pt, Rh, Ru, etc.)	H	6-7	19.3-21.2	.....	tin W to steel Gr
36	Iron	Fe	C	4.5	7.3-7.8	.....	steel Gr, iron Blk

Luster	Fusibility	Solubility	Special Properties	Locality	
V	ef. (802°C)	s. H_2O	decrepitates; diathermanous; X-ray luminescent	A. World-wide; Stassfurt; crystd.: Sicily	1
Pl, W, D	if.	i.	index varies with H_2O	C. Common in clays	2
Sk	4.5-5	s. H_2O	.....	R. Bavaria; Italy; Chile; Mexico	3
V	if.	s. only HF	.....	V.R. Langesundfiord, Norway; Madagascar	4
V	1.5	s. H_2O	photo- and cathode-luminescent	R. Borax Lake, Death Valley, Calif.	5
V	f.	sl. s. HCl	.....	V.R. Victoria, Australia	6
.....	6	gel. HCl	photoluminescent: violet	V.R. Franklin, New Jersey	7
V	3.5	dec. HCl	no intumescence	Unc. Germany; Norway; Scotland; New York	8
W	if.	i.	.....	V.R. Mitchell County, N. Carolina; Hasting County, Ontario	9
R	3	s. HCl	X-ray: structure similar to pyrite; paramagnetic	R. Sicily; New Zealand; Czechoslovakia	10
sM	if.	s. HCl	X-ray: closely related to magnetite	R. Harz Mts.; Sweden; Brazil; Arkansas	11
V-G	4.5	s. HCl	.....	Unc. Mte. Somma; Germany	12
R	....	.....	photoluminescent: bluish gray	V.R. Vermland, Sweden; Franklin, N. J.	13
.....	ef.	s. HCl	40% E_2O_3	V.R. Telemark, Norway	14
V, R	3	s. HCl	X-ray: similar to sodalite; pyroelectric; intumesces	R. Ilmen Mts.; Saxony; Norway; Virginia	15
M, D, E	if.	s. HCl	streak: cherry red; cathode-luminescent	R. Urals; Switzerland; Island of Elba; Brazil	16
V, D	if.	i.	.....	R. Bohemia; Saxony; New York	17
V	df.	s. a.	thermophosphorescent	V.R. Saxony; Bavaria; Maine	18
M	f.	s. HCl	somewhat sectile	V.R. Altai Mts.; Roumania; Chile; California; Colorado	19
M	if.	i.	decrepitates; 1-6% E_2O_3	V.R. Kopparberg, Sweden	20
V, Pl	2-2.5	dec. HCl	.....	Unc. Iceland; Scotland; Switzerland; Harz Mts.; New Jersey	21
.....	if.	i.	.....	R. Lapland; Norway; microscopic from Virginia	22
W, V	2	gel. HCl	sometimes contains ceria earths, 0-2.6%	R. Langesundfiord, Norway	23
V	5	s.a.	New Jersey hopeite may contain Ga	R. Belgium; Germany; Rhodesia; Brit. Columbia; Franklin, N. J.	24
sM	4	dec. HCl	decrepitates	Unc. Peru; Missouri; S. Dakota; Colorado	25
M	....	.....	.....	V.R. Silver Islet, Lake Superior	26
.....	....	.....	.....	R. Binnental, Switzerland	27
V, Sk, sPl, E	if.	s.a.	.....	R. San Benito County, California	28
.....	...	s. h. a., flakes in H_2O	strongly radioactive	V.R. Wodgina, W. Australia	29
.....	....	.....	streak: brown-violet	V.R. Kasolo, Belgian Congo	30
V	0°C		diamagnetic	A. Polar regions; glaciers	31
M	if.	s. HCl	X-ray: similar to corundum	C. Norway; Ilmen Mts.; Urals; New York; Massachusetts	32
sM	2.5	gel. HCl	conducts electricity	C. Elba; Japan; Idaho	33
M	2300°C (?)		.....	V.R. Urals; Brazil; Burma; northern California	34
M	.....	s.aq.reg. i.aq.reg.	slightly malleable	V.R. Colombia; Urals; N. S. Wales; California; Oregon	35
M	1530°C	s. HCl	.....	V.R. W. Greenland; Germany; Ontario; in meteorites	36

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Ishikawaite (Ra)	Columbate, tantalate, U, Fe'', rare earths	R	5-6	6.2-6.4	.....	Blk
2	Jamesonite	$2PbS{\cdot}Sb_2S_3$	M	2-3	5.5-6	.....	steel Gr, d lead Gr
3	Joaquinite	Titano-silicate of Ca, Fe	R	....	.....	.....	honey Y
4	Johannite (Ra)	$(Cu,Fe,Na_2)O{\cdot}UO_3{\cdot}SO_3{\cdot}4H_2O$	Tri.	2	>3.3	1.59	grn Y, canary Y, Grn
5	Johnstrupite	$Na_2O{\cdot}3CaO{\cdot}Ce(F,OH)_3{\cdot}(Ti,Zr)O_2{\cdot}5SiO_2$?	M	4	3.29	1.666	brGrn
6	Julienite	Hydrated cobalt nitrate?	Tet.	....	1.594	1.556ω	Bl
7	Kainite	$KCl{\cdot}MgSO_4{\cdot}3H_2O$	M	3	2.1	1.505	W, d flesh R
8	Kalinite	$K_2SO_4{\cdot}Al_2(SO_4)_3{\cdot}24H_2O$	M	2-2.5	1.75	1.452	W
9	Kalkowskite	$(Fe,Ce)_2O_3{\cdot}4(Ti,Si)O_2$	.....	3-4	4.01	$>1.77\eta$	Blk, Br
10	Kaolin	Term now restricted to white or china clays	.....	....	.....	.....	.....
11	(a) Anauxite	$Al_2O_3{\cdot}2\pm SiO_2{\cdot}2H_2O$	M ?	+2.5	2.524	$1.565-1.561\alpha$	W
12	(b) Dickite	$Al_2O_3{\cdot}2SiO_2{\cdot}2H_2O$	M	+2.5	2.62	$1.562-1.560\alpha$	W
13	(c) Kaolinite	$Al_2O_3{\cdot}2\pm SiO_2{\cdot}2H_2O$	M ?	+2.5	2.59	$1.565-1.561\alpha$	W, yW, pale Green
14	(d) Nacrite	$Al_2O_3{\cdot}2SiO_2{\cdot}2H_2O$	M	+2.5	2.5	$1.562\ 1.557\alpha$	W
15	Kasolite (Ra)	$PbO{\cdot}UO_3{\cdot}SiO_2{\cdot}H_2O$	M	4-5	5.96	1.91	Y, Br
16	Kermesite	$2Sb_2S_3{\cdot}Sb_2O_3$	R or M	1-1.5	4.5-4.6	2.75π	cherry R
16.1	Kernite	$Na_2B_4O_7$	M	2.5	1.91	1.472	W, colorl.
17	Kieserite	$MgSO_4{\cdot}H_2O$	M	3.5	2.5-2.6	1.533	W, gr, Y
18	Kischtimite	Fluo-carbonate of Ce metals near parisite	.....	4.5	4.78	.....	y Br
19	Knopite	Near perovskite, plus Ce_2O_3, FeO	C	5.5	4.2	2.30η	Blk
20	Kochelite (Ra)	Columbate of Y, Zr, Th, Fe, SiO_2, Ca, H_2O, etc.	Tet.?	3.5	3.74	.....	Br, Y
21	Kolbeckite	Be phosphate or silico-phosphate	M ?	3.5-4	2.39	.....	Bl, Bl Gr
22	Koppite	$Ca_2Ta_2O_7$ + Ce, Na, Fe, F, etc.	C	5.5	4.5	2.15η	Br
23	Kyanite	$Al_2O_3{\cdot}SiO_2$	Tri.	5-7	3.6-3.7	1.722	Bl, W, Gr, Grn, Blk
24	Lanarkite	$Pb_2O{\cdot}(SO_4)$	M	2-2.5	6.4-6.8	1.99	grn W, p Y, Gr
25	Langite	$4CuO{\cdot}SO_3{\cdot}4H_2O$	R	2.5-3	3.49	1.760	Bl, grn Bl
26	Lanthanite	$(La,Di,Ce)_2(CO_3)_3{\cdot}8H_2O$	R	3	2.6-2.7	1.587	gr W, Pk, y
27	Larsenite	$PbZnSiO_4$	R	3	5.90	1.95	—, W
28	Laumontite	$(Ca,Na_2)Al_2Si_4O_{12}{\cdot}4H_2O$	M	3-4	2.2-2.4	1.524	W, y, gr R
29	Lavenite	Complex zirconium silicate with Mn, Ca, etc., F, Ti, Ta, etc.	M	6	3.5-3.6	1.750	Y, Br
30	Lawsonite	$H_4CaAl_2Si_2O_{10}$	R	7-8	3.1	1.674	p Bl, gr Bl
31	Lazulite	$(Fe,Mg)Al_2(OH)_2P_2O_8 \pm Ca$	M	5-6	3.1	1.634	azure Bl, p grn Bl
32	Lazurite	$3NaAlSiO_4{\cdot}Na_2S$	C	5-5.5	2.4-2.5	1.500η	berlin Bl, azure Bl

Luster	Fusibility	Solubility	Special Properties	Locality	
.....	....	.....	.....	V.R. Ishikawa, Japan	1
M	ef.	s.h.HCl	decrepitates; photoelectric	Unc. Czechoslovakia; England; Tasmania; Arkansas; S. Dakota	2
.....	....	.....	.....	R. Associated with benitoite; California	3
V	if.	s. a., s. H_2O	.....	V.R. Bohemia; Gilpin County, Colorado	4
V, R, G	3	s.HCl	13.5% Cer.; 1.1% Yttr.; 3.6% $ThO_2 + ZrO_2$; no Cl or NO_3 as first reported	V.R. Langesundfiord, Norway	5
.....	....	.....	.....	V.R. Katanga, Belgian Congo	6
V	1.5-2	s. H_2O	.....	R. Galicia; Stassfurt; northern Germany	7
V	1	s. H_2O	.....	Unc. Lipari Island; Vesuvius; Germany; S. America; Nevada; Maryland	8
sM	....	.....	streak: red-brown; may be identical with arizonite or pseudobrookite	V.R. Minas Geraes, Brazil	9
.....	....	.....	.....	....	10
.....	if.	sl. dec. HCl	X-ray: pattern as kaolinite	A. In kaolins: New York; New Jersey; Bilin, Bohemia; France	11
.....	if.	.....	intumesces; X-ray: distinct pattern	R. Anglesey, England; Chihuahua Mexico; Peru; Arkansas; Oklahoma; Iowa	12
Pl, E, A	if.	sl. dec. HCl	does not intumesce; X-ray: distinct pattern	C. In kaolins: Cornwall, England; N. Carolina; S. Carolina; Arizona	13
Pl	if.	.....	X-ray: distinct pattern; exfoliates	R. Brand, Saxony; Colorado	14
R, G	ef.	gel. s. a.	.....	V.R. Kasalo, Katanga, Belgian Congo	15
A	I: vol.517°C	.....	.....	R. Canada, France, Saxony	16
V, Sn	3	s. h. H_2O	intumesces	V.R. Kern Co., Calif.	16.1
V	2-3	s. H_2O	decrepitates	A. Germany; Poland; Austria; India	17
G, V	....	.....	74.2% Ce	V.R. Kyshtymsk, Urals	18
M	if.	s. HF	4-7% Ce	V.R. Alnö, Sweden; Brit. Columbia ?	19
dG	6	.....	17.22% Y.; 1.33% ThO_2	V.R. Kochelweise, Silesia	20
V, Pl	....	sl. s. a.	.....	V.R. Niederpöbel, Saxony	21
sA-V	if.	dec. H_2SO_4	4-10% Ce	V.R. Schelingen, Baden	22
V, Pl	if.	i.	above 1200°C changes to a mixture of mullite and silica	C. Urals; France; Massachusetts; Connecticut; N. Carolina	23
Pl, G	2	sl. s. dil. a.	photoluminescent	V.R. Lanark, Scotland; Harz Mts.; Austria; France	24
V	3.5	s. HCl	.....	V.R. Cornwall; Slovakia	25
D, Pl	if.	s. a.	54.9% Cer.	V.R. Sweden; New York; Pennsylvania	26
A	....	s. HNO	photoluminescent; pale violet	V.R. Franklin Furnace, N. J.	27
V, Pl	2.5-3	gel. HCl	swells up	Unc. Italy; Scotland; India; New Jersey; Michigan; Nova Scotia	28
V	f.	sl. s. HCl	.....	V.R. Läven, Norway; Brazil; French Guinea; Azores	29
V-G	4	i.	.....	R. California; Italy; France	30
V	if.	i.	.....	R. Austria; Madagascar; N. Carolina; Georgia	31
V	3	s. HCl	intumesces; Chile var. thermophosphorescent beetle-green	Unc. Ovalle, Chile; Persia; Turkestan; Kokcha	32

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Lead	Pb	C	1.5	11.4	2.01_{Na}	lead Gr
2	Leadhillite	$Pb(OH)_2 \cdot PbSO_4 \cdot 2PbCO_3$	M	2.5	6.2-6.4	2.00	W, Y, Grn, Gr
3	Lecontite	$(Na,NH_4,K)_2SO_4 \cdot 2H_2O$	R	2-2.5	1.63	1.452	colorless
4	Lessingite	Silicate Ca, rare earths	.....	4.5	4.7	1.785_Y	Grn-R Y
5	Leucite	$KAl(SiO_3)_2$	C at 600°C	5.5-6	2.45-2.50	1.508	W, Gr
6	Leucophanite	$(Ca,Na)_2BeSi_2(O,OH,F)_7$	R	3-4	2.96	1.595	grn Y
7	Leucosphenite	$Na_4Ba(TiO)_2(Si_2O_5)_5$	M	6.5	3.0	1.661	W
8	Levynite	$CaO \cdot Al_2O_3 \cdot 3SiO_2 \cdot 5H_2O$	H	4-4.5	2.1-2.2	1.496_ω	W, gr, r, y
9	Lewisite	$5CaO \cdot 2TiO_2 \cdot 3Sb_2O_5$	C	5.5	4.9	$2.2 \pm 0.01_\eta$	Y, Br
10	Libethenite	$4CuO \cdot P_2O_5 \cdot H_2O$	R	4	3.6-3.8	1.745	olive Grn
11	Limonite	Mixture of goethite and hematite, ± jarosite	.....	5-5.5	3.6-4.0	.....	.....
12	Linarite	$2CuO \cdot 5PbO \cdot 3SO_3 \cdot CO_2 \cdot 3H_2O$	M	2.5	5.3-5.5	1.838	d Bl
13	Linnaeite	$CoS \cdot Co_2S_3$	C	5.5	4.8-5.0	.....	p steel Gr, copper R
14	Lithomarge	Compact kaolin	.....	....	.....	.....	.....
15	Lithiophilite	$LiMnPO_4$	R	4.5-5	3.42-3.56	1.679	pPk, liver Br
16	Löllingite	$FeAs_2$	R	5-5.5	6.8-7.4	.....	silver W, steel Gr
17	Loparite	$(Na,Ce,Ca)_2(Ti,Cb)_2O_6$?	C ?	5.5	2.77	.....	Blk
18	Lorandite	$TlS \cdot As_2S_3$	M	2-2.5	5.53	$>2.72_{Li}$	cochineal R
19	Loranskite	Tantalate of Y, Ce, Zr, Fe, etc.	R	6	3.8-4.8	.....	Blk, Br, Y
20	Lorenzenite	$Na_2(TiO)_2Si_2O_7$ plus considerable ZrO_2	R	6	3.4	1.76-2.01	.....
21	Löweite	$2MgSO_4 \cdot 2Na_2SO_4 \cdot 5H_2O$	Tet.	3.5	2.4	1.490_ω	p Y
22	Ludwigite	$3MgO \cdot B_2O_3 \cdot FeO \cdot Fe_2O_3$	R	5	4.1	1.85	blk Gr, Blk
23	Mackintoshite (Ra)	$3ThO_2 \cdot 3SiO_2 \cdot UO_2 \cdot 3H_2O$?	Tet.	5.5	5.4	1.77_η	Blk
24	Magnesite	$MgCO_3$	H	3.5-4.5	3-3.1	1.717_ω	W, y, Br, gr W
25	Magnetite	$FeO \cdot Fe_2O_3$	C	5.5-6.5	5.16-5.18	$2.42_{Na\eta}$	iron Blk
26	Maitlandite (Ra)	Related to mackintoshite plus Pb, Ca	Am.	....	.....	.....	Blk
27	Malachite	$CuCO_3 \cdot Cu(OH)_2$	M	3.5-4	3.9-4.03	1.875	bright Grn
28	Malacon	Altered zircon with rare earths, Ca, Fe, H_2O	Tet.	6	3.9-4.1	1.826_η	—, br
29	Manandonite	$H_{24}Li_4Al_{14}B_4Si_6O_{53}$	R ?	....	2.89	1.6 ±	W, —
30	Manganite	$Mn_2O_3 \cdot H_2O$	R	4	4.2-4.4	2.24_{Li}	steel Gr, iron Blk
31	Manganosite	MnO	C	5-6	5.18	2.16_η	emerald Grn
32	Manganotantalite	$MnO \cdot Ta_2O_5$	R	6-6.5	7.3	2.29	Blk
33	Marcasite	FeS_2	R	6-6.5	4.85-4.9	.....	pale bronze Y
34	Margarite	$H_2CaAl_4Si_2O_{12}$	M	3.5-4.5	2.99-3.08	1.643	Grn, Pk, Y
35	Martite	Fe_2O_3	C	6-7	4.8-5.3	.....	iron Blk

Luster	Fusibility	Solubility	Special Properties	Locality	
M	1	sl. s. HNO_3	malleable	V.R. Sweden; Urals; Mexico; New Jersey; Idaho	1
G, A	1.5	s. HNO_3	rather sectile; photo-, cathode- and (R)-luminescent	R. Scotland; England; Missouri; Arizona; Utah	2
V	1	s. H_2O	.....	V.R. From bat guano, Las Piedras, Honduras	3
V	....	.....	22.48% Ce_2O_3;36.65% $(Di, La)_2O_3$	V.R. Stream pebbles, near Kychtym, Urals	4
V	if.	dec. HCl	.....	Unc. Vesuvius; Mte. Somma; Wyoming; Hawaii	5
V-G	6	s. HF	intumesces; thermo-luminescent	V.R. Langesundfiord, Norway	6
.....	6.5	dec. HF	.....	V.R. Narsarsuk, Greenland	7
V	2-2.5	gel. a.	intumesces	R. Ireland; Greenland; Colorado	8
.....	ef.	i.	.....	V.R. Mines Geraes, Brazil	9
G-R	2-2.5	s. HNO_3	.....	R. Urals; Slovakia; Cornwall; Chile; Arizona	10
.....	if.	s. HCl	.....	A. World-wide	11
V, A	1.5	sl. s. HNO_3	photoluminescent	R. Urals; Siberia; Spain; Scotland; Chile; Utah; California	12
M	f.	s. HNO_3	X-ray: structure practically identical in linnaeite, polydymite, sychnodymite	R. Westphalia; Katanga; Sweden; Maryland; Missouri	13
.....	....	.....	.....	....	14
V, R	1.5	s. HCl	sometimes decrepitates	R. Branchville, Connecticut; Maine; California	15
M	if.	s. HNO_3	.....	R. Lölling, Austria; Harz. Mts.; Maine; New York; Colorado	16
.....	....	.....	streak: red-brown	V.R. Kola, Russia	17
sM-A	1	s. HNO_3	.....	V.R. Macedonia; Rambler Mine, Wyoming	18
M	....	.....	10% Yttr.; 3% Cer.	V.R. Impilaks, Finland	19
.....	ef.	i. HCl	.....	V.R. Narsarsuk, Greenland	20
V	1	s. H_2O	.....	R. Salzburg, Austria	21
V, Sk	4	s. HCl	.....	R. Roumania; Montana; Utah	22
.....	if.	v. sl. s. a.	45.3% ThO_2; 1.9% E_2O_3	V.R. Llano, Texas	23
V, Sk, D	if.	s. h. HCl	photoluminescent	Unc. Greece; Austria; Norway; California; Nevada	24
M,sM	6	s. HCl	magnetic; sometimes polar, e. g., lodestone	A. Widespread; Sweden; Norway; New York; Pennsylvania; Arkansas	25
.....	....	.....	.....	V.R. Wodgina, W. Australia	26
A, V, Sk	2	s. a.	streak: green	C. Urals; Katanga; Bisbee, Arizona	27
V, sV	....	.....	2.6-3.4% Hf	V.R. Hitterö, Norway; Haute Loire, France; United States	28
Pl	ef.	dec. H_2SO_4	.....	V.R. Madagascar	29
sM	if.	s. HCl	.....	Unc. Harz Mts.; Cornwall; Michigan; Sweden	30
V	if.	s. a.	becomes black on exposure; photoluminescent, pale violet	V.R. Sweden; Franklin, N. J.	31
sM	if.	i.	.....	R. Western Australia	32
M	2.5-3	i. HCl s. conc. HNO_3	dec. in air (?); diamagnetic	C. Bohemia; Saxony; France; Missouri; Illinois; Iowa; Mexico	33
Pl, V	6	sl. dec. HCl	.....	Unc. Ural Mts.; Greece; Massachusetts; Pennsylvania; N. Carolina	34
sM	....	.....	Not or feebly magnetic	R. Saxony; France; Mexico; Brazil; New York; Michigan; Utah	35

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Mascagnite	$(NH_4)_2SO_4$	R	2	1.76	1.523	—, y, grn
2	Matlockite	$PbO{\cdot}PbCl_2$	Tet.	2-3	7.21	2.15ω	y, grn
3	Mauzeliite	Titano-antimonate Pb, Ca	C	6-6.5	5-11	.....	dBr
4	Medjidite (Ra)	$CaSO_4{\cdot}(UO_2)SO_4{\cdot}15H_2O$?	.....	2.5	.....	.....	d amber
5	Melanocerite	Complex silicate Ca, Ce, La, Di, Y, Ta, B, etc.	H	5-6	4.13	1.73ω	Br, Blk
6	Melanterite	$FeSO_4{\cdot}7H_2O$	M	2	1.89-1.9	1.478	Grn, W, y
7	Meliphanite	$NaF{\cdot}2CaO{\cdot}2BeO{\cdot}3SiO_2$	Tet.	5-5.5	3.0	1.612ω	Y
8	Melonite	$NiTe_2$	H	1-1.5	7.3	.....	rW
9	Mendelyeevite (Ra)	Ca urano-titano-columbate	C	....	.....	.....	Blk
10	Mendipite	$2PbO{\cdot}PbCl_2$	R	2.5-3	7-7.2	2.27	W
11	Mercury	Hg	H, -40° C.	....	13.55	.....	Tin W
12	Mesolite	$Na_2O{\cdot}Al_2O_3{\cdot}3SiO_2{\cdot}2H_2O$	M	5	2.29	1.505	W, —
13	Metatorbernite (Ra)	$Cu(UO_2)_2P_2O_8{\cdot}8H_2O$	Tet. ?	2.5	3.67	1.619-1.650ω	emerald or grass Grn
14	Metazeunerite (Ra)	$Cu(UO_2)_2As_2O_8{\cdot}8(?)H_2O$	Tet. ?	2-2.5	3.28	1.585ω	Grn
15	Miargyrite	$AgSbS_2$	M	2-2.5	5.1-5.3	$>2.72_{Li}$	iron Blk, steel Gr
16	Mica	.....	.....	....	.....	.....	.....
17	(a) Biotite	$H_2K(Mg,Fe)_3(Al,Fe)(SiO_4)_3$	M	2.5-3	2.7-3.1	1.574	Grn to Blk
18	(b) Lepidolite	$(HO,F)_2KLiAl_2Si_3O_{10}$	M	2.5-4	2.8-3.3	1.598	rose, V, Gr, lilac, y Grn, W
19	(c) Lepidomelane	Near biotite plus large amount of ferric iron	M	3	3.1	1.638	Blk, Br
20	(d) Muscovite	$H_2KAl_3(SiO_4)_3$	M	2-2.25	2.76-3	1.590	—, Gr, Br, pGrn, Y, V
21	(e) Paragonite	$H_2NaAl_3(SiO_4)_3$	M	3	2.78-2.9	1.60	y, grn, gr
22	(f) Phlogopite	$H_2KMg_3Al(SiO_4)_3$	M	2.5-3	2.78-2.85	1.606	yBr, brR, Grn, W
23	(g) Zinnwaldite	Lithium-iron mica	M	3	3±	1.60	Grn, V
24	Microlite (Ra?)	$Ca_2Ta_2O_7$ with Cb, F	C	5.5	5.5	1.93	pY, Br
25	Milarite	$K_2O{\cdot}4CaO{\cdot}4BeO{\cdot}Al_2O_3{\cdot}24SiO_2{\cdot}H_2O$	H	5.5-6	2.55-2.59	1.529-1.532	—, pGrn
26	Millerite	NiS	H	3-3.5	5.3-5.6	.....	brass Y
27	Mimetite	$3Pb_3As_2O_8{\cdot}PbCl_2$	H	3.5	7-7.25	2.135ω	pY, Br, O, W, —
28	Minium	Pb_3O_4	Crypt.	2-3	4.6	2.4_η	vivid R with Y
29	Mirabilite	$Na_2SO_4{\cdot}10H_2O$	M	1.5-2	1.481	1.396 pure	W
30	Moissanite	SiC	H	9.5	3.2	$2.654_{Na\omega}$	—, Grn, Bl, R, Blk
31	Molengraafite	Titano-silicate Ca, Na, Al	M	....	.....	1.74	yBr
32	Molybdenite	MoS_2	H	1-1.5	4.7-4.8	4.7_{Na}	lead Gr
33	Monazite	Essentially (Ce, La, Di) PO_4	M	5-5.5	4.9-5.3	1.788	hyacinth R, Br
34	Monticellite	$MgCaSiO_4$	R	5-5.5	3.1-3.3	1.66	—, Gr
35	Montmorillonite	$(Mg,Ca)O{\cdot}Al_2O_3{\cdot}5SiO_2{\cdot}nH_2O$ $n=5$-7	.....	soft	2±	1.560± 0.01	W, Pk, Gr, bl, Grn

Luster	Fusibility	Solubility	Special Properties	Locality	
V	1	s. H_2O	.....	V.R. Near volcanoes: Etna, Vesuvius, islands off Peru	1
A, Pl	1	s. h. HNO_3	decrepitates	V.R. Matlock, England; Greece; Chile	2
V-G	f.	i.	.....	V.R. Jacobsberg, Sweden	3
.....	....	s.a.	.....	V.R. Turkey	4
G, V	if.	dec. HCl	48% Cer.; 9.2% Yttr.; 2.0% ThO_2+ZrO_2	V.R. Kjeö Islands, Norway	5
V, D	1	s. H_2C	from dec. of pyrite, marcasite in air	C. Harz Mts.; Sweden; California	6
V	f.	i.	intumesces	V.R. Langesundfiord, Norway	7
M	f.	s. HNO_3	.....	V.R. Magnolia, Colo.; N. S. Wales; Melones Mine, California	8
.....	....	.....	.....	V.R. Sludianka, Transbaikalia	9
Pl-A	1	s. HNO_3	decrepitates	V.R. Mendip Hills, England; Brilon, Westphalia	10
M	vol.	s. HNO_3	crysts. at −40°C.; X-ray: shows rhombohedral structure	R. Idria, Italy; Mexico; with cinnabar	11
V	ef.	gel. HCl	X-ray: shows it to be intermediate, natrolite—scolecite	Unc. Scotland; Ireland; Pennsylvania; Colorado; Nova Scotia	12
.....	2.5	s. HNO_3	easily formed by dehydrn. of torbenite at 60°-65°C.	R. Cornwall; Spain	13
.....	....	.....	.....	R. Schneeberg, Saxony; Cornwall	14
A, M	1	dec. HNO_3	streak: cherry-red; photoelectric	R. Freiberg; Roumania; Idaho; Chile; Bolivia; Mexico; California	15
.....	....	.....	.....	.. ..	16
V, Pl, Sp	6	dec. H_2SO_4	.....	A. Vesuvius; Norway; New York; N. Carolina; Colorado	17
Pl	2.5	v. sl. s. HCl	intumesces	Unc. Urals; Saxony; Maine; Madagascar; California; Nevada	18
V, Pl	4.5-5	gel.	.....	C. Sweden; Norway; Ireland; Maryland; Maine; Connecticut	19
V, Pl	5.7	i.	.....	A. Most common mica; Switzerland; Pennsylvania; Virginia	20
Pl	6	i. HCl	.....	Unc. Switzerland; Saxony; Italy	21
Pl, sM	5	dec. H_2SO_4	.....	C. Ceylon; Italy; New York; Ontario	22
Pl	1.5-2	sl. s. HCl	.....	R. Saxony; Cornwall; Alaska; Greenland	23
V, G	if.	dec. H_2SO_4	8% E_2O_3	V.R. Sweden; Greenland; Maine; Virginia; Massachusetts	24
V	3	i.	.....	V.R. Switzerland	25
M	f.	s. HNO_3	capillary crysts. elastic	R. Bohemia; Westphalia; Wales; Iowa; Missouri; Ontario	26
R	1	s. HNO_3	.....	R. France; Saxony; Mexico; W. So. Africa; Pennsylvania; Utah	27
D, sG	1.5	.....	.....	Unc Altai Mts.; Germany; N. S. Wales; Idaho; Colorado	28
V	1.5	s. H_2O	effloresces rapidly	Unc. Austria; Bohemia; Utah	29
.....	if.	i. even in HF	dissociates at about 3400°C.	V.R. Found in the Canon Diable meteorite	30
.....	....	.....	.....	V.R. Transvaal, S. Africa	31
M	if.	dec. HNO_3	photoelectric	Unc. Norway; Australia; Maine; Pennsylvania; Ontario	32
R, A	if.	sl. s. HCl	49-74% Cer.; 1-4% Yttr.; 1-20% ThO_2	R Ilmen Mts.; France; Norway; Virginia; N. Carolina; Quebec	33
V	6	gel. HCl	.....	R. Italy; Arkansas; California	34
.....	if.	.....	.....	C. In bentonites; Maine; California; France; Ireland	35

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Mosandrite	Similar to johnstrupite	M	4	2.9-3.0	1.649	rBr
2	Mossite	$(Fe,Mn)[(Cb,Ta)O_3]_2$	Tet.	....	6.45	.....	Blk
3	Muromontite	var. allanite, rich in yttria earths, Be	M	7	4.263	.....	Blk,grn Blk
4	Nadorite	$PbSb_2O_4 \cdot PbCl_2$	R	3.5-4	7	2.35	brY
5	Naëgite (Ra)	Zircon with Y, Cb, Ta, U, Th oxides	Tet.	7.5	4.1	1.818η	Grn,Gr, Br
6	Nagatelite	Silicate, phosphate, Al, Ca, Fe, rare earths	M	5.5	3.91	1.760	Blk
7	Nagyagite	$10PbS \cdot Sb_2S_3 \cdot 2AuTe_3$ or $2AuS$	R	1-1.5	6.8-7.2	.....	blk lead Gr
8	Narsarsukite	$Na_6FeF\,Ti_2Si_{12}O_{32}$?	Tet.	7	2.7	1.609ω	honey Y
9	Natrolite	$Na_2O \cdot Al_2O_3 \cdot 3SiO_2 \cdot 2H_2O$	R	5-5.5	2.2-2.35	1.482	—,W,gr, yr,R
10	Natron	$Na_2CO_3 \cdot 10H_2O$	M	1-1.15	1.4	1.425	W
11	Naumannite	$(Ag_2Pb)Se$	C	2.5	6.5-7	.....	iron Blk
12	Neotantalite	$H_2O \cdot FeO, MnO, (Ta,Cb)_2O_5$ etc.	C	5-6	5.19	1.96η	clear Y
13	Nepheline	$(Na,K)AlSiO_4$	H	5.5-6	2.5-2.6	1.536-1.549ω	—,W,yd Grn, br, R,Blk
14	Neptunite	$(Na,K)_2(Fe,Mn)(Si,Ti)_5O_{12}$	M	5-6	3.23	1.70	Blk
15	Niccolite	NiAs	H	5-5.5	7.3-7.7	.....	p copper R
16	Nicolayite (Ra)	Related to mackintoshite plus Pb, Ca	Tet. ?	....	4.13	1.617η	Y
17	Niter	KNO_3	R	2	2.1	1.504	colorl.
18	Nitrobarite	$Ba(NO_3)_2$	C	1.5-2.5	3.244	1.5717	colorl.
19	Nitrocalcite	$Ca(NO_3)_2 \cdot nH_2O$	M	soft	1.90	1.498	W, Gr
20	Nitroglauberite	$6NaNO_3 \cdot 2Na_2SO_4 \cdot 3H_2O$	R	....	.....	1.500	.....
21	Nitromagnesite	$Mg(NO_3)_2 \cdot nH_2O$	M ?	....	.....	1.506	—, W
22	Nivenite (Ra)	Related to uraninite, higher UO_3	C	5.5	8.01	.....	velvet Blk
23	Nocerite	$Ca_3Mg_3O_2F_8$	H	....	2.96	1.509ω	W,—,br
24	Nohlite (Ra)	var. samarskite $+ H_2O$	.....	4.5-5.5	5.04	.....	brBlk
25	Nontronite	$H_4Fe_2Si_2O_9$	M ?	soft	2.5	1.58-1.65	pale straw Y, Y,grn
26	Noselite	$3Na_2Al_2Si_2O_8 \cdot Na_2SO_4$	C	5.5	2.25-2.4	$1.48\text{-}1.495\eta$	grn,bl,br
27	Octahedrite	TiO_2	Tet.	5.5-6	3.82-3.95	2.534-2.564ω	Br,Blk, indigo Bl
28	Oerstedite	Altered zircon	Tet.	5.5	3.629	.....	rBr
29	Oliveiraite	$3ZrO_2 \cdot 2TiO_2 \cdot 2H_2O$	Am.	....	.....	.....	yGrn
30	Olivenite	$4CuO \cdot As_2O_5 \cdot H_2O$	R	3	4.1-4.4	1.785-1.795	various Grn, Br, grW
31	Olivine	See chrysolite	.....	....	.....	.....	.....
32	Opal	$SiO_2 \cdot nH_2O$	Am.	5.5-6.5	1.9-2.3	1.406 $\pm$	various
33	Orangite (Ra)	var. thorite	Tet.	4.5-5	5.19-5.40	.....	OY
34	Orpiment	As_2S_3	M	1.5-2	3.4-3.5	$>2.72_{Li}$	lemon Y
35	Orthite	See allanite	.....	....	.....	.....	.....
36	Orvillite	Altered zircon	.....	....	.....	.....	.....
37	Pachnolite	$NaF \cdot CaF_2 \cdot AlF_3 \cdot H_2O$	M	3	2.98	1.413	colorl.
38	Palladium	Pd(Pt,Ir)	C	4.5-5	11.3-11.8	.....	w steel Gr

Luster	Fusibility	Solubility	Special Properties	Locality	
V, G	3	s. HCl	.....	V.R. Langesundfiord region, S. Norway	1
M	....	.....	.....	V.R. Norway; Black Hills, N. Dakota	2
V, G	....	.....	9.1% Ce; 37.1% Y	V.R. Mauersberg, Erzgebirge, Saxony	3
A, G	1.5	s. HCl	.....	V.R. Constantine, Algeria	4
.....	....	.....	9.12% Yttr.; 5% ThO_2; 3.5% Hf	V.R. Mino, Japan	5
R	.....	s. HCl	7.84% La; 4.51% Yttr.; 14.58% Ce_2O_3; 0.88% ThO_2	V.R. Nagatejima, Japan	6
M, Sp	vol.	dec. HNO_3	streak: as color	R. Transylvania; Roumania; Colorado; New Zealand	7
.....	ef.	s. only HF	.....	A. Narsarsuk, Greenland	8
V, Pl	2	gel. a.	X-ray: confirms orthorhombic symmetry; pyroelectric	Unc. Bohemia; Italy; France; New Jersey; Arkansas; Nova Scotia; British Columbia	9
V, E	in nature, occurs only in solution		.....	Unc. Soda lakes of Egypt; Nevada; California	10
M	1	sl. s. HNO_3	very sectile; malleable	R. Harz Mts.; Idaho	11
.....	....	.....	....	V.R. With kaolin: Allier, France	12
G, V	3.5	gel. a.	.....	Unc. Ilmen Mts.; Norway; Greenland; Maine; Ontario	13
V, M, G	2.5	i. HF	streak: cinnamon brown	R. Greenland; California	14
M	2	s. aq. reg.	X-ray: niccolite, breithauptite, hexagonal, closely related	R. Saxony; Hessen-Nassau; Ontario; Colorado; New Jersey	15
.....	....	.....	.....	V.R. Wodgina, W. Australia	16
V	1	s. H_2O	deflagrates violently	R. Chile; India; in caves, Kentucky; Tennessee; Missouri	17
V	ef.	s. H_2O	decrepitates; pyroelectric	V.R. Chile	18
Sk	ef.	s. H_2O	.....	V.R. Kentucky limestone caves; Norway	19
.....	.....		*	V.R. Taltal, Chile	20
V	ef.	s. H_2O	.....	R. Efflorescences in limestone caves	21
sM	if.	s. dil. a.	.....	V.R. Llano, Texas	22
Sk	....	.....	.....	V.R. Nocera, Italy	23
V	6	dec. H_2SO_4	decrepitates	V.R. Nohl, Sweden	24
W, E	if.	gel. HCl	.....	R. Nontron, France; Germany; Pennsylvania; Nevada	25
V	5	gel. HCl	.....	Unc. Germany; Italy; Canary and Cape Verde Islands	26
A, sA	if.	i.	.....	R. Switzerland; France; England; Brazil; Arkansas; Colorado; Massachusetts	27
A, Sp	....	.....	.....	R. Norway	28
.....	....	.....	.....	V.R. Minas Geraes, Brazil	29
A, V	2-2.5	s. HNO_3	deflagrates; decrepitates	Unc. Cornwall; S. W. Africa; Utah	30
.....	....	.....	.....	... .	31
V	if.	s. HF	decrepitates; photoluminescent	C. N. S. Wales; Queensland; Mexico; Nevada	32
G	....	.....	.....	V.R. Sweden; Madagascar	33
Pl, R, D	1 (320°C)	s. H_2SO_4	Wholly volatile	Unc. Japan; Utah; Nevada	34
.....	....	.....	.....	....	35
.....	....	.....	0.5-0.7% Hf	V.R. Minas Geraes, Brazil	36
V	1.5	s. H_2SO_4	.....	R. Greenland; Colorado; Ural Mts.	37
M	Pd: 1550°C	s. aq. reg.	.....	R. Brazil; Ural Mts.; N. Carolina	38

* Synthetic studies show this not possible; in nature: probably a mixture of darapskite and soda niter

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Parisite	$[(Ce,La,Di)F]_2Ca(CO_3)_3$	H	4-5	4.358	1.676ω	brY
2	Parsonsite(Ra)	$2PbO{\cdot}UO_3{\cdot}P_2O_5{\cdot}H_2O$	M or Tri.	....	6.23	1.85α	p Br
3	Patronite	Complex, perhaps VS_4	Am.	....	.....	.....	Blk
4	Pectolite	$4CaO{\cdot}Na_2O{\cdot}6SiO_2{\cdot}H_2O$	M	5	2.74-2.88	1.606	w,gr
5	Periclase	MgO	C	5.5-6	3.64-3.9	1.736η	colorl.
6	Perovskite	$CaTiO_3$	C or R	5.5	4	2.38	pY,OY, rBr, grBlk
7	Petalite	$Al_2O_3{\cdot}Li_2O{\cdot}8SiO_2$	M	6-6.5	2.39-2.46	1.510	—,W,Gr, rW,grnW
8	Petzite	$(Ag,Au)_2Te$ [Ag:Au = 3:1]	C	2.5-3	8.7-9.0	.....	steel Gr, iron Blk
9	Pharmacolite	$HCaAsO_4{\cdot}2H_2O$	M	2-2.5	2.6-2.73	1.589	W,gr,r
10	Pharmacosiderite	$6FeAsO_4{\cdot}2Fe(OH)_3{\cdot}12H_2O$	M ?	2.5	2.9-3.0	1.676η 1.693β	Grn,yBr
11	Phenakite	$2BeO{\cdot}SiO_2$	H	7.5-8	2.97-3.0	1.6540ω	—,pY,Br, p. rose
12	Phillipsite	$(K_2,Ca)Al_2Si_4O_{12}{\cdot}4½H_2O$	M	4-4.5	2.2-2.4	1.500	W,r
13	Phoenicochroite	$3PbO{\cdot}2CrO_3$	R	3-3.5	5.78	2.38	cochineal R
14	Phosphuranylite (Ra)	$(UO_2)_3P_2O_8{\cdot}6H_2O$	M ?	....	3.0	1.720	d lemonY
15	Pickeringite	$MgSO_4{\cdot}Al_2(SO_4)_3{\cdot}22H_2O$	M	1	1.85	1.480	—, Y, R
16	Picotite	$MgO{\cdot}Al_2O_3$ + Fe, 7% CrO_3	C	8	4.1 ±	2.05 ± η	d yBr, grnBr
17	Picromerite	$K_2O{\cdot}MgO{\cdot}2SO_3{\cdot}6H_2O$	M	2-2.5	2.15	1.462	colorl.
18	Pilbarite (Ra)	$ThO_2{\cdot}UO_2{\cdot}2SiO_2{\cdot}PbO{\cdot}4H_2O$	Am.	3	4.6	1.74 ± η	canary Y
19	Pisekite (Ra)	Columbate, titanate of U and rare earths	Am.	5.5-6	4.032	.....	y, Blk
20	Pitchblende (Ra)	Massive, amorphous or cryptocrystalline uraninite	.....	3-4	5-6.5	.....	Blk
21	Plagionite	$5PbS{\cdot}4Sb_2S_3$	M	2-3	5.5	.....	blk lead Gr
22	Platinum	Pt(Ir,Pd,Rh,Os,Cu)	C	4-4.5	14-19	.....	w steelGr
23	Plumbogummite	$PbAl_3(OH)_7P_2O_7$	H	4-5	4-5	1.65-1.67η	y,br
24	Plumboniobite (Ra)	Columbate of Y,U,Pb, Fe,etc.	Am.	5-5.5	4.81	.....	dBr,Blk
25	Pollucite	$2Al_2O_3{\cdot}2Cs_2O{\cdot}9SiO_2{\cdot}H_2O$	C	6.5	2.87-2.99	1.525η	colorl., W
26	Polybasite	$9Ag_2S{\cdot}Sb_2S_3$	M	2-3	6-6.2	>2.72	iron Blk
27	Polycrase (Ra)	Columbate, titanate, Y, Er, Ce, U	R	5-6	4.97-5.04	1.70η	Blk
28	Polydymite	Ni_3S_4	C	4.5	4.5-4.8	.....	Gr
29	Polyhalite	$2CaSO_4{\cdot}MgSO_4{\cdot}K_2SO_4{\cdot}2H_2O$	Tri.	2.5-3	2.78	1.562	flesh R, brick R
30	Polymignite	$4(Ca,Ce,Fe)O{\cdot}(Ti,Zr)O_2{\cdot}CaO{\cdot}Cb_2O_5$	R ?	6.5	4.8	2.215η	Blk
31	Porpezite	Au + 7-11 % Pd	C	....	11-15	.....	.....
32	Potash alum	$K_2SO_4{\cdot}Al_2(SO_4)_3{\cdot}24H_2O$	C	2	1.76	1.456η	colorl.
33	Powellite	$Ca(Mo,W)O_4$	Tet.	3.5	4.349	1.974ω	Y
34	Prehnite	$2CaO{\cdot}Al_2O_3{\cdot}3SiO_2{\cdot}H_2O$	R	6-6.5	2.8-2.95	1.626	Grn,pGrn, W, Gr
35	Priceite	$5CaO{\cdot}6B_2O_3{\cdot}9H_2O$	Tri.	3-3.5	2.43	1.591	snow W
36	Priorite (Ra)	Columbate, titanate, Y, Er, Ce, U [Cb_2O_5:TiO_2 = 1:2]	R	5.5	4.8-4.9	.....	brBlk

Luster	Fusibility	Solubility	Special Properties	Locality	
S, Pl	if.	s. HCl	50.8-64.4 % Cer.; 0-2.5 % Yttr.; thermoluminescent	R. Colombia; S. Greenland; Italy; Massachusetts; Montana	1
E	f.	s. a.	.....	V.R. Kasolo, Katanga, Belgian Congo	2
.....	.....	.....	.....	V.R. Cerro de Pasco, Peru	3
sV, Sk	2	gel. HCl	triboluminescent; photoluminescent, yellow	Unc. Italy; Scotland; New Jersey; Michigan; Arkansas	4
V	if. (2800°C)	s.a.	.....	R. Mte. Somma; Vesuvius; Sweden; California	5
A, M	if.	dec. h. H_2SO_4	.....	R. Ural Mts.; Baden; Switzerland; Italy	6
V, Pl	5	s. HF	thermophosphorescent, blue	R. Sweden; Massachusetts; Maine	7
M	f.	sl.s.HCl	slightly sectile	R. Roumania; W. Australia; Colorado; California	8
V	2.5	s. a.	intumesces	R. Germany; France	9
A, G	1.5-2	s. HCl	pseudo isometric; pyroelectric	Unc. Czechoslovakia; France; Cornwall; Utah	10
V	if.	i.	.....	R. Ural Mts ; Brazil; Maine; New Hampshire; Colorado	11
V	3	gel. HCl	.....	R. Germany; Italy; Ireland; ocean sediments	12
R, A	ef.	s. HCl	.....	V.R. Beresovsk, Ural Mts.	13
Pl	3(?)	s. HCl	.....	V.R. Mitchell County, N. Carolina	14
Sk	1	s. H_2O	.....	R. Chile; New Mexico; Nova Scotia	15
A	if. (2135°C)	v. sl. s. H_2SO_4	.....	V.R. Rocklin, California	16
V	2	s. H_2O	.....	R. Italy; Saxony; Poland	17
R	.....	s. a.	31.3 % ThO_2	V.R. Pilbara, W. Australia	18
.....	.....	.....	.....	V.R. Pisek, Czechoslovakia	19
R	....	.....	contains no thoria or E_2O_3	R. Germany; Bohemia; Colorado; Canada	20
M		as zinkenite	.....	R. Wolfsberg, Harz Mts.; Bavaria; France	21
M	if.	s. h. aq. reg.	sometimes magnetic, and may show polarity	R. Colombia; Ural Mts.; S. Africa; California	22
R	2(?)	s. HNO_3	.....	V.R. Cumberland, England; Georgia	23
Pitchy	....	.....	14.3 % Y	V.R. Tanganyika, E. Africa	24
V	6	dec. a.	.....	R. Island of Elba; Hebron, Maine	25
M	1	dec. HNO_3	photoelectric	R. Czechoslovakia; Harz Mts.; Chile; Mexico; Nevada; Idaho	26
V.R.	if.	dec. H_2SO_4	19-33 % Y; trace of Ce, ThO_2	R. Norway; Sweden; N. Carolina; S. Carolina;	27
M	f.	i. HCl, s. HNO_3	decrepitates	V.R. Germany; Ontario ?	28
G	1.5	sl. s. H_2O	.....	Unc. Austria; Germany	29
sM, Sp	if.	dec. a.	2.2-21.5 % Y; 3.9 % ThO_2; 0.6 % Hf; 0-11 % Ce	V.R. Norway; Siberia	30
M	....	.....	.....	V.R. Porpez, Brazil	31
V	1	s. H_2O	see also Kalinite	R. Esmeralda County, Nev.; Imperial Valley, Calif.	32
R	4	dec. a.	.....	V.R. Siberia; Michigan; Idaho; Texas; Utah	33
V	2	dec. HCl	intumesces; pyroelectric	Unc. Italy; Harz Mts.; Scotland; Massachusetts; New Jersey Michigan	34
.....	f.	s. HCl	.....	V.R. Oregon; California; Turkey	35
.....	....	.....	.....	V.R. Swaziland, S. Africa; Madagascar	36

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Pseudobrookite	Fe_2TiO_5	R	6	4.4-4.98	2.39_{Li}	dBr, Blk
2	Psilomelane	Colloidal MnO_2 adsorbing $(Ba,K_2,Na_2)O,H_2O$	Am.	5-7	3.3-4.7	.....	iron Blk
3	Pucherite	$Bi_2O_3 \cdot V_2O_5$	R	4	6.25	2.50	rBr
4	Pyrargyrite	$3AgS \cdot Sb_2S_3$	H	2.5	5.77-5.86	3.084ω	Blk, gr Blk
5	Pyrite	FeS_2	C	6-6.5	4.95-5.10	.....	p brass Y
6	Pyrobelonite	$4(Mn,Pb)O \cdot V_2O_5 \cdot H_2O$	R	3.5	5.377	2.36	fire R
7	Pyrochlore	$(Na,Ca)_2(Cb,Ti)_2(OF)_7$, (suggested by X-ray studies)	C	5-5.5	4.2-4.36	$1.96\text{-}2.02\eta$	Br, dr, blk Br
8	Pyrolusite	$MnO_2 + 2\%H_2O$	R	2-2.5	4.73-4.86	.....	iron Blk
9	Pyromorphite (Ra?)	$3Pb_3P_2O_8 \cdot PbCl_2$	H	3.5-4	6.5-7.1	2.050ω	Grn, Y, Br
10	Pyrophanite	$MnTiO_3$	H	5	4.537	2.481ω	d blood R
11	Pyrophyllite	$Al_2O_3 \cdot 4SiO_2 \cdot H_2O$	R	1-2	2.8-2.9	1.588	W, Grn, gr Y, brGrn
12	Pyroxene	.....	.....	....	.....	.....	.....
13	(a) Acmite	$NaFe'''(SiO_3)_2$	M	6-6.5	3.50-3.55	1.803 ± 0.003	br, rBr, Grn
14	(b) Augite	$CaMg(SiO_3)_2$ with $(Mg,Fe)(Al,Fe)_2SiO_6$	M	5-6	3.2-3.6	1.704	Blk, Br, Grn
15	(c) Babingtonite	$(Ca,Fe,Mn)SiO_3 \cdot Fe_2(SiO_3)_3$	Tri.	5.5-6	3.35-3.37	1.726	grnBlk, br Blk
16	(d) Bronzite	$(Mg,Fe)SiO_3$	R	5.5	3.3-3.5	1.685	olive Grn, Br
17	(e) Clinoenstatite	$MgSiO_3$	M	6	3.19	1.654	—, Y
18	(f) Diopside	$CaMg(SiO_3)_2$	M	5-6	3.2-3.38	1.680	—, Grn
19	(g) Enstatite	$MgSiO_3$	R	5.5	3.1-3.3	1.669	Grn, y Grn
20	(h) Hedenbergite	$CaFe(SiO_3)_2$	M	5-6	3.5-3.58	1.745	Blk
21	(i) Hypersthene	$(Fe,Mg)SiO_3$	R	5-6	3.40-3.5	1.702	d brGrn, grnBlk Br
22	(j) Jadeite	$NaAl(SiO_3)_2$	M	6.5-7	3.3-3.5	1.659	Greens
23	(k) Rhodonite	$MnSiO_3$	Tri.	5.5-6.5	3.4-3.68	1.730-1.740	flesh R, rose, grn, y
24	(l) Spodumene	$LiAl(SiO_3)_2$	M	6.5-7	3.13-3.20	1.666	grnW, grW, y Grn, Y, Pr
25	Pyrrhotite	$Fe_5S_6\text{-}Fe_{16}S_{17}$	H	3.5-4.5	4.58-4.64	.....	bronze Y
26	Quartz	SiO_2	H	7	2.653	1.54418ω	varied; W to Blk
27	(a) Cristobalite	SiO_2	Tet.?	6-7	2.27	1.486 1.487ω	W
28	(b) Tridymite	SiO_2	H?	7	2.28-2.33	1.47	—, W
29	Ralstonite	$3Al(OH,F)_3 \cdot (Na_2,Mg)F_2 \cdot 2H_2O$	C	4.5	2.6	1.43η	—, W
30	Rammelsbergite	$NiAs_2$	R	5.5-6	6.9-7.2	.....	tin W

Luster	Fusibility	Solubility	Special Properties	Locality	
V	if.	dec. H_2SO_4	streak: ocher yellow	R. Norway; Roumania; Italy; France; Spain	1
D,sM	d. f.	s. HCl	X-ray: shows that material included under this name may be one of several substances	Unc. Saxony; Brazil; India	2
V,A	2	s. HCl	decrepitates	V.R. Saxony; Brazil; California	3
M,A	1	dec. HNO_3	photoelectric	Unc. Harz Mts.; Chile; Nevada; Idaho; Cobalt, Ontario	4
M	2.5-3	i. HNO_3. powd. s. HNO_3	X-ray: structure similar to fluorite, but of lower symmetry class; thermoelectric	A. Widespread	5
E, sM, A	....	s. HNO_3	.....	R. Vermland, Sweden	6
V-R	if.	dec. H_2SO_4	B. B. becomes yellowish-green, hence its name; 18% E_2O_3; trace Hf	V.R. Norway; Ilmen Mts.; Tasmania; Urals	7
M	if.	s. HCl	X-ray: same structure as polianite, which is apparently only cryst. form of MnO_2	C. Widespread; Germany; India; Brazil; United States	8
R	1.5	s. HNO_3	photo-, cathode- and (R) luminescent; thermoelectric	R. Urals; Czechoslovakia; France; N. S. Wales; Pennsylvania; Idaho; S. Africa	9
V,sM	if.	s. HCl	streak: ocher yellow	V.R. Sweden; Brazil	10
Pl, G	6	sl. dec. H_2SO_4	B. B. fuses after much change in volume	C. Urals; Sweden; Switzerland; N. Carolina; Georgia; S. Carolina; California	11
.....	....	.....	.....	....	12
V, sR	2	v. sl. s. a.	.....	R. Norway; Magnet Cove, Arkansas	13
V	3	i.	.....	A. Bohemia; Italy; Finland; Utah; Hawaiian Islands	14
V	3	i.	.....	V.R. Mt. Tom, Massachusetts; New Jersey; Norway; Italy	15
A, P, sM	6	i. HCl	.....	Unc. Austria; Bavaria	16
V	if.	i.	.....	R. Rare in igneous rocks and meteorites	17
V	if.	i.	paramagnetic	Unc. Italy; Austria; Sweden; Connecticut; Massachusetts	18
P, V, sM	6	i. HCl	.....	Unc.	19
V	3.5-4	i. HCl	.....	R. Sweden	20
Pl, sM	5	i.a.	.....	Unc. Bavaria; Norway; Canada	21
sV, Pl	2.5	i.	.....	V.R. Burma; Tibet; New Zealand; Mexico	22
V, Pl	2.5	sl. s. HCl	(A) photoluminescent	V.R. Urals; Italy; Sweden; N.S. Wales; Massachusetts; New Jersey	23
V, Pl	3.5	i.	.....	R. Sweden; Madagascar; Brazil; Maine; N. Carolina; California	24
M	1170°C.	dec. HCl	.....	C. Austria; Germany; France; Ontario; Norway; Brazil; Tenn.	25
V	if.	s. only HF	See Note.	A World-wide	26
D	if.	i.	.....	Unc. Mexico; California; on lavas and meteorites	27
V, Pl	if.	s. h. Na_2CO_3	.....	Unc. Mexico; Germany; France; Japan; Wyoming; Washington	28
V	if.	dec. H_2SO_4	.....	V.R. Ivigtut, Greenland; Colorado; Japan	29
M	2	s. aq. reg.	.....	Unc. Austria; Saxony; Franklin, N. J.; Cobalt, Ontario	30

NOTE: circular polarization; X-ray: complicated structure; pyro- and piezo-electric.

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Randite (Ra)	$Ca_5U_2C_6O_{20}\cdot 3H_2O$	.....	2-3	.....	.....	canary Y
2	Raspite	$PbWO_4$	M	2.5	8.46	2.27	brY
3	Rauvite (Ra)	$CaO\cdot 2UO_3\cdot 6V_2O_5\cdot 20H_2O$	.....	....	.....	1.88η	pBlk,
4	Realgar	AsS	M	1.5-2	3.4-3.6	2.68	aurora R, OY
5	Renardite (Ra)	$PbO\cdot 4UO_3\cdot P_2O_5\cdot 9H_2O$	R	....	4.0	1.736	Y
6	Retzian	Basic arsenate Y, Ce, Mn, Ca, H	R	4	4.15	1.788	Br
7	Rhabdophanite	$(La,Di,Y,Er)PO_4\cdot H_2O$	Tet. or H	3.5	4	1.654ω	Br,pk,yW
8	Rhodium gold	30—45% Rh + Au	C	....	15.5-16.8	.....	.....
9	Rhodizite	$(K,Na,Li)_8Be_7Al_6B_{14}O_{39}$?	C	8	3-3.4	1.69η	W
10	Rhodochrosite	$MnCO_3$	H	3.5-4.5	3.4-3.6	1.820ω	rose R, Pk, Br, dR
11	Rinkite	$3NaF\cdot 4CaO\cdot 6(Si,Ti)O_2\cdot Ce_2O_3$	M	5	3.46	1.688	Y,Br
12	Rinkolite	Titano-silicate of Ce, Ca,Sr, Na	M	5	3.4	1.645-1.667	Br, Grn, Y
13	Risörite (Ra)	$Y(Ta,Cb)O_4 \pm$ Ce, Ca, Er, etc. + Ti	Tet.	5.5	4.18	2.05 $\pm \eta$	YBl
14	Roeblingite	$2PbSO_4\cdot H_{10}Ca_7(SiO_4)_6$	R	3	3.433	1.64	W
15	Rogersite (Lausenite)	$Fe_2O_3\cdot 3SO_3\cdot 6H_2O$?	M	3.5	3.313	1.628	W, colorl.
16	Rogersite	Hydrated yttria columbate	Am.	3.5	3.313	.....	W
17	Roscoelite	Muscovite with part of Al replaced by V	M	2.5	2.97	1.685	clove Br, grnBr
18	Roselite	$3(Ca,Co,Mg)_3As_2O_8\cdot 2H_2O$	Tri.	3.5	3.5-3.6	1.725	p rose R to d rose R
19	Rosenbuschite	$Na_2Ca_3(Si,Ti,Zr)_4O_{12}$	M	5-6	3.3	1.687	O,Gr
20	Rossite	$CaO\cdot V_2O_5\cdot 4H_2O$	Tri.	2-3	2.45	1.770	Y
21	Rowlandite	$Fe(Y,Ce,La)_2(YF)_2Si_4O_{14}$	C	6-7	4.5	1.725η	drab Gr
22	Rutherfordite (Ra)	UO_2CO_3	R ?	soft	4.8	1.72-1.80η	ocher Y
23	Rutile	TiO_2	Tet.	6-6.5	4.18-4.25	2.6158ω	rBr, Blk, R, blV
24	Safflorite	$CoAs_2$ + Fe, Ni	R	4.5-5	6.9-7.3	.....	tin W
25	Sal ammoniac	NH_4Cl	C	1.5-2	1.528	1.639η	W
26	Samarskite (Ra)	$R_3''R_2'''(Cb,Ta)_6O_{21}$ R'' = Fe, Ca, UO_2 R''' = Ce, Y, etc.	R	5-6	5.6-5.8	2.21η	velvet Blk
27	Samiresite (Ra)	Columbate, titanate U, Pb, etc.	C	....	5.24	1.92-1.96η	gold Y
28	Sanidine	Glassy orthoclase	M	6	2.57-2.58	.....	.....
29	Sapphirine	$5MgO\cdot 6Al_2O_3\cdot 2SiO_2$	M	7.5	3.42-3.48	1.709	pBl, Grn
30	Sassolite	$B_2O_3\cdot 3H_2O$	Tri.	1	1.44-1.48	1.456	W
31	Scheelite	$CaWO_4$	Tet.	4.5-5	5.9-6.1	1.918ω	W,yW,br, pY, grn, r
32	Schorlomite	$3CaO\cdot(Fe,Ti)_2O_3\cdot 3(Si,Ti)O_2$	C	7-7.5	3.8	1.9-2.0η	Blk
33	Schroeckeringite (Ra)	Hydrous U carbonate	M	soft	.....	1.685	grn, Y
34	Scolecite	$CaO\cdot Al_2O_3\cdot 3SiO_2\cdot 3H_2O$	M	5-5.5	2.16-2.4	1.519	—, W, Y

Luster	Fusibility	Solubility	Special Properties	Locality	
V	if.	s. HCl	.....	V.R. Frankford, Penn.	1
A	2.5-3	dec. HCl	.....	V.R. Broken Hills, N. S. Wales; Minas Geraes, Brazil	2
E	....	.....	apparently metacolloidal	R. Temple Mt., San Rafael Swell, Utah	3
R	1	s. caustic alkalies	burns: blue flame; disintegrates on exposure to light to mixt. of As_2S_3 + As_2O_3	Unc. Roumania; Switzerland; Japan; Wyoming; Utah; Nevada	4
.....	....	.....	.....	V.R. Kasolo, Katanga, Belgian Congo	5
.....	if.	s. a.	8-11 % Cer. + Yttr.	V.R. Vermland, Sweden	6
G	if.	s.a.	resembles brown sphalerite; 53-57 % Cer.; 2-10 % Yttr.	V.R. Cornwall, England; Scoville, Connecticut	7
M	....	.....	.....	V.R. Colombia; Mexico (?)	8
V	if.	i.	heat does not make crysts. isotropic	V.R. Urals; Madagascar	9
V, Pl	if.	s. h. HCl	decrepitates strongly; photoluminescent	Unc. Roumania; Germany; Cornwall; New Jersey; Colorado; Nevada	10
V	if.	dec. H_2SO_4	.....	V.R. Greenland in the Julianehaab district	11
.....	....	.....	21 % Cer.; 0.4-1.4 % Yttr.	V.R. Kola, Russia	12
V	if.	s. H_2SO_4	X-ray: tetragonal structure 2.9-40 % Cer.; 37 % Yttr.	V.R. Risör, Norway	13
.....	3	gel. a.	photoluminescent: pale pink	V.R. Franklin, N. J.	14
Sk	....	.....	.....	V.R. Formed under fumarolic conditions during fire; United Verde mine, Arizona	15
.....	....	.....	60.12 % Y.	V.R. Mitchell County, N. Carolina	16
Pl	3(?)	i.a.	.....	R. California; Colorado; W. Australia	17
V	3	s. a.	.....	V.R. Schneeberg, Saxony	18
V	ef.	s. HCl	0.3-2.4 % Cer.; 0.3 % Hf	V.R. Langesundfiord, Norway; Red Hill, N. H.	19
Pl, V	....	.....	.....	V.R. Bull Penn Canyon, Colorado	20
V	if.	gel. HCl	14.5 % Cer.; 47.7 % Yttr.; 0.6 % ThO_2	V.R. Llano County, Texas	21
V, R	....	s. a.	.....	R. Uluguru Mts., East Africa	22
sM, A	if.	i.	.....	C. Germany; Switzerland; Brazil; Virginia; N. Carolina; Georgia; Pennsylvania	23
M	like smaltite		.....	R. Germany; Sweden; Quebec	24
V	1.5-2	s. H_2O	reversible inversion at 156°C., with volume increase, but no change in symmetry	Unc. About volcanic fumaroles: Etna, Vesuvius, etc.	25
sM, R, V	6	v. sl. s. a.	decrepitates; 7 % ThO_2 + ZrO_2; 1.2-6.4 % Cer.; 4-21 % Yttr.	R. Ilmen Mts.; Madagascar; N. Carolina; Ontario	26
.....	....	.....	.....	V.R. Samiresy, Madagascar	27
V	....	.....	.....	R. Siebengebirge, Germany	28
V	if.	i.	.....	R. S. Greenland; Madagascar; Quebec	29
Pl	0.5	s. H_2O	.....	V.R. Sasso, Tuscany; Lipari Islands	30
A, V	5	dec. HCl	photoluminescent: fluoresces bright blue	R. Bohemia; Saxony; Italy; Cornwall; S. Dakota; California; Colorado	31
V	4	gel. HCl	.....	R. Magnet Cove, Ark.; Brit. Columbia	32
Pl	....	.....	.....	V.R. Joachimsthal, Bohemia	33
V, Sk	2-2.2	gel. a.	B.B. curls up like worm, hence name; X-ray: confirms monoclinic symmetry; pyroelectric	R. Iceland; Greenland; India; Colorado; New Jersey; Rhode Island; Nova Scotia	34

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Sellaite	MgF_2	Tet.	5-6	2.97-3.17	1.378ω	colorl.
2	Senaite	$(Fe,Mn,Pb)O{\cdot}TiO_2$	H	6	5.3	2.50$_{Li}\omega$	Blk
3	Sepiolite	$2H_2O{\cdot}2MgO{\cdot}3SiO_2$	R ?	2-2.5	2	.....	grnW, W, y,bl,r
4	α-sepiolite	$2H_2O{\cdot}2MgO{\cdot}3SiO_2$	R ?	2-2.5	2	1.506	.....
5	β-sepiolite	$2H_2O{\cdot}2MgO{\cdot}3SiO_2$	Am.	2-2.5	2	1.52-1.53η	.....
6	Serpentine	$3MgO{\cdot}2SiO_2{\cdot}2H_2O$	M	2.5-4.5	2.5-2.65	1.490 1.571	Greens, brR
7	Seybertite	$10(Mg,Ca)O{\cdot}5Al_2O_3{\cdot}4SiO_2{\cdot}3H_2O$	M	4-5	3-3.1	1.657	rBr,y, copper R
8	Sicklerite	$Fe_2O_3{\cdot}6MnO{\cdot}4P_2O_5{\cdot}3(Li,H)_2O$	R ?	4	3.45	1.735	dBr
9	Siderite	$FeCO_3$	H	3.5-4	3.83-3.88	1.873ω	Gr,grnGr, Br,brR, W
10	Sillimanite	Al_2SiO_5	R	6-7	3.23-3.24	1.660 red	yGr, gr Grn
11	Silver	Ag	C	2.5-3	10.1-11.1	0.181$_{Na}\eta$	silver W
12	Sincosite	$CaO{\cdot}V_2O_4{\cdot}P_2O_5{\cdot}5H_2O$	Tet.	low	2.84	1.680ω	leek Grn
13	Sipylite	Identical with fergusonite; no erbium	Tet.	5.5-6	4.9	2.06 $\pm\eta$	O, Blk
14	Sklodowskite (Ra)	$MgO{\cdot}2UO_3{\cdot}2SiO_2{\cdot}7H_2O$	R	....	3.54	1.635	p lemon Y
15	Smaltite	Essentially cobalt diarsenide	C	5.5-6	5.7-6.8	.....	r silver W
16	Smectite	Hydrous silicate Al, Mg, Ca, Fe	.....	soft	1.9-2.1	1.490α	grn
17	Smithsonite	$ZnCO_3$	H	5.5	4.3-4.5	1.849ω	W, gr, grn, brW
18	Soda niter	$NaNO_3$	H	1.5-2	2.24-2.29	1.5874ω	W, Br, Gr, lemon Y
19	Sodalite	$3Na_2O{\cdot}3Al_2O_3{\cdot}6SiO_2{\cdot}2NaCl$	C	5.5-6	2.1-2.4	1.4827η	Gr,grn,y, W, Bl,R
20	Soddyite (Ra)	$5UO_3{\cdot}2SiO_2{\cdot}6H_2O$?	R	3-4	4.627	1.68	Y
21	Sperrylite	$PtAs_2$	C	6-7	10.6	.....	tin W
22	Sphalerite	ZnS	C	3.5-4	3.9-4.1	2.370-2.428η	Y,Br,Blk, R, Grn, W,—
23	Spinel	$MgO{\cdot}Al_2O_3$	C	8	3.5-4.1	1.7155-2.00 η	various W-Blk
24	Stannite	$FeS{\cdot}Cu_2S{\cdot}SnS_2$	C	3.5	4.3-4.52	.....	steel Gr, iron Blk
25	Staurolite	$2FeO{\cdot}5Al_2O_3{\cdot}4SiO_2{\cdot}H_2O$	R	7-7.5	3.65-3.77	1.741	dBr, brBlk, yBr
26	Steenstrupine (Ra)	Silicate, rare earths, Zr, Fe, Na, Th, Mn, Al, Ti, H_2O	H	4	3.4	.....	dBr,Blk
27	Stephanite	$5Ag_2S{\cdot}Sb_2S_3$	R	2-2.5	6.2-6.3	.....	iron Blk
28	Stercorite	$HNa(NH_4)PO_4$	M	2	1.615	1.442	W,yBr
29	Sternbergite	$Ag_2S{\cdot}Fe_4S_5$	R	1-1.5	4.21	.....	pinchbeck Br
30	Stibotantalite	$(SbO)_2(Ta,Cb)_2O_6$	R	5.5	6.0-7.4	2.419	Br, Y,r Y
31	Stibnite	$8b_2S_3$	R	2	4.52-4.62	4.046	lead Gr, steel Gr
32	Stichtite	$MgCO_3{\cdot}5Mg(OH)_2{\cdot}2Cr(OH)_3{\cdot}4H_2O$	H	1.7	2.16	1.642ω	lilac

Luster	Fusibility	Solubility	Special Properties	Locality	
V	4 (1221°C)	s. H_2SO_4	intumesces; thermoluminescent	V.R. With fluorite	1
sM	if.	s. h. H_2SO_4	streak: brownish black	V.R. Minas Geraes, Brazil	2
D, E	6-7	dec. HCl	dry masses float on water	R. Asia Minor; Greece; Spain; Morocco; Pennsylvania; New Mexico	3
.....	6-7	gel. a.	.....	....	4
.....	6-7	dec. HCl	.....	....	5
R, G	6	dec. a.	.....	A. Saxony; Cornwall; Massachusetts; Rhode Island; New York; Pennsylvania; Canada; Maryland	6
Pl, sM	if.	dec. a.	.....	R. Warwick, N. Y.; Ural Mts.; Italy	7
.....	ef.	s. a.	.....	R. Tintic, Utah; Pala, California	8
V, Pl	4.5-5	s. h. HCl	decrepitates; photoluminescent	C. Widespread; France; England; Greenland	9
A-V	if.	i.	.....	C. Germany; Austria; France; Mass.; N.Y.; Penn.; N. Car.	10
M	1050°C	s. HNO_3	ductile, malleable	R. Norway; Germany; Chile; N.S. Wales; Michigan; Colorado; Ontario	11
M	.....	s. a.	decrepitates	V.R. Sincos, Peru	12
M, R	if. (6)	i.	decrepitates; glows brilliantly	V.R. Amherst County, Virginia	13
.....	....	gel. HCl	.....	V.R. Katanga, Belgian Congo	14
M	f.	s. h. HNO_3	streak: grayish black; thermoelectric	R. Sweden; Norway; Ontario	15
.....	....	.....	X-ray: same powder pattern as montmorillonite	C. Conde, France; Cilly, Styria; Woburn, England	16
V, Pl	if.	s. HCl	photoluminescent	Unc. Siberia; Greece; England; N. S. Wales; Missouri; Arkansas; Utah	17
V	1	s. H_2O	deflagrates; diamagnetic	R. Northern Chile; Nevada; California	18
V, G	3.5-4	s. HCl	X-ray: normal symmetry, unlike etch figures; lattice: simple cubic but near that of body-centered cubic type.	Unc. Ilmen Mts.; Italy; Norway; Maine; Canada	19
.....	if.	gel. HCl	.....	V.R. Kasolo, Belgian Congo	20
M	if.	sl. s. HCl	decrepitates; streak: black; X-ray: structure like pyrite	R. Sudbury, Ontario; Pennsylvania; Wyoming; Transvaal; Siberia	21
R, A	5	s. HCl	some varieties, triboluminescent; may contain Ga; pyroelectric and diathermanous	C. Bohemia; Harz Mts.; Japan; Mexico; Missouri; Illinois; Wisconsin	22
V	if.	sl. s. H_2SO_4	.....	Unc. Ceylon; Burma; Italy; Madagascar; New York; New Jersey	23
M	f.	dec. HNO_3	decrepitates	R. Bohemia; Cornwall; Tasmania; Bolivia; S. Dakota	24
sV, R	if.	sl. dec. H_2SO_4	X-ray: arrangement partly identical with kyanite	R. Switzerland; New England; Virginia; N. Carolina; Georgia	25
D	ef.	dec. a.	14-32.5% Cer.; 0-16% Yttr.; 2-7% ThO_2	V.R. Kangerdluarsuk, Greenland	26
M	f.	s. h. HNO_3	streak: iron black; decrepitates; photoelectric	R. Czechoslovakia; Germany; Chile; Mexico; Nevada	27
V	f.	s. H_2O	non-efflorescent	V.R. In guano: Ichaboe, Africa; Guanope, Peru	28
M	f.	s. aq. reg.	streak: black; thin laminae, flexible like tin foil	V.R. Bohemia; Saxony	29
A, R	4	s. only HF	pyroelectric	V.R. Nelson, W. Australia; Mesa Grande, California	30
M, Sp	1	s. HCl	photoelectric	Unc. Japan; Harz Mts.; China; California; Nevada	31
G	if.	s. a.	.....	R. Tasmania; Quebec; Transvaal, S. Africa	32

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Stilbite	$(Na_2,Ca)O\cdot Al_2O_3\cdot 6SiO_2\cdot 6H_2O$	M	3.5-4	2.0-2.2	1.498	W, Y, Br, R
2	Stolzite (Ra?)	$PbWO_4$	Tet.	3	7.07-8.23	2.27ω	Grn, Gr, Br
3	Strengite	$FePO_4\cdot 2H_2O$	R	3-4	2.8-2.9	$1.70\text{-}1.76\eta$	pR
4	Stromeyerite	$Ag_2S\cdot Cu_2S$	R	2.5-3	6.1-6.3	.....	steel Gr
5	Strontianite	$SrCO_3$	R	3.5-4	3.6-3.71	1.664	W, Gr, Y, Greens
6	Strüverite	$Fe(Ta,Cb)_2Ti_6O_{18}$	Tet.	6	5.56	$2.50_{Li\omega}$	iron Blk
7	Struvite	$NH_4MgPO_4\cdot 6H_2O$	R	2	1.7-1.8	1.496	W, y
8	Sulfur	S	R	1.5-2.5	2.05-2.09	2.038	Y
9	Sussexite	$HRBO_3$ [R = Mn,Zn, Mg]	R ?	3	3.12	1.709	W, pk, y
10	Sylvite	KCl	C	2	1.97-1.99	1.490η	W, bl, y
11	Sylvanite	$(Au,Ag)Te_2$	M	1.5-2	7.9-8.3	.....	steel Gr, silver W
12	Tachhydrite	$CaCl_2\cdot 2MgCl_2\cdot 12H_2O$	H	2	1.66-1.67	1.520ω	wax Y, honey Y
13	Tachyaphaltite	Altered zircon	Tet.	5.5	3.6	.....	dBr
14	Talc	$3MgO\cdot 4SiO_2\cdot H_2O$	R or M	1-1.5	2.6-2.8	1.589	W, Grn, Gr
15	Tamarugite	$NaAl(SO_4)_2\cdot 6H_2O$	M ?	1	2.3	1.487	colorl.
16	Tantalite	$(Fe,Mn)(Ta,Cb)_2O_6$	R	6	5.3-7.8	2.25	iron Blk, grbr Blk
17	Tantalum	Ta	C	6-6.5	16.6	.....	gr Y
18	Tapiolite	$(Fe,Mn)(Cb,Ta)_2O_6$	Tet.	6	7.3-7.8	2.27ω	Blk
19	Tellurium	Te	H	2-2.5	6.1-6.3	.....	tin W
20	Tengerite	A supposed yttrium carbonate	.....	....	.....	1.57	W
21	Tennantite	$5Cu_2S\cdot 2ZnS\cdot 2As_2S_3$	C	3-4	4.37-4.49	$>2.72_{Li}$	blk, lead Gr, iron Blk
22	Tenorite	CuO	Tri.	3-4	6.45	2.63_{red}	Blk
23	Teschermacherite	HNH_4CO_3	R	1.5	1.45	1.536	W to y
24	Tetradymite	$Bi_2(S,Te)_3$	H	1.5-2	7.2-7.6	.....	p steel Gr
25	Tetrahedrite	$3Cu_2S\cdot Sb_2S_3 \pm Fe,Zn$	C	3-4	4.4-5.1	$>2.72_{Li\eta}$	flint Gr, iron Blk
26	Thalenite	$2Y_2O_3\cdot 4SiO_2\cdot H_2O$	M	6.5	4.1-4.45	1.738	flesh R
27	Thenardite	Na_2SO_4	R	2.5	2.68-2.69	1.477	W, br
28	Thermonatrite	$Na_2CO_3\cdot H_2O$	R	1.5-2	1.6	1.506	W
29	Thomsonite	$2(Ca,Na_2)O\cdot 2Al_2O_3\cdot 4SiO_2\cdot 5H_2O$	R	5-5.5	2.3-2.4	1.503	W, rGrn
30	Thorianite (Ra)	$(Th,U)O_2$	C	6.5	8.0-9.7	2.2η	Blk
31	Thorite (Ra)	$ThSiO_4$	Tet.	4.5-5	4.5-5	$1.68\text{-}1.72\eta$	Blk
32	Thorogummite (Ra)	$UO_3\cdot 3ThO_2\cdot 3SiO_2\cdot 6H_2O$? altered mackintoshite	Tet.?	4-4.5	4.5	.....	dY Br
33	Thorotungstite (Ra)	Essentially tungstic and thorium oxides, rare earths	R ?	....	5.55	$>1.74\eta$	honey Y

Luster	Fusibility	Solubility	Special Properties	Locality	
V, Pl	2-2.5	dec. HCl	exfoliates	Unc. India; Mexico; New Jersey; Nova Scotia	1
R	2	dec. HNO_3	.....	R. Bohemia; N. S. Wales; Minas Geraes, Brazil	2
V, Pl	2.5-3	s.HCl, i. H_2SO_4	.....	R. Germany; France; Sweden; Virginia; California	3
M	f.	s. HNO_3	.....	R. Altai, Siberia; Silesia; Chile; Arizona; Montana; Colorado; Ontario	4
V, r	1497°C	s. HCl	B.B.swells; thermoelectric	C. Austria; Germany; New York	5
.....	if.	.....	.....	V.R. Italy; Madagascar; South Dakota	6
V, R	3	s. a.	pyroelectric	R. Guano beds	7
R	108°C	s. CS_2	X-ray: shows normal symmetry	A. Sicily; Italy; Louisiana; Texas; Nevada	8
Pl, Sk	2	s. HCl	.....	V.R. Franklin Furnace; New Jersey	9
V	1.5	s. H_2O	X-ray: normal symmetry; diathermanous; cathodeluminescent	C. Vesuvius; Stassfurt; Galicia; Poland	10
M	f.	sl. s. HNO_3	.....	V.R. Roumania; Australia; Colorado; California	11
V	1	s. H_2O	decrepitates	R. Stassfurt, Germany	12
.....	....	.....	.....	V.R. Hiterö and Kragerö, Norway	13
Pl, G	if.	undec. a.	exfoliates	A. Switzerland; India; China; Vermont; New York; N. Carolina; Canada	14
V	if.	i.	.....	V.R. Chile	15
sM-G	if.	v. sl. s. a.	.....	R. Finland; Norway; Massachusetts; Connecticut; Alabama; S. Dakota	16
M	2900°C	s. HF	.....	V.R. Ural and Altai Mts.	17
M	if.	sl. s. a.	X-ray: shows close relationship to rutile group	V.R. Sukula, Finland; Topsham, Maine	18
M	vol.	s. h. H_2SO_4	.....	V.R. Roumania; W. Australia; Colorado; New Mexico	19
D	....	s.a.	.....	V.R. Ytterby, Sweden; Llano County, Texas	20
M	1.5	dec. HNO_3	.....	R. Binnental, Switzerland; Sweden; England; Peru; Chile; Colorado; Montana	21
M	3	s. HCl	.....	Unc. Vesuvius; Etna; Europe; Tennessee; Michigan; Arizona	22
V	vol.	s. H_2O	.....	V.R. Guano deposits: Africa; Patagonia	23
M,Sp	f. vol.	s. HCl	thermoelectric	V.R. Czechoslovakia; Norway; Sweden: England; Virginia; Montana; Colorado	24
M	1.5	dec. HNO_3	X-ray: closely similar to sphalerite in structure; fundamental formula $3Cu_2S{\cdot}Sb_2S_3$	V.R. Bohemia; Germany; Cornwall; Utah; Colorado; Arizona; Nevada	25
G	....	.....	59-64% Yttr.	V.R. Osterby, Askagen, Sweden; Hundholmen, Norway	26
V	1.5	s. H_2O	changes at 235°C ± to negative uniaxial form called metathenardite	R. Siberia; Spain; Chile; Arizona; California; Nevada	27
V	1.5	s. H_2O	.....	V.R. Vesuvius	28
V, Pl	2	gel. HCl	pyroelectric; intumesces	Unc. Italy; Ireland; Scotland; India; New Jersey; Arkansas; Michigan; Nova Scotia	29
.....	if.	s. HNO_3	72-79% ThO_2; 1-8% Cer.	V.R. Balangoda, Ceylon; Betroka, Madagascar	30
V	if.	gel. a.	does not gel. after calcination; 41-58% ThO_2; 0-6% E_2O_3	R. Norway; Sweden	31
.....	....	v. s. HNO_3	41.4% ThO_2; 6.7% E_2O_3	V.R. Llano County, Texas	32
.....	....	dec. a., sl. s. NaOH	16% ThO_2	V.R. Pulai, Malay States	33

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Thortveitite	$(Sc,Y)_2Si_2O_7$	M	6-7	3.57	1.793	grGrn, Blk
2	Thucholite (Ra)	Hydrocarbon, Th, Ce, La, Di, Y, Er, H_2, N	.....	3.5-4	1.78-1.57	.....	jet Blk
3	Tiemannite	HgSe	C	2-3	8.19	.....	steel Gr, blk lead Gr
4	Tin	Sn	Tet.	2	7.17	.....	tin W
5	Titanite	$CaO{\cdot}TiO_2{\cdot}SiO_2$	M	5-5.5	3.4-3.6	1.907	Br, Gr, Y, Grn, R, Blk
6	Titano-elpidite	Elpidite with high Ti	.....	6.5	2.55	1.686	Br
7	Topaz	$[Al(F,{\pm}OH)]_2SiO_4$	R	8	3.4-3.6	1.6308_D	Y, W, gr, grn, bl, r
8	Torbernite (Ra)	$Cu(UO_2)_2P_2O_8{\cdot}12H_2O$	R	2-2.5	3.2	1.592_ω	Grns
9	Törnebohmite	$(Ce,La,Al)_3(F,OH)(SiO_4)_2$	M ?	4.5	4.9	1.85	Grn to olive
10	Tourmaline	Complex Al boro-silicate ±Li, Fe, Na, Mg	H	7-7.5	2.9-3.2	1.6366_ω y	various, W to Blk
11	Trimerite	$(Mn,Ca)_2SiO_4{\cdot}Be_2SiO_4$	M	6-7	3.474	1.720	salmonPk, colorl.
12	Triphylite	$Li(Fe,Mn)PO_4$	R	4.5-5	3.42-3.56	1.702	blGrn, grnGr
13	Triplite	$(Mn,Fe)_2FPO_4$	M	4-5.5	3.5-3.8	1.660-1.673	Br, blk Br
14	Tritomite	Complex fluo-silicate of Ce, La, Y, Di, Ca, Ba, etc.	H	5.5-6.0	4.2	1.75_η	dBr
15	Trögerite (Ra)	$(UO_2)_3As_2O_8{\cdot}12H_2O$	M ?	soft	3.3	$1.58\text{-}1.63_\eta$	lemon Y
16	Trona	$Na_2CO_3{\cdot}NaHCO_3{\cdot}2H_2O$	M	2.5-3	2.11-2.14	1.492	Gr, yW
17	Tscheffkinite	$(Ca,Fe)(Ce,Y,Di)_2(Si,Ti)_3O_{10}$	R? or M?	5-5.5	4.5	$1.63\text{-}1.97_\eta$	velvet Blk
18	Tschermigite	$(NH_4)Al(SO_4)_2{\cdot}12H_2O$	C	2	1.64	1.459_η	W, —
19	Tungstenite	WS_2 ?	.....	2.5	7.4	.....	d lead Gr
20	Tungstite	WO_3 (H_2O ?)	R ?	2.5	5.5?	2.24	Y, yGrn
21	Turquois	$3Al_2O_3{\cdot}CuO{\cdot}2P_2O_5{\cdot}9H_2O$	Tri.	5-6	2.6-2.83	1.62	sky Bl, bl Grn, apple Grn
22	Tyuyamunite (Ra)	$CaO{\cdot}UO_3{\cdot}V_2O_5{\cdot}nH_2O$	R	soft	3.7-4.3	1.870±	Y
23	Uhligite	$Ca(Zr,Ti)_2O_5 + Al_2TiO_5$	C	5-6	.....	.....	Blk, Br
24	Ulexite	$NaCaB_5O_9{\cdot}8H_2O$	M'	1	1.65	1.508	W
25	Ullmannite	NiSbS	C	5-5.5	6.2-6.7	.....	steel Gr, silver W
26	Uraconite (Ra)	Hydrous U sulfate ?	R	soft	3.7-3.9	1.79	YO
27	Uraninite (Ra)	Complex, variable uranate with Th, Zr, La, Y, Pb, He, A, N	C	5.5	9.0-9.7	.....	gr, grn, br, velvet Blk
28	Uranochalcite (Ra)	$UO_3{\cdot}SO_3{\cdot}CaO{\cdot}CuO{\cdot}H_2O$?	.....	2-2.5	.....	1.655	grass Grn, apple Grn
29	Uranocircite (Ra)	$Ba(UO_2)_2{\cdot}P_2O_8{\cdot}8H_2O$	R	2	3.5	1.623	yGr
30	Uranoniobite (Ra)	Crystallized uraninite	C	....	9.0-9.7	.....	.....
31	Uranophane (Ra)	$CaO{\cdot}2UO_3{\cdot}2SiO_2{\cdot}7H_2O$	R	2-3	3.81-3.90	1.666	Y
32	Uranopilite (Ra)	$CaO{\cdot}8UO_3{\cdot}2SO_3{\cdot}25H_2O$?	Tri.?	....	3.9	1.623	Y

Luster	Fusibility	Solubility	Special Properties	Locality	
A, R	ef.	i. HCl	51-55% Yttr. of which Sc_2O_3 = 37.6-42%; 0.5% Hf	V.R. Sätersdalen, Norway; Madagascar	1
D, E brilliant	.....	sl.s. HCl	decrepitates	V.R. Conger, Ellsworth, Ontario; Quebec	2
M	vol.	s. aq. reg.	streak: black; decrepitates	R. Harz Mts.; Marysvale, Utah	3
M	223°C	s. HCl	.....	V.R. Russia; N. S. Wales; Bolivia; Mexico; Pennsylvania	4
A, R	3	s. H_2SO_4	pyroelectric	Unc. Austria; Switzerland; Madagascar; New York; Rhode Island; Arkansas	5
.....	....	.....	.....	R. Mt. Chilbina, Russian Lapland	6
V	if.	sl.dec. H_2SO_4	pyroelectric	R. Ural Mts.; Japan; Mexico; Brazil; Maine; New Hampshire; Colorado; Utah	7
Pl, sA	2.5	s. HNO_3	fluorescent; in air below 100° dehydration forms metatorbenite I, with $8H_2O$; at 130°, metatorbenite II	V R Bohemia; Saxony; Cornwall; S. Australia	8
.....	...	s. h. conc. a.	.....	V.R. Vastmanland, Sweden	9
V, R	4-5.5	undec. a.	electric by friction; pyroelectric; piezoelectric	C. Madagascar; Ceylon; Brazil; Maine; California	10
V, brilliant	6	s. HCl	.....	V.R. Vermland, Sweden	11
V, R	1.5	s. a.	sometimes decrepitates	V.R. Bavaria; Finland; Maine; New Hampshire; Massachusetts	12
R, A	2.5	s. a.	streak: yellowish gray	V.R. Bohemia; France; Maine; Nevada	13
R	(?)	gel. HCl	44-59% Cer.; 0.4-4.6% Yttr; 0-10.6% $ThO_2 + ZrO_2$; decrepitates (?)	V.R. Langesundfiord, Norway	14
P	2.5	s. a.	.....	V.R. Neustädtel, Saxony	15
V	1	s. H_2O	photoluminescent	C. Northern Africa; Egypt; Venezuela; Nevada; California	16
V	4	gel. HCl	23-47% Cer.; 0-34% Yttr.; 0-20% $ThO_2 + ZrO_2$	R. Ilmen Mts.; India; Madagascar; Virginia	17
V	1	s. H_2O	.....	R. Bohemia; Italy; Wyoming; New Mexico	18
.....	....	.....	streak: as color	V.R. Emma Mine, Utah	19
E	if.	i. a., s. KOH	Material from Salmo, B.C. proved $WO_3 \cdot H_2O$	R. Cornwall; Cumberland; Monroe; Connecticut	20
W	if.	s. HCl	decrepitates; often artificially treated to give desirable color	R. Persia; Siberia; Virginia; New Mexico; Nevada	21
E, A, Pl	1	.....	.....	V.R. Alai Mts.; Colorado; Utah	22
.....	....	.....	near zirkelite	V.R. Lake Magad, E. Africa	23
S	1	sl. s. h. H_2O	intumesces	C. Chile; Nevada; California; Nova Scotia	24
M	f.	dec. HNO_3	.....	R. Austria; Germany; Sardinia; England; France	25
E	.....	s. a.	similar to zippeite	V.R. Joachimstal, Bohemia	26
sM, G, D	if.	s. HNO_3, s. H_2SO_4	0-3% Cer.; 0-10.2% Yttr.; 1.6-11% ThO_2	R. Roumania; Bohemia; Saxony; E. Africa; Connecticut; Colorado; Canada	27
Sk	.....	s. a.	streak: as color	V.R. Joachimsthal, Bohemia	28
Pl	3	s. HCl	fluorescent; photoluminescent	V.R. Falkenstein; Saxony; Madagascar	29
.....	....	.....	.....	V.R. Norway	30
V, Pl	if.	gel. HCl	.....	R. Silesia; Bavaria; Saxony; S. Australia; Pennsylvania; N. Carolina	31
.....	.....	s.a.	.....	V.R. Saxony; Bohemia; Colorado	32

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Uranospathite (Ra)	Hydrated uranyl phosphate	R	....	2.5	1.510	Y,pGrn
2	Uranosphaerite (Ra)	$Bi_2O_3 \cdot 2UO_3 \cdot 3H_2O$	R ?	2-3	6.36	1.985	OY,brick R
3	Uranospinite (Ra)	$Ca(UO_2)_2 \cdot As_2O_5 \cdot 8H_2O$?	R	2-3	3.45	1.586ω 1.582β	siskin Grn
4	Uranothallite (Ra)	$2CaCO_3 \cdot U(CO_3)_2 \cdot 10H_2O$	R	2.5-3	2.14-2.15	1.503	siskin Grn
5	Uvanite (Ra)	$2UO_3 \cdot 3V_2O_5 \cdot 15H_2O$	R	....	.....	1.879	brY
6	Valentinite	Sb_2O_3	R	2.5-3	5.76	2.35	W
7	Vanadinite	$3Pb_3V_2O_8 \cdot PbCl_2$	H	2.5-3	6.6-7.1	2.354ω	d ruby R, brY, Y,rBr
8	Variscite	$AlPO_4 \cdot 2H_2O$	R	4	2.5	1.558	variscite Grn
9	Vesuvianite	$Ca_6[Al(OH,F)]Al_2(SiO_4)_5$?	Tet.	6.5	3.35-3.45	1.708 to 1.720	Br,Grn, Y, pBl
10	Vietinghofite	Hydrated Fe samarskite	Am.	5.5-6	5.53	.....	Blk
11	Vivianite	$3FeO \cdot P_2O_5 \cdot 8H_2O$	M	1.5-2	2.58-2.68	1.598	—,Bl,Grn
12	Voglite (Ra)	Hydrous carbonate of U, Ca, Cu	Tri.?	soft	3.35	1.547	emerald Grn
13	Volborthite	$6(Cu,Ca,Ba)O \cdot V_2O_5 \cdot 15H_2O$	M ?	3	3.5	2.02η	olive Grn, citron Y
14	Vrbaite	$Tl_2S \cdot 3(As,Sb)_2S_3$	R	3.5	5.3	extreme	grBlk
15	Wagnerite	$3MgO \cdot P_2O_5 \cdot MgF_2$	M	5-5.5	3.07-3.14	1.570	Y,gr,grnR
16	Walpurgite (Ra)	$3UO_3 \cdot 5Bi_2O_3 \cdot 2As_2O_5 \cdot 12H_2O$?	Tri.	3.5	5.8	1.87-2.05η	Y
17	Warwickite	$(Mg,Fe)_3TiB_2O_8$	R	3-4	3.36	1.809	dBr, Blk
18	Wavellite	$4AlPO_4 \cdot 2Al(OH)_3 \cdot 9H_2O$	R	3.5-4	2.31-2.34	1.534	W, Y, Grn, Gr, Br, Blk
19	Weibyeite	Related to ancylite, hydrous carbonate rare earths, Ca, Sr, F	R	....	3.19	.....	y,r, Br
20	Weinschenkite	$(Y,Er)PO_4 \cdot 2H_2O$	M	....	.....	1.6 $\pm \eta$	W
21	Wernerite	$Me_{80}Ma_{20}$ - $Me_{40}Ma_{60}$ [Me = $CaCO_3 \cdot 3CaAl_2Si_2O_8$; Ma = NaCl $\cdot$ $3NaAlSi_3O_8$]	Tet.	5-6	2.66-2.73	1.567ω	W, Gr, bl, grn, r
22	Wiikite	Columbate, titanate, silicate Fe, rare earths; mixture	R ?	6	3.8-4.8	2.0 $\pm \eta$	Blk
23	Willemite	$2ZnO \cdot SiO_2$	H	5-5.5	3.89-4.18	1.691ω	W,grn Y, Grn, R, grW, yBr
24	Witherite	$BaCO_3$	R	3-3.75	4.27-4.35	1.676	W, y, gr
25	Wöhlerite	Zr silicate and columbate of Ca, Na, etc.	M	5.5-6	3.42	1.716	Y, Br
26	Wolframite	$(Fe,Mn)WO_4$	M	5-5.5	7.0-7.5	2.32	d grBlk, brBlk
27	Wollastonite	$CaO \cdot SiO_2$	M	4.5-5	2.8-2.9	1.629	W, Gr, Y, R, Br
28	Wulfenite	$PbMoO_4$	Tet.	2.75-3	6.7-7.0	2.402ω_{Y}	OY, Gr, Grn, Br, R
29	Wurtzite	ZnS	H	3.5-4	3.98	2.33$_{Li}\omega$	brBlk
30	Xenotime	$Y_2O_3 \cdot P_2O_5 \pm$ Ce, Th, Si	Tet.	4-5	4.5-4.6	1.72ω	yBr, rBr, R, W, Y

Luster	Fusibility	Solubility	Special Properties	Locality	
.....	....	.....	on losing H_2O becomes uniaxial	V.R. Redruth, Cornwall	1
D	....	.....	decrepitates	V.R. Neustädtel, Saxony	2
V, Pl	f.	s. a.	fluorescent	V.R. Neustädtel, Saxony	3
V,Pl	if.	s.a.	fluorescent	R. Bohemia; Saxony; Greece	4
.....	....s.	$(NH_4)_2CO_3$		V.R. Emery County, Utah; Colorado	5
A, Pl	1.5	s.HCl	.....	V.R. Czechoslovakia; Saxony; Algeria; South Ham, Quebec	6
G	990°C	v. s. HCl	decrepitates	Unc. Urals; Austria; Spain; Scotland; Mexico; Arizona; New Mexico	7
V, brilliant	if.	s. HCl after ign.	.....	R. Messbach, Saxon Vogtland; Arkansas; Utah	8
V, R	3	sl. dec. HCl	intumesces; pyroelectric	C. Vesuvius; Norway; Japan; Maine; New York; Arkansas; New Jersey; California	9
D	....	.....	8.2% E_2O_3	V.R. Lake Baikal, Siberia	10
Pl, V	1.5	s. HCl	exfoliates; color changes on exposure to light, Fe'' to Fe'''	Unc. France; Cornwall; New Jersey; Delaware; Colorado	11
Pl	if.	s. a.	.....	R. Joachimstal, Bohemia; Russia	12
Pl, V	1.5(?)	i.	.....	V.R. Russia; Thuringia; Utah; Asia; Colorado; Africa	13
.....	ef.	s. HCl	streak: light red	V.R. Allchar, Macedonia	14
V	4	s.HCl,HNO_3	thermophosphorescent	V.R. Salzburg, Austria; Norway	15
A, G	1.5	.....	resembles gypsum	V.R. Neustädtel, Saxony; Joachimstal, Bohemia	16
sM, Pl sV	5.5	dec. H_2SO_4	.....	R. Warwick, New York	17
V,Pl,R	if.	s. HCl	swells; (A) photoluminescent	Unc. Bohemia; Germany; England; Pennsylvania; Arkansas	18
V	.....	s. HCl	66.96% Ce	V.R. Langesundfiord, Norway	19
.....	if.	s. dec. a.	....	V.R. Amberg-Auerbach mines, Bavaria	20
V, Pl, R	3	sl.dec.HCl	intumesces	Unc. Siberia; Finland; Sweden; Madagascar; Massachusetts; New York; New Jersey	21
.....	if.	.....	2.5% Cer.; 7.6% Yttr.; 1.2% Sc_2O_3; 5.5% ThO_2	V.R. In pegmatite: Finland	22
V, R	3.5-4	gel. HCl	photoluminescent: green, yellow	Unc. Belgium; Germany; Africa; New Jersey; Colorado; New Mexico	23
V, R	2.5-3	s. dec. HCl	pyroelectric	C. Cumberland, England; Japan; Kentucky; Ontario	24
V, R	3-3.5	s. HCl	0.5% Hf; trace Ce	V.R. Brevik, Norway; Fr. Guinea; Red Hill, New Hampshire	25
M, D	2-4	dec. a.	decrepitates	Unc. Transbaikalia; Saxony; Cornwall; N. S. Wales; Bolivia	26
V, Pl	4(1540°C)	dec.HCl	often thermophosphorescent; fuses after inversion at 1200°C; photoluminescent	C. Roumania; Italy; Finland; New York; California; Michigan; Canada	27
R, A	2	dec. HCl	decrepitates; diamagnetic; ultra-violet color change	R. N. S. Wales; Mexico; Austria; Bohemia; Pennsylvania; New Mexico; Arizona	28
R	6	s. HCl	sublimes in nitrogen at 1185°C; reforms on cooling; photoluminescent	R. Bohemia; Bolivia; Peru; Butte, Montana; Missouri; Utah	29
R, V	if.	i.	0-11% Cer.; 54-64.7% Yttr.; 1.5% ThO_2	R. Norway; Sweden; Brazil; Switzerland; N. Carolina; Colorado	30

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Yttrialite (Ra)	Silicate Th and Y metals	Am.	5-7	4.575	1.758η	olive Grn, OY
2	Yttrocalcite	$Ca_5Y_2F_{16}$	H	4-6	3.19	1.45(?)η	W, grn
3	Yttrocerite	CaF_2 with varying amounts $(Y,Ce)F_3$	C	4-5	3.3-3.4	1.434η	VBl, Gr, rBr
4	Yttrocrasite (Ra)	$(Ca,Pb)O\cdot(Th,U)O_2\cdot 16TiO_2\cdot 3(Y,Ce,Th)_2O_3\cdot 6H_2O$?	R	5.5-6	4.8	2.1η	Blk
5	Yttrofluorite	CaF_2 with varying amounts of YF_3	C	4.5	3.55	1.46η	Y,Br,Grn
6	Yttrogummite (Ra)	Decomposition product of cleveite	Tet.	4-4.5	4.43-4.54	.....	yBr,Blk
7	Yttrotantalite	$Y_4(Ta_2O_7)_3$? Cb,Ca,Fe, H	R	5-5.5	5.5-5.9	2.15η	Blk,Br, brY,Y
8	Yttrotitanite	Titanite with $\pm 12\%$ $(Y,Ce)_2O_3$ $\pm 5\%Fe_2O_3\cdot Al_2O_3$	M	6-7	3.5-3.7	1.935	BrBlk
9	Zaratite	$NiCO_3\cdot 2Ni(OH)_2\cdot 4H_2O$?	Am.	3-3.5	2.5-2.7	1.56-1.61η	emerald Grn
10	Zeunerite (Ra) (Ra)	$Cu(UO_3)_2As_2O_8\cdot 8H_2O$	R	2-2.5	3.2	1.643ω	apple Grn, emerald Grn
11	Zinc	Zn	H	2	6.9-7.2	.....	W to blGr
12	Zincite	ZnO	H	4-4.5	5.4-5.7	2.013ω	dR,OY
13	Zinkenite	$PbS\cdot Sb_2S_3$	R	3-3.5	5.12-5.35	.....	steel Gr
14	Zippeite (Ra)	$2UO_3\cdot SO_3\cdot H_2O$	M ?	3	1.689-1.710	1.615	Y
15	Zircon	$ZrO_2\cdot SiO_2$	Tet.	7.5	4.68-4.7	1.923 1.960ω	—,y,gr, brY,rBr
16	Zirkelite (Ra)	$(Ca,Fe)(Zr,Ti,Th)_2O$	C	5.5	4.7	2.19η	Blk
17	Zirkite	Mixture silicate and oxide of Zr	.....	....	.....	.....	.....
18	Zoisite	$4CaO\cdot 3Al_2O_3\cdot 6SiO_2\cdot H_2O$	R	6-6.5	3.25-3.37	1.703	grW,Gr, yBr,grn
19	Zunyite	$[Al(OH,F,Cl)_2]_6Al_2Si_3O_{12}$	C	7	2.875	1.589η	colorl., W

TABLE B—SALTS

	Name	Composition	Crystal System	Hardness	Specific Gravity	Refractive Index	Color
1	Humboldtine	$FeC_2O_4\cdot 2H_2O$	R	2	2.28	1.561	Y
2	Mellite	$Al_2C_{12}O_{12}\cdot 18H_2O$	Tet.	2-2.5	1.55-1.65	1.539ω	honey Y
3	Oxammite	$(NH_4)_2C_2O_4\cdot 2H_2O$	R	soft	1.48	1.547	W
4	Whewellite	$CaC_2O_4\cdot H_2O$	M	2.5	2.23	1.555	colorl.

MINERALS

Luster	Fusibility	Solubility	Special Properties	Locality	
V, G	if.	s. HCl	6-8.2% Ce; 43-47% Y; 10.8-12.8% ThO_2	V.R. Llano County, Texas	1
V	if.	s. a.	.....	V.R. Norway	2
V, Pl	if.	s. HCl	proven experimently that CaF_2 can take up 55% CeF_3; 9-18% Cer.; 8-29% Yttr.; decrepitates	V.R. Falun, Sweden; Sussex County, New Jersey; New York	3
R	if.	s. H_2SO_4	3% Cer.; 25.7% Yttr.; 8.7% ThO_2	R. Llano County, Texas	4
V	f.	s. a.	proven experimentally that CaF_2 can take up 50% YF_3; atomic structure similar to fluorite	V.R. Hundholmen, Norway	5
brilliant	....	.....	20-25% Yttr.; 1-2% Cer.; 41.4% ThO_2; 6.7% E_2O_3	V.R. Norway	6
sM, V, G	if.	i.	17-38% Yttr.; 0-2.4% Cer.	V.R. Ytterby, Finbo and Broddbo, Sweden	7
V	f.	dec. HCl	.....	V.R. Arendal and other places in Norway	8
V	if.	s. HCl	.....	R. Spain; Tasmania; N. S. Wales; Greenland; Pennsylvania	9
Pl	3	s. HNO_3	.....	R. Bohemia; Utah; Schneeberg, Saxony	10
M	420°C.	s. a.	.....	V.R. Australia; N. S. Wales; New Zealand; Alabama; California	11
sA	if.	s. a.	streak: orange yellow; X-ray: atomic structure closely related to greenockite and wurtzite	R. Franklin Furnace, New Jersey: Poland; Spain; Tasmania	12
M	1	s. h. HCl	decrepitates; streak: as color	R. Harz Mts.; France; Tasmania; Arkansas; Colorado; Nevada	13
Sk	.....	s. a.	.....	V.R. Joachimstal, Bohemia; Fruita, Utah	14
A	if.	almost i.	0.98% Hf average six analyses; diamagnetic	Unc. Ilmen Mts.; Urals; Norway; Sweden; Ceylon; Madagascar; Maine; New York; N. Carolina; Colorado; Texas	15
R	if.	i.	0-7.3% ThO_2; 0-3% E_2O_3; 1.0% Hf	V.R. Brazil; Ceylon	16
.....	....	.....	.....	.... Caldas, Brazil	17
V, Pl	3-3.5	i.	B. B. swells	Unc. Austria; Italy; Switzerland; Mexico; Massachusetts; Pennsylvania; Tennessee	18
V	if.	i.	.....	V.R. Postmasburg, S. Africa; Zuni mine, Colorado; Guatemala	19

OF ORGANIC ACIDS

Luster	Fusibility	Solubility	Special Properties	Locality	
.....	.....	s.a.	.....	R. Bilin, Bohemia; Germany; Elba; Lambton County, Ontario	1
.....	....dec. h.	H_2O; s. HNO_3	.....	Unc. Bilin, Bohemia; Saxony; Russia; Siberia; Montana	2
.....	ef.	s. H_2O	.....	R. From the guanao of the Guanape Islands, Peru	3
V	7	s.a.	.....	R. Saxony; Bohemia; Alsace	4

SYNONYMS OF MINERAL NAMES

The following list contains the synonym names of minerals listed in the preceding tables of minerals and also some minerals not listed in those tables; some of the names given below are the names of varieties and these are indicated by the abbreviation: *var.*

Acmite, cf. pyroxene
Actinolite, cf. amphibole
Adamine, cf. adamite
Adularia, var. orthoclase
Agalmatolite, cf. pyrophyllite
Agaric mineral, cf. calcite
Agate, cf. chalcedony and quartz
Alabandin, cf. alabandite
Alalite, cf. diopside
Alamandine, cf. alamandite
Alamandine ruby, cf. spinel
Albite, var. feldspar
Allanite cf., bagrationite
Almandite, cf. garnet
Alstonite, var. bromlite
Alum, cf. kalinite
Alum stone, cf. alumite
Aluminum phosphate, cf. wavellite
Aluminum sulfate, cf. aluminite; alunogene
Alunogenite, cf. alunogene
Amazonstone, cf. microcline
Amblystegite, cf. enstatite
Amianthus—silky asbestos
Ammonium alum, cf. tschermigite
Ammonium chloride, cf. sal ammoniac
Ammonium phosphate, cf. struvite
Ammonium sulfate, cf. mascagnite
Amphigene, cf. leucite
Analcime, cf. analcite
Anatase, cf. octahedrite
Anauxite, cf. kaolin
Andesine, var. feldspar (between labradorite and oligoclase)
Andradite, var. garnet (iron-lime)
Anomite, var. biotite + (Li)
Anorthite, cf. feldspar
Anorthoclase, cf. feldspar
Anthraquinone = hoelite
Antimonial nickel sulfide, cf. ullmanite
Anthophyllite, cf. amphibole
Antimonial silver, cf. dyscrasite
Anthracite, cf. coal
Antimonius nickel, cf. breithauptite
Antimony blende, cf. stibnite
Antimony sulfide, cf. stibnite
Aphanesite, cf. clinoclasite
Aquamarine—color phase of beryl
Arfvedsonite, var. amphibole with soda
Argentiferous tetrahedrite, cf. freibergite
Argentine, cf. calcite
Arkansite, var. brookite
Arsenic sulfide, cf. realgar; orpiment
Arsenic white, cf. arsenolite
Arsenical cobalt, cf. smaltite
Arsenical iron, cf. arsenoferrite
Arsenical iron ore, cf. freislebenite
Arsenical nickel, cf. niccolite
Arsenical pyrites, cf. arsenopyrite
Asbolane, cf. asbolite
Asparagus stone, cf. apatite
Astrakanite, var. blodite
Augite, cf. pyroxene
Auriferous pyrites—iron pyrite + Au
Automolite, cf. gahnite; + Zn = zinc spinel
Aventurine feldspar, var. feldspar
Azorite—$ZrSiO_4$
Babingtonite, cf. pyroxene
Baikalite, cf. diopside
Balas ruby—color phase of spinel
Barium carbonate, cf. witherite
Barium sulfate, cf. barite
Barytes, cf. barite
Barytocalcite, cf. alstonite
Bell-metal ore, cf. stannite
Biotite, cf. mica
Bismuth, cf. bismuth ochre
Bismuth carbonate, cf. bismutite
Bismuth glance, cf. bismuthinite
Bismuth sulfide, cf. bismuthinite
Bismuthine cf. bismuthinite
Bitter spar, cf. dolomite
Bitumen, cf. asphaltum
Bituminous coal, cf. coal
Black cobalt, cf. earthy cobalt
Black jack, cf. sphalerite
Black lead, cf. graphite
Black silver, cf. stephanite
Blende, cf. sphalerite
Bloodstone—impure SiO_2; jasper
Blue asbestos, cf. crocidolite
Blue iron ore, cf. vivianite
Blue John, cf. fluorite
Blue vitriol, cf. chalcanthite
Bodenite, var. allanite
Bog iron ore, cf. limonite
Boghead coal—cannel coal (high ash)
Bone turquois—fossil teeth or bone colored with $Fe_3(PO_4)_2$
Boracic acid, cf. sassoline
Borate of calcium-sodium, cf. ulexite
Boronatrocalcite, cf. ulexite
Bort, var. of diamond
Botryolite, var. datolite
Bowenite, var. serpentine
Bragite, cf. fergusonite
Brandisite, cf. seybertite
Bravaisite—near glauconite
Brazilian emerald—color phase of tourmaline
Brazilian saphire—color phase of tourmaline
Brazilite, var. baddeleyite
Brittle silver ore, cf. stephanite
Bromargyrite, cf. bromyrite
Bronzite, cf. pyroxene
Brown coal—lignite
Brown hematite, cf. limonite
Brown ochre, cf. limonite
Brown spar—dolomite + (Mn_2O_3 and Fe_2O_3)
Bucholzite, var. sillimanite
Bunsenine—NiO
Bytownite, cf. feldspar
Cadmium sulfide, cf. greenockite
Calcium nitrate, cf. nitrocalcite
Calcium phosphate, cf. apatite
Calcium sulfate, cf. anhydrite; gypsum
Cannel coal, cf. coal
Capillary pyrites, cf. millerite
Caporcianite, cf. laumonite
Carbonado—diamond for cutting purposes
Castelnaudite, var. xenotime + Zr
Cat's eye—fine fibrous structure SiO_2
Celestine, cf. celestite
Celsian, cf. feldspar
Cerium phosphate, cf. monazite
Cervantite—stibnite decomposed to $Sb_2O_3 \cdot Sb_2O_5$
Chalcolite, cf. torbernite
Chalcotrichite—capillary cuprite
Chalybite, cf. siderite
Chessylite, cf. azurite
Chiastolite, var. andalusite with black crosses on end sections
China clay, cf. kaolin

SYNONYMS OF MINERAL NAMES

Chlorite—group term
Chrome yellow, cf. crocoite
Chromic iron, cf. chromite
Chrysotile, cf. serpentine (fibrous)
Cinnabarite, cf. cinnabar
Cinnamon stone, cf. garnet (lime-alumina)
Citrine, cf. quartz (yellow)
Claudetite—As_2O_3
Clay ironstone, cf. limonite
Cleavelandite—lamellar albite
Clinochlor, var. chlorite; cf. chlorite
Clinoclase, cf. clinoclasite
Clinoenstatite, cf. pyroxene
Clintonite, cf. seyberite
Cobalt arsenate, cf. erythrite
Cobalt glance, cf. smaltite
Cobalt pyrites, cf. smaltite
Cobalt sulfate, cf. bieberite
Cobalt sulfide, cf. linnaeite
Cobalt vitriol, cf. bieberite
Cobaltine, cf. cobaltite
Coccolite, var. hedenbergite; cf. pyroxene
Colophonite, var. andradite garnet (iron-lime); also var. vesuvianite
Copaline—a bitumen
Copper arsenate (44% CuO), cf. tyrolite
Copper black, cf. melaconite
Copper blue, cf. covellite
Copper carbonate, cf. malachite; azurite
Copper chloride, cf. atacamite
Copper emerald, cf. dioptase
Copper froth—copper arsenate (44%CuO)
Copper glance, cf. chalcocite
Copper gray, cf. tetrahedrite
Copper lead selenide, cf. zorgite
Copper mica, cf. chalcophyllite
Copper nickel, cf. kupfernickel
Copper phosphate, cf. pseudomalachite and libethenite
Copper pyrites, cf. chalcopyrite
Copper red, cf. cuprite
Copper selenide, cf. berzelianite
Copper silicate, cf. dioptase; chrysocolla
Copper sulfate, cf. chalcanthite
Copper sulfide, cf. bornite; chalcopyrite
Copper uranite, cf. torbernite
Copper vitriol, cf. chalcanthite
Copperas, cf. melanterite
Cotunnite—$PbCl_2$ (74.5% Pb)
Coxcomb pyrites, cf. marcasite
Cristobalite, cf. quartz
Crocoisite, cf. crocoite
Cromfordite, var. phosgenite
Cyanite, cf. kyanite
Cyanosite, cf. chalcanthite
Cymophane, cf. chrysoberyl
Danaite—mispickel with 6.5% Co
Dawsonite—$Al_2(CO_3)_3{\cdot}Na_2CO_3{\cdot}xH_2O$
Decloizite, cf. descloizite
Derbyshire spar, cf. fluorite
Desmine, cf. stilbite
Dialogite, cf. rhodochrosite
Dichroite, cf. cordierite
Dickite, cf. kaolin
Diopside, cf. pyroxene
Diphanite, var. margarite
Disthene, cf. kyanite
Dog-tooth spar, cf. calcite
Dry bone earth, cf. smithsonite
Earthy cobalt, cf. asbolite
Ehlite, var. pseudomalachite
Elaeolite, cf. nephelite
Elaterite—elastic bitumen
Electric calamine, cf. calamine
Eleonorite, var. beraunite
Eliasite, var. gummite
Elpasolite—cryolite with K replacing Na
Emerald—color phase of beryl; contains Cr
Emerald nickel, cf. zaratite
Emery—corundum + Fe_2O_3, Fe_3O_4
Emeryllite, cf. margarite
Endellionite, var. bournonite
Epsom salt, cf. epsomite
Enstatite, cf. pyroxene
Erubescite, cf. bornite
Erythrine, cf. erythrite
Essonite, var. grossularite, garnet (lime-alumina)
Eulytine, cf. eulytite
Eusynchite—$(Pb, Cu)O{\cdot}V_2O_5$
Fahlerz, cf. tetrahedrite
False topaz, cf. quartz, SiO_2
Feather ore, cf. jamesonite
Ferrotellurite—$FeTeO_4$
Fibrolite, cf. sillimanite
Fiorite, var. opal, SiO_2
Float stone—porous opal
Flos ferri, cf. aragonite
Fluor spar, cf. fluorite
Folliated tellurium, cf. nagyagite
Freyalite, cf. thorite
Galmei, cf. calamine
Geokronite, cf. geocronite
Gismondine, cf. gismondite
Glassy feldspar, cf. sanidine
Glauber salt, cf. mirabilite
Glaucophane, cf. amphibole group
Gold telluride—$AuTe_2$
Gothite, cf. goethite
Grammatite, var. tremolite
Graphic tellurium, cf. sylvanite
Gray copper, cf. tetrahedrite
Green vitriol, cf. melanterite
Greenovite, var. titanite + Mn
Greenstone, cf. hornblende and oligoclase
Grossularite, var. garnet (lime-alumina)
Guanajuatite—Bi_2Se_3
Guano—mostly $Ca_3(PO_4)_2$ of organic origin
Guayacanite, cf. enargite
Gymnite, nickel, cf. genthite
Hair salt, cf. epsomite
Hamartite, cf. basnasite
Hauyine, cf. hauynite
Heavy spar, cf. barite
Hedenbergite, cf. pyroxene
Heliotrope, var. jasper, same as bloodstone
Hematite, brown, cf. limonite
Hemimorphite, cf. calamine
Hiddenite, var. spodumene with emerald-green color
Highgate resin—a bitumen
Hopeite—$Zn_3(PO_4)_2{\cdot}xH_2O$
Horn lead, cf. cromfordite
Horn silver, cf. cerargyrite
Horn stone, cf. flint; cryptocrystalline var. quartz
Hornblend, cf. amphibole group
Horse flesh ore, cf. bornite
Huantajayite—(Na, Ag)Cl
Humboldtilite, var. melilite
Humite—member of group of same name
Hyacinth—color phase of zircon
Hyalite, var. opal
Hyalophane, cf. feldspar
Hydrogillite, cf. gibbsite
Hydronepheline, cf. hydronephelite
Hydrophane, var. opal
Hydrous silica, cf. opal
Hypersthene, cf. pyroxene
Ice stone, cf. cryolite
Iceland spar, cf. calcite
Idocrase, cf. vesuvianite
Indicolite, var. tourmaline with blue color
Iolite, cf. cordierite
Iron carbonate, cf. siderite
Iron phosphate, cf. vivianite

SYNONYMS OF MINERAL NAMES

Iron pyrites, cf. pyrite
Iron sinter, cf. scorodite
Iron stone, clay, cf. limonite
Iron sulfate, cf. melanterite
Iron sulfide, cf. pyrite
Iron titanic, cf. ilmenite
Iron tungstate, cf. wolframite
Iserine, cf. ilmenite
Jade, cf. tremolite or actinolite; or jadeite
Jadeite, var. pyroxene
Jasper, impure SiO_2
Jet—cannel coal
Kalaite, cf. turquois (+Cu, Fe)
Kalinite, cf. alum
Kampylite, cf. mimetite
Kaolinite, cf. kaolin
Kidney ore, cf. red hematite
Kupfernickel, cf. niccolite
Labradorite, cf. feldspar
Lapis lazuli, cf. lazurite
Lausenite, cf. rogersite
Lead arsenate, cf. mimetite
Lead carbonate, cf. cerussite
Lead chloride, cf. phosgenite
Lead chromate, cf. crocoite
Lead molybdate, cf. wulfenite
Lead phosphate, cf. pyromorphite
Lead selenide, cf. clausthalite
Lead sulfate, cf. anglesite
Lead sulfide, cf. galena
Lead telluride, cf. nagyagite
Lead tungstate, cf. stolzite
Leonhardite, cf. laumonite
Lieverite, cf. ilvaite
Lepidolite, cf. mica
Lepidomelane, cf. mica
Lignite, cf. coal
Lime tungstate, cf. scheelite
Lime uranite, cf. autunite
Lithia mica, cf. lepidolite
Liver ore, cf. cinnabar
Livingstonite, cf. antimonite (+14 %Hg)
Lodestone, cf. magnetite
Lollingite, cf. arsenical iron
Loranskite—euxenite-like mineral
Lovenite—$(Ca, Na_2, Zr)O{\cdot}SiO_2$
Ludlamite—$Fe_3(PO_4)_2 + H_2O$
Lydian stone—black variety of jasper
Magnesia alum, cf. pickeringite
Magnesium borate, cf. boracite
Magnesium carbonate, cf. magnesite
Magnesium chloride, cf. carnallite
Magnesium sulfate, cf. epsomite
Magnetic iron ore, cf. magnetite
Magnetic pyrites, cf. pyrrhotite
Malachite, blue, cf. azurite
Malacolite, cf. diopside
Manganblende, cf. alabandite
Manganese carbonate, cf. rhodochrosite
Manganese phosphate, cf. triphylite
Manganese silicate, cf. rhodonite
Manganese spar, cf. rhodonite
Manganese sulfide, cf. alabandite
Manganostilbite—MnS($+As_2S_3$ and Sb_2S_3)
Martite—isometric Fe_2O_3
Masonite, var. chloritoid
Maxite, var. leadhillite
Meerschaum, cf. sepiolite
Melanite, var. andradite; garnet (iron-lime)
Melanosiderite—$Fe_2O_3{\cdot}xH_2O$ (+7.4 %SiO_2)
Meliphanite, cf. melinophane
Menaccanite, cf. ilmenite
Menilite—reniform opal
Mercuriferous tetrahedrite—schwatzite
Mercury chloride, cf. calomel
Mercury selenide, cf. tiemannite
Mercury sulfide, cf. cinnabar
Mesotype, cf. natrolite
Mica, cf. biotite, lepidolite, muscovite and phlogopite
Microcline, cf. feldspar
Mimetisite, cf. mimetite
Mineral pitch, cf. asphaltum
Mispickel, cf. arsenopyrite
Mixite—$Cu_2O{\cdot}As_2O_5{\cdot}xH_2O + 13\%Bi_2O_3$
Mocha stone—chalcedony $+Fe_2O_3$ dendrites
Molybdenum sulfide, cf. molybdenite
Molybdic ochre, cf. ferri molybdite
Moonstone—opalescent adularia
Moss agate—chalcedony $+Fe_2O_3$ dendrites
Mountain cork, cf. asbestos
Mountain leather, cf. asbestos
Mountain tallow, cf. hatchettite
Muller's glass, cf. opal, hyalite
Mundic, cf. iron pyrite
Muriacite, cf. anhydrite
Muscovite, cf. mica
Muscovy glass, cf. muscovite
Nacrite, cf. kaolin
Natrocalcite, cf. gaylussite
Needle ore, cf. aikenite
Nemalite, var. brucite (fibrous +Fe)
Neocianite—$CuO{\cdot}SiO_2$
Neotype, cf. bromlite
Nepheline, cf. nephelite
Nephrite, cf. jade of amphibole group
Nickel gymnite, cf. genthite
Nickel pyrites, cf. millerite
Nickel silicate, cf. garnierite; genthite
Nickel stibnine, cf. ullmannite
Nickel sulfate, cf. morenosite
Nickel sulfide, cf. millerite
Nickel vitriol, cf. morenosite
Nitratine, cf. soda niter
Noumeite, cf. garnierite
Oerstedite—altered zircon ($+TiO_2$)
Oligoclase, cf. feldspar
Olivine, cf. chrysolite
Onyx, cf. chalcedony
Opal jasper, cf. jasp-opal
Ophiolite =serpentine +calcite
Oriental emerald, cf. corundum
Oriental topaz, cf. corundum
Orthite, cf. allanite
Orthoclase, cf. feldspar
Osteolite—altered apatite
Ostranite, cf. zircon
Ottrelite, cf. chloritoid
Ouvarovite, var. garnet (lime-chrome)
Oxalite, cf. humboldtine
Pagodite, cf. pinite
Pandermite, cf. priceite
Paragonite, cf. mica
Parathine, cf. scapolite
Pattersonite, cf. thuringite
Peacock ore, cf. bornite
Pearl sinter—SiO_2
Pearl spar, cf. dolomite
Pelagite—$xFe_2O_3{\cdot}yMnO_2{\cdot}nH_2O$
Pencil stone, cf. pyrophyllite
Pennine, cf. penninite
Penninite, cf. chlorite
Pericline, var. albite
Peridot, cf. chrysolite
Phacolite, cf. chabazite (colorless)
Philippite—$CuSO_4{\cdot}FeSO_4{\cdot}xH_2O$
Phlogopite, cf. mica
Phosphorite, var. apatite
Phosphuranylite—$(U, Pb)O{\cdot}P_2O_5 + H_2O$
Phyllite, var. chloritoid
Physalite, cf. opaque var. topaz
Pisolite—pea sized concretions
Pistacite, cf. epidote
Pitchblende, cf. uraninite
Pitticite—established specie
Plagioclase—general name for basic feldspars

SYNONYMS OF MINERAL NAMES

Plessite—meteoric nickel iron
Plumbago, cf. graphite
Polianite—MnO_2
Pollux, cf. pollucite
Porcelain jasper—a black clay
Potash mica, cf. muscovite
Potassium chloride, cf. sylvite
Potassium nitrate, cf. niter
Potstone—ordinary soapstone; cf. steatite
Praseolite—decomposed cordierite (iolite)
Prochlorite, var. chlorite
Proidonite—SiF_4
Purple copper ore, cf. bornite
Pyreneite, var. melanite; cf. andradite
Pyrochroite—$Mn(OH)_2$
Pyrope, var. garnet (magnesia—alumina)
Pyrostibite, cf. kermesite
Pyroxene—a group term
Pyrrhosiderite, cf. goethite
Quicksilver, cf. mercury
Rabdophane, cf. rabdophanite
Radiated pyrites, cf. marcasite
Rasorite, cf. kernite
Rathotite, cf. pectolite
Red antimony, cf. kermesite
Red chalk, cf. red hematite
Red copper ore, cf. cuprite
Red ochre, cf. red hematite
Red silver ore, cf. pyrargyrite
Red zinc ore, cf. zincite
Reddingite—$3(Mn, Fe)O{\cdot}P_2O_5+H_2O$
Reddle, cf. red ochre; cf. hematite
Redruthite, cf. chalcocite
Remolinite, cf. atacamite
Rennselaerite, var. talc
Retinite, var. amber
Retzbanyite—$Cu_2S{\cdot}3PbS{\cdot}5Bi_2S_3$
Rhodonite, cf. pyroxene
Rhoetizite, cf. kyanite
Rhomb spar—dolomite in rhombs
Richellite—$(Ca, Fe)_3[F_6, (PO_4)_2]$
Riebeckite, cf. amphibole group
Rivotite—$Cu(CO_3, Sb_2O_4)$
Rock crystal, cf. quartz
Rock salt, cf. halite
Rock tallow, cf. hatchettite
Rogersite—$(Fe_2O_3{\cdot}3SO_2{\cdot}6H_2O)$, cf. lausenite
Romeite—$CaO{\cdot}Sb_2O_5$
Roscoelite—vanadium mica
Rosellane—decomposed anorthite
Rosite—decomposed anorthite
Rubellite, var. tourmaline, pink
Rubicelle, cf. ruby spinel
Ruby silver ore, cf. pyrargyrite
Ruby spinel, cf. magnesium spinel
Sagenite—SiO_2 + rutile crystals
Sahlite—cf. salite; cf. hedenbergite
Salite, cf. hedenbergite
Salmiak, cf. sal ammoniac
Salt, cf. halite
Saltpeter, cf. soda niter
Sardonyx—banded chalcedony
Sassoline, cf. sassolite
Satin spar—fibrous calcite or fibrous gypsum
Saussurite—basic feldspar alteration to near zoisite
Scapolite, cf. wernerite
Schiller spar—altered bronzite or enstatite; cf. bastite
Schorl, cf. tourmaline
Selenite, cf. gypsum
Selwynite, cf. limonite
Sericite—muscovite, fine scaly and silky
Siderazote—Fe_5N_2
Silica, cf. quartz
Siliceous sinter—SiO_2, cf. fiorite
Silver chloride, cf. cerargyrite
Silver glance, cf. argentite
Silver iodide, cf. iodyrite
Silver lead ore—argentiferous PbS
Silver ruby, cf. pyrargyrite
Silver selenide, cf. naumannite
Silver sulfide, cf. argentite
Sipylite, cf. fergusonite
Smaltine, cf. smaltite
Soap stone, cf. talc
Soda alum, cf. mendozite
Soda feldspar, cf. plagioclase feldspar
Sodium carbonate, cf. natron
Sodium chloride, cf. halite
Sodium sulfate, anhydrous, cf. thenardite
Sodium sulfate, hydrous, cf. mirabilite
Spathic iron ore, cf. siderite
Spear pyrites, cf. marcasite
Specular iron, cf. black micaceous hematite
Spessarite, cf. garnet (manganese—alumina)
Spinel ruby, cf. spinel
Spodumene, cf. pyroxene
Stannine, cf. stannite
Staurotide, cf. staurolite
Steatite, var. talc (massive, rock form)
Stinkstone, cf. enthraconite
Strontium carbonate, cf. strontianite
Strontium sulfate, cf. celestite
Succinite, var. grossularite; garnet (lime-alumina); cf. amber
Sunstone, var. orthoclase
Tabular spar, cf. wollastonite
Tarapacaite—K_2CrO_4
Telluric bismuth, cf. tetradymite
Telluric ochre—TeO_2, cf. tellurite
Terpin hydrate=flagstaffite
Thomsenolite—$NaF{\cdot}CaF_2{\cdot}AlF_3{\cdot}H_2O$
Thorogummite, cf. nicolayite
Tile ore, cf. cuprite (earthy variety)
Tin pyrites, cf. stannite
Tin stone, cf. cassiterite
Tin sulfide, cf. stannite
Tincal=crude borax
Titanic iron, cf. ilmenite
Topazolite, var. andradite garnet (iron-lime)
Torbanite, var. cannel coal
Touchstone—jasper; lydian stone; SiO_2
Traversellite, var. diopside
Tremolite, cf. amphibole group
Tridymite, var. quartz formed above 800°C
Tripestone—concretionary anhydrite
Tripolite—remains of diatoms; SiO_2
Trippkeite—$(nCuO{\cdot}As_2O_3)$
Troostite, cf. willemite, crystallized, red color
Tyrite, cf. fergusonite
Tysonite, cf. fluocerite
Uintaite, cf. gilsonite
Ultramarine, cf. lazurite
Uraconite—$U_2O_3+(Ra)$
Uralite—pyroxene altered to amphibole
Uranic ochre—$U_2O_3+(Ra)$
Uranium phosphate, cf. torbernite
Uranium sulfate, cf. johannite
Uranvitrol, cf. johannite
Uraravite, cf. garnet
Vermiculites—group term
Vermilion, cf. cinnabar
Vitreous copper ore, cf. chalcocite
Vitreous silver ore, cf. argentite
Voltzite—$4ZnS+ZnO$
Vulpinite, var. anhydrite (scaly)
Warringtonite, var. brochantite
Websterite, cf. aluminite
White iron pyrites, cf. marcasite
White lead ore, cf. cerussite
White nickel, cf. smaltite
White vitriol, cf. goslarite
Woodwardite—$CuSO_4{\cdot}Al_2(SO_4)_3+H_2O$
Wurtzilite, cf. elaterite
Yellow ochre, cf. limonite
Yenite, cf. ilvaite
Yttrium carbonate, cf. parisite

Yttrium phosphate, cf. monazite
Zinc arsenate, cf. adamite
Zinc carbonate, cf. smithsonite
Zinc silicate, cf. willemite; calamine
Zinc sulfate, cf. goslarite
Zinc sulfide, cf. sphalerite
Zinnwaldite, cf. mica
Zippeite—$U_2(SO_4)_3+CuO$
Zirkite, trade name for zirconia ore; impure baddeleyite

TABLE OF RADIO DETECTOR MINERALS

E. T. Wherry, *Amer. Mineralogist, 10, part 2, page 28 (1925).*

GOOD DETECTORS:

Pyrite, impure.
Tennantite
Enargite
Galena, impure.

FAIR DETECTORS:

Graphite
Octahedrite
Brookite
Molybdenite
Pyrolusite
Lollingite
Hematite
Tenite
Chalcopyrite
Tetrahedrite
Linnaite
Glaucodite
Rammelsbergite
Chalcocite
Beegerite
Berzelianite
Famatinite
Stromeyerite
Aguilarite
Naumannite
Hessite
Sylvanite
Calaverite
Zincite
Tiemannite
Coloradorite
Clausthalite
Chiviatite
Guitermanite

HEAVY LIQUIDS FOR MINERALOGICAL ANALYSES

Recommended by Messmore, and Sullivan (*Bu. of Mines, Techn. Paper*, No. 381).

For the laboratory study of ores, only two heavy liquids are usually necessary. Acetylene tetrabromide is recommended for all low gravity work. Many ores contain quartz or calcite as gangue, and acetylene tetrabromide has enough gravity to float free a gangue composed of either of these minerals. As many ores contain more gangue than valuable minerals, the use of acetylene tetrabromide is recommended because it will remove the larger part of the sample; the smaller remaining part may then be treated with a more expensive, heavier liquid.

The most suitable liquid for sink-and-float work on minerals of high specific gravity is a water solution of the double thallous formate-malonate. This double salt, with a specific gravity of 4.9, melts at 60°C. and is miscible in all proportions with water. At room temperatures the salt is sufficiently soluble to give a solution with a specific gravity of nearly 4.3. As a liquid of intermediate gravity, an aqueous solution of thallous formate is recommended. It is less expensive than the formate-malonate. A maximum specific gravity of about 3.5 is reached at room temperatures, and gravities up to 4.95, the gravity of the molten salt, may be obtained.

Because of the cheapness and desirable properties acetylene tetrabromide diluted with carbon tetrachloride is recommended for gravities of 2.95 and below; because of its cheapness compared with the malonate-formate, thallous formate solution is recommended for gravities from 2.95 to 3.5; and the malonate-formate solution is recommended for gravities above 3.5.

Sp. Gr. Range	Heavy Liquid	Diluting and Washing Reagent	Recovery, etc.
Messmore: –			
1.6 to 2.95	acetylene tetrabromide	chloroform or benzene	evapn. or fractional distn.
2.95 to 3.5	thallous formate	water	evapn. on the steam bath
3.5 to 4.9	thallous formate-malonate	water	evapn. on the steam bath
Sullivan:			
1.58 to 2.6	bromoform	carbon tetrachloride	fractional distn.; liquid at room temp.
2.6 to 2.9	acetylene tetrabromide	carbon tetrachloride or benzene	fractional distn.; liquid at room temp.
2.9 to 3.3	stannic bromide ($SnBr_4$)*	carbon tetrachloride	distn.; $SnBr_4$ melts at 31°C. but addition of CCl_4 lowers m.p. to room temp.
3.3 to 3.65	antimony tribromide stannic bromide*	carbon disulfide, abs. alcohol, bromoform or dry acetone	fractional distn.; melts on the steam bath
3.65 to 4.95	thallous formate	water	evapn. on steam bath; melts on the steam bath
4.95 to 5.2	eutectic of mercuric chloride and mercuric iodide + antimony trichloride	aniline, followed by alcohol or ether	melts on oil bath; cannot be used when sulfides are present

* Decomposed by water; mineral particles must be dry.

PHYSICAL CONSTANTS OF

Formula Weights are based upon the International Atomic Weights of 1941 and are computed to the nearest hundredth.

Specific Gravity values are given at room temperatures (15 to 20° C.) unless otherwise indicated by the small figures which follow the value; thus, "$5.6\frac{18°}{4°}$" indicates a specific gravity of 5.6 for the substance at 18°C. referred to water at 4°C. In this table the values for specific gravity of gases are given with reference to air (A) = 1 or hydrogen (D) = 1.

Melting Point is recorded in a certain case as "82 d." and in some other case as "d. 82," the distinction being made in this manner to indicate that the former is a melting point with decomposition at 82°C., while in the latter decomposition only occurs at 82°C. Where a value such as "$-2H_2O$, 82" is given it indicates loss of two moles of water per formula weight of the compound at a temperature of 82°C.

Boiling Point is given at atmospheric pressure (760 mm of mercury) unless otherwise indicated; thus, "82^{15mm} or 82^{15}" indicates the boiling point is 82°C. when the pressure is 15mm.

Solubility is given in parts by weight (of the formula shown at the extreme left) per 100 parts by weight of the solvent; the small exponent indicates the temperature. In the case of gases the solubility is often expressed in some manner as "$5^{10°}$cc" which indicates that at 10°C., 5cc of the gas are soluble in 100 grams of the solvent. The symbols of the common mineral acids: H_2SO_4, HNO_3, HCl, etc., represent dilute aqueous solutions of these acids. See also special tables on *Solubilities*.

Abbreviations used in the table

a., acid
abs., absolute
ac. a., acetic acid
act., acetone
alc., 95% alcohol
alk., alkali (i. e., aq. NaOH or KOH)
anhyd., anhydrous
amorph., amorphous
aq., water (aqua)
aq. reg., aqua regia
atm., atmosphere or 760 mm mercury pressure
bz., benzene, C_6H_6
c., cold
chl., chloroform
C_5H_5N, pyridine
colorl., colorless
conc., concentrated
cryst., crystals or crystalline
d., decomposes
d. 50, decomposes at 50°; 50d., melts at 50° with decompn.
deliq., deliquescent
dil., dilute
et., ether, $(C_2H_5)_2O$
expl., explodes
exs., excess
gel., gelatinous

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Aluminum**	Al	26.97	silvery, cubic
2	acetate, normal	$Al(C_2H_3O_2)_3$	204.10	white, powder
3	acetate, basic	$Al(OH)(C_2H_3O_2)_2$	162.07	white, amorph.
4	arsenate	$AlAsO_4$	165.88	.....
5	bromate	$Al(BrO_3)_3 \cdot 9H_2O$	572.86	cryst., hygr.
6	bromide	$AlBr_3$	266.72	trig.
7	bromide	$AlBr_3 \cdot 6H_2O$	374.82	colorl. crysts.
8	carbide	Al_4C_3	143.91	yellow, hex.
9	chlorate	$Al(ClO_3)_3 \cdot 6H_2O$	385.44	rhombohedral
10	chloride	$AlCl_3$	133.34	white, hex.
11	chloride	$AlCl_3 \cdot 6H_2O$	241.44	colorl., trig., deliq.
12	fluoride	AlF_3	83.97	triclinic
13	fluoride (fluellite)	$AlF_3 \cdot H_2O$	101.99	colorl., rhomb.
14	fluoride	$Al_2F_6 \cdot 7H_2O$	294.05	white cryst. powd.
15	hydroxide	$Al(OH)_3$	77.99	white, monclinic
16	iodide	AlI_3	407.73	brown crysts.*
17	iodide	$AlI_3 \cdot 6H_2O$	515.83	white
18	nitrate	$Al(NO_3)_3 \cdot 9H_2O$	375.14	rhomb., deliq.
19	nitride	Al_2N_2	81.96	yellow, hex.
20	oxide	Al_2O_3	101.94	colorl., hex.
21	oxide (corundum)	Al_2O_3	101.94	white, trig.
22	oxide (diaspore)	$Al_2O_3 \cdot H_2O$	119.96	rhombic
23	oxide (gibbsite)	$Al_2O_3 \cdot 3H_2O$	155.99	white, monocl.

* Color caused by free iodine.

INORGANIC COMPOUNDS

References The information given in this table has been collected mainly from the following sources.

Mellor: *A Comprehensive Treatise on Inorganic and Theoretical Chemistry*. Published by Longmans, Green & Co., New York.

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International Critical Tables, Vol. 1. Published by McGraw-Hill Book Co., New York.

Tables Annuelles Internationales de Constants et Donnes Numeriques. Published by McGraw-Hill Book Co., New York.

Comey and Hahn: *A Dictionary of Chemical Solubilities*. Published by Macmillan, New York.

Seidell: *Solubilities of Inorganic and Organic Compounds*. Published by Van Nostrand & Co., New York.

gly., glycerol, $C_3H_5(OH)_3$ | monocl., monoclinic | octahdrl., octahedral | rhomb., rhombic | s., soluble | satd., saturated | sl., slightly | subl., sublimes | sulf., sulfide | tart. a., tartaric acid | tetrag., tetragonal | tr., transition | tricl., triclinic | trig., trigonal | trim., trimetric | v., very | vac., in vacuo | volt., volatile or volatilizes | yel., yellow | ∞, soluble in all proportions | >, greater than | <, less than | 42±, about or near to 42 | $-3H_2O$, 100, loses 3 molecules of water at 100°C.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts: Cold Water	Hot Water	Other Reagents	
$2.70^{20°}$	660	1800	i.	i.	s. HCl, H_2SO_4, alk.	1
.....	d.200	.....	s.	d.	.....	2
.....	d.	.....	i.	.....	s.a., i. NH_4salts	3
.....	.....	.....	i.	i.	sl. s. a.	4
.....	62.3	d.100	s.	s.	.....	5
$3.01^{\frac{20}{4}°}$	97.5	268	s.	.....	s. alc., act., CS_2	6
.....	d.100	.....	deliq.	s.	s. alc., CS_2	7
2.36	d. >1400	.....	d. to CH_4	.....	s. a., i. act.	8
.....	d.	.....	v.s.	v.s.	.....	9
$2.44^{\frac{20}{4}°}$	1945 2atm	182.7752 subl. 178	69.87[15°]	s. d.	s.et.,chl.,CCl_4;i.bz.	10
.....	.....	.....	400	v.s.	50 alc.; s. et.	11
3.07	1040	.....	s.	s.	i. act.	12
2.17	d.	.....	sl. s.	.....	.....	13
.....	$-4H_2O$,120°	$-6H_2O$,250°	i.	sl. s	.....	14
2.42	$-2H_2O$,300°	.....	i.	i.	s. a., alk.	15
3.98	191	382	s.	d.	s. alc., eth., CS_2	16
.....	.....	.....	v.s.	v.s.	s. alc., CS_2	17
.....	73	d.134	v.s.	v.s.; d.	s. alc., CS_2	18
$3.05^{\frac{20}{4}°}$	2150[4atm]	d. >1400	d. slowly	.....	s. alk. d.	19
3.99	2050	.....	i.	i.	v. sl. s. a., alk.	20
4.00	2050	2210	i.	i.	v. sl. s. a., alk.	21
3.41	d.360	.....	i.	i.	v. sl. s. a., alk.	22
2.423	d.200	.....	i.	i.	v. sl. s. a., alk.	23

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Aluminum** phosphate	$AlPO_4$	121.95	colorl., hex.
2	potassium tartrate	$AlK(C_4H_4O_6)_2$	362.21	.....
3	sodium chloride	$AlCl_3 \cdot NaCl$	191.80	white powder
4	sodium fluoride (cryolite)	$AlF_3 \cdot 3NaF$	209.96	white, monocl.
5	sulfate	$Al_2(SO_4)_3$	342.12	white, crysts.
6	sulfate (alunogenite)	$Al_2(SO_4)_3 \cdot 18H_2O$	666.41	colorl., monocl.
7	sulfide	Al_2S_3	150.12	yellow, hex.
8	**Alum**, ammonium (tschermigite)	$Al_2(SO_4)_3 \cdot (NH_4)_2SO_4 \cdot 24H_2O$	906.64	colorl., octahdrl.
9	ammonium, chrome	$Cr_2(SO_4)_3 \cdot (NH_4)_2SO_4 \cdot 24H_2O$	956.72	green, or violet, octahdrl.
10	ammonium, iron	$Fe_2(SO_4)_3 \cdot (NH_4)_2SO_4 \cdot 24H_2O$	964.40	violet, octahdrl.
11	cesium	$Al_2(SO_4)_3 \cdot Cs_2SO_4 \cdot 24H_2O$	1136.38	colorl., octahdrl.
12	potassium (kalinite)	$Al_2(SO_4)_3 \cdot K_2SO_4 \cdot 24H_2O$	948.76	colorl., monocl.
13	potassium, chrome	$Cr_2(SO_4)_3 \cdot K_2SO_4 \cdot 24H_2O$	998.84	red or grn., cubic
14	potassium, iron	$Fe_2(SO_4)_3 \cdot K_2SO_4 \cdot 24H_2O$	1006.52	colorl., or violet, octahdrl.
15	potassium, manganese	$Mn_2(SO_4)_3 \cdot K_2SO_4 \cdot 24H_2O$	1004.68	violet, cubic
16	rubidium	$Al_2(SO_4)_3 \cdot Rb_2SO_4 \cdot 24H_2O$	1041.53	colorl., octahdrl.
17	sodium	$Al_2(SO_4)_3 \cdot Na_2SO_4 \cdot 24H_2O$	916.56	colorl., octahdrl.
18	thallium	$Al_2(SO_4)_3 \cdot Tl_2SO_4 \cdot 24H_2O$	1279.34	colorl., octahdrl.
19	**Amino sulfite, acid**	NH_2HSO_3	97.09	colorl., rhomb.
20	**Ammonia***	NH_3	17.03	colorl., gas
21	**Ammonium** acetate	$NH_4C_2H_3O_2$	77.08	white, crysts., hygr.
22	antimonate, meta-	$NH_4SbO_3 \cdot 2H_2O$	223.83	cryst.
23	arsenate	$(NH_4)_3AsO_4 \cdot 3H_2O$	247.08	rhomb.
24	arsenate, acid	$(NH_4)_2HAsO_4$	176.00	monocl.
25	arsenate, acid	$NH_4H_2AsO_4$	158.97	tetrag.
26	arsenite, meta-	NH_4AsO_2	124.95	prisms
27	auricyanide	$Au(CN)_3 \cdot NH_4CN \cdot H_2O$	337.33	plates
28	aurocyanide	$AuCN \cdot NH_4CN$	267.28	.....
29	benzoate	$NH_4C_7H_5O_2$	139.15	colorl., rhomb.
30	borofluoride (fluoborate)	NH_4BF_4	104.86	hex. prisms
31	bromide	NH_4Br	97.96	colorl., cubic
32	bromoplatinate	$(NH_4)_2PtBr_6$	710.81	red, cubic
33	bromoselenate	$(NH_4)_2SeBr_6$	594.54	cubic
34	carbonate	$(NH_4)_2CO_3 \cdot H_2O$	114.11	colorl. plates
35	carbonate, acid (bicarbonate)	NH_4HCO_3	79.06	monocl. or rhombic
36	carbonate, carbamate	$NH_4HCO_3 \cdot NH_2CO_2NH_4$	157.11	white crysts.
37	carbonate, sesqui	$(NH_4)_2CO_3 \cdot 2NH_4HCO_3 \cdot 1H_2O$	272.22	.....
38	chloraurate	$(NH_4AuCl_4)_4 \cdot 5H_2O$	1518.35	yellow, monocl.
39	chlorate	NH_4ClO_3	101.50	white, monocl.
40	chloride (salammoniac)	NH_4Cl	53.50	white, cubic
41	chloroiridate	$(NH_4)_2IrCl_6$	441.92	red-brown, cubic
42	chloropalladate	$(NH_4)_2PdCl_6$	355.52	red-brown, cubic
43	chloropalladite	$(NH_4)_2PdCl_4$	284.61	olive grn., tetrag.
44	chloroplatinate	$(NH_4)_2PtCl_6$	444.05	yellow, cubic
45	chloroplatinite	$(NH_4)_2PtCl_4$	373.14	tetragonal
46	chloroplumbate	$(NH_4)_2PbCl_6$	456.03	lemon yel., cubic
47	chlorostannate	$(NH_4)_2SnCl_6$	367.52	pink, cubic

*See special tables.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
2.59	.....	.....	i.	i.	s. a., alk.; i. ac. a.	1
.....	.....	.....	s.	s.	.....	2
.....	185	.....	s.	s.	.....	3
2.90	1000	.....	sl. s.	.....	i. HCl	4
2.71	d.770	.....	$31.3^{0°}$	$89^{100°}$	.....	5
$1.69^{17°}$	d.86.5	.....	$86.9^{0°}$	$1104^{100°}$	i. alc.	6
$2.02^{1\frac{1}{4}2°}$	1100	subl. 1550 in N_2	d.	.....	s. a.; i. act.	7
$1.64^{2\frac{1}{4}0°}$	93.5	$-20H_2O$, 120°; $-24H_2O$, 200°	$3.9^{0°}$	$\infty^{100°}$	i. alc.	8
1.72	100d.	.....	$21.2^{25°}$	.....	s. alc.	9
1.71	40	.....	$124^{25°}$	.....	i. al.	10
$1.87^{0°}$	117	.....	$0.34^{0°}$	$42.54^{100°}$	.....	11
$1.76^{2\frac{1}{4}0°}$	92	$-18H_2O$,64.5	$5.7^{0°}$	$\infty^{93°}$	.....	12
1.83	89	.....	20	50	i. alc.	13
1.83	33	.....	$20^{12.5°}$	v. s.	i. alc.	14
.....	.....	.....	d.	.....	.....	15
1.89	99	.....	$1.3^{0°}$	$43.25^{80°}$	.....	16
$1.675^{2\frac{1}{4}0°}$	61	.....	$110^{15°}$ (anhyd.)	$146.3^{100°}$ (anhyd.)	i. alc.	17
2.32	91	.....	$4.84^{0°}$	$65.19^{60°}$	.....	18
$2.03^{1\frac{1}{4}2°}$	205d.	.....	$20^{0°}$	$40^{70°}$	.....	19
0.817–79°; 0.5971 (A)	−77.7	−33.4	$89.9^{0°}$	$7.49^{60°}$	$14.82^{20°}$alc.; s. et.	20
1.073	114	d.	$148^{4°}$	.....	.....	21
.....	d.	.....	i.	.....	.....	22
.....	.....	.....	s.	d.	.....	23
$1.989^{2\frac{1}{4}0°}$	d.	.....	s.	.....	.....	24
$2.311^{2\frac{1}{4}1°}$	d.	.....	sl.s.	.....	....	25
.....	.....	.....	v.s.	.....	s. alk.; i. act.	26
.....	d.200	.....	s.	v.s.	i. alc.	27
.....	d.150–200	.....	s.	.....	s. alk.	28
$1.262^{4°}$	198	.....	$19.6^{14.5°}$	$83.3^{100°}$	$3.57^{25°}$, $13.2^{78°}$ alc.	29
$1.851^{17°}$	.....	.....	$25^{16°}$	97	.....	30
$2.327^{1\frac{1}{4}5°}$	subl.542	.....	$68^{10°}$	$145.6^{100°}$	s. alc., et., act.	31
$4.265^{2\frac{1}{4}4°}$	d.	.....	$0.59^{20°}$	.....	.....	32
3.326	.....	.....	.....	.....	.....	33
.....	d.58	.....	$100^{15°}$	.....	i. alc., CS_2, NH_3	34
1.573	d.35–60	.....	$11.9^{0°}$	$27^{30°}$	i. alc.	35
.....	subl.	.....	$25^{15°}$	$67^{65°}$	.....	36
.....	d.	.....	$20^{18°}$	$50^{49°}$	.....	37
.....	$-5H_2O$,100°	.....	s.	.....	s. alc.	38
.....	expl. 100°	.....	v.s.	.....	i. alc.	39
$1.53^{17°}$	d.350	subl. 520	$29.4^{0°}$	$77.3^{100°}$	s. NH_3; sl.s. alc., m.alc.	40
2.856	.....	.....	$0.71^{4.4°}$	$2.8^{69°}$	i. alc.	41
2.418	d.	.....	s.	.....	.....	42
2.17	d.	.....	v.s.	.....	i. alc.	43
3.065	d.	.....	$0.71^{5°}$	$1.25^{100°}$	0.005 alc.	44
.....	d.	.....	s.	v.s.	.....	45
2.925	d.120	.....	s.	.....	.....	46
2.4	.....	.....	$33.3^{15°}$	.....	.....	47

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Ammonium** chromate	$(NH_4)_2CrO_4$	152.09	yellow, monocl.
2	citrate	$(NH_4)_3C_6H_5O_7$	243.22	white powd. deliq
3	cyanate	NH_4CNO	60.06	needles
4	cyanide	NH_4CN	44.06	colorl., cubic
5	dichromate	$(NH_4)_2Cr_2O_7$	252.10	orange, monocl.
6	dithionate	$(NH_4)_2S_2O_6 \cdot \frac{1}{2}H_2O$	205.21	colorl., monocl.
7	ferric oxalate	$(NH_4)_3Fe(C_2O_4)_3 \cdot 4H_2O$	446.05	light green crysts.
8	ferrocyanide	$(NH_4)_4Fe(CN)_6 \cdot 6H_2O$	392.21	monocl.
9	fluoride	NH_4F	37.04	hexagonal
10	fluoride, acid (bifluoride)	$NH_4F \cdot HF$	57.05	rhombic
11	fluosilicate (cryptohalite)	$(NH_4)_2SiF_6$	178.14	cubic
12	formate	HCO_2NH_4	63.06	monocl.
13	gallate	$NH_4C_7H_5O_5 \cdot H_2O$	205.17	.....
14	hydroxide	NH_4OH	35.05	known in solution only
15	hypophosphite	$NH_4H_2PO_2$	83.04	rhombic
16	iodate	NH_4IO_3	192.96	rhombic
17	iodide	NH_4I	144.96	colorl., cubic
18	iodoplatinate	$(NH_4)_2PtI_6$	992.83	cubic
19	magnesium arsenate	$MgNH_4AsO_4 \cdot 6H_2O$	289.37	tetrag.; rhomb.
20	magnesium phosphate	$MgNH_4PO_4 \cdot 6H_2O$	245.44	rhombic
21	molybdate	$(NH_4)_2MoO_4$	196.03	monocl.
22	molybdate, hepta-or commercial am. molybd.	$(NH_4)_6Mo_7O_{24} \cdot 4H_2O$ (?)	1235.95	colorl., monocl.
23	nitrate (α) stable–16 to 32°	NH_4NO_3	80.05	colorl., tet., tr. 50°C.
24	nitrate (β) stable 32 to 84°	NH_4NO_3	80.05	colorl., rhomb. or monocl.
25	nitrite	NH_4NO_2	64.05	white needles
26	osmochloride	$(NH_4)_2OsCl_6$	439.02	cubic
27	oxalate	$(NH_4)_2C_2O_4 \cdot H_2O$	142.12	colorl., rhombic
28	oxalate, acid (binoxalate)	$NH_4HC_2O_4 \cdot H_2O$	125.08	colorl., trimetric
29	perchlorate	NH_4ClO_4	117.50	colorl., rhombic
30	perchromate	$(NH_4)_3CrO_8$	234.13	red, octahedrl.
31	periodate	NH_4IO_4	208.96	tetragonal
32	permanganate	NH_4MnO_4	136.97	rhombic
33	persulfate	$(NH_4)_2S_2O_8$	228.20	white, monocl.
34	phosphate, di-	$(NH_4)_2HPO_4$	132.07	monocl., colorl.
35	phosphate, meta-	$(NH_4)_4P_4O_{12}$	388.08	colorl., monocl.
36	phosphate, mono-	$NH_4H_2PO_4$	115.04	tetragonal
37	phosphite, acid	$NH_4H_2PO_3$	99.07	colorl., deliq.
38	phosphomolybdate	$(NH_4)_3PO_4 \cdot 12MoO_3 \cdot 3H_2O$?	1930.55	yellow
39	salicylate	$NH_4C_7H_5O_3$	155.15	colorl., monocl.
40	selenate	$(NH_4)_2SeO_4$	179.04	monocl.
41	selenate, acid	NH_4HSeO_4	162.01	rhombic
42	sulfate (mascagnite)	$(NH_4)_2SO_4$	132.14	colorl., rhombic
43	sulfate, acid (bisulfate)	NH_4HSO_4	115.11	colorl., rhombic
44	sulfide	$(NH_4)_2S$	68.14	yel.- white
45	sulfide, penta-	$(NH_4)_2S_5$	196.38	orange-red prisms
46	sulfite	$(NH_4)_2SO_3 \cdot H_2O$	134.16	colorl., monocl.
47	sulfite, acid	NH_4HSO_3	99.11	rhombic
48	sulfhydrate (hydrosulfide)	NH_4HS	51.11	colorl., rhombic
49	tartrate	$(NH_4)_2C_4H_4O_6$	184.15	colorl., monocl.
50	tartrate, acid	$NH_4HC_4H_4O_6$	167.12	colorl., rhomb.
51	tellurate	$(NH_4)_2TeO_4$	227.69	white powder

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
1.917$^{12°}$	d.180	.....	40.5$^{30°}$	d.	sl.s. act., NH_3	1
.....	d.	.....	s.	.....	.....	2
.....	d.	.....	v.s.	d.	sl. s. alc.	3
0.79$^{1000°}$ (A)	36	.....	s.	v.s.	s. alc.	4
2.15	d.	.....	47.2$^{30°}$	v.s.	s. alc.; i. act.	5
1.704	d.130	.....	178.5$^{19°}$	.....	i. alc.	6
1.779$^{17°}$	$-3H_2O$, 100°	d. 165	42.8$^{0°}$	345$^{100°}$	.....	7
.....	d.	.....	s.	.....	i. alc.	8
.....	.....	.....	v.s.	d.	s. alc.; i. NH_3	9
1.21$\frac{1}{2}^{\frac{2}{2}°}$	.....	.....	v.s.	.....	.....	10
2.01	.....	subl.	18.5$^{17.5°}$	55.5	s. aq. alc.; i. act.	11
1.266	114-116	d.180; subl. in vacuo	102$^{0°}$	531$^{80°}$	.....	12
.....	.....	.....	s.	.....	.....	13
.....	.....	.....	.....	.....	.....	14
.....	200	d.240	s.	s.	v.s. alc.	15
3.309$^{\frac{3}{4}1°}$	d.150	.....	2.6$^{15°}$	14.5$^{100°}$	.....	16
2.511	subl. 551	235 vac.	154.2$^{0°}$	250.3$^{100°}$	v.s. alc., act.; v.sl.s.et.	17
4.61$^{\frac{2}{4}0°}$	.....	.....	.....	.....	.....	18
1.932$^{15°}$	d.	.....	0.034$^{0°}$	0.024$^{80°}$	s.a.; i. alc.	19
1.72	d.	.....	0.023$^{0°}$	0.0195$^{80°}$	s.a.; i. alc.	20
2.27	d.	.....	d.	d.	i. alc., NH_3	21
.....	.....	.....	s.	.....	.....	22
1.66$^{\frac{2}{4}5°}$	169.6	d.210	.....	.....	.....	23
1.725$^{\frac{3}{4}5°}$	.....	d.210	118.3$^{0°}$	871$^{100°}$	3.8$^{20°}$alc.; 17.1$^{20°}$ m. alc.; v.s. NH_3	24
1.69	expl.	.....	s.	d.	s. alc.	25
2.93$^{\frac{2}{4}0°}$	.....	.....	.....	.....	.....	26
1.501	.....	.....	2.5$^{0°}$	11.8$^{50°}$	i. NH_3	27
1.556	d.	.....	s.	.....	.....	28
1.95	d.	.....	10.9$^{0°}$	46.9$^{100°}$	2$^{25°}$ alc.; s. act.	29
.....	d.40	.....	sl.s.	.....	sl.s. NH_3; i. alc., et.	30
3.056$^{\frac{1}{4}8°}$	expl.	.....	2.7$^{16°}$	.....	.....	31
2.208	expl. 60°	.....	8$^{15°}$	d.	.....	32
1.98	d.120	.....	58.2$^{0°}$	d.	.....	33
1.619	.....	.....	131$^{15°}$	.....	i. act.	34
2.21	.....	.....	s.	.....	.....	35
1.803$^{\frac{1}{4}9°}$	.....	.....	20	.....	.....	36
.....	123	d. 150	171$^{0°}$	260$^{31°}$	i. alc.	37
.....	d.	.....	0.03$^{15°}$	i.	s. alk.; i. alc., HNO_3	38
.....	.....	.....	103$^{25°}$	s.	43.5$^{25°}$, 100$^{79°}$ alc.	39
2.194$^{\frac{2}{4}0°}$	d.	.....	117$^{0°}$	197$^{100°}$	i. alc., act., NH_3	40
2.162$^{\frac{2}{4}0°}$	d.	.....	.....	.....	.....	41
1.769$^{\frac{2}{4}0°}$	513d.	.....	70.6$^{0°}$	103.3$^{100°}$	i. alc., act., CS_2	42
1.78	146.9	490	100	.....	v. sl. s. alc.; i. act.	43
.....	d.	.....	v. s.	.....	.....	44
.....	.....	.....	s.	.....	.....	45
1.41	d.	.....	100$^{12°}$	.....	i. alc., act.	46
2.03$^{\frac{1}{4}5°}$	d.	.....	s.	.....	.....	47
.....	d.	subl. 120	v.s.	.....	s. alc.	48
1.60	d.	.....	5.9$^{15°}$	s.	.....	49
1.68	d.	.....	2.2$^{15°}$	.....	s.a., alk.; i. alc.	50
3.01$^{\frac{2}{4}5°}$	.....	.....	sl.s.	s.	.....	51

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Ammonium** thiocarbonate	$(NH_4)_2CS_3$	144.27	yellow
2	thiocyanate	NH_4CNS	76.12	colorl., monocl.
3	thiosulfate	$(NH_4)_2S_2O_3$	148.20	monocl.
4	triiodide	NH_4I_3	398.80	brown, rhombic
5	tungstate, meta-	$(NH_4)_2W_4O_{13}\cdot 8H_2O$	1123.89	colorl., octahedrl.
6	tungstate, para-	$(NH_4)_6W_7O_{24}\cdot 6H_2O$	1887.78	rhombic
7	uranyl pentafluoride	$(NH_4)_3UO_2F_5$	419.19	tetrag.
8	vanadate, meta-	NH_4VO_3	116.99	colorl. crysts.
9	**Antimonic** acid, meta-	$HSbO_3$	170.77	white powder
10	acid, ortho-	H_3SbO_4	188.78	white powder
11	acid, pyro-	$H_4Sb_2O_7$	359.55	white, amorphous
12	**Antimonous acid,** ortho-	H_3SbO_3	172.78	white, amorphous
13	**Antimony**	Sb	121.76	tin white, trig.
14	bromide	$SbBr_3$	361.51	colorl., orthorhomb.
15	chloride (butter of antimony)	$SbCl_3$	228.13	colorl., rhomb.
16	chloride, penta-	$SbCl_5$	299.05	pale yel. liquid
17	fluoride, tri-	SbF_3	178.76	colorl., rhomb.
18	fluoride, penta-	SbF_5	216.76	oily liquid
19	hydride (stibine)	SbH_3	124.78	colorl. gas
20	iodide, tri-	SbI_3	502.52	red-yellow, rhomb. or monocl.
21	iodide, penta-	SbI_5(?)	756.36	dark brown
22	oxide (valentinite)	Sb_2O_3	291.52	rhombic
23	oxide (senarmontite)	Sb_2O_3	291.52	cubic
24	oxide, tetra-	Sb_2O_4	307.52	white powder
25	oxide, penta-	Sb_2O_5	323.52	yellow powder
26	oxychloride (ous)	SbOCl	173.22	white monocl.
27	oxychloride (ic)	$SbOCl_3$	244.13	yellow
28	selenide	Sb_2Se_3	480.40	gray powder
29	sulfate	$Sb_2(SO_4)_3$	531.70	white powder
30	sulfide, tri- (stibnite)	Sb_2S_3	339.70	black, rhomb.
31	sulfide, penta-(?)	Sb_2S_5	403.82	orange
32	telluride	Sb_2Te_3	626.35	gray
33	**Antimonyl** potassium tartrate (tartar emetic)	$K(SbO)C_4H_4O_6\cdot\frac{1}{2}H_2O$	333.94	rhomb.
34	sulfate, basic	$(SbO)_2SO_4\cdot Sb_2(OH)_4$	683.13	white powder
35	sulfate, normal	$(SbO)_2SO_4$	371.58	white powder
36	**Argon**	A	39.94	colorl. gas
37	**Arsenic** (crystalline) (α)	As_4	299.64	metallic, hex.
38	**Arsenic** (black) (β)	As_4	299.64	black, amor.
39	**Arsenic** (yellow) (γ)	As_4	299.64	yellow, cubic
40	**Arsenic** acid, meta-	$HAsO_3$	123.92	.....
41	acid, ortho-	$H_3AsO_4\cdot\frac{1}{2}H_2O$	150.94	colorless
42	acid, pyro-	$H_4As_2O_7$	265.85	colorless
43	fluoride	AsF_5	169.91	colorl. gas
44	iodide, di-	AsI_2	328.75	red crysts.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	subl.	.....	v.s.	.....	i. alc., et.	1
1.305	149.6	d.170	$120^{0°}$	$170^{20°}$	s.alc., act., NH_3, SO_2	2
.....	d. 150	.....	s.	.....	s. act.; i. alc.	3
3.749	.....	.....	s. d.	d.	.....	4
.....	$-7H_2O$, 100°	.....	$120^{15°}$	v.s.	i. alc., et.	5
.....	$-4H_2O$,100°	.....	$2.8^{15°}$	$4.5^{22°}$	i. alc.	6
$3.186^{20°}$	volt.	.....	s.	.....	.....	7
2.326	d.	.....	$0.44^{18°}$	$3.05^{70°}$	i. alc., NH_4Cl	8
6.6	d.	.....	sl.s.	sl.s.	s.a., alk.; i. act.	9
6.6	d.	.....	sl.s.	sl.s.	s. alk.	10
.....	$-H_2O$, 200	.....	sl.s.	sl.s.	s. alk.	11
.....	d.	.....	i.	i.	i. alc.	12
$6.684^{25°}$	630.5	1440	i.	i.	s.aq. reg.,h.conc.H_2SO_4	13
$4.148^{23°}$	96.6	280	d.	d.	s. CS_2, HCl, HBr, NH_3, act.	14
$3.14^{\frac{20°}{4°}}$	73.4	220.2	$601.6^{0°}$	∞ 80°	s. alc., HCl, HBr, $H_2C_4H_4O_6$	15
2.346	2.8	92^{30mm}	d.	d.	s. HCl	16
$4.379^{20.9°}$	292	subl.	$384.7^{0°}$	$563.6^{30°}$	i. NH_3	17
$2.99^{23°}$	7	149.5	s.	.....	s. KF	18
$2.26^{-25°C}$; $4.344^{15°}$ (A)	−88	−17;d.150	$0.41^{10°}$	4c.c.	1500c.c. alc.;2500c.c. CS_2	19
$4.768^{22°}$ (monocl.)	167	401	d.	d.	s. alc., act., CS_2, HCl, HI, KI	20
.....	79	400.6	d.	d.	.....	21
5.67	656	1570	v.sl.s.	sl.s.	s HCl, KOH, $H_2C_4H_4O_6$	22
5.2	652	.....	.....	.....	.....	23
6.2	−O,1060	.....	i.	i.	s. HCl, HI, KOH	24
3.78	−O, 450	−2O, 1060	0.3	.....	s. HCl, HI, KOH	25
.....	170 d.	.....	i.	d.	s. HCl, CS_2; i. NH_3, chl.	26
.....	d.	.....	i.	d.	s. alc.	27
.....	611	.....	v.sl.s.	.....	.....	28
$3.62^{\frac{4°}{4°}}$	d.	.....	d.	d.	s. H_2SO_4	29
4.64	550	.....	$0.00017^{18°}$	d.	s. HCl, alk., NH_4HS, K_2S; i. ac. a.	30
$4.120^{0°}$	−2S, 135	.....	i.	i.	s. HCl, alk., NH_4HS	31
.....	629	.....	.....	.....	.....	32
2.60	$-\frac{1}{2}H_2O$, 100	.....	$5.26^{8.7°}$	$35.7^{100°}$	s. gly.; i. alc.	33
.....	.....	.....	i.	d.	$5.15^{15°}$ gly.	34
4.89	.....	.....	d.	d.	.....	35
$1.65^{-233°}$ $1.402^{-185.7°}$ 1.38(A)	−189.2	−185.7	$5.6^{0°}$c.c.	$3.4^{50°}$c.c.	.....	36
$5.727^{14°}$	814^{36atm}	subl. 615	i.	i.	s. HNO_3	37
$4.72^{0°}$	.....	.....	i.	i.	s. HNO_3, aq.reg., aq. Cl_2, h. alk.	38
4.71	d. 358	.....	.....	.....	.....	39
.....	d.	.....	d. to form H_3AsO_4	.....	.....	40
2.0-2.5	35.5	$-H_2O$, 160	16.7	50	s. alk.	41
.....	d. 206	.....	d. to form H_3AsO_4	.....	.....	42
5.964(D)	−80	−53	s.	.....	s. alk., alc., et.	43
.....	130	380	d.	.....	s. alc., et., chl., CS_2	44

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Arsenic** iodide, penta-	AsI_5	709.51	brown, monocl.
2	pentoxide	As_2O_5	229.82	white, amorphous
3	sulfide, di- (realgar)	As_2S_2	213.94	red, monocl.
4	sulfide, penta-	As_2S_5	310.12	yellow
5	**Arsenous** bromide	$AsBr_3$	314.66	colorl. prisms
6	chloride (butter of arsenic)	$AsCl_3$	181.28	oily liq.
7	fluoride	AsF_3	131.91	oily liq.
8	hydride (arsine)	AsH_3	77.93	colorl. gas
9	iodide	AsI_3	455.67	red, hexagonal
10	oxide (arsenolite)	As_2O_3	197.82	colorl., cubic or fibrous
11	oxide (claudetite)	As_2O_3	197.82	colorl., monocl.
12	oxide	As_2O_3	197.82	amorph. or vitreous
13	oxychloride	AsOCl	126.39	.....
14	phosphide	AsP	105.89	red powder
15	selenide	As_2Se_3	386.70	dark brown
16	sulfide (orpiment)	As_2S_3	246.00	yel.or red, monocl
17	**Auribromic acid**	$HAuBr_4 \cdot 5H_2O$	607.95	brown crysts.
18	**Auric** bromide	$AuBr_3$	436.95	dark brown
19	chloride	$AuCl_3$	303.57	red, deliq.
20	chloride	$AuCl_3 \cdot 2H_2O$	339.60	orange crysts.
21	cyanide	$Au(CN)_3 \cdot 6H_2O$	383.35	.....
22	hydrogen nitrate	$Au(NO_3)_3 \cdot HNO_3 \cdot 3H_2O$	500.29	yellow, tricl., octahdrl.
23	hydroxide	$Au(OH)_3$	248.22	brown-black powder
24	iodide	AuI_3	577.96	dark green, rhombic
25	oxide	Au_2O_3	442.40	brown-black
26	phosphide	Au_2P_3	487.46	gray
27	sulfate	$Au_2(SO_4)_3 \cdot H_2O$	700.60	purple-red
28	sulfide	Au_2S_3	490.58	brown-black
29	**Aurous** bromide	AuBr	277.12	yellow-gray
30	chloride	AuCl	232.66	yellow crysts.
31	cyanide	AuCN	223.22	yellow crysts.
32	hydroxide	AuOH	214.21	violet
33	iodide	AuI	324.12	yellow or white
34	oxide	Au_2O	410.40	gray-violet
35	sulfide	Au_2S	426.46	black-brown
36	Cf. also under gold	.....	.....	.....
37	**Barium**	Ba	137.36	silvery metal
38	acetate	$Ba(C_2H_3O_2)_2$	255.45	colorl.
39	acetate	$Ba(C_2H_3O_2)_2 \cdot H_2O$	273.46	tricl. prisms
40	amide	$Ba(NH_2)_2$	169.41	gray-white
41	arsenate	$Ba_3(AsO_4)_2$	689.90	white powder
42	arsenate, acid	$BaHAsO_4 \cdot H_2O$	295.29	rhomb. or monocl.
43	arsenide	Ba_3As_2	561.90	brown
44	boride	BaB_6	202.28	black, cubic
45	bromate	$Ba(BrO_3)_2 \cdot H_2O$	411.21	monocl.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
$3.93^{20°}_{4°}$	70	.....	s.	.....	s. alc., et.	1
4.086	.....	d.	$59.5^{0°}$	$76.7^{100°}$	s. alk.	2
(α) $3.506^{19°}$	tr. 267	565	i.	d.	s. K_2S, $NaHCO_3$	3
(β) $3.254^{19°}$	(β) 307					
.....	.....	d. 500	i.	i.	s. HNO_3, alk.	4
$3.54^{25°}_{4°}$	31	221	d.	d.	s. HCl, HBr, CS_2	5
liq. 2.163	−18	130	d.	d.	s. HCl, HBr, PCi_3	6
liq. $2.666^{0°}_{4°}$	−8.5	63^{752mm}	d.	d.	s. alc., et., bz.	7
2.695(A)	−113.5	−55;d. 230	20 c.c.	sl.s.	sl. s. alk.	8
$4.39^{15°}_{4°}$	146	403	s.	$30^{100°}$	s. alc., et., bz., chl., CS_2	9
$3.865^{25°}_{4°}$	subl.	.....	.....	.....	.....	10
3.85	subl.	.....	.....	.....	.....	11
3.738	315	.....	$1.20^{2°}$	$2.93^{40°}$	s. HCl, alk., Na_2CO_3	12
.....	.....	.....	d.	d.	.....	13
.....	.....	.....	d.	d.	sl.s. CS_2;i. alc., et.,chl.	14
4.75	360	.....	i.	d.	s. alk.	15
3.43	300	707	$0.00005^{18°}$	sl.s.	s. alk., Na_2CO_3	16
.....	27	.....	s.	.....	.....	17
.....	160d.	.....	s.	.....	s. et.	18
3.9	254d.	subl. 265	68	v. s.	s. alc., et.; sl.s. NH_3; i. CS_2	19
.....	d.	.....	v. s.	v. s.	s. HCl,alc.,et.;sl.s. NH_3	20
.....	d. 50	.....	v. s.	v. s.	s. alc.	21
2.84	72d.	.....	d.	.....	s. HNO_3	22
.....	$-1\frac{1}{2}H_2O$,250	.....	i.	i.	s. HNO_3	23
.....	.....	.....	i.	d.	s. iodides; d. alk.	24
.....	−O,160	−3O, 250	i.	i.	s. HCl	25
6.67	d.	.....	.....	.....	i. HCl	26
.....	.....	.....	deliq.	d.	s. HCl, H_2SO_4	27
8.754	d.197	.....	i.	.....	s. Na_2S; i. a., et.; d. conc. HNO_3	28
.....	d. 115	.....	i.	i.	s. NH_4OH; d. a.	29
7.4	$AuCl_3$, 170	d. 290	d.	d.	s. HCl, HBr; d. alc.	30
.....	d.	.....	i.	i.	s. KCN; i. alc., et.	31
.....	H_2O, 200	.....	s.	.....	.....	32
.....	d. 120	.....	i.	sl. s. d.	s. warm dil.a., excess KI	33
.....	O, 205	.....	i.	i.	s. HCl; sl.s.alk.;i. H_2SO_4, HNO_3, alc.	34
.....	.....	.....	i.	.....	s. KCN, K_2S_x; i. a.	35
.....	.....	.....	.....	.....	.....	36
3.78	850	1140	d.	d.	s. a	37
2.468	.....	.....	$77.8^{45°}$	$75.0^{100°}$	.....	38
2.19	$-H_2O$,41	.....	$75^{30°}$ (anhyd.)	$79^{40°}$ (anhyd.)	i. alc.	39
.....	280	.....	d.	d.	.....	40
.....	.....	.....	0.055	.....	s. a., NH_4Cl	41
$3.93^{15°}$	$-H_2O$, 150	$-1\frac{1}{2}H_2O$,225	d. to $Ba_3(AsO_4)_2$	and to $BaH_4(AsO_4)_2$	.....	42
$4.11^{8°}$	.....	.....	.....	.....	d. by Cl_2, F_2 or Br_2	43
$4.36^{15°}$	.....	.....	i.	i.	s. HNO_3	44
$3.99^{18°}$	$-H_2O$, 170	d. 260	$0.3^{0°}$	$5.97^{100°}$	i. act.	45

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Barium** bromoplatinate	$BaPtBr_6 \cdot 10H_2O$	992.25	monocl.
2	bromide	$BaBr_2$	297.19	.....
3	bromide	$BaBr_2 \cdot 2H_2O$	333.22	colorl., monocl.
4	butyrate	$Ba(C_4H_7O_2)_2 \cdot 2H_2O$	347.59	.....
5	carbide	BaC_2	161.38	gray crysts.
6	carbonate (witherite)	$BaCO_3$	197.37	white, rhombic
7	carbonate (α)	$BaCO_3$	197.37	white, hexagonal
8	carbonate (β)	$BaCO_3$	197.37	white
9	chlorate	$Ba(ClO_3)_2$	304.27	colorl.
10	chlorate	$Ba(ClO_3)_2 \cdot H_2O$	322.29	colorl., monocl.
11	chloride	$BaCl_2$	208.27	colorl., monocl.
12	chloride	$BaCl_2$	208.27	colorl., cubic
13	chloride	$BaCl_2 \cdot 2H_2O$	244.31	colorl., monocl.
14	chloroplatinate	$BaPtCl_6 \cdot 6H_2O$	653.43	red, monocl.
15	chloroplatinite	$BaPtCl_4 \cdot 3H_2O$	528.47	.....
16	chromate	$BaCrO_4$	253.37	yellow, rhomb.
17	citrate	$Ba_3(C_6H_5O_7)_2 \cdot 7H_2O$	916.39	white powder
18	cyanide	$Ba(CN)_2$	189.40	white powder
19	dichromate	$BaCr_2O_7$	353.38	red, monocl.
20	dichromate	$BaCr_2O_7 \cdot 2H_2O$	389.41	yellow needles
21	dithionate	$BaS_2O_6 \cdot 2H_2O$	333.51	rhomb. or monocl.
22	ferrocyanide	$Ba_2Fe(CN)_6 \cdot 6H_2O$	594.77	yellow, monocl.
23	fluobromide	$BaF_2 \cdot BaBr_2$	472.55	colorl. plates
24	fluochloride	$BaF_2 \cdot BaCl_2$	383.63	colorl., tetrag.
25	fluoiodide	$BaF_2 \cdot BaI_2$	566.56	plates
26	fluoride	BaF_2	175.36	colorl., cubic
27	fluosilicate	$BaSiF_6$	279.42	prisms
28	formate	$Ba(HCO_2)_2$	227.40	rhombic
29	hydride	BaH_2	139.38	crystalline
30	hydroxide	$Ba(OH)_2$	171.38	monocl.
31	hydroxide	$Ba(OH)_2 \cdot 8H_2O$	315.50	colorl., monocl.
32	hypochlorite	$Ba(ClO)_2$	240.27	colorl.
33	hypophosphate	$BaPO_3$	216.34	needles
34	hypophosphite	$Ba(H_2PO_2)_2 \cdot H_2O$	285.37	colorl., monocl.
35	iodate	$Ba(IO_3)_2$	487.20	monocl.
36	iodate	$Ba(IO_3)_2 \cdot H_2O$	505.22	monocl.
37	iodide	$BaI_2 \cdot 2H_2O$	427.23	monocl.
38	iodide	$BaI_2 \cdot 6H_2O$	499.30	hexagonal
39	malate	$BaC_4H_4O_5$	269.43	.....
40	malonate	$BaC_3H_2O_4 \cdot H_2O$	257.42	.....
41	manganate	$BaMnO_4$	256.29	green, hex.
42	molybdate	$BaMoO_4$	297.31	white powder
43	nitrate (nitrobarite)	$Ba(NO_3)_2$	261.38	colorl., cubic
44	nitride, hexa-	BaN_6	221.41	rhombic
45	nitride, hexa-	$BaN_6 \cdot H_2O$	239.42	crystalline
46	nitrite	$Ba(NO_2)_2$	229.38	.....
47	nitrite	$Ba(NO_2)_2 \cdot H_2O$	247.39	needles; hex.
48	oxalate	BaC_2O_4	225.38	.....
49	oxide	BaO	153.36	colorl., cubic
50	perchlorate	$Ba(ClO_4)_2$	336.27	hexagonal
51	perchlorate	$Ba(ClO_4)_2 \cdot 3H_2O$	390.32	hexagonal
52	permanganate	$Ba(MnO_4)_2$	375.22	black, rhombic
53	peroxide	BaO_2	169.36	powder, gr or wh
54	peroxide	$BaO_2 \cdot 8H_2O$	313.49	pearly scales

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
3.713	.....	.....	.....	.....	.....	1
$4.781^{\frac{2}{4}4^\circ}$	847	d.	98^{0°	149^{100°	v. s. m. alc.	2
3.69	$-2H_2O$,100	d.	v. s.	v. s.	.....	3
.....	.....	.....	37.42^{0°	42.12^{80°	.....	4
3.75	.....	.....	d. to form C_2H_2	.....	d. a.	5
4.29	tr. 811 to α	d. 1450	0.0022^{18°	0.0065^{100°	s. a.; i. alc.	6
.....	tr. 982 to β	.....	.....	.....	.....	7
.....	$1740^{90\,atm}$	.....	0.0022^{18°	0.0065^{100°	s. a.; i. alc.	8
.....	414	.....	20.35^{0°	84.8^{80°	.....	9
3.179	d.120	.....	s.	s.	sl. s. alc., act.	10
$3.856^{\frac{2}{4}4^\circ}$	tr. 925	1560	31^{0°	59^{100°	sl.s. HCl, HNO_3; i. alc.	11
.....	962	1560	.....	.....	.....	12
$3.097^{\frac{2}{4}4^\circ}$	$-2H_2O$,100	.....	39.3^{0°	76.8^{100°	sl. s.HCl, HNO_3;i.alc.	13
2.86	.....	.....	s.	.....	d. a.	14
2.868	.....	.....	s.	.....	v s. 93% alc.	15
4.498^{15°	.....	.....	0.00037^{20°	0.00046^{30°	s. HCl, HNO_3	16
.....	.....	.....	0.040^{618°	0.057^{225°	sl.s. alc.	17
.....	.....	.....	80^{14°	.....	18^{14° 70% alc.	18
.....	.....	.....	d.	.....	s.h. conc. H_2SO_4	19
.....	$-2H_2O$,120	.....	d.	.....	.....	20
$4.536^{13.5^\circ}$	.....	.....	24.75^{18°	90.9^{100°	i. alc.	21
.....	.....	.....	0.11^{5°	17^{5°	.....	22
4.96^{18°	.....	.....	d.	d.	s.conc.HCl,HNO_3;i.alc.	23
4.51^{18°	1008	.....	d.	d.	s.conc.HCl,HNO_3;i.alc.	24
5.21^{18°	.....	.....	d.	d.	s.conc.HCl,HNO_3;i.alc.	25
4.828	1280	1400	0.159^{0°	0.162^{30°	s.a., NH_4Cl	26
4.279^{15°	.....	.....	0.026^{17°	0.09^{100°	sl.s.HCl, NH_4Cl;i.alc.	27
3.21	.....	.....	27.76^{0°	39.71^{80°	i. alc., et.	28
4.21^{0°	d.675	volt. 1200	d.	d.	d. a.	29
4.495	.....	.....	4.29^{25°	101.4^{80°	.....	30
2.188^{16°	77.9	$-8H_2O$, 550	5.6^{15°	.....	v.sl.s.alc.; i. et.	31
.....	d. 235	.....	.....	.....	.....	32
.....	.....	.....	sl.s.	.....	s.alc.; v. sl.s.ac.a.	33
2.90^{17°	.....	.....	29	33.3^{100°	i. alc.	34
5.0^{15°	.....	.....	v. sl. s.	0.197^{100°	sl. s. warm HNO_3	35
5.5^{15°	$-H_2O$, 130	.....	0.008^{0°	0.21^{100°	s. HCl, HNO_3; i. H_2SO_4, alc., act.	36
5.15	740d.	$-2H_2O$, 539	322^{40°	396^{100°	v.s. alc.	37
.....	25.7	.....	410^{0°	v. s.	v. s. alc.	38
.....	.....	.....	0.883^{20°	1.044^{80°	.....	39
.....	.....	.....	0.143	0.326^{80°	.....	40
4.85	.....	.....	i.	.....	d. a.	41
4.65	.....	.....	0.0058^{23°	.....	s. a.	42
3.244^{23°	592	d.	5.0^{0°	34.2^{100°	sl.s. a.; i. alc.	43
.....	d. 219	expl.	.....	.....	.....	44
.....	expl.	.....	v. s.	v. s.	sl.s. abs. alc.; i. et.	45
3.23^{23°	217	.....	67.5^{20°	300^{100°	.....	46
3.173^{29°	d. 115	.....	s.	v. s.	1.6, 94% alc.; i. act.	47
2.658	.....	.....	0.0016^{8°	0.0024^{24°	s.a., NH_4Cl; i. alc.	48
5.72	1923	2000±	1.5^{0°	90.8^{80°	s. HCl, HNO_3, abs. alc.; i. NH_3, act.	49
.....	505	.....	205.8^{0°	562.3^{100°	v. s. alc.	50
2.74	d.400	.....	s.	s.	v. s. alc.	51
3.77	d. 220	.....	62.5^{11°	72.4^{25°	.....	52
4.958	$-O$, 800°	.....	i.	d.	s. dil. a.; i. act.	53
.....	$-8H_2O$, 100	.....	0.168	d.	s.dil.a.;i.alc.,et.,act.	54

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Barium** persulfate	$BaS_2O_8 \cdot 4H_2O$	401.54	prisms
2	phosphate, di-	$BaHPO_4$	233.35	rhombic needles
3	phosphate, mono-	$BaH_4(PO_4)_2$	331.35	triclinic
4	phosphate, pyro-	$Ba_2P_2O_7$	448.68	white, rhombic
5	phosphate, tri-	$Ba_3(PO_4)_2$	602.04	white, cubic
6	platinocyanide	$BaPt(CN)_4 \cdot 4H_2O$	508.73	yellow, monocl.
7	propionate	$Ba(C_3H_5O_2)_2 \cdot H_2O$	301.52	rhombic
8	selenate	$BaSeO_4$	280.32	white, rhombic
9	silicate	$BaSiO_3$	213.42	colorl., monocl.
10	silicate	$BaSiO_3 \cdot 6H_2O$	321.52	rhombic
11	succinate	$BaC_4H_4O_4$	253.43	.....
12	sulfate (barite)	$BaSO_4$	233.42	colorl. rhomb.
13	sulfhydrate (hydrosulfide)	$Ba(SH)_2 \cdot 4H_2O$	275.56	white, rhombic
14	sulfide, mono-	BaS	169.42	colorl., cubic
15	sulfide, tetra-	$BaS_4 \cdot 2H_2O$	301.63	red, rhombic
16	sulfide, tri-	BaS_3	233.54	yellow-green
17	sulfite	$BaSO_3$	217.42	white, tetrag.
18	tellurate	$BaTeO_4$	328.97	white
19	thiocyanate	$Ba(CNS)_2 \cdot 2H_2O$	289.55	needles
20	thiosulfate	$BaS_2O_3 \cdot H_2O$	267.50	rhombic
21	tungstate	$BaWO_4$	385.28	white, tetrag.
22	tungstate, meta-	$BaW_4O_{13} \cdot 9H_2O$	1243.18	rhombic
23	vanadate, pyro-	$Ba_2V_2O_7$	488.62	white
24	**Beryllium** (glucinum)	Be, (Gl)	9.02	gray met., hex.
25	aluminum silicate (beryl)	$3BeO \cdot Al_2O_3 \cdot 6SiO_2$	537.36	usually green; hexagonal
26	bromide	$BeBr_2$	168.85	colorl. needles
27	carbide	Be_2C	30.05	yellow, hex.
28	carbonate	$BeCO_3 \cdot 4H_2O$	141.09	.....
29	carbonate, basic	$(BeO)_5 \cdot CO_2 \cdot 5H_2O$	259.19	white powder
30	chloride	$BeCl_2$	79.93	white, needles
31	chloride	$BeCl_2 \cdot 4H_2O$	152.00	crystals
32	fluoride	BeF_2	47.02	transparent glass
33	hydroxide	$Be(OH)_2$	43.04	white
34	iodide	BeI_2	262.86	colorl. needles
35	nitrate	$Be(NO_3)_2 \cdot 4H_2O$	205.10	crystals
36	oxide (bromellite)	BeO	25.02	white, hexagonal
37	potassium fluoride	$BeF_2 \cdot 2KF$	163.21	rhombic
38	selenate	$BeSeO_4 \cdot 4H_2O$	224.04	rhombic
39	sodium fluoride	$BeF_2 \cdot 2NaF$	131.01	rhombic; monocl.
40	sulfate	$BeSO_4$	105.08	.....
41	sulfate	$BeSO_4 \cdot 4H_2O$	177.14	colorl., tetrag.
42	**Bismuth**	Bi	209.00	silvery white or reddish; hex.
43	arsenate	$BiAsO_4$	347.91	monocl.
44	bromide	$BiBr_3$	448.75	yellow
45	carbonate, sub-	$Bi_2O_3 \cdot CO_2 \cdot H_2O$	528.03	white powder
46	chloride, di-	$BiCl_2$ (?)	279.91	black needles
47	chloride, tri-	$BiCl_3$	315.37	white crystals
48	citrate	$BiC_6H_5O_7$	398.10	crystals
49	dichromate, basic	$(BiO)_2Cr_2O_7$	666.02	orange red
50	fluoride	BiF_3	266.00	gray powder
51	hydroxide	$Bi(OH)_3$	260.02	white
52	iodate	$Bi(IO_3)_3$	733.76	white

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	.....	.....	52.20°	.....	i. alc.	1
$4.165^{15°}$	.....	.....	0.015	.....	s.a., NH_4 salts	2
$2.94^{4°}$	.....	.....	d.	d.	s.a.	3
$3.92^{20°}$	.....	.....	0.01	.....	s.a., NH_4 salts	4
$4.11^{6°}$	.....	.....	i.	.....	s. a.	5
3.05	$-2H_2O$,100	$-4H_2O$,150	$3^{16°}$	.....	s. alc.	6
.....	.....	.....	$47.98^{0°}$	$67.85^{80°}$	.....	7
4.75	d.	.....	0.0118	$0.0138^{100°}$	s. HCl; i. HNO_3	8
$4.399^{4°}$	1604	.....	s.	d.	s. HCl	9
2.59	.....	.....	0.17d.	d.	.....	10
.....	.....	.....	$0.421^{0°}$	$0.237^{80°}$	sl. s. alc.	11
$4.499^{15°}$	1580 d.	tr. to monocl. 1149	$0.000115^{0°}$	$0.000285^{30°}$	s. conc. H_2SO_4; 0.006, 3% HCl	12
.....	d.	.....	s.	s.	i. alc.	13
$4.25^{15°}$	.....	.....	d.	d.	d. HCl; i. alc.	14
$2.988^{20°}$	d. 200	.....	$41^{15°}$	v.s.	i. alc., CS_2	15
.....	d. 400	.....	s.	s.	.....	16
.....	.....	.....	$0.0197^{0°}$	$0.00177^{80°}$	s. HCl, alc.	17
$4.48^{16°}$	.....	.....	v. sl.s	sl. s.	.....	18
.....	.....	.....	$43^{20°}$	s.	s. alc.	19
$3.45^{18°}$	d.100	.....	$0.208^{20°}$	.....	i. alc.	20
6.35	d.	.....	sl. s.	.....	.....	21
4.298	.....	.....	d.	.....	.....	22
.....	863±	.....	.....	.....	.....	23
$1.73^{15°}$	1300	1500	i.	sl. s., d.	s. dil. a., alk.	24
2.66	1410	.....	.....	.....	.....	25
.....	490	subl. 450	deliq.	v. s.	s. abs. alc.	26
$1.91^{15°}$	d. >2100	.....	d.	d.	s. a.	27
.....	d.100	.....	$0.36^{0°}$	.....	i. NH_3	28
.....	.....	.....	i.	d.	s. a., alk.	29
$1.899^{\frac{2}{4}5°}$	440	520	deliq.	v. s.	v.s.alc.,et.;sl.s.chl.,CS_2; i. NH_3, act.	30
.....	.....	.....	deliq.	v. s.	s. alc.	31
$2.01^{15°}$	800	subl.	v. s.	v. s.	s. H_2SO_4, alc.	32
.....	d.	.....	i.	.....	s. a., alk., $(NH_4)_2CO_3$	33
$4.2^{15°}$	510	590	d.	d.	s. alc., et.	34
.....	60	d. 100	deliq.	v. s.	i. alc., act.	35
$3.02^{0°}$	2450±50	3900	i.	.....	s.conc.H_2SO_4;i.a.,alk.	36
.....	.....	.....	$2^{220°}$	$5.26^{100°}$	.....	37
2.03	d. 110	.....	s.	.....	.....	38
.....	d.	.....	$1.47^{18°}$	$2.94^{100°}$	.....	39
2.443	.....	.....	i.	form $BeSO_4 \cdot 4H_2O$	.....	40
$1.713^{10.5°}$	$-2H_2O$,100	.....	$105.5^{30°}$	$\propto^{100°}$	i. alc., act.	41
$9.80^{20°}$	271	1450	i.	i.	s. aq. reg., conc. H_2SO_4, HNO_3	42
$7.142^{\frac{1}{4}5°}$	.....	.....	sl.s.	.....	v. sl. s. a.	43
5.604	218	453	d.	d.	s. HBr, et.	44
6.86	d.	.....	i.	i.	s. a.	45
4.86	163	d. 300	d.	.....	.....	46
4.75	230	447	d.	.....	s. alc.	47
.....	d.	.....	$0.01^{25°}$	.....	s. NH_4OH; i. alc.	48
.....	.....	.....	i.	i.	s. a.; i. alk.	49
$5.32^{\frac{2}{4}0°}$	.....	.....	i.	.....	d. a.	50
4.36	$-H_2O$, 100	$-1\frac{1}{2}H_2O$, 150	0.00014	.....	s. a.; i. alk.	51
.....	.....	.....	i.	.....	sl. s. HNO_3	52

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Bismuth** iodide	BiI_3	589.76	dark, hexagonal
2	nitrate	$Bi(NO_3)_3 \cdot 5H_2O$	485.10	colorl., tricl.
3	nitrate, sub-	$BiONO_3 \cdot H_2O$	305.02	hexagonal plates
4	oxalate	$Bi_2(C_2O_4)_3$	682.06	white powder
5	oxide, tri-	Bi_2O_3	466.00	yellow, rhombic
6	oxide, tri-	Bi_2O_3	466.00	cubic
7	oxide, tri-	Bi_2O_3	466.00	rhombic
8	oxide, tetra-	$Bi_2O_4 \cdot 2H_2O$	518.03	brownish yellow
9	oxide, penta-	Bi_2O_5	498.00	brown
10	oxide, penta-	$Bi_2O_5 \cdot H_2O$	516.02	red
11	oxybromide	BiOBr	304.92	colorl. crystals
12	oxychloride	BiOCl	260.46	white, amorph.
13	oxyfluoride	BiOF	244.00	white crystals
14	oxyiodide	BiOI	351.92	red, rhombic
15	phosphate, ortho-	$BiPO_4$	303.98	monocl.
16	selenide (guanajuatite)	Bi_2Se_3	654.88	black, rhombic
17	sulfate	$Bi_2(SO_4)_3$	706.18	white needles
18	sulfide (bismuthinite)	Bi_2S_3	514.18	brown, rhombic
19	telluride	Bi_2Te_3	800.83	.....
20	**Boric acid** (boracic acid)	H_3BO_3	61.84	white, triclinic
21	**Boron**	B	10.82	green; amorph., monocl.
22	bromide	BBr_3	250.57	colorl. liquid
23	carbide	B_6C	76.93	black crystals
24	chloride	BCl_3	117.19	liquid
25	fluoride	BF_3	67.82	colorl. gas
26	hydride (boroethane)	B_2H_6	27.69	gas
27	iodide	BI_3	391.58	colorl. plates
28	oxide (boric anhydride)	B_2O_3	69.64	colorl. glass
29	oxide (sassolite)	$B_2O_3 \cdot 3H_2O$	123.69	triclinic
30	phosphide	BP	41.80	maroon powder
31	sulfide, tri-	B_2S_3	117.82	white crystals
32	sulfide, penta- (?)	B_2S_5	181.94	white crystals
33	**Borofluohydric acid**	HBF_4	87.83	.....
34	**Bromic acid**	$HBrO_3$	128.92	colorl.; in soln. only
35	**Bromine**	Br_2	159.83	rhombic or red liq.
36	fluoride	BrF_3	136.92	colorl. liq.
37	hydrate	$Br_2 \cdot 10H_2O$	339.99	red octahdrl.
38	iodide	BrI	206.84	dark gray crysts.
39	**Bromoplatinic** cf. platinic	.....	.....	.....
40	**Cadmium**	Cd	112.41	silvery met.; hex.
41	acetate	$Cd(C_2H_3O_2)_2$	230.50	colorl.
42	acetate	$Cd(C_2H_3O_2)_2 \cdot 2H_2O$	266.53	colorl., monocl.
43	ammonium chloride	$CdCl_2 \cdot 4NH_4Cl$	397.31	rhombic
44	arsenate, acid	$CdHAsO_4 \cdot H_2O$	270.34	.....
45	arsenide	Cd_3As_2	487.05	dark gray; cubic
46	borotungstate	$Cd_2B_2W_9O_{32} \cdot 18H_2O$	2738.03	yellow crysts.
47	bromate	$Cd(BrO_3)_2 \cdot H_2O$	386.26	monocl.
48	bromide	$CdBr_2$	272.24	white plates
49	carbonate	$CdCO_3$	172.42	trigonal

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
5.64	439	500d.	i.	d.	3.5$^{20°}$abs.alc.; s.HI,KI	1
2.82	d.30	$-5H_2O$,80	d.	.....	42$^{19°}$act.; s. a.	2
4.928$^{15°}$	d. 260	.....	i.	i.	s. a.	3
.....	.....	.....	i.	i.	s. a.	4
8.9	820	1900±	i.	i.	s. a.	5
8.20	tr. 704	.....	.....	.....	.....	6
8.55	860	.....	.....	.....	.....	7
5.6	d.100	$-O$,305°	i.	.....	s. a.	8
5.10	$-O$,150°	$-2O$, 357°	i.	i.	s. a., KOH	9
5.75	$-H_2O$, 120	$-2O$, 357°	i.	.....	s. a., KOH	10
8.08	d.	.....	i.	.....	s. a.	11
7.72$^{15°}$	.....	.....	sl. s.	sl. s.	s. a.; i. act., NH_3, $H_2C_4H_4O_6$	12
7.5	d.	.....	i.	.....	s. a.	13
7.92	d.	.....	i.	.....	s. a.; i. KI	14
6.323	d.	.....	v. sl. s.	sl. s.	s. HCl; i. dil. HNO_3	15
6.82	710	d.	i.	.....	i. alk.	16
5.08	d. 418	.....	d.	.....	s. a.	17
7.00	685d.	.....	0.000018$^{18°}$	.....	s. HNO_3	18
7.7 $^{2}_{4}0°$	573	.....	.....	.....	d. HNO_3; i. cold HCl or H_2SO_4	19
1.435$^{15°}$	185 ($-H_2O$)	.....	2.66$^{0°}$	40.2$^{100°}$	28$^{20°}$gly., 0.24 $^{25°}$ et., s. alc.	20
2.45	2300	2550	i.	i.	s. HNO_3, H_2SO_4; i.alc.	21
liq. 2.69	-45	90.6	d.	.....	d. alc.	22
2.54	2350	>3500	i.	i.	i. a.	23
liq. 1.434 $^{0°}_{4}$	-107	13^{764mm}	d.	d.	d. alc.	24
2.3(A)	-126.8	-101	105.7°c.c.	.....	d. alc.	25
.....	-169	-87.5	sl.s.	d.	s. NH_4OH	26
liq. 3.3$^{50°}$	43	210	d.	.....	v. s. CS_2, CCl_4	27
1.85	577	>1500	1.1$^{0°}$	15.7$^{100°}$	s. a., alc.	28
1.49	d.	.....	sl. s.	s.	.....	29
.....	ign. 200°	.....	i.	i.	i. in most solvents	30
1.55	310	.....	d.	.....	sl. s. PCl_3, SCl_2	31
1.85	390	.....	d.	.....	d. alc.	32
.....	.....	130	s.	.....	.....	33
.....	d. 100	.....	v. s.	d.	.....	34
3.119$^{20°}$	-7.2	58.78	4.22$^{0°}$	3.13$^{30°}$	s. alc., et., alk., CS_2	35
5.87(A)						
.....	5	135	forms O_2 HOBr, $HBrO_3$, HF	.....	d. alk.	36
.....	d. 6.8	.....	s.	.....	.....	37
4.414$^{10°}$	42±	116±	d.	.....	s. chl., CS_2	38
.....	.....	.....	.....	.....	.....	39
8.65$^{20°}$	320.9	770	i.	i.	s. a., NH_4NO_3	40
2.341	256	d.	v. s.	.....	.....	41
2.01	$-H_2O$,130	.....	v. s.	.....	.....	42
2.01 $^{2}_{4}0°$	tr.-20	.....	s.	.....	.....	43
4.164 $^{15}_{4}°$	>120	.....	.....	.....	.....	44
6.211 $^{15}_{4}°$	721	.....	.....	.....	d. a.	45
.....	.....	.....	1250$^{17°}$	.....	.....	46
3.8	d.	.....	125$^{17°}$	.....	.....	47
5.192 $^{25}_{4}°$	580	963	61.08$^{0°}$	165$^{80°}$	26.61$^{5°}$alc.; 0.41$^{5°}$ et.	48
4.258$^{4°}$	d. < 500	.....	i.	i.	s. a., KCN, NH_4 salts; i. NH_3	49

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Cadmium** chlorate	$Cd(ClO_3)_2 \cdot 2H_2O$	315.36	deliquescent
2	chloride	$CdCl_2$	183.32	white, cubic
3	chloride	$CdCl_2 \cdot 2\frac{1}{2}H_2O$	228.36	colorl., monocl.
4	cyanide	$Cd(CN)_2$	164.45	.....
5	dithionate	$CdS_2O_6 \cdot 6H_2O$	380.63	triclinic
6	ferrocyanide	$Cd_2Fe(CN)_6$	436.78	.....
7	fluoride	CdF_2	150.41	cubic
8	formate	$Cd(HCO_2)_2 \cdot 2H_2O$	238.48	monocl.
9	hydroxide	$Cd(OH)_2$	146.43	white, trig.
10	iodate	$Cd(IO_3)_2$	462.25	pale brown crysts
11	iodate	$Cd(IO_3)_2 \cdot H_2O$	480.27	.....
12	iodide (α)	CdI_2	366.25	brownish, hex.
13	iodide (β)	CdI_2	366.25	.....
14	lactate	$Cd(C_3H_5O_3)_2$	290.55	needles
15	nitrate	$Cd(NO_3)_2$	236.43	.....
16	nitrate	$Cd(NO_3)_2 \cdot 4H_2O$	308.49	needles
17	oxalate	CdC_2O_4	200.43	colorl.
18	oxalate	$CdC_2O_4 \cdot 3H_2O$	254.48	colorl. crysts.
19	oxide	CdO	128.41	brown, cubic
20	oxide	CdO	128.41	brown, amorph.
21	oxide, sub-	Cd_2O	240.82	green, amorph.
22	permanganate	$Cd(MnO_4)_2 \cdot 6H_2O$	458.37	.....
23	phosphate	$Cd_3(PO_4)_2$	527.19	amorphous
24	phosphate (dihydrogen)	$Cd(H_2PO_4)_2 \cdot 2H_2O$	342.43	triclinic
25	phosphate, pyro-	$Cd_2P_2O_7 \cdot 2H_2O$	434.81	.....
26	potassium iodide	$CdI_2 \cdot 2KI \cdot 2H_2O$	734.31	deliquescent
27	selenate	$CdSeO_4 \cdot 2H_2O$	291.40	rhombic
28	selenide	$CdSe$	191.37	gray-brown; hex.
29	silicate	$CdSiO_3$	188.47	rhombic
30	sulfate	$CdSO_4$	208.47	rhombic
31	sulfate	$CdSO_4 \cdot H_2O$	226.49	monoclinic
32	sulfate	$3CdSO_4 \cdot 8H_2O$	769.54	monoclinic
33	sulfate	$CdSO_4 \cdot 4H_2O$	280.53	.....
34	sulfate	$CdSO_4 \cdot 7H_2O$	334.58	monoclinic
35	sulfide (greenockite)	CdS	144.47	yellow-orange, hex.
36	sulfite	$CdSO_3$	192.47	crystals
37	telluride	$CdTe$	240.02	black, cubic
38	tungstate	$CdWO_4$	360.33	yellow, rhombic
39	**Calcium**	Ca	40.08	silvery met., cubic
40	acetate	$Ca(C_2H_3O_2)_2 \cdot H_2O$	176.18	needles
41	aluminate	$Ca(AlO_2)_2$	158.02	colorl., rhombic or monocl.
42	aluminum silicate (anorthite)	$CaO \cdot Al_2O_3 \cdot 2SiO_2$	278.14	triclinic
43	ammonium arsenate	$NH_4CaAsO_4 \cdot 6H_2O$	305.13	plates, monocl.
44	ammonium phosphate	$NH_4CaPO_4 \cdot 7H_2O$	279.24	monoclinic
45	arsenate	$Ca_3(AsO_4)_2$	398.06	white powder
46	arsenide	Ca_3As_2	270.06	red crystals
47	borate, meta-	$Ca(BO_2)_2 \cdot 2H_2O$	161.75	colorl., cubic
48	boride	CaB_6	105.00	black, cubic
49	bromate	$Ca(BrO_3)_2 \cdot H_2O$	313.93	monoclinic
50	bromide	$CaBr_2$	199.91	deliq. needles

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
2.3	80	.....	298^{0}	$487^{65°}$	s. a., act.	1
$4.047^{25°}_{4°}$	568	960	90°	$147^{100°}$	$1.52^{15°}$ alc.; i. et., act.	2
3.327	tr. 34	.....	$168^{20°}$	$180^{100°}$	$2.05^{15°}$ m. alc.	3
.....	d. > 200	.....	$1.7^{15°}$	.....	s. a., NH_4OH, KCN	4
$2.272^{20°}_{4°}$	d.	.....	.....	.....	.....	5
.....	.....	.....	i.	.....	s. HCl	6
6.64	520	>1200	$4.35^{25°}$	.....	s. a.; i. alc., NH_3	7
2.44	d.	.....	v. s.	.....	.....	8
$4.79^{15°}_{4°}$	d. 300	.....	$0.00026^{25°}$	.....	s. a., NH_4 salts; i. alk.	9
6.43	d.	.....	sl. s.	sl. s.	s. HNO_3, NH_4OH	10
$6.43^{20°}_{4°}$	tr. 160	.....	s.	.....	s. HNO_3	11
$5.670^{0°}_{4°}$	385	713	$79.8^{0°}$	$127.6^{100°}$	s. a., alc., et., NH_4OH; sl.s. NH_3	12
$5.305^{0°}_{4°}$	.....	.....	.....	.....	.....	13
.....	.....	.....	10	12.5	i. alc.	14
.....	350	.....	$109.7^{0°}$	$326^{59.5°}$	v. s. a.	15
$2.455^{17°}_{4°}$	59.4	132	215°	.....	s. alc., NH_3; i. HNO_3	16
$3.32^{19°}_{4°}$	d. 340	.....	$0.00337^{18°}$	0.009	.....	17
$3.32^{18°}_{4°}$ (anhyd.)	d.	.....	.....	.....	s. a., NH_4OH	18
8.15	.....	.....	i.	i.	s. a., NH_4 salts; i. alk.	19
6.95	d. 900–1000	.....	i.	i.	s. a., NH_4 salts; i. alk.	20
$8.192^{18°}_{4°}$	d.	.....	.....	.....	d. alk., a.	21
2.81	d.95	.....	v. s.	.....	.....	22
.....	1500	.....	i.	.....	s. a., NH_4 salts	23
$2.742^{15°}_{4°}$	d. 100	.....	.....	.....	s. HCl; i. alc., et.	24
$4.965^{16°}_{4°}$	900	.....	.....	.....	.....	25
3.359	.....	.....	$137^{15°}$	.....	71 alc.	26
3.632	d. 100	.....	v. s.	.....	.....	27
$5.81^{15°}_{4°}$	>1350	.....	.....	.....	d. a.	28
$4.93^{25°}_{4°}$	1242	.....	.....	.....	.....	29
$4.691^{24°}_{4°}$	1000	.....	$76.5^{0°}$	$60.8^{100°}$	i. act., NH_3	30
$3.786^{20°}$	tr. 108	.....	s.	s.	....	31
3.09	tr. 41.5	.....	$114.2^{0°}$	$127.6^{60°}$	.....	32
3.05	.....	.....	s.	s.	i. alc.	33
$2.48^{20°}_{4°}$	tr. 4	.....	$350^{-5°}$	.....	i. alc.	34
4.58	1750 $^{100 atm.}$	subl. in N_2 980	0.000001	colloidal	s. a.; v. s. NH_4OH	35
.....	d.	.....	sl. s	.....	s. a., NH_4OH; i. alc.	36
$6.20^{15°}_{4°}$	1041	.....	i.	.....	d. HNO_3; i. a.	37
.....	.....	.....	0.05	.....	s. NH_4OH	38
$1.55^{20°}$	810	1200 ± 30	d.	d.	s. a.; sl.s. alc.	39
.....	d.	.....	$52^{0°}$	$45.5^{80°}$	sl.s. alc.	40
$3.67^{20°}$	1600	.....	d.	.....	s. HCl	41
2.765	1551	.....	.....	.....	.....	42
$1.905^{15°}$	d.	.....	0.02	s.	s. NH_4Cl; i. NH_4OH	43
$1.561^{15°}$	d.	.....	i.	d.	s. a.	44
.....	.....	.....	i.	i.	.....	45
$2.51^{5°}$	d.	.....	d.	d.	s. a.	46
.....	$-2H_2O$, 200–300	.....	$0.40^{30°}$	$0.40^{90°}$	s. a., NH_4 salts	47
$2.331^{5°}$	.....	.....	i.	i.	s. HNO_3	48
3.329	d.	.....	v. s.	.....	.....	49
$3.353^{25°}_{4°}$	760	810	$125^{0°}$	$312^{105°}$	s. alc., act.; sl. s. NH_3	50

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Calcium** bromide	$CaBr_2 \cdot 6H_2O$	308.01	hexagonal
2	carbide	CaC_2	64.10	gray, rhombic
3	carbonate (aragonite)	$CaCO_3$	100.09	colorl., rhombic
4	carbonate (calcite)	$CaCO_3$	100.09	colorl., hex.
5	chlorate	$Ca(ClO_3)_2 \cdot 2H_2O$	243.03	deliq., monocl.
6	chloride (hydrophilite)	$CaCl_2$	110.99	deliq., cubic
7	chloride	$CaCl_2 \cdot H_2O$	129.01	colorl.
8	chloride	$CaCl_2 \cdot 6H_2O$	219.09	colorl., trig.
9	chromate	$CaCrO_4 \cdot 2H_2O$	192.12	yellow, monocl.
10	citrate	$Ca_3(C_6H_5O_7)_2 \cdot 4H_2O$	570.50	colorl. needles
11	cyanide	$Ca(CN)_2$	92.12	cubic
12	cyanamide	$CaCN_2$	80.11	colorl., rhombdrl.
13	dithionate	$CaS_2O_6 \cdot 4H_2O$	272.26	trigonal
14	ferrocyanide	$Ca_2Fe(CN)_6 \cdot 12H_2O$	508.31	yellow, tricl.
15	fluoride (fluorite)	CaF_2	78.08	cubic
16	fluosilicate	$CaSiF_6$	182.14	.....
17	fluosilicate	$CaSiF_6 \cdot 2H_2O$	218.17	tetragonal
18	formate	$Ca(HCO_2)_2$	130.12	colorl., rhombic
19	hydride	CaH_2	42.10	crysts. or white powder
20	hydroxide	$Ca(OH)_2$	74.10	colorl., hex.
21	hypochlorite	$Ca(ClO)_2 \cdot 4H_2O$	215.06	feathery crysts.
22	hypophosphate	$Ca_2P_2O_6 \cdot 2H_2O$	274.15	granular
23	iodate (lautarite)	$Ca(IO_3)_2$	389.92	triclinic
24	iodide	CaI_2	293.92	deliquescent plates
25	iodide	$CaI_2 \cdot 6H_2O$	402.02	.....
26	lactate	$Ca(C_3H_5O_3)_2 \cdot 5H_2O$	308.30	colorl.
27	magnesium carbonate (dolomite)	$CaO \cdot MgO \cdot 2CO_2$	184.42	trigonal
28	magnesium silicate (diopside)	$CaO \cdot MgO \cdot 2SiO_2$	216.52	white, monocl.
29	molybdate	$CaMoO_4$	200.03	tetragonal
30	nitrate (nitrocalcite)	$Ca(NO_3)_2$	164.10	colorl., cubic
31	nitrate	$Ca(NO_3)_2 \cdot 4H_2O$	236.16	monocl.
32	nitride	Ca_3N_2	148.26	brown crystals
33	nitrite	$Ca(NO_2)_2 \cdot H_2O$	150.11	deliq., hex.
34	oxalate	CaC_2O_4	128.10	colorl., cubic
35	oxide (lime)	CaO	56.08	colorl., cubic
36	permanganate	$Ca(MnO_4)_2 \cdot 4H_2O$	350.00	purple prisms
37	peroxide	$CaO_2 \cdot 8H_2O$	216.21	pearly, tetrag.
38	phosphate, di-	$CaHPO_4 \cdot 2H_2O$	172.10	monocl. plates
39	phosphate, hypo-	$Ca_2P_2O_6 \cdot 2H_2O$	274.15	granular
40	phosphate, meta-	$Ca(PO_3)_2$	198.04	white
41	phosphate, mono-	$CaH_4(PO_4)_2 \cdot H_2O$	252.09	triclinic
42	phosphate, pyro-	$Ca_2P_2O_7$	254.12	colorl. biaxial
43	phosphate, pyro- (brushite)	$Ca_2P_2O_7 \cdot 5H_2O$	344.20	monocl.
44	phosphate, tri-	$Ca_3(PO_4)_2$	310.20	white, amorph.
45	phosphide	Ca_3P_2	182.20	red crystals
46	phosphite, ortho-	$2CaHPO_3 \cdot 3H_2O$	294.19	.....
47	phosphite, hypo-	$Ca(H_2PO_2)_2$	170.07	colorl., monocl.
48	plumbate	Ca_2PbO_4	351.38	yellow powder
49	plumbite	$CaPbO_2$	279.30	crystalline

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	38.2	149-150	594°	v. s.	.....	1
$2.22^{18°}$	2300	.....	forms C_2H_2	.....	.....	2
2.93	d.825	.....	$0.001^{220°}$	$0.002^{100°}$	s. a., NH_4Cl	3
$2.711^{\frac{2}{4}5°}$	$1339^{103atm.}$	.....	$0.001^{425°}$	$0.002^{1000°}$	s. a., NH_4Cl	4
.....	$-H_2O > 100$	.....	177.7°	.....	s. alc., act.	5
$2.152^{\frac{1}{4}5°}$	772	>1600	59.5°	$347^{260°}$	s. alc.	6
.....	.....	.....	s.	s.	s. alc.	7
$1.68^{17°}$	29.92	$-6H_2O$, 200	v. s.	v. s.	s. alc.	8
.....	$-2H_2O$, 200	.....	22.2°	$18.2^{45°}$	s. a., alc.	9
.....	$-2H_2O$, 130	$-4H_2O$, 185	$0.085^{18°}$	$0.096^{25°}$	$0.006^{518°}$ alc.	10
.....	.....	.....	s.	d.	.....	11
.....	.....	.....	s. d.	d.	.....	12
2.18	d. 110	$-4H_2O$, 78	$40.65^{19°}$	$125^{100°}$	i. alc., act.	13
1.7	.....	.....	.....	$150^{90°}$	.....	14
$3.180^{20°}$	1330	.....	$0.001^{618°}$	$0.001^{726°}$	sl. s. a.	15
$2.662^{17.5°}$	.....	.....	sl. s. d.	.....	s. HCl, HF, alc.	16
2.25	.....	.....	d.	.....	s. H_2SiF_6	17
2.015	d.	.....	16°	$18.4^{100°}$	i. alc., et.	18
1.7	d. 675	.....	d.	.....	d. a.; i. bz.	19
2.2	$-H_2O$, 580	.....	$0.185^{0°}$	$0.077^{100°}$	s. NH_4Cl	20
.....	d.	.....	deliq.	d.	d. a.	21
.....	$-2H_2O$, 200	.....	i.	.....	s. HCl, $H_4P_2O_6$	22
$4.591^{15°}$	d.	.....	$0.4^{15°}$	$0.95^{100°}$	s. HNO_3	23
$3.956^{\frac{2}{4}5°}$	575	718	$182^{0°}$	$426^{100°}$	s. a., abs. alc.; act.	24
.....	42	160	$754^{0°}$	v. s.	.....	25
.....	$-3H_2O$,100	.....	10.5	∞	∞ h. alc.; i. et.	26
2.872	d. 730-760	.....	$0.032^{18°}$	.....	.....	27
3.3	1391	.....	.....	.....	.....	28
4.35	.....	.....	.....	.....	.....	29
2.36	561	.....	$102^{0°}$	$376^{151°}$	$14^{15°}$ alc.; s. amyl. alc., NH_3	30
1.82	42.7	.....	$266^{0°}$	v. s.	.....	31
$2.63^{17°}$	900	.....	d.	d.	s. dil. a.; i. abs. alc.	32
$2.23^{34°}$	.....	.....	$77^{0°}$	$417^{90°}$	s. 90% alc.	33
$2.2^{4°}$	d.	.....	$0.0006^{713°}$	$0.001^{495°}$	s. a.; i. ac. a.	34
3.32	2570	2850	forms $Ca(OH)_2$	.....	s. a.	35
2.4	d.	.....	$331^{14°}$	$388^{250°}$	.....	36
.....	$-8H_2O$,100	expl. 275	sl.s.	d.	s. a.; i. alc., et.	37
$2.306^{\frac{1}{4}0°}$	d.	.....	$0.02^{24.5°}$	$0.075^{100°}$	.....	38
.....	$-2H_2O$, 200	.....	i.	.....	s. HCl, $H_4P_2O_6$	39
2.82	975	.....	i.	i.	i. a.	40
$2.220^{\frac{1}{4}0°}$	$-H_2O$, 100	d. 200	.....	d.	.....	41
3.09	1230	.....	i.	.....	s. a.	42
2.25	.....	.....	sl. s.	.....	s. a.; i. NH_4Cl	43
3.14	1670	.....	0.0025	d.	s. a.	44
$2.51^{18°}$	>1600	.....	d.	.....	s. dil. a.; i. alc., et.	45
.....	$-3H_2O$, 200-300	.....	sl. s	d.	s. NH_4Cl	46
.....	d.	.....	17	s.	i. alc.	47
5.71 (97%)	d.	.....	i.	.....	s. a.	48
.....	.....	.....	sl. s.	.....	.....	49

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Calcium** potassium sulfate (syngenite)	$CaK_2(SO_4)_2 \cdot H_2O$	328.41	monoclinic
2	salicylate	$Ca(C_7H_5O_3)_2 \cdot 2H_2O$	350.33	octahedrl.
3	selenate	$CaSeO_4 \cdot 2H_2O$	219.07	monoclinic
4	silicate (α) (pseudowollastonite)	$CaSiO_3$	116.14	colorl., pseudo hex.; monocl.?
5	silicate (β) (wollastonite)	$CaSiO_3$	116.14	colorl., monocl.
6	silicide	$CaSi_2$	96.20	.....
7	sodium sulfate	$CaSO_4 \cdot 2Na_2SO_4 \cdot 2H_2O$	456.28	.....
8	sulfate (anhydrite)	$CaSO_4$	136.14	colorl., rhombic or monocl.
9	sulfate (gypsum)	$CaSO_4 \cdot 2H_2O$	172.17	colorl., monocl.
10	sulfhydrate	$Ca(SH)_2 \cdot 6H_2O$	214.31	colorl., prismatic
11	sulfide (oldhamite)	CaS	72.14	colorl., cubic
12	sulfite	$CaSO_3 \cdot 2H_2O$	156.17	crystalline
13	tartrate	$CaC_4H_4O_6 \cdot 4H_2O$	260.22	colorl., rhombic
14	thiocarbonate	$CaCS_3$	148.27	yellow
15	thiocyanate	$Ca(CNS)_2 \cdot 3H_2O$	210.28	cryst., deliq.
16	thiosulfate	$CaS_2O_3 \cdot 6H_2O$	260.30	color., tricl.
17	tungstate (scheelite)	$CaWO_4$	288.00	white, tetrag.
18	**Carbon,** cf. table of organic compounds			
19	**Carbon,** amorphous	C	12.01	black, amorph.
20	**Carbon,** graphite	C	12.01	black, hex.
21	**Carbon,** diamond	C	12.01	colorl., cubic
22	dioxide	CO_2	44.01	colorl., gas
23	disulfide	CS_2	76.13	colorl. liquid
24	monoxide	CO	28.01	colorl., poisonous odorless gas
25	monosulfide	CS	44.07	red powder
26	oxybromide (carbonyl bromide)	$COBr_2$	187.84	liquid
27	oxychloride (carbonyl chloride or phosgene)	$COCl_2$	98.92	poisonous gas
28	oxysulfide (carbonyl sulfide)	COS	60.07	gas
29	selenosulfide	$CSSe$	123.03	yellow liquid
30	silicide	CSi_2	68.13	gray crystals
31	suboxide	C_3O_2	68.03	gas
32	tellurosulfide	$CSTe$	171.68	yellow-red liq.
33	thionyl chloride (thiophosgene)	$CSCl_2$	114.98	yellow-red liq.
34	thionyl perchloride	$CSCl_4$	185.90	golden yellow liq.
35	**Ceric** carbide	CeC_2	164.15	red, hexagonal
36	fluoride (fluocerite)	$CeF_4 \cdot H_2O$	234.15	brown, amorph.
37	hydroxide	$2CeO_2 \cdot 3H_2O$	398.31	yellow gelatinous
38	hydroxynitrate	$Ce(OH)(NO_3)_3 \cdot 3H_2O$	397.21	red, monocl.
39	oxide	CeO_2	172.13	white, pale yel. cubic

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
2.60	.....	.....	0.25	d.	s. a.	1
.....	.....	.....	v. s.	.....	s. alc.	2
2.676	.....	.....	9.4°	6.17°	.....	3
2.905	1540	.....	0.0095$^{17°}$	.....	s. HCl	4
2.915	tr. 1190 to α	.....	.....	.....	.....	5
2.5	.....	.....	i.	d.	.....	6
.....	$-2H_2O$, 80	.....	.....	d.	.....	7
2.96	1450 monocl.	tr. 1193 to rhomb.	0.298$^{20°}$	0.1619$^{100°}$	s.a., $Na_2S_2O_3$, NH_4 salts	8
2.32	$-1\frac{1}{2}H_2O$ 2^{P}	$-2H_2O$, 163	0.223°	0.257$^{50°}$	s.a., gly., $Na_2S_2O_3$, NH_4 salts	9
.....	d. 15	.....	v. s.	v. s.	s. alc.	10
2.8$^{15°}$	.....	.....	d.	d.	s. a.	11
.....	$-2H_2O$,100	d.650	0.0043$^{18°}$	0.0027$^{90°}$	s. H_2SO_3	12
.....	d.	.....	0.037°	0.22$^{85°}$	sl. s. alc.	13
.....	.....	.....	s.	.....	s. alc.	14
.....	.....	.....	s.	v. s.	v. s. alc.	15
1.873$^{16°}$	d.	.....	71.2°	d.	i. alc.	16
6.06	.....	.....	0.2	.....	s. NH_4Cl; i. a.	17
.....	.....	.....	.....	.....	.....	18
1.8 to 2.1	>3500	4200	i.	i.	i. a., alk.	19
2.25$^{20°}$	>3500	4200	i.	i.	i. a., alk.	20
3.51$^{20°}$	>3500	4200	i.	i.	i. a., alk.	21
liq. 1.101 $^{-37°}$ 1.53(A) solid 1.56$^{-79°}$	$-56.6^{5.2atm}$	subl. -78.5	179.7$^{0°}$c.c.	90.1$^{20°}$c.c.	s. a., alk.	22
liq. 1.261 $\frac{20°}{4°}$ 2.63(A)	-108.6	46.3	0.20°	0.014$^{50°}$	s. alc., et.	23
liq. 0.814 $\frac{-183°}{4°}$ 0.968(A)	-207	-192	0.0044°; 3.5°c.c.	0.0018$^{50°}$; 2.32$^{20°}$c.c.	s. alc., Cu_2Cl_2	24
1.66	d.	.....	i.	.....	s. et., CS_2; i. alc.	25
2.44	-80	64-5	v. sl.	d.	.....	26
1.392$^{13°}_{4°}$	-104	8.2^{756mm}	v. sl.	d.	s. ac. a., CCl_4; d. a.	27
liq.1.24 $^{-87°}$ 2.10(A)	-138.2	-50.2^{760mm}	133°c .c.	40.3$^{30°}$c.c.	v.s. alk., alc.	28
1.98	-85	84.5	i.	i.	s. CS_2; sl. s. alc.	29
2.5	.....	.....	d.	.....	s. HNO_3, H_2SO_4; i. alc., et.	30
liq. 1.114$^{0°}$	-107	7^{761mm}	d.	.....	s. et.	31
2.9$^{-50°}$	-54	d.	.....	.....	s. CS_2, bz.	32
1.509$^{15°}$	.....	73.5	.....	.....	.....	33
1.712$^{13°}$	.....	146	.....	d.	.....	34
5.23	.....	.....	d.	.....	s. a.	35
.....	d.	.....	i.	.....	.....	36
.....	.....	.....	.....	.....	s. a.; sl.s.alk.carbonate; i. alk.	37
.....	.....	.....	d.	.....	.....	38
7.3	1950	.....	i.	i.	s. H_2SO_4	39

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Ceric** peroxide	CeO_3	188.13	red
2	silicide	$CeSi_2$	196.25	....
3	sulfate	$Ce(SO_4)_2 \cdot 4H_2O$	404.31	yellow, rhombic
4	**Cerium**	Ce	140.13	steel gray; cubic; hex.
5	**Cerous** acetate	$Ce(C_2H_3O_2)_3$	317.26	colorl.
6	acetate	$Ce_2(C_2H_3O_2)_6 \cdot 3H_2O$	688.57	colorl. needles
7	bromate	$Ce(BrO_3)_3 \cdot 9H_2O$	686.02	colorl., hex.
8	bromide	$CeBr_3 \cdot H_2O$	397.89	colorl. needles
9	carbonate	$Ce_2(CO_3)_3 \cdot 5H_2O$	550.37	white powder
10	chloride	$CeCl_3$	246.50	white, deliq.
11	dithionate	$Ce_2(S_2O_6)_3 \cdot 15H_2O$	1030.86	triclinic
12	fluoride	CeF_3	197.13	.....
13	hydroxide	$2Ce(OH)_3 \cdot 3H_2O$	436.36	.....
14	iodide	$CeI_3 \cdot 9H_2O$	683.03	colorl. crystals
15	molybdate	$Ce_2(MoO_4)_3$	760.11	yellow, tetrag.
16	nitrate	$Ce(NO_3)_3 \cdot 6H_2O$	434.25	colorl., deliq.
17	oxalate	$Ce_2(C_2O_4)_3 \cdot 9H_2O$	706.46	.....
18	oxide	Ce_2O_3	328.26	white powder
19	oxychloride	$Ce_2O_3 \cdot 2CeCl_3$	821.26	purple
20	phosphate (monazite)	$CePO_4$	235.11	monocl. or rhomb.
21	phosphate, meta-	$Ce(PO_3)_3$	377.07	.....
22	selenate	$Ce_2(SeO_4)_3$	709.14	rhombic
23	sulfate	$Ce_2(SO_4)_3$	568.44	white, monocl. or rhomb.
24	sulfate	$Ce_2(SO_4)_3 \cdot 8H_2O$	712.57	triclinic
25	sulfide	Ce_2S_3	376.44	yellow crystals
26	tungstate	$Ce_2(WO_4)_3$	1024.02	yellow, tetrag.
27	**Cesium**	Cs	132.91	silvery met., hex.
28	bromate	$CsBrO_3$	260.83	.....
29	bromide	CsBr	212.83	cubic
30	bromide, tri-	$CsBr_3$	372.66	rhombic
31	bromoiodide	$CsBrI_2$	466.67	.....
32	carbonate	Cs_2CO_3	325.82	white, deliq.
33	carbonate, acid	$CsHCO_3$	193.92	rhombic
34	chloraurate	$CsAuCl_4$	471.94	yellow, monocl.
35	chloride	CsCl	168.37	colorl., deliq. cubic
36	chloroplatinate	Cs_2PtCl_6	673.79	yellow, cubic
37	chromate	Cs_2CrO_4	381.83	yellow, monocl.
38	cyanide	CsCN	158.92	colorl.
39	fluoride	CsF	151.91	colorl. cubic
40	fluosilicate	Cs_2SiF_6	407.88	cubic
41	hydride	CsH	133.92	crystalline
42	hydroxide	CsOH	149.92	gray, deliq.
43	iodate	$CsIO_3$	307.83	monocl.
44	iodate, per-	$CsIO_4$	323.83	rhombic
45	iodide	CsI	259.83	cubic
46	iodide, tri-	CsI_3	513.67	rhombic
47	mercuric bromide	$CsBr \cdot 2HgBr_2$	933.71	.....
48	mercuric chloride	$CsCl \cdot HgCl_2$	439.89	cubic or rhombic
49	nitrate	$CsNO_3$	194.92	hexagonal
50	nitrite	$CsNO_2$	178.92	yellow crysts.
51	oxide, mono	Cs_2O	281.72	orange-red
52	oxide, di-	Cs_2O_2	297.72	pale yellow needles
53	oxide, tri-	Cs_2O_3	313.72	chocolate brown

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	.....	.....	.....	.....	.....	1
5.67$^{17°}$	.....	.....	i.	.....	.....	2
.....	.....	.....	s. d.	.....	.....	3
6.92$^{20°}$cubic	645	1400	i.	slowly oxidized	s. dil. a.; i. alc.	4
6.7 hex.						
.....	308d.	.....	20$^{15°}$	127$^{5°}$	.....	5
.....	$-3H_2O$, 115	d.	26.45$^{15°}$	16.27$^{6°}$	.....	6
.....	49	d.	.....	.....	.....	7
.....	d.	.....	deliq.	s.	s. alc.	8
.....	.....	.....	i.	.....	s. $(NH_4)_2CO_3$	9
3.92$^{0°}_{4}$	822	.....	100	d.	30, alc.; s. act.	10
2.288	.....	.....	.....	.....	.....	11
5.8	1324	.....	i.	.....	.....	12
.....	.....	.....	.....	.....	s. a., $(NH_4)_2CO_3$;i.alk.	13
.....	.....	d.	s.	.....	s. alc.	14
5.03$^{1\frac{1}{8}°}$	973	.....	.....	.....	.....	15
.....	$-3H_2O$, 100	d. 200	s.	v. s.	50, alc.; s. act.	16
.....	$-8H_2O$, 110	.....	0.053$^{25°}$	.....	i. $H_2C_2O_4$	17
6.9 to 7.0	.....	.....	i.	.....	s. H_2SO_4	18
.....	.....	.....	i.	.....	s. dil. a.	19
5.22	.....	.....	i.	i.	s. a.	20
3.27	.....	.....	.....	.....	.....	21
4.456	.....	.....	.....	.....	.....	22
3.91	.....	.....	18.98$^{0°}$	0.4$^{100°}$	.....	23
2.886$^{17°}$	$-8H_2O$, 630	.....	25$^{0°}$	7.6$^{40°}$	.....	24
5.020$^{11°}$	d.	.....	i.	d.	s. dil. a.	25
6.77$^{16.5°}$	1089	.....	.....	.....	.....	26
1.90$^{20°}$	28.5	670	d.	.....	s. a., alc.	27
4.10$^{19.5°}$	420	.....	4.54$^{30°}$	.....	.....	28
4.433	636	1300	123$^{25°}$	.....	d. alc.	29
.....	180	.....	.....	s.	.....	30
.....	195.5	.....	d.	.....	s. alc.	31
.....	d. 610	.....	260.7$^{20°}$	v. s.	11.1$^{19°}$,20.17$^{99°}$, alc.	32
.....	$-\frac{1}{2}CO_2$, 175°	.....	210$^{15°}$	v. s.	s. alc.	33
.....	.....	.....	0.5$^{10°}$	27.5$^{100°}$	s. alc.	34
3.97$^{20°}$	646	1290	161.4$^{0°}$	270.5$^{100°}$	s. alc.	35
.....	.....	.....	0.024$^{0°}$	0.377$^{100°}$	.....	36
4.237	.....	.....	71.35$^{13°}$	88.66$^{30°}$	.....	37
.....	.....	.....	s.	.....	i. alc.	38
3.586$^{\frac{7.5}{4}°}$	683	1250	366.5$^{18°}$	.....	i. alc.	39
3.3756$^{18°}$	.....	.....	60$^{17°}$	less s.hot	i. alc.	40
2.7	d.	.....	d.	.....	d. a.	41
3.675$^{11°}$	272	.....	385$^{15°}$	305.3$^{30°}$	s. alc.	42
4.85	.....	.....	2.6$^{24°}$	.....	.....	43
4.259$^{\frac{1.5}{4}°}$	.....	.....	2.15$^{15°}$	s.	.....	44
4.51$^{\frac{2}{4}°}$	621	1280	44$^{0°}$	160$^{61°}$	.....	45
.....	207.5	.....	v. sl. s.	.....	.....	46
.....	.....	.....	0.807$^{16°}$	.....	sl. s. alc.	47
.....	.....	.....	1.44$^{17°}$	.....	i. abs. alc.	48
3.687$^{\frac{2.8}{4}°}$	414	d.	9.33$^{0°}$	197$^{100°}$	s. act.; sl. s. abs. alc.	49
.....	.....	.....	v. s.	v. s.	.....	50
4.36	360 to 400 d.	.....	v. s.	d.	reduced by H_2	51
4.47$^{15°}$	400 to 500	$-O$, 650°	s.	d.	.....	52
4.25$^{0°}$	400	.....	d.	.....	.....	53

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Cesium** oxide, tetra-	Cs_2O_4	329.82	yellow crysts.
2	perchlorate	$CsClO_4$	232.37	colorl., rhombic
3	periodate	$CsIO_4$	323.83	rhombic plates
4	permanganate	$CsMnO_4$	251.84	violet, rhombic
5	silicotungstate	$Cs_8SiW_{12}O_{42}$	3970.38	white crysts.
6	sulfate	Cs_2SO_4	361.88	rhombic needles
7	sulfate, acid	$CsHSO_4$	229.98	rhombic
8	sulfide	$Cs_2S \cdot 4H_2O$	369.94	white, deliq.
9	sulfide, di-	Cs_2S_2	329.94	dark red, amorph
10	sulfide, di-	$Cs_2S_2 \cdot H_2O$	347.96	crystalline
11	sulfide, tri-	Cs_2S_3	362.00	orange
12	sulfide, penta-	Cs_2S_5	426.12	.....
13	tartrate, acid	$CsHC_4H_4O_6$	281.99	rhombic
14	**Chloric acid**	$HClO_3 \cdot 7H_2O$	210.58	liquid
15	**Chlorine**	Cl_2	70.91	rhombic or green-yellow gas
16	hydrate	$Cl_2 \cdot 8H_2O$	215.04	rhombic
17	oxide, mono-	Cl_2O	86.91	yellow-red gas or red-brown liq.
18	oxide, di- or per-	ClO_2	67.46	red-yellow gas
19	oxide, hept-	Cl_2O_7	182.91	colorl. liq.
20	oxide, tetra-	ClO_4 (?)	99.46	.....
21	**Chlorostannic acid**	$H_2SnCl_6 \cdot 6H_2O$	441.55	deliq.
22	**Chlorosulfonic acid**	$HO \cdot SO_2Cl$	116.52	colorl. liq.
23	**Chromic** acetate	$Cr_2(C_2H_3O_2)_6 \cdot 2H_2O$	494.32	green
24	arsenide	CrAs	126.92	gray, hex.
25	boride	CrB	62.83	silvery crysts.
26	bromide	$CrBr_3$	291.76	olive green, hex.
27	bromide	$CrBr_3 \cdot 6H_2O$	399.85	green hex. plates
28	carbide	Cr_3C_2	180.05	gray crysts.
29	chloride	$CrCl_3$	158.38	pink, trigonal
30	chloride	$CrCl_3 \cdot 6H_2O$	266.48	violet or green hex. plates
31	fluoride	CrF_3	109.01	green, rhombic
32	hydroxide	$Cr(OH)_3$	103.03	green or blue gelatinous
33	hydroxide	$Cr(OH)_3 \cdot 2H_2O$	139.07	green
34	nitrate	$Cr(NO_3)_3 \cdot 9H_2O$	400.18	purple prisms
35	nitrate	$Cr(NO_3)_3 \cdot 7\frac{1}{2}H_2O$	373.15	purple, monocl.
36	nitride	CrN	66.02	amorphous
37	oxide	Cr_2O_3	152.02	dark green, hex.
38	phosphate	$CrPO_4 \cdot 3H_2O$	201.04	blue-green
39	phosphate	$CrPO_4 \cdot 6H_2O$	255.09	violet, tricl.
40	phosphide	CrP	82.99	gray-black
41	silicide	Cr_3Si_2	212.15	gray, tetrag.
42	sulfate	$Cr_2(SO_4)_3$	392.20	rose, powder
43	sulfate	$Cr_2(SO_4)_3 \cdot 5H_2O$	482.28	green
44	sulfate	$Cr_2(SO_4)_3 \cdot 15H_2O$	662.44	violet

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
$3.77^{19°}$	600	d.	d.	.....	.....	1
3.327	d.	.....	$0.8^{0°}$	$30^{100°}$	i. abs. alc.	2
$4.259\frac{1}{4}^{5°}$	.....	.....	$2.15^{15°}$	more soluble.	.....	3
$3.597^{10.3°}$	d. 320	.....	$0.093^{0°}$	$1.31^{60°}$	.....	4
.....	.....	.....	$0.005^{20°}$	$0.52^{100°}$	sl.s. NH_4OH; i. HCl, alc.	5
$4.243\frac{2}{4}^{0°}$	1010	tr. to hex. 660	$167^{0°}$	$220^{100°}$	i. alc., act.	6
$3.352^{16°}$	d.	.....	s.	.....	.....	7
.....	.....	.....	v. s.	v. s.	.....	8
.....	460	>800	hygr.	s.	.....	9
.....	.....	.....	s.	.....	.....	10
.....	217	>800	s.	.....	.....	11
$2.806^{16°}$	210	.....	.....	.....	s. alc.	12
.....	.....	.....	$9.7^{25°}$	$98^{100°}$	.....	13
$1.282^{14.2°}$	<-20	d.40	v. s.	.....	.....	14
liq.$1.56^{-33.6°}$	-101.6	-34.6	$1.46^{0°}$; $310^{100°}$ c.c.	$0.57^{30°}$; $177^{30°}$ c.c.	s. alk.	15
$2.49^{0°}$ (A)						
1.23	d. 9.6	.....	s.	.....	s. alk.	16
2.9 (A)	-20	$3.8^{766\ mm}$ expl.	$20000^{0°}$ c.c.	forms HOCl	s. alk.; H_2SO_4; expl. with C compds.	17
$2.411^{0°}$ (A)	-76	9.9^{730mm} expl. 100	$2000^{4°}$ c.c.	forms Cl_2, O_2, $HClO_3$	s. alk., H_2SO_4; expl. with C compds.	18
.....	.....	82; expl.	s. d.	.....	s. bz.	19
.....	.....	d.	.....	.....	formed from $AgClO_4 + I_2$	20
$1.971^{28°}$	19.2	.....	s.	.....	.....	21
$1.787^{25°}$	-80	151.5^{765mm}	d.	.....	d. alc.; i. CS_2	22
.....	.....	.....	s.	.....	i. alc.	23
$6.35\frac{1}{4}^{0°}$	.....	.....	i.	i.	i. a.	24
$5.41^{7°}$	.....	.....	i.	.....	i. d. a.; d. by F_2	25
$4.25\frac{3}{4}^{5°}$	.....	.....	i.*	s.	v. s. alc.	26
$5.41^{7°}$	.....	.....	200	.....	v. s. alc., fused Na_2O_2; i. et.	27
6.68	1890	3800	i.	i.	s. dil. HCl	28
$2.757^{15°}$	.....	1200-1500d.	i.*	sl. s.	i. a., act., CS_2	29
$1.635\frac{3}{4}^{5°}$	subl. 83	.....	v. s. d.	.....	s. alc.; i. et.	30
3.8	>1000	d.	i.	.....	sl. s. a.; i. alc., NH_3	31
.....	.....	.....	i.	.....	s. a., alk.; sl. s. NH_3	32
.....	.....	$-2H_2O$, 100	i.	i.	s. a., alk.	33
.....	36.5	d. 100	s.	s.	s. a., alk., alc., act.	34
.....	100	d.	s.	s.	.....	35
$5.8\frac{3}{4}^{5°}$	d. 1500	.....	i.	i.	i. a., alk.	36
5.21	1900	.....	i.	i.	sl. s. a.	37
.....	.....	.....	sl. s.	.....	s. a., alk.; i. ac. a.	38
2.121	$-3\frac{1}{2}H_2O$, 100	.....	sl. s.	.....	s. a., alk.; i. ac. a.	39
$5.71^{5°}$	.....	.....	i.	.....	s. HNO_3 + HF; i. a.	40
$5.6^{0°}$	.....	.....	i.	i.	s. HCl, HF; i. H_2SO_4, HNO_3	41
3.012	.....	.....	i.*	.....	i. a.	42
.....	.....	.....	s.	.....	s. alc., H_2SO_4	43
$1.867^{17°}$	100	$-10H_2O$, 100	s.	d. 67°	s. alc.	44

*Also a soluble modification.

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Chromic** sulfate	$Cr_2(SO_4)_3 \cdot 18H_2O$	716.49	violet, cubic
2	sulfide	Cr_2S_3	200.20	brown-black powder
3	sulfite	$Cr_2(SO_3)_3$	344.20	greenish-white
4	**Chromium**	Cr	52.01	gray, cubic
5	dioxide	CrO_2	84.01	brown or black powder
6	tetrasulfide	Cr_3S_4	284.27	gray-black powder
7	trioxide (chromic anhyd.)	CrO_3	100.01	red, rhombic
8	**Chromous** carbonate	$CrCO_3$	112.02	blue-green amorph.
9	chloride	$CrCl_2$	122.92	white, deliq.
10	fluoride	CrF_2	90.01	gray, monocl.
11	hydroxide	$Cr(OH)_2$	86.03	yellow-brown
12	iodide	CrI_2	305.85	gray-white
13	oxalate	$CrC_2O_4 \cdot H_2O$	158.05	yel. wh. powd.
14	oxide	CrO	68.01	black powder
15	sulfate	$CrSO_4 \cdot 7H_2O$	274.18	blue
16	sulfide (daubrelite)	CrS	84.07	black powder
17	**Chromyl chloride**	CrO_2Cl_2	154.92	dark red liq.
18	**Cobalt**	Co	58.94	silvery met., cubic
19	arsenosulfide (cobaltite)	CoAsS	165.91	cubic
20	boride	CoB	69.76	prisms
21	bromoplatinate	$CoPtBr_6 \cdot 12H_2O$	949.86	trigonal
22	carbonyl	$Co(CO)_4$	170.98	orange crysts.
23	chloroplatinate	$CoPtCl_6 \cdot 6H_2O$	575.01	trigonal
24	chlorostannate	$CoSnCl_6 \cdot 6H_2O$	498.48	rhombic; trigonal
25	iodoplatinate	$CoPtI_6 \cdot 9H_2O$	1177.83	trigonal
26	phosphide	Co_2P	148.86	needles
27	silicide	CoSi	87.00	needles
28	**Cobaltic** boride	CoB	69.76	prisms
29	chloride	$CoCl_3$	165.31	red crysts.
30	chloride, dichro	$Co(NH_3)_3Cl_3 \cdot H_2O$	234.42	.....
31	chloride, luteo	$Co(NH_3)_6Cl_3$	267.50	org., monocl.
32	chloride, praseo	$Co(NH_3)_4Cl_3 \cdot H_2O$	251.46	green, rhombic
33	chloride, purpureo	$Co(NH_3)_5Cl_3$	250.47	rhombic
34	chloride, roseo	$Co(NH_3)_5Cl_3 \cdot H_2O$	268.49	brick red
35	chromate	$2CoO \cdot CrO_3 \cdot 2H_2O$	285.92	.....
36	hydroxide	$Co(OH)_3$	109.96	black
37	oxide	Co_2O_3	165.88	black
38	potassium nitrite	$2Co(NO_2)_3 \cdot 6KNO_2 \cdot 3H_2O$	958.60	yellow prisms
39	sulfate	$Co_2(SO_4)_3$	406.06	blue crysts.
40	sulfide	Co_2S_3	214.06	black crysts.
41	sulfide, di-	CoS_2	123.06	black, cubic
42	**Cobalto-cobaltic oxide**	Co_3O_4	240.82	black, cubic
43	**Cobaltous** acetate	$Co(C_2H_3O_2)_2 \cdot 4H_2O$	249.09	red-violet, monocl.
44	ammonium chloride	$CoCl_2 \cdot NH_4Cl \cdot 6H_2O$	291.45	red, deliq.
45	ammonium sulfate	$CoSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$	395.24	monoclinic
46	arsenate (erythrite)	$Co_3(AsO_4)_2 \cdot 8H_2O$	598.77	red, monocl.
47	arsenite	$Co_3H_6(AsO_3)_4 \cdot H_2O$	692.52	rose red
48	bromate	$Co(BrO_3)_2 \cdot 6H_2O$	422.87	red, octahdrl.
49	bromide	$CoBr_2$	218.77	deliq., green

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
$1.7^{22°}$	.....	$-12H_2O$,100	$120^{20°}$	d.	s. alc.	1
$3.77^{19°}$	–S, 1350	.....	i.	d.	s. h. HNO_3	2
2.2	d.	.....	.....	.....	.....	3
7.1	1615	2200	i.	i.	s. HCl, dil.H_2SO_4; i. HNO_3	4
.....	–O, 300°	.....	i.	.....	s. HNO_3	5
.....	.....	.....	i.	.....	s. HNO_3; i. HCl, dil. H_2SO_4	6
2.7	190d.	.....	$164.9^{0°}$	$206.7^{100°}$	s.H_2SO_4, alc., et.	7
.....	.....	.....	v. sl. s.	.....	i. et.	8
2.75	.....	.....	v. s.	v. s.	sl. s. alc.; i. et.	9
4.11	1100	>1300	sl. s.	.....	s.h. HCl; i. abs. alc.	10
.....	d.	.....	d.	.....	s. conc. a.	11
5.2	.....	.....	v. s.	.....	.....	12
2.46	.....	.....	.....	.....	.....	13
.....	.....	.....	i.	i.	i. dil. HNO_3	14
.....	.....	.....	$12.35^{0°}$	.....	sl. s. alc.	15
3.97	1550	.....	i.	.....	v. s. a.	16
1.92	–96.5	117.6	d.	.....	s. et.	17
8.9^{200}	1480	2900	i.	i.	s. a.	18
6.2	d.	.....	.....	.....	.....	19
$7.25^{18°}$	.....	.....	d.	.....	s.HNO_3	20
2.762	.....	.....	.....	.....	.....	21
$1.73^{18°}$	51	d. 52	i.	i.	s. alc., et., CS_2	22
2.699	d.	.....	.....	.....	.....	23
2.699	d.100	.....	.....	.....	.....	24
3.618	.....	.....	.....	.....	.....	25
$6.4^{15°}$	.....	.....	i.	i.	s. HNO_3	26
$6.30^{\frac{3}{4}0°}$	.....	.....	.....	.....	s. HCl; i. HNO_3, H_2SO_4	27
$7.25^{18°}$	.....	.....	d.	.....	s. HNO_3	28
2.94	subl.	.....	s.	s.	.....	29
.....	.....	.....	s.	.....	s. a., alc.	30
$1.7016^{20°}$	.....	.....	$4.26^{0°}$	$12.74^{46.5°}$	i. alc., NH_4OH	31
1.847	.....	.....	v. s.	.....	s. a.; i. alc.	32
$1.819^{\frac{3}{2}0°}$	.....	.....	$0.232^{0°}$	$1.031^{46.5°}$	i. alc.	33
.....	d. 100	.....	$16.12^{0°}$	$24.87^{16°}$	sl. s. HCl	34
.....	.....	.....	d.	.....	.....	35
.....	$-1\frac{1}{2}H_2O$, 100	.....	i.	i.	s. a.; i. alc.	36
5.18	d. 900	.....	i.	i.	s. a.	37
.....	$-H_2O$, 200	.....	$0.09^{20°}$	d.	i. alc., et.	38
.....	.....	.....	d.	.....	s. H_2SO_4	39
4.8	.....	.....	i.	.....	d. a.	40
4.269	.....	.....	i.	.....	s. HNO_3, aq. reg.	41
6.07	.....	.....	i.	i.	s. H_2SO_4; i. HCl, HNO_3	42
$1.7053^{18.7°}$	$-4H_2O$, 140	.....	s.	s.	s. a.	43
.....	.....	.....	s.	v. s.	.....	44
1.901	.....	.....	$20.5^{20°}$	$45.4^{80°}$	i. alc.	45
2.912	.....	.....	i.	i.	s. a., NH_4OH	46
.....	$-H_2O$, 100	.....	i.	.....	s. a.	47
.....	.....	.....	$45.5^{17°}$	.....	s. NH_4OH	48
$4.909^{\frac{8}{4}0°}$	d.	.....	$66.7^{59°}$	$68.1^{97°}$	s. a., et.	49

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Cobaltous** bromide	$CoBr_2 \cdot 6H_2O$	326.87	red, deliq.
2	carbonate (spheroco-baltite)	$CoCO_3$	118.95	red, trigonal
3	carbonate, basic	$2CoCO_3 \cdot 3Co(OH)_2$	516.77	red
4	chlorate	$Co(ClO_3)_2 \cdot 6H_2O$	333.95	red, cubic
5	chloride	$CoCl_2$	129.85	blue crysts.
6	chloride	$CoCl_2 \cdot 6H_2O$	237.95	red, monocl.
7	chromate	$CoCrO_4$	174.95	yellow-brown
8	cyanide	$Co(CN)_2 \cdot 2H_2O$	147.01	buff
9	ferricyanide	$Co_3[Fe(CN)_6]_2$	600.74	red
10	ferrocyanide	$Co_2Fe(CN)_6 \cdot 7H_2O$	455.95	gray-green
11	fluoride	$CoF_2 \cdot 2H_2O$	132.97	rose red, monocl.
12	fluoride	$CoF_2 \cdot 5HF \cdot 6H_2O$	305.08	orange red, trig.
13	fluosilicate	$CoSiF_6 \cdot 6H_2O$	309.10	pale red, trig.
14	hydroxide	$Co(OH)_2$	92.96	rose red, rhombic
15	iodate	$Co(IO_3)_2$	408.78	violet needles
16	iodate	$Co(IO_3)_2 \cdot 6H_2O$	516.88	red, octahdrl.
17	iodide	CoI_2	312.78	deliquescent
18	iodide	$CoI_2 \cdot 2H_2O$	348.81	green, deliq.
19	iodide	$CoI_2 \cdot 6H_2O$	420.88	red, hex.
20	nitrate	$Co(NO_3)_2 \cdot 6H_2O$	291.05	red, monocl.
21	oxalate	CoC_2O_4	146.96	red-white
22	oxide	CoO	74.94	brown, cubic
23	perchlorate	$Co(ClO_4)_2$	257.85	red needles
24	perchlorate	$Co(ClO_4)_2 \cdot 6H_2O$	365.95	red, hex.
25	phosphate	$Co_3(PO_4)_2$	366.78	reddish
26	phosphate	$Co_3(PO_4)_2 \cdot 8H_2O$	510.91	red powder
27	phosphite, ortho-	$CoHPO_3 \cdot 2H_2O$	174.96	red-white
28	potassium carbonate	$CoCO_3 \cdot KHCO_3 \cdot 4H_2O$	291.13	rose crysts.
29	selenide	$CoSe$	137.90	yellow crysts.
30	silicate	Co_2SiO_4	209.94	ruby red
31	silicide	Co_2Si	145.94	.....
32	sulfate	$CoSO_4$	155.00	red powder
33	sulfate	$CoSO_4 \cdot H_2O$	173.02	red powder
34	sulfate (bieberite)	$CoSO_4 \cdot 7H_2O$	281.11	red, monocl.
35	sulfide (syeporite)	CoS	91.00	brown needles
36	sulfite	$CoSO_3 \cdot 5H_2O$	229.08	red
37	**Columbic acid**	$3Cb_2O_5 \cdot 7H_2O$	923.57	white, amorph.
38	**Columbium** (niobium)	$Cb(Nb)$	92.91	steel gray
39	bromide	$CbBr_5$	492.49	purple-red
40	chloride	$CbCl_5$	270.20	yellow needles
41	fluoride	CbF_5	187.91	colorl., monocl.
42	hydride	CbH	93.92	gray powder
43	nitride	CbN	106.92	black
44	oxalate, acid	$Cb(HC_2O_4)_5$	538.05	monocl.
45	oxide, mono-	CbO	108.91	black, cubic
46	oxide, di-	CbO_2	124.91	black
47	oxide, penta-	Cb_2O_5	265.82	white crysts.
48	oxybromide	$CbOBr_3$	348.66	yellow crysts.
49	oxychloride	$CbOCl_3$	215.28	white needles
50	oxysulfide	Cb_2OS_3	298.00	black

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	$-4H_2O$, 100	$-6H_2O$, 130	s.	153.2$^{97°}$	s. a., et.	1
4.13	d.	.....	i.	i.	s. a.; i. NH_3	2
.....	.....	.....	i.	d.	s. $(NH_4)_2CO_3$	3
1.92	61	d.100	185$^{0°}$	v. s.	s. alc.	4
3.356	subl.	1049	45$^{7°}$	105$^{96°}$	31, alc.; 8.6, act.	5
1.924 $\frac{25°}{25°}$	86	$-6H_2O$, 110	116.5$^{0°}$	177$^{30°}$	v. s. et.	6
.....	d.	.....	i.	.....	s. a., NH_4OH	7
.....	$-2H_2O$, 280	.....	i.	.....	s. HCl, NH_4OH, KCN	8
.....	.....	.....	i.	.....	s. NH_4OH; i. HCl	9
.....	.....	.....	i.	.....	s. KCN; i. HCl	10
4.43 (anhyd.)	.....	.....	s.	d.	s. HF	11
2.045	.....	.....	s.	.....	.....	12
2.087	.....	.....	s.	.....	.....	13
3.597$^{15°}$	d.	.....	i.	i.	s. NH_4 salts; i. alk.	14
5.008$^{18°}$	.....	.....	1.22$^{0°}$	0.91$^{100°}$	.....	15
3.689$^{21°}$	61d.	.....	s.	.....	.....	16
5.68	.....	.....	159$^{9°}$	420$^{100°}$	v. sl. s. alc., act.	17
.....	.....	.....	s.	s.	.....	18
2.9	$-6H_2O$, 135	.....	s.	s.	.....	19
1.883 $\frac{25°}{25°}$	<100	d.	84.03$^{0°}$ (anhyd.)	334.9$^{90°}$ (anhyd.)	100$^{12.5°}$, alc.; s. act.; sl. s. NH_3	20
2.325 $\frac{18°}{4}$	d.	.....	i.	.....	s. a., NH_4OH	21
5.68	d.1800	.....	i.	i.	s. a., NH_4OH; i. alc.	22
3.327	.....	.....	100$^{0°}$	115$^{45°}$	s. alc., act.	23
.....	143	.....	v. s.	.....	v. s. alc.	24
.....	.....	.....	i.	i.	s. NH_4OH, H_3PO_4	25
.....	$-8H_2O$, 250	.....	i.	i.	s. H_3PO_4	26
.....	.....	.....	sl. s.	.....	.....	27
.....	.....	.....	d.	.....	.....	28
7.65	.....	.....	.....	.....	.....	29
4.63	.....	.....	i.	.....	s. dil. HCl	30
7.11$^{7°}$	1327	.....	.....	.....	d. a.	31
3.710 $\frac{25°}{4°}$	989	d.880	25.6$^{0°}$	83$^{100°}$	1.04$^{18°}$ m. alc.; i. NH_3	32
3.13	d.	.....	s.	s.	.....	33
1.948 $\frac{25°}{4°}$	96.8	$-7H_2O$, 420	s.	s.	2.53$^{0°}$ alc.	34
5.45$^{18°}$	>1100	.....	0.00038$^{18°}$	.....	s. a., aq. reg.	35
.....	.....	.....	i.	.....	s. H_2SO_3	36
4.3	d.	.....	i.	.....	s. H_2SO_4, HF, alk.; i. NH_3	37
8.4$^{20°}$	Ign. 1950	>3300	i.	i.	s.h. H_2SO_4; sl.s. HCl, HNO_3	38
.....	150	270	d.	.....	d. alc.	39
2.75	194	240.5	d.	.....	s. HCl, CCl_4; d. alc.	40
3.29	75.5	229	d.	.....	s. HNO_3	41
6.0 to 6.6	d.	.....	.....	.....	s. HF; i. a.	42
.....	.....	.....	.....	.....	s. HF + HNO_3; i. HNO_3	43
.....	.....	.....	d.	.....	s. $H_2C_2O_4$; d. alc.	44
6.3 to 6.7	.....	.....	i.	.....	s. H_2SO_4, HCl, i. HNO_3, alk.	45
.....	.....	.....	i.	i.	s. H_2SO_4; i. HNO_3	46
4.6 $\frac{0}{4}$	1520	.....	i.	.....	s. H_2SO_4, HF	47
.....	subl.	.....	d.	.....	s. a.	48
.....	subl. 400	.....	d.	.....	s. H_2SO_4, alc.; i. HCl	49
.....	d.	.....	i.	i.	s. H_2SO_4; sl. s. HF; i. HCl	50

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Copper**	Cu	63.57	yellow-red met., cubic
2	boride	Cu_3B_2	212.35	yellow
3	hydride	Cu_2H_2	129.16	red-brown
4	nitride	Cu_3N	204.72	.....
5	peroxide	$CuO_2 \cdot H_2O$	113.59	olive green
6	suboxide	Cu_4O	270.28	olive green
7	**Cupric** acetate	$Cu(C_2H_3O_2)_2$	181.66	.....
8	acetate	$Cu(C_2H_3O_2)_2 \cdot H_2O$	199.67	dark green, monocl.
9	aceto-arsenite (Paris green)	$(CuOAs_2O_3)_3 \cdot Cu(C_2H_3O_2)_2$	1013.83	green
10	ammonium chloride	$CuCl_2 \cdot 2NH_4Cl \cdot 2H_2O$	277.51	blue, tetrag.
11	ammonium sulfate	$CuSO_4 \cdot 4NH_3 \cdot H_2O$	245.77	blue, rhombic
12	arsenate	$Cu_3(AsO_4)_2 \cdot 4H_2O$	540.59	blue-green
13	arsenate, acid	$Cu_5H_2(AsO_4)_4 \cdot 2H_2O$	911.54	blue
14	arsenide	Cu_5As_2	467.67	blue, octahdrl.
15	arsenite (Paris green) *	$CuHAsO_3$	187.49	green
16	bromate	$Cu(BrO_3)_2 \cdot 6H_2O$	427.50	blue-green, cubic
17	bromide	$CuBr_2$	223.40	black, monocl.
18	carbonate (azurite)	$2CuCO_3 \cdot Cu(OH)_2$	344.75	blue, monocl.
19	carbonate, basic (malachite)	$CuCO_3 \cdot Cu(OH)_2$	221.17	dark green, monocl.
20	chlorate	$Cu(ClO_3)_2 \cdot 6H_2O$	338.58	green deliq., cubic
21	chloride (eriochalcite)	$CuCl_2$	134.48	brown-yellow powder
22	chloride	$CuCl_2 \cdot 2H_2O$	170.52	green, rhombic
23	chromate, basic	$CuCrO_4 \cdot 2CuO \cdot 2H_2O$	374.75	yellow-brown
24	cyanide	$Cu(CN)_2$	115.61	yellow-green
25	dichromate	$CuCr_2O_7 \cdot 2H_2O$	315.62	black, triclinic
26	ferricyanide	$Cu_3[Fe(CN)_6]_2$	614.63	yellow-green
27	ferrocyanide	$Cu_2Fe(CN)_6 \cdot 7H_2O$	465.21	red-brown
28	fluoride	$CuF_2 \cdot 2H_2O$	137.60	blue, monocl.
29	fluosilicate	$CuSiF_6 \cdot 6H_2O$	313.73	blue, deliq., rhombic
30	formate	$Cu(HCO_2)_2$	153.61	blue, monocl.
31	hydroxide	$Cu(OH)_2$	97.59	blue, gelatinous
32	iodate	$Cu(IO_3)_2$	413.41	green, monocl.
33	iodate	$Cu(IO_3)_2 \cdot H_2O$	431.43	blue, triclinic
34	iodate, basic	$Cu(OH)IO_3$	255.50	green, rhombic
35	lactate	$Cu(C_3H_5O_3)_2 \cdot 2H_2O$	277.74	dark blue, monocl
36	nitrate	$Cu(NO_3)_2 \cdot 3H_2O$	241.63	blue, deliq.
37	nitrate	$Cu(NO_3)_2 \cdot 6H_2O$	295.68	blue, rhombic
38	nitroprusside	$CuFe(CN)_5NO \cdot 2H_2O$	315.55	green-white
39	oxalate	$CuC_2O_4 \cdot \frac{1}{2}H_2O$	160.60	blue-white
40	oxychloride	$CuCl_2 \cdot 2CuO \cdot 4H_2O$	365.69	blue-green
41	oxide (paramelaconite)	CuO	79.57	black, cubic
42	oxide (tenorite)	CuO	79.57	black, triclinic
43	periodate	Cu_2HIO_6	351.07	green powder
44	phosphate	$Cu_3(PO_4)_2 \cdot 3H_2O$	434.72	blue-green, rhombic
45	phosphide	Cu_3P_2	252.67	black

*Also called Scheele's green.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
$8.92^{20°}$	1083	2310	i.	i.	s. HNO_3, h. H_2SO_4	1
8.116	.....	.....	.....	.....	.....	2
.....	d.60	.....	.....	.....	d. HCl	3
.....	d. 300	.....	d.	.....	d. a.	4
.....	.....	.....	i.	.....	d. a.	5
.....	.....	.....	i.	.....	d. a.	6
$1.930^{\frac{20°}{4°}}$	.....	.....	s.	.....	.....	7
1.882	115	240d.	7.2	20	7, alc.; s. et.	8
.....	.....	.....	i.	.....	s. a., NH_4OH	9
1.98	d.110	.....	$33.8^{0°}$	$99.3^{80°}$	s. a.	10
1.81	d.150	.....	$18.05^{21.5°}$	d.	i. alc.	11
.....	.....	.....	i.	i.	s. a., NH_4OH	12
.....	.....	.....	i.	.....	s. a., NH_4OH	13
7.56	forms Cu_3As	.....	i.	i.	s. a., NH_4OH	14
.....	d.	.....	i.	i.	s. a., NH_4OH	15
2.583	d. 180	$-6H_2O$, 200	v. s.	.....	s. NH_4OH	16
.....	498	.....	v. s.	.....	s. NH_3, alc., act.; i. bz.	17
3.88	d. 220	.....	i.	d.	s. NH_4OH, h. aq. $NaHCO_3$	18
3.9	d.	.....	i.	d.	s. KCN; 0.03 aq. CO_2	19
.....	65	d.100	$207^{0°}$	v. s.	s. alc., act.	20
3.054	498	forms Cu_2Cl_2, 993	$70.7^{0°}$	$107.9^{100°}$	$53^{15°}$ alc.; $68^{15°}$m. alc.	21
$2.39^{22.4°}$	$-2H_2O$, 110	d.	$110.4^{0°}$	$192.4^{100°}$	s. alc., et., NH_4Cl	22
.....	$-2H_2O$, 260	.....	i.	.....	s. HNO_3, NH_4OH	23
.....	d.	.....	i.	.....	s. KCN, C_5H_5N	24
$2.286^{18°}$	$-2H_2O$,100	.....	sl. s.	d.	s. a., NH_4OH	25
.....	.....	.....	i.	.....	s. NH_4OH; i. HCl	26
.....	.....	.....	i.	i.	s. NH_4OH; i. a., NH_3	27
2.9	.....	.....	sl. s.	d.	s. HNO_3, HCl, HF, alc.; i. NH_3	28
$2.158^{19°}$	.....	.....	$233.6^{17°}$	.....	$0.16^{20°}$, 92% alc.	29
1.831	.....	.....	12.5	d.	0.25 alc.	30
3.368	$-H_2O$	.....	i.	d.	s. a., NH_4OH, KCN, alc.	31
$5.241^{15°}$	d.	.....	$0.1364^{25°}$	i.	s. dil. H_2SO_4; i. dil. HNO_3	32
$4.876^{15°}$	$-H_2O$, 240	d.290	$0.33^{15°}$	$0.65^{100°}$	s. dil. H_2SO_4, NH_4OH; i. dil. HNO_3, alc.	33
$4.878^{15°}$	d.290	.....	i.	i.	s. dil. H_2SO_4	34
.....	.....	.....	16.7	$45^{100°}$	sl.s. alc.	35
$2.047^{3.9°}$	114.5	$-HNO_3$,170	$381^{40°}$	$666^{80°}$	$100^{12.5°}$ alc.	36
2.074	$-3H_2O$, 26.4	.....	$243.7^{0°}$	∞	s. alc.	37
.....	.....	.....	i.	.....	d. alk.; i. alc.	38
.....	.....	.....	i.	.....	i. ac. a.	39
.....	$-3H_2O$, 140	.....	i.	.....	s. a.	40
6.40	d. 1026	.....	i.	i.	s. a., KCN, NH_4Cl	41
6.45	d. 1026	.....	i.	i.	s.a., KCN, NH_4Cl	42
.....	d.110	.....	i.	i.	s. dil. HNO_3	43
.....	d.	.....	i.	sl.s.	s. a., NH_4OH; i. NH_3	44
6.35	d.	.....	i.	.....	s. HNO_3; i. HCl	45

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Cupric** phosphite, ortho-	$CuHPO_3 \cdot 2H_2O$	179.59	.....
2	salicylate	$Cu(C_7H_5O_3)_2 \cdot 4H_2O$	409.86	blue-green needles
3	sulfate (hydrocyanite)	$CuSO_4$	159.63	green-white, rhombic
4	sulfate (blue vitriol or chalcanthite)	$CuSO_4 \cdot 5H_2O$	249.71	blue, triclinic
5	sulfide (covellite)	CuS	95.63	black hex. or monocl.
6	tartrate	$CuC_4H_4O_6 \cdot 3H_2O$	265.69	*light green powd.*
7	**Cuprous** ammonium iodide	$CuI \cdot NH_4I \cdot H_2O$	353.47	rhombic plates
8	antimonide	Cu_3Sb	312.47	light gray
9	arsenide	Cu_3As	265.62	hexagonal
10	bromide	Cu_2Br_2	286.97	white, tetrahedral
11	carbonate	Cu_2CO_3	187.15	yellow
12	chloride (nantokite)	Cu_2Cl_2	198.05	white, cubic
13	cyanide	$Cu_2(CN)_2$	179.16	white, monocl.
14	ferricyanide	$Cu_3Fe(CN)_6$	402.67	brown-red
15	ferrocyanide	$Cu_4Fe(CN)_6$	466.24	brown-red
16	fluoride	Cu_2F_2	165.14	red crysts.
17	hydroxide	Cu(OH)	80.58	yellow
18	iodide (marshite)	Cu_2I_2	380.98	red-brown, cubic
19	oxide (cuprite)	Cu_2O	143.14	red, cubic
20	phosphide	Cu_6P_2	443.38	gray-black
21	selenide (berzelianite)	Cu_2Se	206.10	black, cubic
22	silicide	Cu_4Si	282.34	white, metallic
23	sulfide (chalcocite)	Cu_2S	159.20	black, rhombic
24	sulfide	Cu_2S	159.20	black, cubic
25	sulfite	$Cu_2SO_3 \cdot H_2O$	225.22	red or white, hex.
26	thiocyanate	CuCNS	121.65	white powder
27	**Cyanogen**	C_2N_2	52.02	poisonous gas
28	**Cyanogen compounds** cf. organic table	.....	.....	.....
29	**Dysprosium**	Dy	162.46	.....
30	acetate	$Dy(C_2H_3O_2)_3 \cdot 4H_2O$	411.66	yellow needles
31	bromate	$Dy(BrO_3)_3 \cdot 9H_2O$	708.35	yellow, hex.
32	carbonate	$Dy_2(CO_3)_3 \cdot 4H_2O$	577.01	.....
33	chloride	$DyCl_3$	268.83	yellow plates
34	chromate	$Dy_2(CrO_4)_3 \cdot 10H_2O$	853.11	yellow crysts.
35	oxalate	$Dy_2(C_2O_4)_3 \cdot 10H_2O$	769.08	prisms
36	oxide	Dy_2O_3	372.92	white
37	phosphate	$DyPO_4 \cdot 5H_2O$	347.52	yellow
38	selenate	$Dy_2(SeO_4)_3 \cdot 8H_2O$	897.93	yellow needles
39	**Erbium**	Er	167.2	.....
40	acetate	$Er(C_2H_3O_2)_3 \cdot 4H_2O$	416.40	triclinic
41	chloride	$ErCl_3 \cdot 6H_2O$	381.67	deliq.
42	nitrate	$Er(NO_3)_3 \cdot 6H_2O$	461.32	crystalline
43	oxide	Er_2O_3	382.40	.....
44	sulfate	$Er_2(SO_4)_3$	622.58	.....

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts: Cold Water	Hot Water	Other Reagents	
.....	d.	.....	i.	i.	.....	1
.....	.....	.....	v. s.	d. 100°	v. s. alc.	2
3.606$^{15°}$	200	forms CuO, 650	14.3$^{0°}$	75.4$^{100°}$	i. alc.	3
2.286$^{15.6°}$	$-4H_2O$, 110	$-5H_2O$, 250	24.3$^{0°}$	205$^{100°}$	i. alc.	4
4.6	tr. 103	d. 220	0.000033$^{18°}$	.....	s. HNO_3, KCN	5
.....	d.	.....	0.02$^{15°}$	0.14$^{85°}$	.....	6
.....	.....	.....	d.	.....	s. NH_4I	7
8.51$^{20°}$	687	.....	.....	.....	.....	8
8.0$^{20°}$	830	.....	.....	.....	.....	9
4.72$^{12°}$	504	1345	v. sl. s.	d.	s. HBr, HCl, NH_4OH; i. act.	10
4.4	d.	.....	i.	i.	s. a., NH_4OH	11
3.53	422	1366	1.52$^{25°}$	.....	s. HCl, NH_4OH	12
2.9	474.5	d.	i.	i.	s. KCN, HCl, NH_4OH; sl. s. NH_3	13
.....	.....	.....	i.	.....	s. NH_4OH; i. HCl	14
.....	.....	.....	i.	.....	s. NH_4OH; l. NH_4Cl	15
.....	908	subl. 1100	i.	.....	s. HF, HCl, HNO_3; i. alc.	16
3.4	$-\frac{1}{2}H_2O$,360	.....	i.	i.	s. a., NH_4OH	17
5.63$^{15.5°}$	605	1290	0.000$^{18°}$	.....	s. KI; i. a., alc.	18
6.0	1235	$-O$, 1800	i.	i.	s. HCl, NH_4Cl, NH_4OH	19
6.4 to 6.8	.....	.....	i.	.....	s. HNO_3; i. HCl	20
6.749$^{30°}$	1113	.....	.....	.....	d. HCl	21
7.53$^{20°}$	850	.....	.....	.....	d. HNO_3; i. HCl	22
5.6	1100	.....	0.000$^{18°}$	.....	s. HNO_3, NH_4OH; i. act.	23
5.80	1130	.....	0.000$^{18°}$	.....	s. HNO_3, NH_4OH; i. act.	24
3.83$^{15°}$	.....	.....	sl.s.	.....	s. HCl, NH_4OH; i. alc., et.	25
2.846	d.	.....	0.000$^{18°}$	.....	s. NH_4OH, et.; i.dil.a.	26
liq.0.866 $^{17.2°}$	-34.4	-20.5	450$^{20°}$ c.c.	.....	2300$^{20°}$ c.c. alc.;	27
1.806 (A)	.....	.....	.....	.....	500$^{18°}$ c.c. et.	28
.....	.....	.....	.....	.....	.....	29
.....	d. 120	.....	s.	.....	v. sl. s. alc.	30
.....	78	$-6H_2O$, 110	v. s..	.....	sl.s. alc.	31
.....	$-3H_2O$,150	.....	i.	.....	.....	32
3.67$^{0°}$	655	.....	s.	.....	.....	33
.....	$-3\frac{1}{2}H_2O$, 150	d.	1.002$^{25°}$	.....	.....	34
.....	.....	.....	i.	.....	s. dil. a.	35
7.81	.....	.....	.....	.....	s. a.	36
.....	$-5H_2O$, 200	.....	i.	.....	s. dil. a., ac. a.	37
.....	$-8H_2O$, 200	.....	v. s.	.....	i. alc.	38
.....	.....	.....	.....	.....	.....	39
2.114	.....	.....	.....	.....	.....	40
.....	.....	.....	s.	s.	s. alc.	41
.....	.....	.....	s.	.....	s. alc., et., act.	42
8.640	.....	3000	i.	.....	s. h. a.	43
3.678	d. 950	.....	43$^{0°}$	.....	.....	44

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Erbium** sulfate	$Er_2(SO_4)_3 \cdot 8H_2O$	766.71	red, monocl.
2	**Europium**	Eu	152.0	.....
3	oxide	Eu_2O_3	352.00	pale pink powder
4	**Ferric** acetate, basic	$Fe(OH)(C_2H_3O_2)_2$	190.95	amorphous
5	ammonium sulfate cf.alum	.....	.....	.....
6	arsenate (scorodite)	$FeAsO_4 \cdot 4H_2O$	266.82	white, rhombic
7	arsenite, basic	$2FeAsO_3 \cdot Fe_2O_3 \cdot 5H_2O$	607.30	brown-yellow
8	bromide	$FeBr_3$	295.60	dark red, deliq.
9	bromide	$FeBr_3 \cdot 6H_2O$	403.69	red
10	chloride (molysite)	$FeCl_3$	162.22	blk-br., hex.
11	chloride	$FeCl_3 \cdot 6H_2O$	270.32	red-yellow
12	ferrocyanide (Prussian-blue)	$Fe_4[Fe(CN)_6]_3$	859.27	bark blue
13	fluoride	FeF_3	112.85	green, rhombic
14	fluoride	$FeF_3 \cdot 4\frac{1}{2}H_2O$	193.92	yellow crysts.
15	formate	$Fe(HCO_2)_3 \cdot H_2O$	208.92	yellow crysts.
16	hydroxide	$Fe(OH)_3$	106.87	red-brown
17	hypophosphite	$Fe(H_2PO_2)_3$	250.84	gray powder
18	lactate	$Fe(C_3H_5O_3)_3$	323.06	brown, amorph.
19	nitrate	$Fe(NO_3)_3 \cdot 6H_2O$	349.97	deliq., rhombic
20	oxalate	$Fe_2(C_2O_4)_3$	375.76	amorphous
21	oxide (hematite)	Fe_2O_3	159.70	red or blk., trig.
22	phosphate (strengite)	$FePO_4 \cdot 2H_2O$	186.86	yellow, rhombic or monocl.
23	pyrophosphate	$Fe_4(P_2O_7)_3 \cdot 9H_2O$	907.42	yellow powd.
24	sulfate	$Fe_2(SO_4)_3$	399.88	amorphous
25	sulfate (coquimbite)	$Fe_2(SO_4)_3 \cdot 9H_2O$	562.02	yellow, trig.
26	sulfide	Fe_2S_3	207.88	yellow-green
27	thiocyanate	$Fe(CNS)_3 \cdot 3H_2O$	284.13	red, deliq., cubic
28	**Ferroso-ferric** chloride	$FeCl_2 \cdot 2FeCl_3 \cdot 18H_2O$	775.49	yellow, deliq.
29	ferricyanide (Prussian green)	$Fe'''_4Fe''_3[Fe(CN)_6]_6$	1662.70	green
30	hydrate	$Fe_3O_4 \cdot 4H_2O$	303.61	black
31	oxide (magnetite or magnetic)	Fe_3O_4	231.55	black, cubic
32	sulfide	Fe_3S_4	295.79	hexagonal
33	**Ferrous** acetate	$Fe(C_2H_3O_2)_2 \cdot 4H_2O$	246.00	monocl., needles
34	ammonium sulfate	$FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$	392.15	blue-green, monocl.
35	arsenate	$Fe_3(AsO_4)_2 \cdot 6H_2O$	553.47	green, amorph.
36	arsenite, pyro-	$Fe_2As_2O_5$	341.52	green-white
37	bromide	$FeBr_2$	215.68	green, hex.
38	bromide	$FeBr_2 \cdot 6H_2O$	323.78	red, rhombic
39	carbonate (siderite)	$FeCO_3$	115.86	gray, trig.
40	carbonate	$FeCO_3 \cdot H_2O$	133.88	amorphous
41	chloride (lawrencite)	$FeCl_2$	126.76	grn.-yel., hex.
42	chloride	$FeCl_2 \cdot 4H_2O$	198.83	blue-grn., monocl
43	chloroplatinate	$FePtCl_6 \cdot 6H_2O$	571.92	yellow, hex.
44	ferricyanide (Turnbull's blue)	$Fe_3[Fe(CN)_6]_2$	591.47	dark blue
45	ferrocyanide	$Fe_2Fe(CN)_6$	323.66	blue-wh., amorph.
46	fluoride	$FeF_2 \cdot 8H_2O$	237.98	green
47	formate	$Fe(HCO_2)_2 \cdot 2H_2O$	181.92	.....
48	hydroxide	$Fe(OH)_2$	89.87	light green

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
3.18	.....	.....	$30^{20°}$	$100^{100°}$	.....	1
.....	.....	.....	.....	.....	.....	2
7.42	.....	.....	.....	.....	.....	3
.....	.....	.....	i.	.....	s. a., alc.	4
.....	.....	.....	.....	.....	.....	5
3.18	d.	.....	i.	i.	s. HCl; i. HNO_3	6
.....	d.	.....	sl.s.	.....	s. a., alk.	7
.....	subl. d.	.....	s.	s.	s. alc., et.; sl.s. NH_3	8
.....	27	.....	s.	s.	.....	9
$2.804^{11°}$	315	315	$74.4^{0°}$	$535.7^{100°}$	v. s. alc., et. + HCl	10
.....	37	280	$246^{0°}$	∞	s. alc.	11
.....	d.	.....	i.	d.	s. HCl, conc. H_2SO_4; i. alc., et.	12
3.18	.....	.....	sl.s.	s.	s. a.; i. alc., et.	13
.....	$-3H_2O$, 100	.....	sl. s.	s.	i. alc.	14
.....	.....	.....	s.	d.	.....	15
3.4 to 3.9	$-1\frac{1}{2}H_2O$, 500	.....	i.	i.	s. a.; i. alc., et.	16
.....	d.	.....	$0.043^{25°}$	$0.083^{100°}$	s. alk. citrate	17
.....	.....	.....	deliq.	v. s.	i. et.	18
$1.684^{20°}$	35	d.	$150^{0°}$	∞	s. alc., act.	19
.....	.....	.....	v. s.	d. 100°	s. a.; i. alc.	20
5.12	1560 d.	.....	i.	.....	s. HCl	21
2.87	.....	.....	i.	$0.67^{100°}$	s. a.; i. ac. a.	22
.....	.....	.....	i.	.....	s. a.	23
$3.097^{18°}$	d. 480	.....	sl. s.	d.	i. H_2SO_4, NH_3	24
2.1	.....	.....	440	d.	s. abs. alc.	25
4.3	d.	.....	d.	.....	d. a.	26
.....	d.	.....	v. s.	v. s.	v. s. alc., et.	27
.....	d.50	.....	s.	s.	.....	28
.....	d. 180	.....	i.	.....	s. d. h. HCl	29
.....	d.	.....	i.	i.	s. a.	30
5.2	1538d.	.....	i.	i.	i. alc.	31
4.55	.....	.....	i.	.....	s. a.	32
.....	d.	.....	v. s.	v. s.	.....	33
1.864	d.	.....	$18^{0°}$	$100^{75°}$	i. alc.	34
.....	d.	.....	i.	i.	s. dil. HCl; sl.s. NH_4OH	35
.....	.....	.....	i.	.....	s. NH_4OH	36
$4.636^{4.5°}$	d.	.....	$109^{10°}$	$170^{95°}$	s. alc.	37
.....	27	.....	$313.2^{0°}$	∞	s. alc.	38
3.8	d.	.....	$0.0065^{20°}$	i.	s. aq. CO_2, a.	39
.....	d.	.....	sl.s.	.....	s. aq. CO_2, a.	40
2.7	.....	deliq.	$64.4^{10°}$	$105.7^{100°}$	100 alc.; s. act.; i. et.	41
1.926	.....	deliq.	$160.1^{10°}$	$415.5^{100°}$	s. alc.	42
2.714	.....	.....	v. s.	v. s.	.....	43
.....	d.	.....	i.	.....	i. dil. a., alc.	44
.....	.....	.....	i.	.....	.....	45
4.09 (anhyd.)	$-8H_2O$,100	.....	sl. s.	.....	s.a., HF; i. alc., et.	46
.....	d.	.....	sl.s.	.....	.....	47
3.4	.....	.....	0.00067	.....	s.a., NH_4Cl	48

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Ferrous** iodide	FeI_2	309.69	gray, hex.
2	iodide	$FeI_2 \cdot 4H_2O$	381.75	green, deliq.
3	lactate	$Fe(C_3H_5O_3)_2 \cdot 3H_2O$	288.04	green
4	nitrate	$Fe(NO_3)_2 \cdot 6H_2O$	287.96	crystalline
5	oxalate	$FeC_2O_4 \cdot 2H_2O$	179.90	lt. yel., rhombic
6	oxide	FeO	71.85	black
7	perchlorate	$Fe(ClO_4)_2 \cdot 6H_2O$	362.86	green
8	phosphate (vivianite)	$Fe_3(PO_4)_2 \cdot 8H_2O$	501.64	blue, monocl.
9	potassium oxalate	$K_2Fe(C_2O_4)_2 \cdot 2H_2O$	346.11	yellow needles
10	silicate	$FeSiO_3$	131.91	monocl.
11	sulfate (siderotilate)	$FeSO_4 \cdot 5H_2O$	241.99	grn., tricl.
12	sulfate (copperas)	$FeSO_4 \cdot 7H_2O$	278.02	bl.-grn., monocl.
13	sulfide	FeS	87.91	black, hex.
14	sulfite	$FeSO_3 \cdot 2\frac{1}{2}H_2O$	180.95	.....
15	tartrate	$FeC_4H_4O_6$	203.92	white powder
16	thiocyanate	$Fe(CNS)_2 \cdot 3H_2O$	226.05	grn., rhomb. pr.
17	thiosulfate	$FeS_2O_3 \cdot 5H_2O$	258.05	green
18	**Cf.** also under iron	.....	.....	.....
19	**Fluorine**	F_2	38.00	green-yel. gas
20	oxide	F_2O	54.00	colorl. gas or yel.-brown liq.
21	**Fluosilicic acid**	H_2SiF_6	144.08	.....
22	**Gadolinium**	Gd	156.9	.....
23	acetate	$Gd(C_2H_3O_2)_3 \cdot 4H_2O$	406.10	triclinic
24	bromide	$GdBr_3 \cdot 6H_2O$	504.74	rhombic plates
25	chloride	$GdCl_3$	263.27	white, monocl.
26	chloride	$GdCl_3 \cdot 6H_2O$	371.37	deliq.
27	nitrate	$Gd(NO_3)_3 \cdot 6\frac{1}{2}H_2O$	460.03	triclinic
28	oxalate	$Gd_2(C_2O_4)_3 \cdot 10H_2O$	758.02	monocl.
29	oxide	Gd_2O_3	361.80	white powder
30	potassium sulfate	$Gd_2(SO_4)_3 \cdot K_2SO_4 \cdot 2H_2O$	812.26	crystalline
31	selenate	$Gd_2(SeO_4)_3 \cdot 8H_2O$	886.81	pearly, monocl.
32	sulfate	$Gd_2(SO_4)_3$	601.98	.....
33	sulfate	$Gd_2(SO_4)_3 \cdot 8H_2O$	746.11	monoclinic
34	**Gallium**	Ga	69.72	gray, tetrag.
35	bromide	$GaBr_3$	309.47	cryst., deliq.
36	chloride, di-	$GaCl_2$	140.63	white crysts.
37	chloride, tri-	$GaCl_3$	176.09	wh., deliq. need.
38	hydroxide	$Ga(OH)_3$	120.74	.....
39	iodide	GaI_3	450.48	colorl. needles
40	nitrate	$Ga(NO_3)_3$	255.74	deliq.
41	oxide, mono-	GaO	85.72	gray
42	oxide, sesqui-	Ga_2O_3	187.44	wh. amor.
43	sulfate	$Ga_2(SO_4)_3$	427.62	white
44	sulfide	Ga_2S_3	235.62	white
45	**Germanium**	Ge	72.60	gray, cubic
46	bromide	$GeBr_4$	392.26	gray, octahdrl.
47	chloride, di-	$GeCl_2$	143.51	white powder
48	chloride, tetra-	$GeCl_4$	214.43	liquid
49	chloroform	$GeHCl_3$	179.98	colorl. liq.
50	fluoride	$GeF_4 \cdot 3H_2O$	202.65	white crysts.
51	hydride	GeH_4	76.63	colorl. gas
52	iodide	GeI_4	580.28	yel.-red cubic

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	177	.....	s.	.....	.....	1
2.873	.....	.....	s.	d.	s. alc., et.	2
.....	d.	.....	2.1 $^{10°}$	8.5 $^{100°}$	i. alc.	3
.....	60.5	.....	200 $^{0°}$	300 $^{25°}$	.....	4
2.28	d. 160	.....	0.022	0.026	s. a.	5
5.7	1420	.....	i.	i.	s. a.; i. alk.	6
.....	d. >100	.....	s.	.....	s. alc.	7
2.58	.....	.....	i.	i.	s. a.; i. ac. a.	8
.....	d.	.....	s.	s.	.....	9
3.5	1550	.....	.....	.....	.....	10
2.2	.....	$-5H_2O$, 300	s.	s.	i. alc.	11
1.899 $^{14.8°}$	64	$-7H_2O$,300	32.8 $^{0°}$	149 $^{50°}$	i. alc.	12
4.84	1193	d.	0.0006161 $^{8°}$	.....	s.a.; i. NH_3	13
.....	d. 250	.....	v. sl. s.	.....	s. aq. SO_2, a.; i. alc.	14
.....	.....	.....	0.877 $^{16°}$	.....	.....	15
.....	d.	.....	v. s.	.....	s. alc., et., act.	16
.....	.....	deliq.	v. s.	d.	v. s. alc.	17
.....	.....	.....	.....	.....	.....	18
liq. 1.11 $^{-187°}$ 1.31 $^{15°}$ (A)	-223	-187	d.	.....	.....	19
liq. 1.65 $^{-190°}$	.....	-167	v. sl.s.	.....	.....	20
.....	.....	.....	s.	s.	.....	21
.....	.....	.....	.....	.....	.....	22
1.611	.....	.....	sl. s.	.....	.....	23
2.844 $^{15°}$	.....	.....	s.	s.	s. HBr	24
4.52 $\frac{0°}{4°}$	628	.....	s.	s.	.....	25
2.424 $\frac{0°}{4°}$	.....	.....	s.	s.	.....	26
2.332	91	.....	v. s.	v. s.	.....	27
.....	$-6H_2O$, 110	.....	0.11	.....	s. HNO_3	28
7.407 $\frac{15°}{4°}$	.....	.....	.....	.....	.....	29
3.503 $^{16°}$	.....	.....	s.	s.	s. K_2SO_4	30
3.309	$-8H_2O$, 130	.....	s.	s.	.....	31
4.139 $^{14.6°}$	.....	.....	3.98 $^{0°}$	2.26 $^{34.4°}$	.....	32
3.010 $^{14.6°}$	.....	.....	2.92 $^{0°}$	2.24 $^{0°}$	.....	33
5.885 $^{24°}$	30	1700	i.	i.	s. a., alk.	34
.....	.....	.....	s.	s.	.....	35
.....	164	535	deliq.	d.	.....	36
2.36 $\frac{20°}{20°}$	75.5	215	s.	d.	.....	37
.....	d.	.....	i.	.....	s. a., alk.	38
4.2	.....	deliq.	s.	s.	.....	39
.....	d. 110	forms Ga_2O_3, 200	v. s.	v. s.	.....	40
.....	.....	.....	i.	.....	s. a.	41
.....	>red heat	.....	i.	.....	s. a.	42
.....	.....	.....	v. s.	v. s.	s. alc.; i. et.	43
3.5	1250±	.....	.....	.....	.....	44
5.36 $^{20°}$	958	2700	i.	i.	s. h. H_2SO_4, aq. reg.	45
3.132 $\frac{25°}{5°}$	26.1	185.9 ^{760mm}	d.	.....	.....	46
.....	.....	.....	d.	.....	.....	47
1.874 $\frac{25°}{5°}$	-49.5	86.5	d.	.....	i. h. H_2SO_4	48
liq. 1.93	-71	72	i.	d.	.....	49
.....	d.	.....	deliq.	s.	.....	50
liq. 1.623 $^{-14}$ $\frac{2°}{4°}$	-165	-90	.....	.....	sl.s.h. HCl; d.HNO_3	51
4.322 $\frac{25°}{5°}$	144	375	deliq.	s. d.	d. h. conc. H_2SO_4	52

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Germanium** oxide, mono-	GeO	88.60	gray-black
2	oxide, di-	GeO_2	104.60	color., rhombic
3	oxychloride	$GeOCl_2$	159.51	colorl. liq.
4	sulfide, mono-	GeS	104.66	rhombic or monocl.
5	sulfide, di-	GeS_2	136.72	white powder
6	**Glucinum** cf. beryllium	.....	.....	.....
7	**Gold**	Au	197.20	yel. metal, cubic
8	colloidal	Au	197.20	blue to violet
9	**Cf.** under auric and aurous	.....	.....	.....
10	**Hafnium**	Hf	178.6	hexagonal
11	oxide	HfO_2	210.60	.....
12	**Helium**	He	4.00	colorl. gas
13	**Holmium**	Ho	164.94	.....
14	**Hydrazine**	N_2H_4	32.05	colorl. liq.
15	azoimide	$N_2H_4 \cdot HN_3$	75.08	deliquescent
16	formate	$N_2H_4 \cdot 2HCO_2H$	124.10	cubic
17	hydrate	$N_2H_4 \cdot H_2O$	50.06	colorl.
18	hydrochloride	$N_2H_4 \cdot HCl$	68.51	yellow liq.
19	hydrochloride, di-	$N_2H_4 \cdot 2HCl$	104.98	cubic
20	nitrate	$N_2H_4 \cdot HNO_3$	95.06	crystalline
21	nitrate, di-	$N_2H_4 \cdot 2HNO_3$	158.08	needles
22	sulfate	$N_2H_4 \cdot \frac{1}{2}H_2SO_4$	81.09	plates, deliq.
23	sulfate	$N_2H_4 \cdot H_2SO_4$	130.12	rhombic
24	**Hydrazoic acid** (azoimide)	HN_3	43.03	colorl. liq.
25	**Hydrobomic acid** (hydrogen bromide)	HBr	80.92	colorl. gas
26	**Hydrobromic acid**	$HBr \cdot H_2O$	98.94	colorl. liq.
27	**Hydrobromic acid**	$HBr\ (47.8\%) + H_2O$	98.94	colorl. liq.
28	**Hydrobromic acid**	$HBr \cdot 2H_2O$	116.96	white crysts.
29	**Hydrochloric acid** (hydrogen chloride)	HCl	36.47	colorl. gas
30	**Hydrochloric acid**	$HCl\ (45.2\%) + H_2O$	54.48	colorl. liq.
31	**Hydrochloric acid**	$HCl \cdot 2H_2O$	72.50	colorl. liq.
32	**Hydrochloric acid**	$HCl \cdot 3H_2O$	90.51	colorl. liq.
33	**Hydrocyanic acid**	HCN	27.03	poisonous gas or colorl. liq.
34	**Hydroferricyanic acid**	$H_3Fe(CN)_6$	214.98	green-brown needles
35	**Hydrofluoric acid** (hydrogen fluoride)	HF	20.01	gas or colorl. liq.
36	**Hydrofluoric acid**	$HF\ (35.35\%) + H_2O$	38.02	colorl. liq.
37	**Hydriodic acid** (hydrogen iodide)	HI	127.93	colorl. gas
38	**Hydriodic acid**	$HI \cdot H_2O$	145.94	colorl. liq.
39	**Hydriodic acid**	$HI \cdot 2H_2O$	163.96	colorl. liq.
40	**Hydriodic acid**	$HI \cdot 3H_2O$	181.98	colorl. liq.
41	**Hydriodic acid**	$HI \cdot 4H_2O$	199.99	colorl. liq.
42	**Hydrogen**	H_2	2.016	colorl. gas or cubic
43	peroxide	H_2O_2	34.02	colorl. liq.
44	persulfide	H_2S_2	66.14	colorl. liq.
45	selenide	H_2Se	81.22	colorl. gas

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	.....	.....	sl. s.	.....	s. HCl; i. alk.	1
$4.703^{18°}$	1100	.....	$0.405^{20°}$	$1.05^{100°}$	sl. s. a., alk.	2
.....	.....	>100	i.	.....	s. a.	3
$3.541^{1000°}$ (A)	.....	.....	0.25	sl. s.	s. HCl, KOH	4
.....	d.	.....	0.45	sl. s.	s. alk.; d. aq. reg.; i. a.	5
.....	.....	.....	.....	.....	.....	6
$19.3^{20°}$	1063	2600	i.	i.	s. aq. reg., KCN; i. a.	7
.....	.....	.....	s.	.....	s. aq. reg., alk.; i. a.	8
.....	.....	.....	.....	.....	.....	9
12.1	>1700	>3200 (?)	.....	.....	.....	10
9.68	2812	.....	i.	.....	.....	11
0.1368 (A)	<-272.2	-268.9	$1.487^{0.5°}$c.c.	$1.371^{25°}$c.c.	absorb. by Pt	12
.....	.....	.....	.....	.....	.....	13
$1.011\ ^{1.6°}_{4}$	1.4	113.5	∞	∞	s. alc.	14
.....	65	.....	v. s.	v. s.	v. s. alc.	15
.....	128	.....	s.	.....	.....	16
$1.03^{21°}$	-40	$118.5^{739.5mm}$	∞	∞	∞ alc.; i. et.	17
.....	.....	.....	v. s.	v. s.	sl.s. alc.	18
1.42	198	.....	s.	v. s.	s. alc.	19
.....	70.7	subl. 140	$174.9^{100°}$	v. s.	.....	20
.....	104	d.	v. s.	.....	.....	21
.....	85	.....	v. s.	.....	i. alc.	22
1.378	254	.....	$3.055^{22°}$	$27.65^{60°}$	v. sl.s. abs. alc.	23
.....	-80	37	∞	∞	∞ alc.	24
$2.71^{0°}$ (A)	-86	-67	$22^{10°}$	$130^{100°}$	s. alc.	25
1.78	.....	.....	.....	.....	Stable at -15.5° and 1 atm.; at -11.3° and 2.5 atm.	26
1.486	.....	126	∞	.....	s. alc.	27
$2.11^{-15°}$	-11	.....	s.	s.	.....	28
$1.268^{0°}$ (A)	-111	-85	$82.3^{0°}$	$56.1^{60°}$	s. alc., et.	29
1.48	-15.35	.....	∞	.....	s. alc.	30
$1.46\ ^{-183°}_{4}$	0	d.	∞	.....	s. alc.	31
.....	-24.4	d.	∞	.....	s. alc.	32
$0.697^{18°}$	-14	26	∞	.....	∞ alc., et.	33
.....	d.	.....	deliq.	s.	s. alc.	34
$0.988^{11.6°}$	-83	19.4	∞ 0° to 19.4°	v. s.	.....	35
1.15	-35	120	v. s.	.....	.....	36
$4.40^{0°}$ (A)	-50.8	-35.5	$42,500^{10°}$c.c.	v. s.	s. alc.	37
$1.7^{15°}$	.....	127^{774mm}	∞	.....	∞ alc,	38
.....	-43	.....	∞	.....	s. alc.	39
.....	-48	.....	∞	.....	s. alc.	40
.....	-36.5	.....	∞	.....	s. alc.	41
liq.	-259.1	-252.7	2.1°c.c.	$0.85^{80°}$c.c.	sl. s. Fe, Pd, Pt	42
$0.0709^{-252.7°}$						
0.06948 (A)						
$1.438\ ^{2.2°}_{4}$	-0.89	151.4^{760mm}	∞	.....	s. alc., et.; i. petr. et.	43
$1.376^{15°}$	-88	74.5	d.	.....	s. bz., CS_2; i. alc.	44
$2.12^{-42°}$	-64	-42	$377^{4°}$c.c.	$270^{22.5°}$c.c.	s. CS_2, $COCl_2$	45

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Hydrogen** sulfide	H_2S	34.08	colorl. gas
2	telluride	H_2Te	129.63	colorl. gas
3	**Hydroxylamine**	NH_2OH	33.03	deliq., rhombic
4	hydrochloride	$NH_2OH{\cdot}HCl$	69.50	colorl., monocl.
5	nitrate	$NH_2OH{\cdot}HNO_3$	96.05	colorl. crysts.
6	sulfate	$NH_2OH{\cdot}\frac{1}{2}H_2SO_4$	82.07	colorl., monocl.
7	**Hypobromous acid**	HBrO	96.92	yellow
8	**Illinium**	Il	146 ?	.....
9	**Indium**	In	114.76	tetragonal, metal
10	bromide	$InBr_3$	354.51	deliq. crysts.
11	chloride, mono-	InCl	150.22	dark red crysts.
12	chloride, di-	$InCl_2$	185.67	colorl. crysts.
13	chloride, tri-	$InCl_3$	221.13	white plates
14	cyanide	$In(CN)_3$	192.81	.....
15	fluoride	$In_2F_6{\cdot}18H_2O$	667.81	white needles
16	hydroxide	$In(OH)_3$	165.78	gelatinous
17	iodate	$In(IO_3)_3$	639.52	crystalline
18	iodide	InI_3	495.52	yellow crysts.
19	nitrate	$In(NO_3)_3{\cdot}4\frac{1}{2}H_2O$	381.86	deliq. needles
20	oxide, mono-	InO	130.76	black
21	oxide, sesqui-	In_2O_3	277.52	yellow, amorph. or trig.
22	perchlorate	$In(ClO_4)_3{\cdot}8H_2O$	557.26	colorl., deliq.
23	sulfate	$In_2(SO_4)_3$	517.70	white crysts.
24	sulfide	In_2S_3	325.70	yellow
25	sulfite	$2In_2O_3{\cdot}3SO_2{\cdot}8H_2O$	891.35	white crysts.
26	**Iodic acid**	HIO_3	175.93	colorl., rhombic
27	**Iodine**	I_2	253.84	bl.-blk., rhombic
28	bromide	IBr	206.84	dark gray crysts.
29	chloride, mono-(α)	ICl	162.38	red, cubic
30	chloride, mono- (β)	ICl	162.38	red-brown, rhombic
31	chloride, tri-	ICl_3	233.29	yel. or red-brown rhombic
32	fluoride	IF_5	221.92	colorl. liq.
33	oxide, di-	IO_2	158.92	yellow crysts.
34	oxide, penta-	I_2O_5	333.84	white, trimetric
35	**Iodoplatinic** cf. platinic	.....	.....	.....
36	**Iridium**	Ir	193.10	white, cubic
37	bromide tri-	$IrBr_3{\cdot}4H_2O$	504.91	olive green crysts.
38	bromide, tetra-	$IrBr_4$	512.76	blue, deliq.
39	chloride, di-	$IrCl_2$ (?)	264.01	blk.-grn. crysts.
40	chloride, tri-	$IrCl_3$	299.47	olive green
41	chloride, tetra-	$IrCl_4$	334.93	dark red, deliq.
42	hydroxide, di-	$IrO_2{\cdot}2H_2O$	261.13	dark blue
43	hydroxide, sesqui-	$Ir_2O_3{\cdot}3H_2O$	488.25	black
44	iodide, tri-	IrI_3	573.86	black crysts.
45	iodide, tetra-	IrI_4	700.78	black crysts.
46	oxide, di-	IrO_2	225.10	black
47	oxide, sesqui-	Ir_2O_3 (?)	434.20	blue-black
48	sulfide, mono-	IrS (?)	225.16	blue-black
49	sulfide, di-	IrS_2	257.22	black
50	sulfide, sesqui-	Ir_2S_3	482.38	brown-black
51	**Iron,** cast*	Fe	55.85	gray
52	pure	Fe	55.85	silvery metal, cubic

*See also a table of alloys.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
1.1895(A)	−82.9	−59.6	437^{0} c.c.	$186^{40°}$ c.c.	$9.54^{15°}$ c.c. alc.; s. CS_2	1
$2.57^{-\frac{20}{4}°}$	−48	−1.8	sl.s.	.....	s. alk.	2
$1.35^{18°}$	34	56.5^{22mm}	s.	d.	s.a., alc.	3
$1.67^{17°}$	151	d.	$83.3^{17°}$	v. s.	s. alc.; i. et.	4
.....	48	d. <100	v. s.	d.	v. s. abs. alc.	5
.....	170d.	.....	$32.9^{0°}$	$68.5^{90°}$	v. sl.s.alc.; i. et., abs. alc.	6
.....	.....	40^{30mm}	s.	d.	.....	7
.....	.....	.....	.....	.....	.....	8
$7.3^{20°}$	155	1450	i.	i.	s. a.	9
.....	.....	.....	v.s.	v.s.	.....	10
.....	.....	deliq.	d.	d.	.....	11
.....	.....	deliq.	d.	d.	.....	12
4.0	.....	subl. 440	s.	v.s.	sl.s. alc., et.	13
.....	.....	.....	i.	.....	s. HCN	14
.....	d.	.....	sl.s.	d.	s. HCl, HNO_3; i. alc., et.	15
.....	$-H_2O$, >150	.....	i.	.....	s.a., alk.; i. NH_4OH	16
.....	.....	d.	$0.067^{20°}$	.....	s. dil. H_2SO_4, HNO_3	17
.....	199	deliq.	s.	s.	s. alc., chl.	18
.....	$-4\frac{1}{2}H_2O$,100	d.	v. s.	v. s.	s. abs. alc.	19
.....	.....	.....	i.	.....	s. a.	20
7.179	.....	sl.volt.900	i.	.....	amorph. s.a.; cryst. i. a., NH_3	21
.....	80	d. 200	s.	d.40°	s. abs. alc.; sl. s. et.	22
3.438	.....	deliq.	s.	v. s.	.....	23
4.9	.....	.....	.....	.....	d.a.; s. $(NH_4)_2S$	24
.....	$-3H_2O$,100	$-8H_2O$,260	i.	.....	s. a.	25
$4.629^{0°}$	110 d.	.....	$286^{0°}$	$576^{101°}$	v.s. 87% alc.; i. abs. alc., et., chl.	26
$4.93^{20°}$	113.5	184.35	$0.0162^{20°}$	$0.09566^{60°}$	s. alc., KI, et.	27
$4.414^{10°}$	42	116	sl.s. d.	.....	s. alc., et., chl.	28
$3.182^{0°}$	27.2	97	d.	.....	s. HCl, alc., et.	29
$3.24^{\frac{13}{4}\frac{1}{4}°}$	13.9	97	d.	.....	s. HCl, alc., et.	30
$3.117^{18°}$	33	77 d.	s.d.	.....	s. CCl_4, bz.; s.d.alc.,et.	31
3.5	−8	97	d.	.....	d. a.	32
$4.2^{\frac{1}{7}0°}$	d. 130	.....	d.	.....	s. H_2SO_4; i. alc., et.	33
$4.799^{\frac{25}{4}°}$	d. 300	.....	$187.4^{13°}$	.....	i. abs. alc., et., chl.	34
.....	.....	.....	.....	.....	.....	35
$22.4^{20°}$	2350	>4800	i.	i.	sl.s.aq. reg., aq. Cl_2	36
.....	$-3H_2O$,100	.....	s.	.....	i. alc., et.	37
.....	d.	.....	s.	.....	s. alc.	38
.....	d. 773	.....	s.	.....	i. a., alk.	39
5.30	d. 763	.....	i.	.....	i. a., alk.	40
.....	d.	.....	s.	d.	s. alc., dil. HCl	41
.....	$-2H_2O$, 350	.....	i.	.....	s. alk., HCl	42
.....	.....	.....	i.	.....	i. a.	43
.....	.....	.....	sl. s.	s.	i. alc.	44
.....	d. 360	.....	i.	i.	s. KI; i. a.	45
.....	.....	.....	i.	.....	i. a., alk.	46
.....	−O, 400	.....	i.	.....	s. h. HCl, H_2SO_4; i. alk.	47
.....	d.	.....	i.	.....	s. K_2S; i. a.	48
.....	d.	.....	i.	.....	s. K_2S; i. a.	49
.....	d.	.....	sl. s.	.....	s. K_2S, HNO_3	50
7.03	1275	.....	i.	i.	s. a.; i. alk.	51
$7.86^{20°}$	1535	3000	i.	i.	s. a.; i. alk.	52

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Iron,** steel	Fe	55.85	silvery gray
2	white pig	Fe	55.85	gray
3	wrought	Fe	55.85	gray
4	arsenide	FeAs	130.76	silvery gray
5	arsenide, di- (arsenoferrite)	$FeAs_2$	205.67	silvery, cubic
6	boride	FeB	66.67	yellowish gray
7	carbide (cementite)	Fe_3C	179.56	pseudo-rhex.
8	carbonyl	$Fe(CO)_5$	195.90	pale yellow liq.
9	nitride	Fe_2N	125.71	gray
10	phosphide	FeP	86.83	.....
11	phosphide	Fe_2P	142.68	gray crysts.
12	silicide	FeSi	83.91	yellow-gray, octahdrl.
13	sulfide, di- (marcasite)	FeS_2	119.97	yellow, rhombic
14	sulfide, di- (pyrite)	FeS_2	119.97	yellow, cubic
15	sulfide (pyrrhotite)	Fe_7S_8	647.43	hexagonal
16	**Cf.** also under ferrous and ferric	.....	.....	.....
17	**Krypton**	Kr	83.70	colorl. gas
18	**Lanthanum**	La	138.92	lead gray
19	bromate	$La_2(BrO_3)_6 \cdot 18H_2O$	1369.62	hexagonal
20	bromide	$LaBr_3 \cdot 7H_2O$	504.78	colorl. crysts.
21	carbide	LaC_2	162.94	yellow crysts.
22	carbonate (lanthanite)	$La_2(CO_3)_3 \cdot 8H_2O$	602.00	trimetric
23	chloride	$LaCl_3$	245.29	white, deliq.
24	chloride	$LaCl_3 \cdot 7H_2O$	371.40	wh., triclinic
25	molybdate	$La_2(MoO_4)_3$	757.69	tetragonal
26	nitrate	$La(NO_3)_3 \cdot 6H_2O$	433.04	triclinic, deliq.
27	oxalate	$La_2(C_2O_4)_3 \cdot 9H_2O$	704.04	tetragonal
28	oxide, sesqui-	La_2O_3	325.84	white, amorph. or rhombic
29	sulfate	$La_2(SO_4)_3$	566.02	white powder
30	sulfate	$La_2(SO_4)_3 \cdot 9H_2O$	728.16	colorl., hex.
31	sulfide	La_2S_3	374.02	red-yel. crysts.
32	**Lead**	Pb	207.21	silvery metal, cubic
33	acetate	$Pb(C_2H_3O_2)_2$	325.30	white crysts.
34	acetate (sugar of lead)	$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	379.35	white, monocl.
35	acetate	$Pb(C_2H_3O_2)_2 \cdot 10H_2O$	505.46	rhombic
36	acetate, basic	$Pb_2(C_2H_3O_2)_3OH$	608.56	white
37	acetate, basic	$Pb(C_2H_3O_2)_2 \cdot Pb(OH)_2 \cdot H_2O$	584.54	white needles
38	acetate, basic	$Pb(C_2H_3O_2)_2 \cdot 2Pb(OH)_2$	807.75	white needles
39	arsenate, mono-	$PbH_4(AsO_4)_2$	489.06	triclinic
40	arsenate, di- (schultenite)	$PbHAsO_4$	347.13	monocl.
41	arsenate, meta-	$Pb(AsO_3)_2$	453.03	hexagonal
42	arsenate, pyro-	$Pb_2As_2O_7$	676.24	rhombic
43	azide (azoimide)	PbN_6	291.26	colorl. needles
44	borate, meta-	$Pb(BO_2)_2 \cdot H_2O$	310.87	white crysts.
45	bromate	$Pb(BrO_3)_2 \cdot H_2O$	481.06	monoclinic
46	bromide	$PbBr_2$	367.05	colorl., rhombic
47	carbonate (cerussite)	$PbCO_3$	267.22	white, rhombic
48	carbonate, basic (hydrocerussite; white lead)	$2PbCO_3 \cdot Pb(OH)_2$	775.67	white, hex.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
7.6-7.8	1375	.....	i.	i.	s. a.; i. alk.	1
7.6-7.8	1075	.....	i.	i.	s. a.; i. alk.	2
7.86	1505	.....	i.	i.	s. a.; i. alk.	3
7.83	1020	.....	.....	.....	.....	4
7.38	990	.....	i.	.....	sl.s. HNO_3; i. HCl	5
$7.15^{18°}$	.....	.....	i.	.....	s. HNO_3; s.h. H_2SO_4	6
7.4	1837	.....	i.	i.	s. a.	7
$1.457^{21°}$	-21	102.5^{760mm}	.....	.....	s. alc., H_2SO_4, alk.	8
6.35	d. >560	.....	d.	.....	s. HCl, H_2SO_4	9
$5.2\frac{20°}{4°}$	.....	.....	.....	.....	.....	10
5.74	1290	.....	i.	i.	s. HNO_3 + HF, aq. reg.; i. a.	11
$6.1\frac{0°}{4°}$	.....	.....	.....	i.	i. aq. reg.	12
4.87	tr. 450	d.	0.00049	.....	i. dil. a.	13
5.0	1171	d.	0.0005	.....	i. dil. a.	14
$4.6\frac{20°}{4°}$	d. >700	.....	i.	.....	.....	15
.....	.....	.....	.....	.....	.....	16
2.818 (A)	-169	-151.8	.....	.....	.....	17
$6.15^{20°}$	826	1800	d.	.....	s. a.	18
.....	37.5	$-14H_2O$, 100	$416^{25°}$	.....	i. alc.	19
.....	.....	.....	v. s.	.....	v. s. alc.; i. et.	20
$5.02^{20°}$	.....	.....	d.	.....	s. H_2SO_4; i. conc. HNO_3	21
2.6-2.7	.....	.....	i.	.....	sl.s. aq. CO_2; i. ac.a.	22
$3.947\frac{18°}{4°}$	907	.....	v. s.	d.	v.s. alc.; i. act.	23
.....	d. 91	.....	v. s.	v. s.	v. s. alc.	24
$4.77\frac{16°}{4°}$	1181	.....	sl. s.	.....	.....	25
.....	40	126	$151^{25°}$	v. s.	v.s. alc.; s. act.	26
.....	d.	.....	$0.00008^{25°}$	.....	.....	27
$6.51^{15°}$	2000	4200	sl. s. forms $La(OH)_2$	.....	s.a., alc., NH_4Cl; i. act.	28
$3.60^{15°}$	d. 1150	.....	$3.0^{0°}$	$0.69^{100°}$	sl.s.alc.; i. act.	29
2.821	d.	.....	$3.9^{0°}$	$0.89^{100°}$	sl.s. HCl	30
$4.911^{11°}$	>1000	.....	i.	d.	s. dil. a.	31
$11.337\frac{0°}{0°}$	327.5	1620	i.	i.	s. HNO_3	32
$3.251\frac{0°}{4°}$	280	.....	s.	s.	.....	33
2.55	$-3H_2O$,75	.....	$45.64^{15°}$	$200^{100°}$	sl.s. alc.	34
1.689	22	.....	s.	s.	.....	35
.....	.....	.....	v. s.	.....	sl.s. alc.	36
.....	.....	.....	v. s.	.....	s. alc.	37
.....	.....	.....	5.55	18.2	s. alc.	38
$4.46^{15°}$	d.140	.....	d.	.....	s. HNO_3	39
5.94	d. >200	$-H_2O$, 280	i.	sl.s.	s. HNO_3	40
$6.42^{15°}$	.....	.....	d.	.....	s. HNO_3	41
$6.85\frac{15°}{4°}$	802	.....	i.	d.	s. HCl, HNO_3; i.ac.a.	42
.....	expl. 350	.....	i.	$0.05^{100°}$	v.s.ac.a.; i. NH_4OH	43
5.598 (anhyd)	.....	$-H_2O$,160	i.	i.	s.a.; i. alc.	44
5.53	d. 180	.....	$1.38^{20°}$	.....	.....	45
6.66	373	918	$0.4554^{0°}$	$4.75^{100°}$	s.a., KBr; sl.s. NH_3; i.alc.	46
6.6	d. 315	.....	$0.00011^{20°}$	d.	s.a., alk; i. NH_3, alc.	47
6.14	d.400	.....	i.	i.	sl.s. aq. CO_2	48

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Lead** chlorate	$Pb(ClO_3)_2 \cdot H_2O$	392.14	deliq. monocl.
2	chloride (cotunnite)	$PbCl_2$	278.12	white, rhombic
3	chloride, tetra-	$PbCl_4$	349.04	yellow liquid
4	chlorite	$Pb(ClO_2)_2$	342.12	yellow, monocl.
5	chromate (crocoite)	$PbCrO_4$	323.22	yellow, monocl.
6	chromate, basic	$PbCrO_4 \cdot PbO$	546.43	orange-yellow needles
7	cyanate	$Pb(CNO)_2$	291.25	white crysts.
8	cyanide	$Pb(CN)_2$	259.25	white crysts.
9	dichromate	$PbCr_2O_7$	423.23	red crysts.
10	dithionate	$PbS_2O_6 \cdot 4H_2O$	439.39	colorl., trig.
11	ferricyanide	$Pb_3[Fe(CN)_6]_2 \cdot 6H_2O$	1153.64	red crysts.
12	ferrocyanide	$Pb_2Fe(CN)_6 \cdot 3H_2O$	680.43	yel.-wh. powd.
13	fluoride	PbF_2	245.21	white, rhombic
14	formate	$Pb(HCO_2)_2$	297.25	rhombic
15	hydroxide	$Pb(OH)_2$	241.23	white
16	hydroxide	$3PbO \cdot H_2O$	687.65	cubic
17	iodate	$Pb(IO_3)_2$	557.05	white
18	iodide	PbI_2	461.05	yellow, hex.
19	molybdate (wulfenite)	$PbMoO_4$	367.16	yellowish, tetrag.
20	nitrate	$Pb(NO_3)_2$	331.23	colorl., cubic or monocl.
21	oxalate	PbC_2O_4	295.23	white
22	oxide, mono- (litharge)	PbO	223.21	yellow, tetrag.
23	oxide, mono- (massicotite)	PbO	223.21	yellow, rhombic
24	oxide, mono-	PbO	223.21	amorphous
25	oxide, di- (plattnerite)	PbO_2	239.21	brown, tetrag.
26	oxide, red (minium)	Pb_3O_4	685.63	red, amorph.
27	oxide, sesqui-	Pb_2O_3	462.42	red-yellow, amorph.
28	oxide, sub-	Pb_2O	430.42	black, amorph.
29	oxychloride (matlockite)	$PbCl_2 \cdot PbO$	501.33	white, tetrag.
30	oxychloride (mendipite)	$PbCl_2 \cdot 2PbO$	724.54	colorl. or yellow, rhombic
31	oxychloride	$PbCl_2 \cdot 3PbO$	947.75	yellow
32	oxychloride (cassel yellow)	$PbCl_2 \cdot 7PbO$	1840.59	yellow crysts.
33	perchlorate	$Pb(ClO_4)_2 \cdot 3H_2O$	460.17	white, rhombic
34	periodate	$PbHIO_5$	415.14	crysts.
35	periodate	$PbHIO_5 \cdot H_2O$	433.15	amorphous
36	persulfate	$PbS_2O_8 \cdot 3H_2O$	453.38	deliq. crysts.
37	phosphate	$Pb_3(PO_4)_2$	811.59	colorl., hex.
38	phosphite	$PbHPO_3$	287.20	white crysts.
39	pyrophosphate	$Pb_2P_2O_7$	588.38	rhombic
40	pyrophosphate	$Pb_2P_2O_7 \cdot H_2O$	606.40	rhombic
41	selenate	$PbSeO_4$	350.17	white, rhombic
42	selenide (clausthalite)	$PbSe$	286.17	gray, cubic
43	silicate	$PbSiO_3$	283.27	colorl. monocl.
44	sulfate (anglesite)	$PbSO_4$	303.27	white, rhombic or monocl.
45	sulfate, acid	$Pb(HSO_4)_2 \cdot H_2O$	419.36	crystalline
46	sulfate, basic (lanarkite)	$PbSO_4 \cdot PbO$	526.48	colorl., monocl.
47	sulfide (galena)	PbS	239.27	lead gray, cubic

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
4.037	d.110	.....	$151^{18°}$	$171^{80°}$	.....	1
5.80	501	954^{760mm}	$0.673^{0°}$	$3.34^{100°}$	sl.s.dil. HCl, NH_3; i. alc.	2
$3.18^{0°}_{4}$	−15	expl. 105	d.	.....	s. conc. HCl	3
.....	expl. 126	.....	v. sl. s.	sl. s.	s. aq. KOH	4
6.12	844	d.	$0.000007^{20°}$	i.	s.a., alk.; i. NH_3, ac.a.	5
.....	.....	.....	i.	i.	s.a., alk.	6
.....	d.	.....	i.	sl.s.	.....	7
.....	.....	.....	sl.s.	s.	s. aq. KCN	8
.....	.....	.....	d.	.....	s.a., alk.	9
3.24	d.	.....	$115^{20.5°}$	v. s.	.....	10
.....	d.	.....	sl.s.	s.	s. HNO_3, alk.	11
.....	d.	.....	i.	.....	sl.s. H_2SO_4	12
8.24	855	1290	$0.064^{20°}$	.....	s. HNO_3; i. NH_3, act.	13
4.56	d.190	.....	$1.6^{16°}$	$18^{100°}$,d	i. alc.	14
.....	d. 145	.....	$0.016^{20°}$	sl.s.	s.a., alk.; i. act.	15
7.592	$-H_2O$, 130	.....	0.014	.....	s.a., alk.	16
.....	d. 300	.....	$0.0012^{20°}$	$0.003^{25°}$	sl.s. HNO_3; i. NH_3	17
6.16	402	954	$0.044^{20°}$	$0.436^{100°}$	s. KI; i. alc.	18
$6.7^{17.5°}$	1068	.....	i.	.....	s. a.	19
4.53	d. 470	.....	$38.8^{0°}$	$138.8^{100°}$	$8.8^{22°}$ alc.	20
5.28	d.300	.....	$0.00016^{18°}$	.....	s. HNO_3; i. alc.	21
9.53	888	.....	$0.0017^{20°}$	.....	s.alk., PbAc, NH_4Cl, $CaCl_2$	22
8.0	.....	.....	.....	.....	.....	23
9.2-9.5	.....	.....	i.	i.	s. alk., PbAc, NH_4Cl, $CaCl_2$	24
9.375	d. 290	.....	i.	i.	s. ac. a.; i. alc.	25
9.1	d.500	.....	i.	i.	s. ac. a.	26
.....	d. 360	.....	i.	d.	s. a., alk.	27
8.34	d. red heat	.....	i.	i.	s.a., alk.	28
7.21	524d.	.....	i.	i.	s. alk.	29
7.08	693	.....	i.	i.	s. alk.	30
.....	.....	.....	$0.0056^{18°}$	$0.077^{4°}$	.....	31
.....	.....	.....	i.	.....	.....	32
2.6	d. 100	.....	s.	.....	s. alc.	33
.....	d. 130	.....	i.	i.	s. dil. HNO_3	34
.....	$-H_2O$, 110	.....	i.	i.	s. dil. HNO_3	35
.....	.....	.....	v.s.	v.s.	d. alk.	36
6.9-7.3	1014	.....	$0.000014^{20°}$	i.	s. HNO_3; i. ac.a.	37
.....	d.	.....	i.	i.	s. HNO_3	38
$5.8^{20°}$	815d.	.....	i.	d.	s. a., KOH; i. act.	39
.....	.....	.....	i.	d.	s. HNO_3, KOH, $Na_4P_2O_7$	40
$6.37^{\frac{3}{4}0°}$	d.	.....	i.	i.	s. conc. a.	41
$8.10^{15°}$	1065	.....	i.	i.	s. HNO_3, h.conc. HCl	42
6.49	766	.....	i.	.....	s. a.	43
6.2	1170	.....	$0.002^{80°}$	$0.005^{640°}$	s. conc. a., NH_4 salts; i. alc.	44
.....	d.	.....	$0.0001^{18°}$	.....	sl.s. H_2SO_4	45
6.92	977	.....	$0.004^{18°}$	.....	sl. s. H_2SO_4	46
7.5	1120	.....	$0.0009^{18°}$	i.	s.a.; i. alk.	47

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Lead** sulfite	$PbSO_3$	287.27	white powder
2	sulfochloride	$3PbS \cdot PbCl_2$	995.93	red
3	telluride	$PbTe$	334.82	tin white, cubic
4	thiocyanate	$Pb(CNS)_2$	323.37	colorl., monocl.
5	thiosulfate	PbS_2O_3	319.33	white powder
6	tungstate (raspite)	$PbWO_4$	455.13	monocl.
7	tungstate (stolzite)	$PbWO_4$	455.13	colorl., tetrag.
8	**Lithium**	Li	6.94	silvery metal, cubic
9	acetate	$LiC_2H_3O_2 \cdot 2H_2O$	102.02	white, rhombic
10	aluminate	$LiAlO_2$	65.91	.....
11	amide	$LiNH_2$	22.96	colorl., cubic
12	antimonide	Li_3Sb	142.58	.....
13	arsenate	Li_3AsO_4	159.73	.....
14	benzoate	$LiC_7H_5O_2$	128.05	leaflets
15	bicarbonate	$LiHCO_3$	67.96	in soln. only
16	borate, meta-	$LiBO_2$	49.76	triclinic
17	borate, tetra-	$Li_2B_4O_7 \cdot 5H_2O$	259.24	.....
18	bromide	$LiBr$	86.86	white, deliq., cubic
19	bromide	$LiBr \cdot 2H_2O$	122.89	prismatic
20	carbide	Li_2C_2	37.90	white crysts.
21	carbonate	Li_2CO_3	73.89	colorl., monocl.
22	chlorate	$LiClO_3$	90.40	.....
23	chlorate	$LiClO_3 \cdot \frac{1}{2}H_2O$	99.40	deliq., tetrag.
24	chloride	$LiCl$	42.40	white, deliq., cubic
25	chloroplatinate	$Li_2PtCl_6 \cdot 6H_2O$	529.95	orange-red, hex.
26	chromate	$Li_2CrO_4 \cdot 2H_2O$	165.92	yellow, rhombic
27	citrate	$Li_3C_6H_5O_7 \cdot 4H_2O$	281.98	crystalline
28	dichromate	$Li_2Cr_2O_7 \cdot 2H_2O$	265.93	deliq., black-brown
29	dithionate	$Li_2S_2O_6 \cdot 2H_2O$	210.03	rhombic
30	fluoride	LiF	25.94	cubic
31	fluosilicate	$Li_2SiF_6 \cdot 2H_2O$	191.97	monocl.
32	formate	$LiHCO_2 \cdot H_2O$	69.97	rhombic
33	hydride	LiH	7.95	white, cubic
34	hydroxide	$LiOH$	23.95	white crysts.
35	hydroxide	$LiOH \cdot H_2O$	41.96	colorl., monocl.
36	iodide	LiI	133.86	deliq., cubic
37	iodide	$LiI \cdot 3H_2O$	187.91	monocl.
38	nitrate	$LiNO_3$	68.95	colorl., trig.
39	nitrate	$LiNO_3 \cdot 3H_2O$	123.00	colorl.
40	nitrite	$LiNO_2 \cdot H_2O$	70.96	white needles
41	oxalate	$Li_2C_2O_4$	101.90	colorl. cryst.
42	oxalate, acid	$LiHC_2O_4 \cdot H_2O$	113.98	.....
43	oxide	Li_2O	29.88	colorl.
44	perchlorate	$LiClO_4$	106.40	deliquescent
45	perchlorate	$LiClO_4 \cdot 3H_2O$	160.45	hexagonal
46	permanganate	$LiMnO_4$	125.87	crystalline
47	phosphate, dihydrogen	LiH_2PO_4	103.94	.....
48	phosphate	Li_3PO_4	115.80	white, rhombic
49	phosphate	$Li_3PO_4 \cdot 12H_2O$	331.99	trigonal
50	salicylate	$LiC_7H_5O_3$	144.05	colorl.
51	silicate, meta-	Li_2SiO_3	89.94	colorl., rhombic
52	silicate, ortho-	Li_4SiO_4	119.82	colorl., rhombic

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	d.	.....	i.	i.	s. HNO_3	1
.....	.....	.....	i.	d.	i. dil. a.	2
$8.16^{\frac{4}{4}^{0°}}$	917	.....	.....	.....	.....	3
3.82	d. 190	.....	$0.05^{20°}$	s.	s. KCNS, HNO_3	4
5.18	d.	.....	0.03	d.100	s. $Na_2S_2O_3$	5
8.46	1123	.....	i.	i.	d. h. HNO_3; i. NH_4OH	6
8.23	.....	.....	.....	.....	.....	7
$0.53^{20°}$	186	>1200	d.	d.	s.a.	8
.....	70	d.	$300^{15°}$	v.s.	21.5 alc.	9
$2.554^{\frac{25.3}{4}°}$	>1625	.....	.....	.....	.....	10
$1.178^{18.5°}$	390	430	d.	.....	.....	11
$3.2^{17°}$	>950	.....	.....	.....	.....	12
3.07	.....	.....	s.	s.	.....	13
.....	.....	.....	$33^{25°}$	$40^{100°}$	$7.7^{25°}$, $107^{80°}$ alc.	14
.....	.....	.....	s.	.....	.....	15
.....	843	.....	sl. s.	.....	.....	16
.....	$-2H_2O$, 200	.....	v. s.	.....	i. alc.	17
$3.464^{\frac{4.5}{4}°}$	547	1265	$143^{0°}$ ($2H_2O$)	$266^{100°}$ ($1H_2O$)	s. alc.	18
.....	44	.....	$246^{20°}$	.....	s. alc.	19
$1.65^{18°}$	.....	.....	d.	.....	s. a.	20
$2.11^{0°}$	618	d.	$1.54^{0°}$	$0.73^{100°}$	i. alc., act., NH_3	21
.....	129	d. 270	$313.5^{18°}$	v.s.	.....	22
.....	(50) 65	$-\frac{1}{2}H_2O$, 90	s.	∞	v.s. alc.	23
$2.068^{\frac{2.5}{4}°}$	614	1360	$67^{0°}$	$127.5^{100°}$	$2.48^{15°}$ alc.; s. et.	24
.....	$-6H_2O$, 180	.....	s.	s.	s. alc.; i. et.	25
.....	$-2H_2O$, 130	.....	$111^{20°}$	$100^{30°}$	.....	26
.....	d.	.....	$61.2^{15°}$	$66.7^{100°}$	sl. s. alc., et.	27
.....	$-2H_2O$, 130	.....	$124^{0°}$	$188^{100°}$	.....	28
2.158	d.	.....	v.s.	.....	.....	29
$2.295^{21.5°}$	870	1670	$0.27^{18°}$	.....	s. HF; i. act.	30
$2.31^{2°}$	$-2H_2O$, 100	d.	$73^{17°}$	.....	s. alc.; i. et., act.	31
1.46	$-H_2O$, 94	.....	$49.2^{0°}$	$346.6^{104°}$	sl. s. alc., et.	32
0.820	680	.....	d.	.....	i. et.	33
2.54	450	d.	$12.7^{0°}$	$17.5^{100°}$	sl. s. alc.	34
1.83	.....	d.	$22.3^{10°}$	$26.8^{80°}$	sl. s. alc.	35
$4.061^{\frac{3.5}{4}°}$	446	1190	$151^{0°}$	$481^{100°}$	$251^{25°}$alc.; v.s. NH_3	36
3.5	73	$-3H_2O$, 300	s.	s.	s. abs. alc.	37
2.38	261	.....	$53.4^{0°}$	$194^{70°}$	s. alc.	38
.....	29.88	.....	v. s.	∞	.....	39
$1.615^{0°}$	<100	d.	$125^{0°}$	$459^{50°}$	v. s. abs. alc.	40
$2.121^{17.5°}$	d.	.....	$819.5^{0°}$	s.	i. alc., et.	41
.....	d.	.....	$81^{7°}$	.....	.....	42
$2.013^{\frac{2.5}{4}°}$	.....	subl. <1000	forms LiOH	.....	.....	43
2.43	236	d.410	s.	s.	v. s. alc.	44
1.84	95	$-2H_2O$, 100; $-3H_2O$, 150	s.	s.	v. s. alc.	45
2.06	d.190	.....	$71.43^{16°}$	.....	d. alk.	46
2.461	>100	.....	.....	.....	.....	47
$2.537^{17.5°}$	837	.....	$0.034^{18°}$	v. sl. s.	s. a., NH_4Cl; i. act.	48
1.645	100	.....	v. sl. s.	v. sl. s.	.....	49
.....	d.	.....	$128^{25°}$	.....	v. s. alc.	50
$2.52^{\frac{2.5}{4}°}$	1201	.....	i.	s. d.	s. dil. HCl	51
2.28	1256	.....	i.	d.	d. a.	52

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Lithium** silicide	Li_6Si_2	97.76	blue crysts.
2	sulfate	Li_2SO_4	109.94	colorl., monocl.
3	sulfate	$Li_2SO_4 \cdot H_2O$	127.96	colorl., monocl.
4	sulfate, acid	$LiHSO_4$	104.01	prisms
5	sulfide	Li_2S	45.94	white, amorph. or cubic; red-yel.
6	sulfite	Li_2SO_3	93.94	white powder
7	urate	$LiHC_5H_2N_4O_3$	174.05	white powder
8	**Lutecium**	Lu	174.99	.....
9	chloride	$LuCl_3$	281.36	.....
10	**Magnesium**	Mg	24.32	silvery metal,hex.
11	acetate	$Mg(C_2H_3O_2)_2$	142.41	.....
12	acetate	$Mg(C_2H_3O_2)_2 \cdot 4H_2O$	214.47	monocl. prisms
13	aluminate (spinel)	$MgO \cdot Al_2O_3$	142.26	colorl., cubic
14	ammonium arsenate	$MgNH_4AsO_4 \cdot 6H_2O$	289.37	white, rhombic
15	ammonium chloride	$MgCl_2 \cdot NH_4Cl \cdot 6H_2O$	256.83	rhombic, deliq.
16	ammonium chromate	$MgCrO_4 \cdot (NH_4)_2CrO_4 \cdot 6H_2O$	400.52	yellow, monocl.
17	ammonium phosphate (struvite)	$MgNH_4PO_4 \cdot 6H_2O$	245.44	colorl., rhombic
18	ammonium sulfate (boussingaultite)	$MgSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$	360.62	monoclinic, colorl.
19	antimonide	Mg_3Sb_2	316.48	metallic
20	arsenate, acid (roesslerite)	$MgHAsO_4 \cdot 7H_2O$	290.35	monoclinic
21	arsenite, ortho-	$Mg_3(AsO_3)_2$	318.78	.....
22	benzoate	$Mg(C_7H_5O_2)_2 \cdot 3H_2O$	320.59	white powder
23	bismuthide	Mg_3Bi_2	490.96	metallic
24	borate, meta-	$Mg(BO_2)_2 \cdot 8H_2O$	254.09	colorl., tetrag.
25	bromate	$Mg(BrO_3)_2 \cdot 6H_2O$	388.25	cubic
26	bromide	$MgBr_2$	184.15	white, deliq.
27	bromide	$MgBr_2 \cdot 6H_2O$	292.25	colorl., hex.
28	bromoplatinate	$MgPtBr_6 \cdot 12H_2O$	915.24	trigonal
29	carbonate (magnesite)	$MgCO_3$	84.33	white, trig.
30	carbonate (nesquehonite)	$MgCO_3 \cdot 3H_2O$	138.38	colorl., rhombic
31	carbonate, basic (hydromagnesite)	$3MgCO_3 \cdot Mg(OH)_2 \cdot 3H_2O$	365.37	rhombic, white
32	chlorate	$Mg(ClO_3)_2 \cdot 6H_2O$	299.33	deliq.
33	chloride (chloro-magnesite)	$MgCl_2$	95.23	colorl., hex.
34	chloride (bischofite)	$MgCl_2 \cdot 6H_2O$	203.33	deliq., monocl.
35	chloropalladate	$MgPdCl_6 \cdot 6H_2O$	451.86	hexagonal
36	chloroplatinate	$MgPtCl_6 \cdot 6H_2O$	540.39	trigonal
37	chlorostannate	$MgSnCl_6 \cdot 6H_2O$	463.86	trigonal
38	chromate	$MgCrO_4 \cdot 7H_2O$	266.44	yellow, rhombic
39	ferrocyanide	$Mg_2Fe(CN)_6 \cdot 12H_2O$	476.79	pale yellow
40	fluoride (sellaite)	MgF_2	62.32	colorl., tetrag.
41	fluosilicate	$MgSiF_6 \cdot 6H_2O$	274.48	colorl., trig.
42	formate	$Mg(HCO_2)_2 \cdot 2H_2O$	150.39	rhombic
43	hydroxide (brucite)	$Mg(OH)_2$	58.34	white, trig.
44	hypophosphite	$Mg(H_2PO_2)_2 \cdot 6H_2O$	262.41	tetragonal
45	iodate	$Mg(IO_3)_2 \cdot 4H_2O$	446.22	monoclinic
46	iodide	MgI_2	278.16	white, deliq.
47	nitrate	$Mg(NO_3)_2 \cdot 6H_2O$	256.43	deliq., monocl.
48	nitride	Mg_3N_2	100.98	grn.-yel., amorph
49	oxalate	$MgC_2O_4 \cdot 2H_2O$	148.37	white powder

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
1.12	ign. in air	.....	d.	.....	d. a.	1
2.22	860	.....	$35.34^{0°}$	$29.9^{100°}$	i. act., 80% alc.	2
2.06	$-H_2O$, 130	.....	$43.6^{0°}$	$35^{100°}$	i. 80% alc.	3
$2.123^{13°}$	170.5	.....	d.	.....	.....	4
1.66	.....	.....	v. s.	v. s.	v. s. alc.	5
.....	455d.	.....	s.	.....	sl. s. alc.	6
.....	.....	.....	$0.27^{20°}$	$2.5^{100°}$	.....	7
.....	.....	.....	.....	.....	.....	8
3.98	>916	.....	.....	.....	.....	9
$1.74^{20°}$	651	1110	i.	sl. s. d.	s. a., NH_4 salts	10
1.42	323	.....	v. s.	v. s.	.....	11
1.454	.....	.....	v. s.	v. s.	v. s. alc.	12
3.6	2135	.....	i.	.....	v. sl. s. dil. HCl; i. dil. HNO_3	13
$1.932^{15°}$	d.	.....	$0.0339^{0°}$	$0.0237^{80°}$	s. a.; i. alc.	14
1.456	$-4H_2O$, 195	.....	16.7	s.	.....	15
$1.84^{16°}$	d.	.....	v. s.	v. s.	.....	16
1.715	d.	.....	$0.0231^{0°}$	$0.0195^{80°}$	s. a.; i. alc.	17
1.72	>120	.....	$16.86^{0°}$	$130^{100°}$	.....	18
.....	961	.....	i.	.....	.....	19
$3.155^{15°}$	$-5H_2O$, 100	.....	d. ..	.....	.....	20
.....	d.	.....	s.	v. s.	s. a., NH_4Cl; i. NH_4OH	21
.....	$-3H_2O$, 110	.....	$4.5^{25°}$ (anhyd.)	s.	.....	22
.....	715	.....	.....	.....	.....	23
2.30	.....	.....	i.	i.	s. a.	24
2.29	$-6H_2O$, 200	d.	$71.5^{7°}$	v. s.	.....	25
3.72	700	.....	$91^{0°}$	$120.2^{100°}$	.....	26
.....	165d.	.....	$310^{0°}$	v. s.	s. alc., act.; sl. s. NH_3	27
2.802	.....	.....	.....	.....	.....	28
3.037	d.350	.....	0.0106	.....	s. a.,aq. CO_2; i. act.,NH_3	29
1.852	$-H_2O$,100	.....	$0.1518^{19°}$	d.	s. a., aq. CO_2	30
2.16	d.	.....	0.04	0.011	s. a., NH_4 salts	31
$1.80^{25°}$	35	d.120	$494^{0°}$	v. s.	sl. s. alc.	32
$2.325^{25°}$	712	1412	$52.8^{0°}$	$73^{100°}$	50 alc.	33
1.56	118d.	d.	$281^{0°}$	$918^{100°}$	50 alc.	34
2.12	d.	.....	.....	.....	.....	35
2.437	d.	.....	.....	.....	.....	36
2.08	d. 100	.....	.....	.....	.....	37
1.695	$-3H_2O$, 120	.....	$211.5^{18°}$	v. s.	.....	38
.....	.....	.....	33	.....	.....	39
3.0	1396	.....	$0.0076^{18°}$	i.	s. HNO_3; i. alc.	40
$1.788^{4^{\circ}/4^{\circ}}$	d.	.....	$64.8^{17.5°}$	s.	d. HF	41
.....	.....	.....	7.7	.....	i. alc., et.	42
2.4	d.	.....	$0.0009^{18°}$	.....	s. NH_4 salts	43
$1.59^{13°}$	d. 100	.....	s.	.....	d. HNO_3	44
$3.3^{13.5°}$	$-4H_2O$, 210	d.	$8.8^{0°}$	$29.9^{100°}$	.....	45
$4.25^{25°}$	d.	.....	$120.8^{0°}$	$173.2^{40°}$	s. alc., et., NH_3	46
1.464	95	$-5H_2O$, 330	$223^{0°}$	∞	s. alc.	47
.....	d.	.....	i.	d.	s. a.; i. alc.	48
.....	d.	.....	$0.07^{16°}$	$0.08^{100°}$	s. a., alk. oxalate	49

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Magnesium** oxide (periclase; magnesia)	MgO	40.32	colorl., cubic
2	perchlorate	$Mg(ClO_4)_2 \cdot 6H_2O$	331.33	.....
3	permanganate	$Mg(MnO_4)_2 \cdot 6H_2O$	370.28	deliq., purple needles
4	phosphate	$Mg_3(PO_4)_2 \cdot 4H_2O$	334.98	monoclinic
5	phosphate (bobierite)	$Mg_3(PO_4)_2 \cdot 8H_2O$	407.05	monocl., prisms
6	phosphate, acid (newberyite)	$MgHPO_4 \cdot 3H_2O$	174.36	rhombic
7	phosphate, acid	$MgHPO_4 \cdot 7H_2O$	246.42	monoclinic
8	phosphate, pyro-	$Mg_2P_2O_7$	222.60	colorl., monocl.
9	phosphate, pyro-	$Mg_2P_2O_7 \cdot 3H_2O$	276.65	white, amorph.
10	phosphite, ortho-	$MgHPO_3 \cdot 3H_2O$	158.36	.....
11	potassium chloride (carnallite)	$MgCl_2 \cdot KCl \cdot 6H_2O$	277.88	deliq., rhombic
12	potassium sulfate (picromerite)	$MgSO_4 \cdot K_2SO_4 \cdot 6H_2O$	402.75	monoclinic
13	selenate	$MgSeO_4 \cdot 6H_2O$	275.38	colorl., monocl.
14	silicide	Mg_2Si	76.70	slate blue, cubic
15	silicide	Mg_5Si_3	205.78	.....
16	sodium chloride	$MgCl_2 \cdot NaCl \cdot H_2O$	171.70	.....
17	sulfate	$MgSO_4$	120.38	colorl.
18	sulfate (epsom salt, epsomite)	$MgSO_4 \cdot 7H_2O$	246.49	colorl., rhombic
19	sulfide	MgS	56.38	pale red, cubic
20	sulfite	$MgSO_3 \cdot 6H_2O$	212.47	white powder; trig.
21	tartrate	$Mg(C_4H_4O_6) \cdot 5H_2O$	262.47	monoclinic
22	thiosulfate	$MgS_2O_3 \cdot 6H_2O$	244.54	rhombic prisms
23	**Manganese**	Mn	54.93	gray-pink metal
24	acetate	$Mn(C_2H_3O_2)_2$	173.02	.....
25	acetate	$Mn(C_2H_3O_2)_2 \cdot 4H_2O$	245.08	pale pink, monocl
26	ammonium arsenate	$Mn(NH_4)AsO_4 \cdot 6H_2O$	319.98	red powder
27	ammonium phosphate	$MnNH_4PO_4 \cdot H_2O$	185.97	white crysts.
28	ammonium sulfate	$MnSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$	391.25	monocl.
29	arsenate, acid	$MnHAsO_4 \cdot H_2O$	212.86	.....
30	benzoate	$Mn(C_7H_5O_2)_2 \cdot 3H_2O$	351.20	flat prisms
31	boride	MnB_2	76.57	gray-violet
32	bromide	$MnBr_2$	214.76	deliq., rose red
33	bromide	$MnBr_2 \cdot 4H_2O$	286.83	deliq., red, monocl.
34	bromoplatinate	$MnPtBr_6 \cdot 12H_2O$	945.85	trigonal
35	carbide	Mn_3C	176.80	tetrahedral
36	carbonate (rhodochrosite)	$MnCO_3$	114.94	rose, trigonal
37	chloride (scacchite)	$MnCl_2$	125.84	deliq., rose, cubic
38	chloride	$MnCl_2 \cdot 4H_2O$	197.91	deliq., rose red, monocl.
39	chloride, per-	$MnCl_4$	196.76	green
40	chloroplatinate	$MnPtCl_6 \cdot 6H_2O$	571.00	trigonal
41	dithionate	$MnS_2O_6 \cdot 6H_2O$	323.15	rose, triclinic
42	ferrocyanide	$Mn_2Fe(CN)_6 \cdot 7H_2O$	447.93	grn.-wh. powd.
43	fluoride, di-	MnF_2	92.93	red prisms
44	fluoride, sesqui-	MnF_3	111.93	crystals
45	fluosilicate	$MnSiF_6 \cdot 6H_2O$	305.09	pink, trigonal

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
3.65	2800	3600	0.00062	.....	s. a., NH_4 salts	1
$1.970^{\frac{3}{4}\,0°}$	147	.....	s.	.....	s. alc.	2
.....	d.	.....	v. s.	d.	s. ac. a., m. alc.	3
$1.64^{15°}$	.....	.....	0.02	.....	s. a; i. NH_3, NH_4 salts	4
2.41	d.	.....	i.	.....	s. HNO_3, NH_4 citrate	5
2.10	.....	.....	0.025	.....	s. a.	6
.....	$-3H_2O$, 100	forms $Mg_2P_2O_7$	0.31	0.20	s. a.; i. alc.	7
$2.598^{22°}$	1383	.....	i.	i.	s. a.; i. alk.	8
2.56	$-3H_2O$, 100	.....	i.	sl. s.	s. a.; i. alc.	9
.....	.....	.....	0.25	.....	s. a.	10
$1.60^{\frac{1\,0}{4}\,4°}$	265	.....	64.5^{190} d.	d.	d. alc.	11
2.15	d. 72	.....	$19.26^{0°}$	$81.7^{75°}$	.....	12
1.928	.....	.....	v. s.	v. s.	.....	13
2	1102	.....	d.	.....	d. HCl	14
.....	1102	.....	i.	d.	d. a., NH_4Cl	15
.....	.....	.....	s.	s.	.....	16
2.66	1185	.....	$26.9^{0°}$	$68.3^{100°}$	s. alc.	17
1.68	70 d.	.....	$72.4^{0°}$	$178^{40°}$	s. alc.	18
2.80	d.	.....	d.	.....	s. a.	19
.....	$-6H_2O$, 200	d.	1.25	0.833	i. alc., NH_3	20
1.67	d.	.....	$0.8^{18°}$	$1.4^{90°}$	.....	21
$1.818^{24°}$	$-3H_2O$, 100	d.	v. s.	v. s.	s. alc.	22
$7.2^{220°}$	1260	1900	d.	.....	s. dil. a.	23
$1.74^{\frac{4}{4}\,0°}$	.....	.....	s.	s.	.....	24
1.589	.....	.....	3	.....	s. alc.	25
.....	d.	.....	i.	.....	s. a.; i. alc.	26
.....	.....	.....	0.0031	0.005	i. alc., NH_4 salts	27
1.831	.....	.....	$51.3^{25°}$	v. s.	.....	28
.....	$-H_2O$, 140	.....	0.013	d.	s. a.	29
.....	.....	.....	$6.55^{15°}$	.....	.....	30
6.9	.....	.....	d.	.....	s. a.	31
$4.39^{\frac{4}{4}\,5°}$	d.	.....	$127.3^{0°}$	$228^{100°}$	i. NH_3	32
.....	64.3d.	.....	$296.7^{0°}$	$985^{70°}$	.....	33
$2.759^{\frac{4}{4}\,0°}$	.....	.....	.....	.....	.....	34
$6.89^{17°}$	.....	.....	d.	.....	s. a.	35
3.125	d.	.....	$0.0065^{25°}$	.....	s. aq. CO_2, dil. a.; i. NH_3	36
$2.977^{\frac{4}{4}\,0°}$	650	1190	$63.4^{0°}$	$123.8^{106°}$	s. alc., i. et., NH_3	37
2.01	58.0	$-H_2O$, 106 $-4H_2O$, 200	$151^{8°}$	∞	s. alc.; i. et.	38
.....	.....	.....	s.	s.	s. alc., et.	39
2.692	d.	.....	.....	.....	.....	40
$1.757^{\frac{4}{4}\,0°}$	.....	.....	s.	.....	.....	41
.....	.....	.....	i.	.....	s. HCl; i. NH_4 salts	42
3.98	856	.....	$0.186^{25°}$	d.	s. a.; sl. s. NH_3; i. alc., et.	43
3.54	d.	.....	d.	.....	s. a.	44
$1.904^{17.5°}$	d.	.....	$140^{18°}$	v. s.	s. alc.	45

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Manganese** formate	$Mn(HCO_2)_2 \cdot 2H_2O$	181.00	rhombic
2	hydroxide (ous), (pyrochroite)	$Mn(OH)_2$	88.95	white, trig.
3	hydroxide (ic), (manganite)	$Mn_2O_3 \cdot H_2O$	175.88	brown, rhombic
4	hypophosphite	$Mn(H_2PO_2)_2 \cdot H_2O$	202.94	rose red, monocl.
5	iodide	MnI_2	308.77	white, pink or brown
6	iodide	$MnI_2 \cdot 4H_2O$	380.83	rose red, monocl.
7	iodoplatinate	$MnPtI_6 \cdot 9H_2O$	1173.82	trigonal
8	lactate	$Mn(C_3H_5O_3)_2 \cdot 3H_2O$	287.12	pale red, monocl.
9	nitrate	$Mn(NO_3)_2 \cdot 6H_2O$	287.04	rose red, monocl.
10	oxalate	MnC_2O_4	142.95	.....
11	oxalate	$MnC_2O_4 \cdot 2\frac{1}{2}H_2O$	187.99	white
12	oxide (ous) (manganosite)	MnO	70.93	gray-green, cubic
13	oxide (ic)	Mn_2O_3	157.86	brown, black, cubic
14	oxide, di- (pyrolusite, polianite)	MnO_2	86.93	black, rhombic
15	oxide, tri-	MnO_3	102.93	red, deliq.
16	oxide, hepta-	Mn_2O_7	221.86	red oil
17	oxide, ous-ic (hausmannite)	Mn_3O_4	228.79	brown-black, tetrag.
18	perchlorate	$Mn(ClO_4)_2 \cdot 8H_2O$	397.97	.....
19	phosphate (ic)	$MnPO_4 \cdot H_2O$	167.93	gray cryst. powder
20	phosphate (ous)	$Mn_3(PO_4)_2 \cdot 7H_2O$	480.86	red, amorph.
21	phosphate (ous), acid	$MnHPO_4 \cdot 3H_2O$	204.97	crystalline
22	phosphate (ous), di-acid	$Mn(H_2PO_4)_2 \cdot 2H_2O$	284.95	prisms
23	phosphide	MnP	85.91	gray
24	phosphite	$MnHPO_3 \cdot H_2O$	152.93	red-white
25	pyrophosphate	$Mn_2P_2O_7$	283.82	brown-pink, monocl.
26	pyrophosphate	$Mn_2P_2O_7 \cdot 3H_2O$	337.87	white powder, amorph.
27	selenate	$MnSeO_4 \cdot 2H_2O$	233.92	rhombic
28	selenide	MnSe	133.89	gray, cubic
29	silicate (hermannite, rhodonite)	$MnSiO_3$	130.99	pink, tricl.
30	silicide	MnSi	82.99	tetrahedral
31	silicide, di-	$MnSi_2$	111.05	gray, octahdrl.
32	silicide (ous)	Mn_2Si	137.92	gray prisms
33	sulfate (ic)	$Mn_2(SO_4)_3$	398.04	green, deliq. crysts.
34	sulfate (ous)	$MnSO_4$	150.99	red-white
35	sulfate (ous) (szmikite)	$MnSO_4 \cdot H_2O$	169.01	pale pink, monocl
36	sulfate (ous)	$MnSO_4 \cdot 2H_2O$	187.02	.....
37	sulfate (ous)	$MnSO_4 \cdot 3H_2O$	205.04	.....
38	sulfate (ous) (usual form)	$MnSO_4 \cdot 4H_2O$*	223.05	pink, monocl. or rhombic.
39	sulfate (ous)	$MnSO_4 \cdot 5H_2O$	241.07	pink, tricl.
40	sulfate (ous)	$MnSO_4 \cdot 6H_2O$	259.09	.....

*The commercial salt is this hydrate.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
1.953	d.	.....	s.	s.	.....	1
$3.258^{13°}$	d.	.....	$0.002^{20°}$	i.	s. a., NH_4 salts; i. alk.	2
3.258	d.	.....	i.	i.	s. h. H_2SO_4	3
.....	$-H_2O$, 150	d.	$15.2^{25°}$	16.6	.....	4
5.01	d. 80	.....	v. s.	.....	s. NH_3	5
.....	d.	.....	v. s.	v. s.	.....	6
$3.604^{\frac{2}{4}0°}$	d.	.....	.....	.....	.....	7
.....	d.	.....	s.	v. s.	.....	8
$1.82^{21°}$	25.8	129.5	$426^{0°}$	∞	v. s. alc.	9
$2.43^{21.7°}$	d.	.....	v. sl. s.	v. sl. s.	.....	10
$2.453^{20°}$	d. 150	.....	$0.03^{25°}$	$0.08^{100°}$	s. dil. a.	11
5.18	1650	.....	i.	i.	s. a., NH_4Cl	12
4.81	–O, 1080	.....	i.	i.	s. a.; i. act.	13
5.026	–O, >230	.....	i.	i.	s. HCl; i. HNO_3, act.	14
.....	d.	.....	s.	d.	s. H_2SO_4; d. et.	15
2.4	<–20	expl.	v. s.	d.	s. conc. H_2SO_4	16
4.718	1705	.....	i.	i.	s. HCl, H_2SO_4	17
$1.99^{\frac{2}{4}0°}$	.....	.....	.....	.....	.....	18
.....	$-H_2O$, 300	d.	i.	.....	s. h. conc. H_2SO_4, conc. H_3PO_4	19
.....	.....	.....	v. sl. s.	.....	s. a., ac. a.; i. alc.	20
.....	$-3H_2O$, 200	d.	sl. s.	d. 100	s. a.; i. alc.	21
.....	.....	.....	s.	.....	i. alc.	22
$5.39^{\frac{1}{4}1°}$	1190	.....	l.	i.	s. HNO_3; i. HCl	23
.....	$-H_2O$, 200	.....	sl. s.	.....	s. aq. $MnCl_2$, aq. $MnSO_4$	24
$3.707^{\frac{2}{4}5°}$	1196	.....	l.	.....	s. a.	25
.....	.....	.....	i.	.....	s. aq. $K_4P_2O_7$, H_2SO_3; i. act.	26
$2.949^{\frac{2}{4}0°}$	.....	.....	s.	s.	.....	27
$5.59^{15°}$	.....	.....	i.	d.	d. dil. a.	28
$3.48^{\frac{2}{4}5°}$	1273	.....	i.	i.	i. HCl	29
$5.90^{15°}$	1280	.....	i.	i.	s. HF; v. sl. s. a.	30
$5.24^{15°}$	.....	.....	i.	i.	s. alk., HF; i. a.	31
$6.20^{15°}$	1316	.....	l.	i.	s. HCl, alk.	32
3.24	d. 160	.....	v. s.	d.	s. HCl, dil. H_2SO_4; i. conc. H_2SO_4, HNO_3	33
3.235	700	d. 850.	$53^{0°}$	$70^{70°}$	s. alc.; i. et.	34
2.87	stable 57-117	.....	$98.47^{48°}$	$79.77^{100°}$	.....	35
$2.526^{15°}$	stable 40-57	.....	$85.27^{35°}$	$106.8^{55°}$	.....	36
$2.356^{15°}$	stable 30-40	.....	$74.22^{5°}$	$99.31^{57°}$	.....	37
2.107	stable 18-30	.....	$136^{16°}$	$169^{50°}$	.....	38
$2.103^{15°}$	stable 8-18	.....	$142^{5°}$	$200^{35°}$	.....	39
.....	stable –5 to +8	.....	$204^{0°}$	$247^{9°}$	.....	40

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Manganese** sulfate (ous)	$MnSO_4 \cdot 7H_2O$	277.10	pink, monocl. or rhombic
2	sulfide (ic) (hauerite)	MnS_2	119.05	black, cubic
3	sulfide (ous) (alabandite)	MnS	86.99	green or pink, cubic
4	thiocyanate	$Mn(CNS)_2 \cdot 3H_2O$	225.13	colorl., deliq.
5	**Manganocyanhydric acid**	$H_4Mn(CN)_6$	215.07	.....
6	**Masurium**	Ma	98-99.5	.....
7	**Mercuric** acetate	$Hg(C_2H_3O_2)_2$	318.70	white plates
8	arsenate	$Hg_3(AsO_4)_2$	879.65	yellow, monocl.
9	bromate	$Hg(BrO_3)_2 \cdot 2H_2O$	492.47	white crysts.
10	bromide	$HgBr_2$	360.44	white, rhombic
11	carbonate, basic	$2HgO \cdot HgCO_3$	693.84	brown-red
12	chlorate	$Hg(ClO_3)_2$	367.52	needles
13	chloride (corrosive sublimate)	$HgCl_2$	271.52	white, rhombic
14	chromate	$HgCrO_4$	316.62	red, rhombic
15	cyanide	$Hg(CN)_2$	252.65	white, tetrag.
16	fluoride	HgF_2	238.61	transparent, cubic
17	fluosilicate, basic	$HgSiF_6 \cdot HgO \cdot 3H_2O$	613.33	yellow needles
18	fulminate	$Hg(CNO)_2$	284.65	cubic
19	hydroxide	$Hg(OH)_2$	234.63	.....
20	iodate	$Hg(IO_3)_2$	550.45	wh. amor. powd.
21	iodide, red	HgI_2	454.45	red, tetrag.
22	iodide, yellow	HgI_2	454.45	yellow, rhombic
23	iodobromide	$HgIBr$	407.45	yellow, rhombic
24	iodochloride	$HgICl$	362.99	red, rhombic
25	nitrate	$Hg(NO_3)_2 \cdot \frac{1}{2}H_2O$	333.63	transparent crysts.
26	nitride	Hg_3N_2	629.85	brown powder
27	oxalate	HgC_2O_4	288.63	powder
28	oxide (montroydite)	HgO	216.61	yellow or red, rhombic
29	oxybromide	$HgBr_2 \cdot 3HgO$	1010.27	yellow crysts.
30	oxychloride (kleinite)	$HgCl_2 \cdot 3HgO$	921.35	yellow, hex.
31	oxycyanide	$Hg(CN)_2 \cdot HgO$	469.26	needles
32	oxyfluoride	$HgF_2 \cdot HgO \cdot H_2O$	473.24	yellow crysts.
33	oxyiodide	$HgI_2 \cdot 3HgO$	1104.28	yellow-brown
34	phosphate	$Hg_3(PO_4)_2$	791.79	white-yellow
35	potassium iodide	$2HgI_2 \cdot 2KI \cdot 3H_2O$	1294.98	yellow, deliq.
36	selenide (tiemannite)	$HgSe$	279.57	gray pl., cubic
37	sulfate	$HgSO_4$	296.67	white, rhombic
38	sulfate, basic (turpeth)	$HgSO_4 \cdot 2HgO$	729.89	yellow, tetrag.
39	sulfide	HgS	232.67	black, amorph.
40	sulfide (cinnabarite)	HgS (α)	232.67	red, hex.
41	thiocyanate	$Hg(CNS)_2$	316.77	colorl.
42	**Mercurous** acetate	$HgC_2H_3O_2$	259.65	scales
43	arsenate	Hg_3AsO_4	740.74	orange, rhombic
44	arsenate, acid	Hg_2HAsO_4	541.14	yellow-red
45	bromate	$HgBrO_3$	328.53	yellow-white
46	bromide	$HgBr$	280.53	white, tetrag.
47	carbonate	Hg_2CO_3	461.23	yellow powder

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
2.092	stable −10 to −5; 19d.	$-7H_2O$, 280	$176^{0°}$	$251^{14°}$	.....	1
3.463	d.	.....	i.	i.	d. HCl	2
3.99-4.04	1620 (vac.) d. in air	.....	0.0007	i.	s. dil. a.; i. $(NH_4)_2S$	3
.....	$-3H_2O$, 160	.....	s.	v. s.	s. alc.	4
.....	d.	.....	i.	.....	sl. s. alc.; i. et.	5
11.5	2300?	.....	.....	.....	.....	6
3.270	d.	.....	$25^{100°}$	$100^{100°}$	s. alc. sl. d.	7
.....	d. red heat	.....	.....	v. sl. s.	s. HCl, HNO_3	8
.....	d. 130	.....	0.154	1.56	s. HNO_3, $Hg(NO_3)_2$, d. HCl	9
6.053	237	322	$0.5^{20°}$	$25^{100°}$	$15^{0°}$ alc.; v. sl. s. et.	10
.....	.....	.....	i.	.....	s. aq. CO_2, NH_4Cl	11
4.998	d.	.....	25	.....	.....	12
5.44	277	304	$3.6^{0°}$	$61.3^{100°}$	$33^{25°}$ 99% alc.; 33 et.	13
.....	d.	.....	sl. s.	d.	s. NH_4Cl; i. act.; d. a.	14
4.00	d.	.....	$9.3^{20°}$	$53^{100°}$	$10^{20°}$ alc., s. NH_3; i. bz.	15
$8.95^{15°}$	645d.	.....	d.	.....	s. HF, dil. HNO_3	16
.....	.....	.....	d.	.....	s. a.	17
4.42	expl.	.....	sl. s.	.....	s. NH_4OH, alc.	18
.....	$-H_2O$, 175	.....	i.	i.	s. a.	19
.....	.....	.....	i.	.....	s. HCl, NH_4Cl; i. HNO_3	20
6.283	tr. 127; 259	354	$0.006^{25°}$	.....	$1.8^{25°}$ abs. alc.; s. $Na_2S_2O_3$, alk. salts	21
6.271	259	354	i.	.....	.....	22
.....	229	360	.....	.....	s. alc., et.	23
.....	153	315	i.	sl. s.	s. alc.; sl. s. dil. HCl	24
4.3	79	d.	v. s.	d.	s. HNO_3, NH_3, act.; i. alc.	25
.....	expl.	.....	d.	.....	s. NH_4OH, NH_4 salts; d. a.	26
.....	d. 165	expl.	i.	v. sl. s.	s. HCl; sl. s. HNO_3	27
11.14	d. 100	.....	$0.005^{25°}$	$0.041^{100°}$	s. a.; i. alc.	28
.....	.....	.....	i.	sl. s.	s. alc.	29
7.93	d. 260	.....	i.	d.	s. HCl	30
$4.437^{19°}$	expl.	.....	1.3	.....	.....	31
.....	d. 100	.....	d.	.....	s. dil. HNO_3	32
.....	.....	.....	d.	.....	s. HI	33
.....	d.	.....	i.	sl. s.	s. a., NH_4Cl; i. alc.	34
$4.289^{23.5°}$	.....	.....	d.	.....	s. alc., et., KI	35
7.1-8.5	subl.	.....	i.	.....	s. aq. reg.; i. HCl	36
6.47	d.	.....	d.	.....	s. a.; i. alc., act., NH_3	37
6.44	.....	.....	0.005	$0.167^{100°}$	s. a.; i. alc.	38
7.67	subl. 446	.....	$0.000001^{18°}$	i.	s. alk. sulfides, aq. reg; i. HNO_3	39
8.10	subl. 580	.....	i.	i.	s. K_2S, aq. reg.; i. HNO_3	40
.....	d.	.....	$0.07^{25°}$	sl. s.	s. NH_3, NH_4 salts; sl. s. alc.	41
.....	d.	.....	$0.75^{13°}$	d.	s. H_2SO_4, HNO_3, i. alc.	42
.....	d.	.....	i.	.....	s. HNO_3; i. ac. a.	43
.....	d.	.....	i.	.....	s. HNO_3; i. ac. a., NH_4OH	44
.....	d.	.....	d.	.....	sl. s. HNO_3	45
7.307	subl. 345	.....	7×10^{-9}	i.	s. a.; i. alc., act.	46
.....	d. 130	.....	i.	d.	s. NH_4Cl	47

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Mercurous** chlorate	$HgClO_3$	284.07	white, rhombic
2	chloride (calomel)	$HgCl$	236.07	white, tetrag.
3	chromate	Hg_2CrO_4	517.23	red, rhombic
4	fluoride	HgF	219.61	yellow, cubic?
5	fluosilicate	$Hg_2SiF_6 \cdot 2H_2O$	579.31	prisms
6	formate	$HgHCO_2$	245.63	shiny scales
7	iodate	$HgIO_3$	375.53	yellowish
8	iodide	HgI	327.53	yellow, tetrag.
9	nitrate	$HgNO_3 \cdot H_2O$	280.63	white, monocl.
10	nitrite	$HgNO_2$	246.62	yellow
11	oxalate	$Hg_2C_2O_4$	489.24	crysts.
12	oxide	Hg_2O	417.22	black
13	phosphate	Hg_3PO_4	696.81	white crysts.
14	sulfate	Hg_2SO_4	497.28	white, monocl.
15	sulfide	Hg_2S	433.28	black
16	thiocyanate	$HgCNS$	258.69	white
17	trinitride	HgN_3	242.63	white crysts.
18	**Mercury***	Hg	200.61	silvery liq. or hex. (?)
19	**Mercury-ammonium compounds**	.....	.....	.....
20	Dimercuri-diammonium chloride (infusible white precipitate)	$Hg_2NCl \cdot NH_4Cl$	504.18	crystalline
21	Dimercuri-tetrammonium chloride (fusible white precipitate)	$Hg_2NCl \cdot 3NH_4Cl$	611.18	red crysts.
22	**Molybdenum**	Mo	95.95	gray, cubic
23	bromohydroxide	$Mo_3Br_4(OH)_2$	641.53	red powder
24	bromide, di-	$MoBr_2$	255.78	yellow-red
25	bromide, tri-	$MoBr_3$	335.70	blk.-grn. needles
26	bromide, tetra-	$MoBr_4$	415.61	blk., deliq. need.
27	carbide	MoC	107.96	gray prisms
28	chloride, di-	$MoCl_2$	166.85	yellow, amorph.
29	chloride, tri-	$MoCl_3$	202.32	dark red powder
30	chloride, tetra-	$MoCl_4$	237.78	brown, deliq.
31	chloride, penta-	$MoCl_5$	273.24	black crysts.
32	chlorohydroxide	$Mo_3Cl_4(OH)_2 \cdot 2H_2O$	499.71	yellow, amorph.
33	fluoride, hexa-	MoF_6	209.95	white crysts.
34	oxide, di-	MoO_2	127.95	blue-black, tetrag.
35	oxide, sesqui-	Mo_2O_3	239.90	black
36	oxide, tri- (molybdite)	MoO_3	143.95	colorl., rhombic
37	oxybromide	MoO_2Br_2	287.78	yellow, deliq.
38	oxychloride	$MoOCl_4$	253.78	green, deliq.

* See also special tables.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
6.409	expl. 250	.....	s.	d.	s. alc., ac. a.	1
7.150	302	383.7	$0.0001^{0°}$	$0.000743^{0°}$	s. aq. reg., $Hg(NO_3)_2$; sl. s. HNO_3, HCl; i. alc., et.	2
.....	d.	.....	v. sl. s.	sl. s.	s. HNO_3, KCN; i. act.	3
8.73	570	.....	forms Hg_2O	.....	.....	4
.....	.....	.....	sl. s.	.....	i. HCl	5
.....	d.	.....	$0.417^{0°}$	d.	i. alc.	6
.....	volt. 250	.....	v. sl. s.	v. sl. s.	s. dil. HCl; i. cold HNO_3	7
7.70	290 d.	subl. 140; 310 d.	2×10^{-6}	v. sl. s.	s. KI; i. alc.	8
$4.785^{3.9°}$	70	expl.	v. s.	d.	s. HNO_3; i. alc., et.	9
$7.33^{\frac{3}{4}0°}$	d. 100	.....	d.	.....	.....	10
.....	.....	.....	i.	i.	sl. s. HNO_3	11
9.8	d. 100	.....	i.	0.0007	s. h. ac. a.; i. alk., dil. HCl, NH_3	12
.....	d.	.....	i.	d.	s. HNO_3, aq. $HgNO_3$; i. H_3PO_4	13
7.56	d.	.....	$0.055^{16.5°}$	$0.092^{100°}$	s. H_2SO_4, HNO_3	14
.....	d. 0	.....	i.	.....	i. a., $(NH_4)_2S$	15
.....	d.	.....	i.	.....	s. HCl, aq. KCNS, aq. $Hg(NO_3)_2$	16
.....	expl. 245°	.....	0.025	.....	.....	17
$13.546^{20°}$	−38.87	356.9	i.	i.	s. HNO_3; i. HCl	18
.....	.....	.....	.....	.....	.....	19
5.70	.....	.....	0.14	d.	s. a.; i. alc.	20
.....	300	.....	i.	d.	s. a., KI	21
10.2	2620±10	3700	i.	i.	s. h. conc. H_2SO_4; i. HCl, HF, NH_3, dil. H_2SO_4	22
.....	.....	.....	.....	.....	s. alk.	23
.....	infusible	.....	i.	i.	s. alk., i. a., aq. reg.	24
.....	d.	.....	i.	i.	i. a.; d. alk.	25
.....	d.	volt.	v. s.	.....	d. alk.	26
$8.48^{20°}$	2570	.....	i.	i.	s. HNO_3, HF, h. H_2SO_4	27
$3.714^{\frac{4}{4}0°}$	d.	.....	i.	i.	s. HCl, H_2SO_4, NH_4OH, alc., et.	28
$3.578^{\frac{4}{4}0°}$	d.	.....	i.	d.	s. HNO_3, H_2SO_4; v. sl. s. alc., et.	29
.....	volt.	d.	s.	d.	s. HNO_3, H_2SO_4; sl. s. alc., et.	30
$2.928^{\frac{4}{4}0°}$	194	268	s.	d.	s. HNO_3, H_2SO_4, abs. alc., et.	31
.....	.....	.....	i.	.....	s. a.; i. alc.	32
.....	17	35	sl. s. d.	d.	d. NH_3 gas	33
6.44	.....	.....	i.	i.	sl. s. H_2SO_4, $KHC_4H_4O_6$; i. alk., HCl	34
.....	.....	.....	i.	i.	i. a., alk.	35
$4.50^{19.5°}$	795	subl.	$0.107^{18°}$	$2.106^{79°}$	s. a., NH_4OH	36
.....	subl.	.....	s.	.....	.....	37
.....	<100	subl. <100	s.	d.	.....	38

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Molybdenum** oxychloride	MoO_2Cl_2	198.86	yellow-white
2	oxychloride	$MoOCl_3$	218.32	green
3	oxychloride	$Mo_2O_3Cl_5$	417.19	dark brown, deliq.
4	oxyfluoride	$MoOF_4$	187.95	blue-white
5	phosphate, meta-	$Mo(PO_3)_3$	332.89	.....
6	phosphide	Mo_2P_2	253.94	gray crysts.
7	sulfide, di- (molybdenite)	MoS_2	160.07	black, hex.
8	sulfide, tri-	MoS_3	192.13	red-brown
9	sulfide, tetra-	MoS_4	224.19	brown powder
10	**Molybdic acid**	H_2MoO_4	161.97	yellow-white, hex.
11	**Molybdic acid**	$H_2MoO_4 \cdot H_2O$	179.98	yellow, monocl.
12	**Neodymium**	Nd	144.27	yellowish
13	bromate	$Nd_2(BrO_3)_6 \cdot 18H_2O$	1380.32	red, hex.
14	carbide	NdC_2	168.29	yellow, hex.
15	chloride	$NdCl_3$	250.64	violet prisms
16	chloride	$NdCl_3 \cdot 6H_2O$	358.74	red, rhombic
17	molybdate	$Nd_2(MoO_4)_3$	768.39	tetragonal
18	oxide	Nd_2O_3	336.54	blue
19	sulfate	$Nd_2(SO_4)_3 \cdot 8H_2O$	720.85	monoclinic
20	sulfide	Nd_2S_3	384.72	olive green
21	**Neon**	Ne	20.18	colorl. gas
22	**Nickel**	Ni	58.69	silvery metal, cubic
23	acetate	$Ni(C_2H_3O_2)_2$	176.78	green prisms
24	ammonium chloride	$NiCl_2 \cdot NH_4Cl \cdot 6H_2O$	291.20	green, deliq., monocl.
25	ammonium sulfate	$NiSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$	394.99	blue-green, monocl.
26	antimonide	NiSb	180.45	hex.
27	arsenate (xanthiosite)	$Ni_3(AsO_4)_2$	453.89	yellow, amorph.
28	arsenide	Ni_5As_2	325.89	metallic, tetrag.
29	arsenide (nicollite)	NiAs	133.60	hex.
30	boride	NiB	69.51	bright prisms
31	bromate	$Ni(BrO_3)_2 \cdot 6H_2O$	422.62	green, cubic
32	bromide	$NiBr_2$	218.52	yellow, deliq.
33	bromide	$NiBr_2 \cdot 3H_2O$	272.57	green, deliq.
34	bromide, ammonia	$NiBr_2 \cdot 6NH_3$	320.71	violet powder
35	bromoplatinate	$NiPtBr_6 \cdot 6H_2O$	841.51	trigonal
36	carbonate	$NiCO_3$	118.70	light green, rhombic
37	carbonate, basic	$2NiCO_3 \cdot 3Ni(OH)_2 \cdot 4H_2O$	587.58	light green
38	carbonyl	$Ni(CO)_4$	170.73	liquid
39	chlorate	$Ni(ClO_3)_2 \cdot 6H_2O$	333.70	green crysts.
40	chloride	$NiCl_2$	129.60	yellow, deliq.
41	chloride	$NiCl_2 \cdot 6H_2O$	237.70	grn., deliq. monocl.
42	chloride ammonia	$NiCl_2 \cdot 6NH_3$	231.80	.....
43	chloropalladate	$NiPdCl_6 \cdot 6H_2O$	486.23	hex.
44	chloroplatinate	$NiPtCl_6 \cdot 6H_2O$	574.76	trigonal
45	cyanide	$Ni(CN)_2 \cdot 4H_2O$	182.79	green plates
46	dimethylglyoxime	$NiC_8H_{14}O_4N_4$	288.91	scarlet red crysts.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	subl.	.....	s.	.....	s. alc., et.	1
.....	subl. <100	.....	d.	.....	.....	2
.....	subl.	.....	s.	s.	.....	3
3.001	98	180	s.	.....	s. alc.	4
$3.28^{0°}$	.....	.....	.....	.....	.....	5
6.17	d.	.....	i.	.....	s. h. HNO_3	6
$4.80^{14°}$	1185	.....	i.	i.	s. H_2SO_4, aq. reg.	7
.....	d.	.....	sl. s.	s.	s. alk. sulfides	8
.....	d.	.....	i.	i.	s. alk. sulfides; i. NH_3	9
.....	d. 115	.....	v. sl. s.	sl. s.	s. NH_4OH, H_2SO_4; i. NH_3	10
$3.124^{15°}$	$-H_2O$, 70	$-2H_2O$, 200	$0.133^{18°}$	$2.13^{70°}$	s. a., NH_4OH, NH_4 salts	11
$6.9^{20°}$	840	.....	d.	.....	.....	12
.....	66.7	$-18H_2O$, 150	$146^{25°}$	.....	.....	13
5.15	d.	.....	d.	.....	s. H_2SO_4, dil. a.; i. conc. HNO_3	14
$4.134^{\frac{2}{4}5°}$	784	.....	$96.7^{13°}$	$140.4^{100°}$	s. alc.; i. et., chl.	15
$2.282^{\frac{1}{4}\frac{6}{4}°}$	124	$-5H_2O$, 105 $-6H_2O$, 160	$246^{13°}$	$511.6^{100°}$	s. alc.	16
$5.14^{\frac{1}{1}8°}$	1176	.....	.....	.....	.....	17
7.24	$1900\pm$	.....	i.	i.	s. HCl	18
2.850	.....	.....	$12^{0°}$	$2.8^{100°}$	.....	19
$5.179^{11°}$	d.	.....	i.	d.	s. dil. a.	20
liq. $1.204^{-245.9°}$ 0.674 (A)	−248.67	−245.9	1.140°c.c.	.....	s. liq. O_2	21
$8.90^{20°}$	1452	2900	i.	i.	s. dil. HNO_3; sl. s. H_2SO_4, HCl; i. NH_3	22
1.798	d.	.....	16.6	.....	i. alc.	23
1.645	.....	.....	v. s.	v. s.	.....	24
1.923	.....	.....	$2.5^{3.5°}$	$39.2^{85°}$	v. sl. s. $(NH_4)_2SO_4$	25
$7.70^{0°}$	1158	d. 1400	.....	.....	.....	26
4.982	.....	.....	i.	.....	s. a.	27
$7.86^{0°}$	1000	.....	.....	.....	.....	28
$7.57^{0°}$	968	.....	i.	i.	s. aq. reg.	29
$7.39^{18°}$	.....	.....	d.	.....	s. HNO_3, aq. reg.	30
2.575	d.	.....	28	.....	s. NH_4OH	31
$4.64^{\frac{2}{4}5°}$	d.	.....	$112.8^{0°}$	$156^{100°}$	s. alc., et., NH_4OH	32
.....	$-3H_2O$, 200	.....	$199^{9°}$	$316^{100°}$	s. alc., et., NH_4OH	33
1.837	.....	.....	v. s.	d.	i. cold NH_4OH	34
3.715	.....	.....	.....	.....	.....	35
.....	d.	.....	$0.0093^{25°}$	i.	s. a.	36
.....	d.	.....	i.	d.	s. a., NH_4 salts	37
$1.31^{17°}$	−25	437^{51mm}	$0.018^{9.8°}$	i.	s. aq. reg., HNO_3, alc., et.	38
2.07	80 d.	.....	$352^{0°}$	v. s.	.....	39
3.544	subl.	973	$53.8^{0°}$	$87.6^{100°}$	s. NH_4OH, alc.; i. NH_3	40
.....	.....	.....	v. s.	v. s.	v. s. alc.	41
.....	.....	.....	s.	d.	s. NH_4OH; i. alc.	42
2.353	.....	.....	.....	.....	.....	43
2.798	.....	.....	.....	.....	.....	44
.....	$-4H_2O$, 200	d.	i.	i.	s. KCN; i. dil. KCl	45
.....	subl. 250	.....	i.	i.	s. abs. alc., a.; i. ac. a., NH_4OH	46

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Nickel** dithionate	$NiS_2O_6 \cdot 6H_2O$	326.91	green, tricl.
2	ferrocyanide	$Ni_2Fe(CN)_6 \cdot 11H_2O$	527.51	green-white
3	fluoride	NiF_2	96.69	green
4	fluoride, acid	$NiF_2 \cdot 5HF \cdot 6H_2O$	304.83	blue-green, trig.
5	fluosilicate	$NiSiF_6 \cdot 6H_2O$	308.85	green, trigonal
6	formate	$Ni(HCO_2)_2 \cdot 2H_2O$	184.76	green crysts.
7	hydroxide (ic)	$Ni(OH)_3$	109.71	black
8	hydroxide (ous)	$Ni(OH)_2 \cdot \frac{1}{4}H_2O$	97.21	light green
9	hypophosphite	$Ni(H_2PO_2)_2 \cdot 6H_2O$	296.78	green, cubic
10	iodate	$Ni(IO_3)_2$	408.53	yellow needles
11	iodate	$Ni(IO_3)_2 \cdot 4H_2O$	480.59	hexagonal
12	iodide	NiI_2	312.53	black, deliq.
13	iodide ammonia	$NiI_2 \cdot 6NH_3$	414.72	.....
14	nitrate	$Ni(NO_3)_2 \cdot 6H_2O$	290.80	green, monocl.
15	nitrate ammonia	$Ni(NO_3)_2 \cdot 4NH_3 \cdot 2H_2O$	286.87	.....
16	oxalate	NiC_2O_4	146.71	.....
17	oxide, mono- (bunsenite)	NiO	74.69	green-black, cubic
18	oxide, sesqui-	Ni_2O_3	165.38	black
19	oxide (ous-ic)	Ni_3O_4	240.07	gray
20	oxide (ous-ic)	$Ni_3O_4 \cdot 2H_2O$	276.10	.....
21	oxyiodide	$NiI_2 \cdot 9NiO \cdot 15H_2O$	1254.98	.....
22	perchlorate	$Ni(ClO_4)_2 \cdot 5H_2O$	347.68	blue-green, hex.
23	perchlorate	$Ni(ClO_4)_2 \cdot 6H_2O$	365.70	blue-green, hex.
24	phosphate	$Ni_3(PO_4)_2 \cdot 7H_2O$	492.14	green
25	phosphide	Ni_3P_2	238.03	gray-white
26	phosphide	Ni_2P	148.36	gray crysts.
27	pyrophosphate	$Ni_2P_2O_7 \cdot 6H_2O$	399.44	green
28	potassium cyanide	$Ni(CN)_2 \cdot 2KCN \cdot H_2O$	258.97	red-yellow, monocl.
29	selenate	$NiSeO_4 \cdot 6H_2O$	309.75	green, tetrag. or monocl.
30	selenide	NiSe	137.65	silvery white, cubic
31	silicide	Ni_2Si	145.44	.....
32	sulfate	$NiSO_4$	154.75	yellow, cubic
33	sulfate	$NiSO_4 \cdot 6H_2O$	262.85	blue tetrag. or green monocl.
34	sulfate (morenosite)	$NiSO_4 \cdot 7H_2O$	280.86	green, rhombic
35	sulfide, mono- (beyrichite)	NiS	90.75	black, trigonal
36	sulfide, sub-	Ni_2S	149.44	yellow crysts.
37	sulfide (ous-ic) (polydymite)	Ni_3S_4	304.31	gray-black, cubic
38	sulfite	$NiSO_3 \cdot 6H_2O$	246.85	green, tetrahdrl.
39	**Niobium** cf. columbium	.....	.....	.....
40	**Nitric acid**	HNO_3	63.02	colorl. liq.
41	**Nitric acid**	$HNO_3 \cdot H_2O$	81.03	colorl. liq.
42	**Nitric acid**	$HNO_3 \cdot 3H_2O$	117.06	colorl. liq.
43	**Nitro acid sulfite***	NO_2HSO_3	127.08	colorl., rhombic
44	**Nitrogen**	N_2	28.02	colorl. gas or cubic crysts.
45	bromophosphide	$NPBr_2$	204.82	colorl., rhombic
46	chloride	NCl_3	120.38	yellow oil
47	chlorophosphide	$(NPCl_2)_3$	347.71	rhombic

*Chamber crystals; nitrosyl sulfuric acid.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
1.908	d.	.....	.....	.....	.....	1
.....	.....	.....	i.	.....	s. KCN, NH_4OH; i. HCl	2
4.63	.....	.....	0.02	.....	i. a., NH_3, alc., et.	3
2.132	.....	.....	s.	.....	s. dil. a.; d. NH_4OH	4
2.134	d.	.....	v. s.	.....	.....	5
2.154	d.	.....	s.	.....	.....	6
.....	d.	.....	i.	i.	s. a., NH_4OH, NH_4Cl	7
4.36	d.	.....	v. sl. s.	v. sl. s.	s. a., NH_4OH; i. alk.	8
1.824	d. 100	.....	s.	.....	.....	9
5.07	.....	.....	sl. s.	v. sl. s.	.....	10
.....	d. 100	.....	v. sl. s.	sl .s.	.....	11
5.834	subl.	.....	$124.2^{20°}$	$188.2^{90°}$	s. alc.	12
2.101	d.	.....	d.	.....	s. NH_4OH	13
2.05	56.7	136.7	$243^{0°}$	$\infty^{56.7°}$	s. NH_4OH; i. abs. alc.	14
.....	.....	.....	v. s.	.....	i. alc.	15
2.235	.....	.....	.....	.....	.....	16
7.45	forms Ni_2O_3, 400	.....	i.	i.	s. a., NH_4OH	17
$4.83^{16°}$	forms NiO, 600	.....	i.	i.	s. HCl, NH_4OH	18
.....	.....	.....	i.	i.	s. a.	19
$3.412^{32°}$	.....	.....	i.	i.	s. a.	20
.....	.....	.....	i.	.....	s. HNO_3; i. NH_4OH	21
.....	149	.....	$222.5^{0°}$	$273.7^{45°}$	s. alc.; i. chl.	22
.....	149	.....	s.	s.	s. alc.	23
.....	.....	.....	i.	i.	s. a., NH_4 salts	24
5.99	.....	.....	i.	i.	s. HNO_3; i. HCl	25
$6.31^{15°}$	1112	.....	i.	.....	s. HNO_3 + HF; i. a.	26
$3.932^{5°}$ (anhyd.)	.....	.....	i.	.....	s. a., NH_4OH	27
$1.875^{11°}$	$-H_2O$, 100	.....	s.	.....	d. a.	28
2.314	.....	.....	s.	.....	.....	29
8.46	red heat	.....	i.	.....	s. aq. reg., HNO_3; i. HCl	30
$7.21^{7°}$	1309	.....	i	.....	i. a.	31
3.68	$-SO_3$, 840	.....	$27.2^{0°}$	$76.7^{100°}$	i. alc., et., act.	32
2.07	tr. 53.3	$-6H_2O$, 280	$131^{50°}$	$280^{100°}$	v. s. NH_4OH, alc.	33
1.948	98 to 100	$-6H_2O$, 103	$63.5^{0°}$	$117.8^{30°}$	s. alc.	34
4.60	797	.....	$0.00036^{18°}$	d.	s. aq. reg., HNO_3	35
5.52	.....	.....	i.	.....	s. HNO_3	36
4.7	.....	.....	i.	.....	s. HNO_3	37
.....	.....	.....	i.	.....	s. HCl, H_2SO_3	38
.....	.....	.....	.....	.....	.....	39
1.502	-42	86	∞	∞	expl. with alc.	40
.....	-38	.....	∞	∞	d. alc.	41
.....	-18.5	.....	$263^{-20°}$	∞	d. alc.	42
.....	73 d.	.....	d.	.....	s. H_2SO_4	43
$1.026^{-252.5°}$ $0.808^{-195.8°}$ $12.5^{0°}$(D)	-209.86	-195.8	$2.35^{0°}$ c.c.	$1.55^{20°}$ c.c.	sl. s. alc.	44
.....	190	.....	i.	.....	s. et., chl., CS_2	45
1.653	expl. 93	<71	l.	d.	s. chl., PCl_3, CS_2	46
1.98	114	127^{13mm}	i.	d.	s. alc., et., chl., $POCl_3$	47

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Nitrogen** iodide	NI_3	394.77	black
2	iodoazoimide	NH_3NI_3	411.80	red, rhombic
3	oxide, mono- (ous)	N_2O	44.02	colorl. gas
4	oxide, di- (ic)	NO or $(NO)_2$	30.01 (60.02)	colorl. gas
5	oxide, tri-	N_2O_3	76.02	red-brown gas or blue liq. or solid
6	oxide, tetra- (per- or di-)	NO_2 or $(NO_2)_2$	46.01 (92.02)	red-brown gas, yellow liq. or colorl. solid
7	oxide, penta-	N_2O_5	108.02	white, rhombic
8	oxybromide (nitrosyl bromide)	NOBr	109.92	brown liq.
9	oxychloride (nitrosyl chloride)	NOCl	65.47	red-yellow liq. or gas
10	oxyfluoride	NOF	49.01	colorl. gas
11	selenide	NSe	92.97	orange yellow
12	sulfide	N_4S_4	184.27	orange-red, monocl.
13	sulfide, penta-	N_2S_5	188.32	red liq.
14	**Nitroso tribromide**	$NOBr_3$	269.76	brown liq.
15	**Nitroxyl** chloride	NO_2Cl	81.47	yellow-brown gas
16	fluoride (nitryl fluoride)	NO_2F	65.01	colorl. gas
17	**Osmium**	Os	190.2	blue, hex.
18	ammonium trichloride	$2(OsCl_3 \cdot 2NH_4Cl) \cdot 3H_2O$	861.18	red-brown crysts.
19	chloride, di-	$OsCl_2$	261.11	green, deliq.
20	chloride, tri-	$OsCl_3$	296.57	brown, cubic
21	chloride, tetra-	$OsCl_4$	332.03	red-yel. needles
22	oxide, mono-	OsO	206.20	black powder
23	oxide, di-	OsO_2	222.20	copper red
24	oxide, sesqui-	Os_2O_3	428.40	black powder
25	oxide, tetra- (perosmic acid)	OsO_4	254.20	colorl., monocl.
26	potassium trichloride	$2(OsCl_3 \cdot 3KCl) \cdot 6H_2O$	1148.56	red crysts.
27	potassium tetrachloride	$OsCl_4 \cdot 2KCl$	481.13	red, cubic
28	sulfide, di-	OsS_2	254.32	brown-yellow
29	sulfide, tetra-	OsS_4	318.44	brown-black
30	sulfite (ous)	$OsSO_3$	270.26	blue-black
31	**Oxygen**	O_2	32.00	colorl. gas or hex. solid
32	**Ozone**	O_3	48.00	colorl. gas
33	**Palladium**	Pd	106.70	silvery metal, cubic
34	bromide	$PdBr_2$	266.53	brown
35	chloride	$PdCl_2$	177.61	brown, cubic
36	chloride	$PdCl_2 \cdot 2H_2O$	213.65	brown prisms
37	cyanide	$Pd(CN)_2$	158.74	yellow
38	fluoride	PdF_2	144.70	brown

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	expl.	.....	i.	d.	s. aq. $Na_2S_2O_3$, KCNS	1
3.5	d. >20	expl.	d.	.....	s. HCl, $Na_2S_2O_3$, KCN; i. abs. alc.	2
liq. 1.226^{-89} 1.530 (A)	−102.3	−90.7	130.52°c.c.	60.82$^{24°}$c.c.	s. H_2SO_4, alc.	3
liq. 1.269 $^{-150.2°}_{4}$ 1.0367 (A)	−161	−151	7.34°c.c.	0.0$^{100°}$	26.6 c.c. alc.; 3.5 c.c. H_2SO_4; s. aq. $FeSO_4$	4
1.447$^{20°}$	−102	3.5	s.	.....	s. a., et.	5
1.448$^{20°}$	−9.3	21.3	d.	.....	s. HNO_3, H_2SO_4, chl., CS_2	6
1.63$^{18°}$	30	47	s.	forms HNO_3	.....	7
>1.0	−55.5	−2	d.	.....	.....	8
1.417$^{-12°}$ 2.31 (A)	−64.5	−5.5	d.	.....	s. fuming H_2SO_4	9
1.68 (A)	−134	−56	d.	.....	.....	10
.....	expl. 200	.....	i.	d. 150°	s. HNO_3, CS_2; i. abs. alc., et.	11
2.22$^{15°}$	178	subl. 135	i.	d.	s. chl., CS_2; sl. s. alc., et.	12
1.901 $^{1\frac{1}{2}°}_{4}$	11	d.	i.	.....	s. CS_2; sl. s. alc., et.	13
2.637	−40	32d.	d.	.....	.....	14
liq. 1.32$^{14°}$	<−30	5	d.	.....	.....	15
2.24 (A)	−139	−63.5	d.	.....	d. alc., et.	16
22.48$^{20°}$	2700	>5300	i.	i.	sl. s. aq. reg., HNO_3; i. NH_3	17
.....	.....	.....	v. s.	d.	v. s. alc.; i. et.	18
.....	.....	.....	s. d.	.....	s. NaCl, alc., et.	19
.....	d. 560-600	.....	sl. s.	.....	s. a., alk., alc.; sl. s. et.	20
.....	.....	.....	s. d.	.....	s. HCl, alc.	21
.....	.....	.....	i.	i.	i. a.	22
7.91	.....	.....	i.	i.	i. a.	23
.....	.....	.....	i.	i.	i. a.	24
4.91	39-40	134-8	5.88$^{15°}$	.....	s. alc. d.	25
.....	−6 H_2O, 150	.....	v. s.	.....	v. s. alc.; i. et.	26
.....	d.	.....	sl. s.	.....	i. HCl, alc.	27
.....	.....	.....	sl. s.	.....	i. alk.	28
.....	d.	.....	i.	.....	s. dil. HNO_3; i. alk.	29
.....	d. in air	.....	i.	.....	s. dil. HCl	30
1.426$^{-252.5°}$ 1.14$^{-183°}$ 1.1053 (A)	−218.4	−183	4.89°c.c.	2.63$^{0°}$c.c. 1.71$^{100°}$c.c.	sl. s. alc.; s. fused Ag	31
1.71$^{-183°}$ 3.03$^{-80°}$ 1.658 (A)	−251	−112	0.88$^{1°}$ c.c.	0$^{60°}$	s. oil turp., oil cinn.	32
12.0$^{20°}$ 11$^{1550°}$	1555	2200	i.	i.	s. aq. reg., h. H_2SO_4; i. NH_3	33
.....	.....	.....	i.	i.	s. HBr	34
.....	500 d.	.....	s.	s.	s. HCl, act.	35
.....	.....	.....	s.	s.	s. HCl, act.	36
.....	d.	.....	i.	i.	s. HCN, KCN, NH_4OH; i. dil. a.	37
.....	.....	.....	sl. s.	.....	s. HF	38

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Palladium** hydride	Pd_2H	214.41	metallic
2	hydroxide	$Pd(OH)_2$	140.72	brown
3	iodide	PdI_2	360.54	black
4	nitrate	$Pd(NO_3)_2$	230.72	yellow-brown, deliq., rhombic
5	oxide, sub-	Pd_2O	229.40	black
6	oxide, mono-	PdO	122.70	black
7	oxide, di-	PdO_2	138.70	black
8	selenide	$PdSe$	185.66	dark gray
9	silicide	$PdSi$	134.76	.....
10	sulfate	$PdSO_4 \cdot 2H_2O$	238.79	deliq., brown
11	sulfide, sub-	Pd_2S	245.46	gray
12	sulfide, mono-	PdS	138.76	black
13	sulfide, di-	PdS_2	170.82	brown
14	**Palladous** diammonium chloride	$PdCl_2 \cdot 2NH_3$	211.68	red or yellow, tetrag.
15	diammonium hydroxide	$Pd(OH)_2 \cdot 2NH_3$	174.78	crystalline
16	**Perchloric acid**	$HClO_4$	100.46	unstable, colorl. liq.
17	**Perchloric acid**	$HClO_4 \cdot H_2O$	118.48	fairly stable needles
18	**Perchloric acid**	$HClO_4 \cdot 2H_2O$	136.50	stable liq., colorl.
19	**Periodic acid**	HIO_4	191.93	white crysts.
20	**Periodic acid**	$HIO_4 \cdot 2H_2O$	227.96	deliq., monocl.?
21	**Permanganic acid**	$HMnO_4$	119.94	exists only in soln.
22	**Permolybdic acid**	$HMoO_4 \cdot 2H_2O$	196.99	white crysts.
23	**Persulfuric acid**	$H_2S_2O_8$	194.14	hyg. cryst.
24	**Phosphamic acid**	$PONH_2 \cdot (OH)_2$	97.02	cubic
25	**Phosphatomolybdic acid**	$H_7P(Mo_2O_7)_6 \cdot 28H_2O$	2365.88	yellow, cubic
26	**Phosphine**	PH_3	34.00	colorl. gas
27	**Phosphine**	$(PH_2)_2$	65.99	liquid
28	**Phosphine**	$(P_4H_2)_3$	377.81	yellow solid
29	**Phosphonium bromide**	PH_4Br	114.93	gas or colorl., cubic
30	chloride	PH_4Cl	70.47	white, cubic
31	iodide	PH_4I	161.93	transparent, tetrag.
32	sulfate	$(PH_4)_2SO_4$	166.08	white crysts.
33	**Phosphoric acid**, hypo-	$H_4P_2O_6$	161.99	crystalline
34	**Phosphoric acid**, meta-	HPO_3	79.99	vitreous, deliq.
35	**Phosphoric acid**, ortho-	H_3PO_4	98.00	transparent, rhombic
36	**Phosphoric acid**, pyro-	$H_4P_2O_7$	177.99	white needles
37	**Phosphorous acid**, hypo-	H_3PO_2	66.00	syrupy
38	**Phosphorous acid**, ortho-	H_3PO_3	82.00	colorl.
39	**Phosphorous acid**, pyro-	$H_4P_2O_5$	145.99	needles
40	**Phosphorus**, black	P_4	123.92	rhombdrl.
41	**Phosphorus**, red	P_4	123.92	red, cubic

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
11.06	d.	.....	.....	.....	.....	1
.....	.....	.....	i.	i.	i. a., alk., NH_4Cl; i. $Na_2B_4O_7$	2
.....	d. 350	.....	i.	i.	s. excess KI; i. dil. HCl alc., et.	3
.....	d.	.....	s. d.	.....	s. HNO_3	4
.....	d.	.....	i.	.....	i. a.	5
.....	d. 877	.....	i.	.....	sl. s. h. a.	6
.....	-O, 200	.....	i.	i.	v. sl. s. a.	7
.....	<960	.....	i.	.....	.....	8
$7.31^{15°}$	.....	.....	i.	.....	.....	9
.....	.....	.....	v. s.	d.	.....	10
7.3	800 d.	.....	i.	i.	sl. s. aq. reg.; i. a.	11
.....	950	.....	i.	i.	s. HCl; i. $(NH_4)_2S$	12
.....	d.	.....	i.	i.	s. aq. reg.; d. HNO_3	13
2.5	.....	.....	s.	.....	s. a., NH_4OH	14
.....	d. <100	.....	s.	d.	.....	15
$1.768^{0}_{4}{}^{20°}$	-112	161^{18mm}	s.	.....	.....	16
1.88	50	d.	s.	.....	.....	17
$1.71^{25°}_{4}$	-17.8	200	v. s.	.....	s. alc	18
.....	d. 138	subl. 110	s.	.....	.....	19
.....	d. 110	.....	v. s.	v. s.	sl. s. alc., et.	20
.....	.....	.....	v. s.	d.	d. alc.	21
.....	.....	.....	v. s.	v. s.	.....	22
.....	<60	.....	v. s.	d.	.....	23
.....	d.	.....	v. s.	v. s. d.	i. alc.	24
.....	78	$-25H_2O$, 140	s.	.....	s. HNO_3	25
liq. $0.746^{-90°}$ 1.146 (A)	-132.5	-85	$26^{17°}$ c.c.	$i.^{100°}$	s. Cu_2Cl_2, alc., et.	26
1.012	<-10	57-58	i.	.....	s. alc., turpentine	27
$1.83^{19°}$	.....	ign. 200	i.	i.	s. P, P_2H_4; i. alc.	28
1.906 (A)	.....	30 d.	d.	.....	d. $COCl_2$	29
.....	28^{46atm}	subl.	d.	.....	.....	30
2.86	.....	80	d.	.....	d. alc.	31
.....	.....	.....	d.	.....	.....	32
.....	55	d. 70	s.	.....	.....	33
2.2-2.5	subl.	.....	s.	forms H_3PO_4	i. liq. CO_2	34
$1.834^{18.2°}$	42.35	$-\frac{1}{2}H_2O$, 213	$2340^{26°}$	v. s.	s. alc.	35
.....	61	.....	v. s.	forms H_3PO_4	v. s. alc., et.	36
$1.493^{18.8°}$	26.5	d.	∞	∞	.....	37
$1.651^{21.2°}$	74	d. 200	$307.3^{0°}$	$730^{40°}$	.....	38
.....	38	d. 130	d.	.....	.....	39
2.69	.....	ign. in air, 400	i.	i.	i. CS_2	40
$2.20^{20°}$	590^{43atm}	ign in air, 725	i.	i.	s. aq. alk.; i. CS_2, NH_3, et.	41

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Phosphorus**, yellow	P_4	123.92	yellow, hex.
2	**Phosphorus** arsenide	PAs	105.89	.....
3	bromide, tri-	PBr_3	270.73	colorl., fuming liq.
4	bromide, penta-	PBr_5	430.56	yellow, rhombic
5	bromofluoride	PBr_2F_3	247.81	brown liq.
6	bromonitride	PBr_2N	204.82	colorl., rhombic prisms
7	bromodichloride, hepta-	PBr_7Cl_2	661.31	orange crysts.
8	bromotrichloride, di-	PBr_2Cl_3	297.18	brown needles
9	bromotrichloride, octa-	PBr_8Cl_3	776.68	yellow crysts.
10	bromotetrachloride, mono-	$PBrCl_4$	252.72	colorl., fuming liq.
11	chloride, tri-	PCl_3	137.35	deliq., tetrag.
12	chloride, penta-	PCl_5	208.27	colorl. gas
13	chlorofluoride	PCl_2F_3	158.89	colorl. gas
14	fluoride, tri-	PF_3	87.98	colorl. gas
15	fluoride, penta-	PF_5	125.98	.....
16	hydride cf. phosphine	.....	.....	orange, tricl.
17	iodide, di-	P_2I_4	569.64	red, deliq., hex.
18	iodide, tri-	PI_3	411.74	red, hex.
19	iodochloride	PI_2Cl_3	391.19	white, amorph.
20	nitride	P_3N_5	162.98	white, deliq., monocl.
21	oxide, tri-	P_2O_3	109.96	white, deliq., rhombic ?
22	oxide, tetra-	P_2O_4	125.96	white, deliq., amorph.
23	oxide, penta- (phosphoric anhydride)	P_2O_5	141.96	colorl. plates
24	oxybromide	$POBr_3$	286.73	tablets or yellow liq.
25	oxybromodichloride	$POBrCl_2$	197.81	colorl., fuming liq.
26	oxychloride	$POCl_3$	153.35	gas
27	oxyfluoride	POF_3	103.98	red crysts.
28	oxyiodide	$P_3O_8I_6$	982.46	white, amorph.
29	oxynitride	PON	60.99	red
30	selenide, mono-	P_2Se	140.92	red needles
31	selenide, penta-	P_2Se_5	456.76	yellow liq.
32	selenide, sub-	P_4Se	202.88	dark red
33	selenide, tri-	P_2Se_3	298.84	yellow, rhombic
34	sulfide, sesqui-	P_4S_3	220.10	yellow needles
35	sulfide, di-	P_2S_6	285.30	gray-yellow
36	sulfide, tri-	P_4S_6	316.28	yellow, deliq.
37	sulfide, penta-	P_2S_5	222.26	colorl., deliq., tetrag.
38	sulfoxide	$P_4S_4O_6$	348.16	amorph. yellow or white
39	thioamide	$PS(NH_2)_3$	111.11	colorl. or yellow liq.
40	thiobromochloride	$PSBrCl_2$	213.87	yellow, cubic
41	thiobromide	$PSBr_3$	302.79	colorl., deliq.
42	thiochloride	$PSCl_3$	169.41	liquid
43	thiocyanate	$P(CNS)_3$	205.21	

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
$1.82^{20°}$ liq. $1.745^{44.5°}$	44.1	280	0.0003	sl. s.	0.4 alc., 1000 CS_2, 1.5^{00}, $10^{81°}$ bz.; s. NH_3	1
.....	subl. d.	.....	d.	.....	s. CS_2; i. alc., et.; d. HNO_3	2
$2.852\frac{1.5}{4}^{0°}$	−40	$175.3^{760.2mm}$	d.	.....	s. CS_2, et., chl.; d. al.	3
.....	<100	106 d.	d.	.....	d. al.	4
.....	−20	d. 15°	d.	.....	attacks glass	5
.....	190	.....	i.	.....	s. et.; sl. s. chl., CS_2	6
.....	.....	.....	d.	.....	s. PCl_3	7
.....	d. 35	.....	d.	.....	d. ac. a.	8
.....	25	.....	d.	.....	s. CS_2	9
.....	.....	.....	d.	.....	.....	10
$1.574\frac{20.5°}{4}$	−111.8	75.95^{760mm}	d.	.....	s. et., chl., CS_2	11
solid 1.6 $3.60^{295°}$ (A)	148 under press.	subl. 160	d.	.....	s. CS_2, C_6H_5COCl	12
5.4 (A)	.....	−8	d.	.....	s. d. alc.	13
3.022 (A)	−160	−151.5	−101.2	.....	s. alc., d. alk.	14
4.49 (A)	−83	−75	d.	.....	d. alk.	15
.....	.....	.....	.....	.....	.....	16
.....	110	.....	d.	.....	s. CS_2, d. AgCl	17
.....	61	d.	d.	.....	v. s. CS_2	18
.....	d. 259	.....	d.	.....	s. CS_2	19
$2.51^{18°}$	d.	.....	i.	v. sl. s.d.	i. any solvent	20
$2.135\frac{21°}{4}$	22.5	173.1^{760mm}	forms H_3PO_4	.....	s. CS_2, et., chl.	21
$2.537\frac{23.6°}{4}$	>100	180	s.	d. forms H_3PO_3	.....	22
2.387	subl. 250	.....	forms H_3PO_4	v. s.	s. H_2SO_4; i. NH_3, act.	23
2.822	56	189.5^{774mm}	d.	.....	s. et., bz., CS_2, H_2SO_4	24
liq. $2.104^{14°}$	13	137.6	d.	.....	.....	25
1.675	2	107.2^{760mm}	d.	.....	d. alc.	26
3.69 (A)	−68	−40	d.	.....	d. alc.	27
.....	140	d.	s.	.....	s. alc., et.	28
.....	red heat	.....	i.	i.	i. a., alk.	29
.....	.....	.....	d.	.....	v. s. CS_2; i. alc., et.	30
.....	burns in air	.....	d.	.....	s. CCl_4; i. CS_2	31
.....	−7	ign.	d.	.....	s. CS_2; i. et.; d. alc.	32
.....	d.	.....	.....	d.	s. KOH; i. CS_2	33
$2.03^{17°}$	172.5	408^{760mm}	i.	d.	60 CS_2; s. bz., PCl_3	34
.....	298	$337^{10.5mm}$	.....	.....	v. sl. s. CS_2	35
.....	290	490	d.	.....	s. alk., alc., et.; v. sl. s. CS_2	36
2.03	276	530	d.	.....	0.22 CS_2; s. alk.	37
.....	102	295	d.	.....	50 CS_2	38
$1.7^{13°}$	d. 200	.....	sl. s.	d.	sl. s. alc., et., CS_2	39
$2.12^{0°}$	−30	d. 150	d.	.....	.....	40
$2.85^{17°}$	38	d. 175	d.	.....	s. et., CS_2, PBr_3, PCl_3	41
1.636	−36.2 (−40.8)	125	d.	.....	s. bz., CS_2, CCl_4	42
$1.625^{18°}$	<−20	265	d.	.....	s. alc., et., bz., CS_2	43

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Phosphorus** thiofluoride	PSF_3	120.04	colorl. gas
2	**Phosphotungstic acid**	$P_2O_5 \cdot 12WO_3 \cdot 42H_2O$	3681.67	yellow-green crysts.
3	**Platinic acid,** bromo-	$H_2PtBr_6 \cdot 9H_2O$	838.89	red, deliq. monocl.
4	**Platinic acid,** chloro-	$H_2PtCl_6 \cdot 6H_2O$	518.08	red-brown, deliq.
5	**Platinic acid,** iodo-	$H_2PtI_6 \cdot 9H_2O$	1120.91	brown, deliq., monocl.
6	**Platinum**	Pt	195.23	silvery metal, cubic
7	bromide (ous)	$PtBr_2$	355.06	brown
8	bromide (ic)	$PtBr_4$	514.89	dark brown
9	chloride (ous)	$PtCl_2$	266.14	brown
10	chloride (ic)	$PtCl_4$	337.06	brown
11	chloride (ic)	$PtCl_4 \cdot 8H_2O$	481.19	red monocl.
12	cyanide	$Pt(CN)_2$	247.27	yellow-brown
13	fluoride (ic)	PtF_4	271.23	brown, deliq.
14	hydroxide (ous)	$Pt(OH)_2$	229.25	black
15	hydroxide (ous)	$Pt(OH)_2 \cdot 2H_2O$	265.28	yellow
16	hydroxide (ic)	$Pt(OH)_4$	263.26	red-brown
17	iodide (ous)	PtI_2	449.07	black
18	iodide (ic)	PtI_4	702.91	brown-black, amorph.
19	oxide (ic)	PtO_2	227.23	black
20	oxide (ic)	$PtO_2 \cdot H_2O$	245.25	black
21	oxide (ic)	$PtO_2 \cdot 2H_2O$	263.26	brown
22	oxide (ic)	$PtO_2 \cdot 3H_2O$	281.28	ochre
23	oxide (ic)	$PtO_2 \cdot 4H_2O$	299.29	yellow needles
24	oxide (ous)	PtO	211.23	violet-black
25	oxide (ous-ic), (platino-platinic)	Pt_3O_4	649.69	black
26	pyrophosphate	PtP_2O_7	369.19	grn.-yellow
27	silicide	PtSi	223.29	. . . . .
28	sulfate	$Pt(SO_4)_2 \cdot 4H_2O$	459.41	yellow plates
29	sulfide (ic)	PtS_2	259.35	black or gray needles
30	sulfide (ous) (cooperite)	PtS	227.29	black, tetrag.
31	sulfide, sesqui-	Pt_2S_3	486.64	gray
32	**Potassium**	K	39.10	silvery metal; cubic
33	acetate	$KC_2H_3O_2$	98.14	white powder
34	acetate, acid	$KH(C_2H_3O_2)_2$	158.19	deliq. needles or plates
35	aluminate	$K_2(AlO_2)_2 \cdot 3H_2O$	250.18	crysts.
36	aluminum silicate (muscovite)	$K_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 2H_2O$	796.40	monoclinic
37	aluminum silicate (orthoclase)	$K_2O \cdot Al_2O_3 \cdot 6SiO_2$	556.49	colorl., monocl.
38	amide	KNH_2	55.12	yellow-green
39	antimonate, meta-	$KSbO_3$	208.86	colorl. cryst.
40	antimonide	K_3Sb	239.05	yellow-green
41	antimonyl tartrate (tartar emetic)	$KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$	333.94	colorl., rhombic

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	−148.8	−52.3	d.	.....	sl. s. et.; i. bz., CS_2	1
.....	.....	.....	s.	.....	s. alc. et.	2
.....	<100 d.	.....	v. s.	v .s.	v. s. alc., et., chl.	3
2.431	60	.....	v. s.	v. s.	s. alc., et.	4
.....	.....	.....	s. d.	.....	.....	5
$21.45^{20°}$ liq. $19^{1755°}$	1755	4300	i.	i.	s. aq. reg., fused alk.	6
.....	d. 300	.....	i.	i.	s. HBr; sl. s. KBr	7
.....	d. 180	.....	$0.41^{20°}$	sl. s.	s. HBr; sl. s. alc.	8
$5.87^{9°}$	d. 581	.....	i.	i.	s. HCl, NH_4OH; sl.s. NH_3; i. alc., et.	9
.....	d. 370	.....	v. s.	v. s.	s. alc., act.; sl. s. NH_3; i. et.	10
2.43	$-4H_2O$, 100	.....	v. s.	v. s.	s. alc., et.	11
.....	.....	.....	i.	i.	i. alk.	12
.....	d.	.....	s. d.	.....	.....	13
.....	d.	.....	i.	i.	s. HCl, HBr, alk.	14
.....	$-2H_2O$, 100	.....	i.	i.	s. a., alk.	15
.....	d.	.....	i.	i.	s. aq. reg., HCl	16
.....	d. 325	.....	i.	i.	sl. s. Na_2SO_3; i. a., alc., act.	17
.....	d. 100	.....	i.	.....	v. s. NH_3; s. HI, KI, alk.	18
.....	430	.....	i.	i.	i. aq. reg., a.	19
.....	$-H_2O$, 100	.....	i.	i.	s. NaOH; i. ac. a.	20
.....	$-2H_2O$,100	.....	i.	i.	s. NaOH; i. ac. a.	21
.....	d. 300	.....	i.	i.	i. aq. reg., a.	22
.....	d.	.....	i.	i.	i. a.	23
.....	555	.....	i.	i.	s. HCl, H_2SO_3	24
.....	d.	.....	i.	i.	i. aq. reg., a.	25
$4.856^{\frac{3}{4}0°}$	d. >600	.....	v. sl. s.	.....	.....	26
$11.63^{\frac{1}{4}0°}$	1100	.....	i.	i.	s. aq. reg., i. a.	27
.....	.....	.....	s.	d.	s. a., alc., et.	28
5.27	d.	.....	i.	i.	s. aq. reg., $(NH_4)_2S$	29
8.897	d.	.....	i.	i.	s aq. reg., $(NH_4)_2S$; i.a.	30
5.52	d.	.....	i.	.....	slowly s. aq. reg.; i. a.	31
$0.86^{20°}$ liq. $0.83^{62°}$	62.3	760	d.	forms KOH	s. a., alc., Hg.	32
1.8	292	.....	$216.7^{0°}$	$396^{90°}$	33 alc.; i. et.	33
.....	148	d. 200	d.	.....	s. ac. a.	34
.....	.....	.....	v. s.	d.	s. alk.; i. alc.	35
2.9	d.	.....	i.	.....	.....	36
2.56	1170 d.	.....	i.	.....	.....	37
.....	338	subl. 400	d.	.....	d. alc.	38
.....	.....	.....	i.	sl. s.	s. h. KOH; i. CS_2	39
.....	812	.....	d.	.....	d. in air	40
2.607	$-\frac{1}{2}H_2O$, 100	.....	$5^{8°}$	$52^{100°}$	i. alc.	41

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Potassium** arsenate (tribasic)	K_3AsO_4	256.20	deliq. crysts.
2	arsenate (dibasic)	$K_2HAsO_4 \cdot H_2O$	236.13	trigonal
3	arsenate (monobasic)	KH_2AsO_4	180.02	colorl., tetrag.
4	arsenite, meta-	$KAsO_2$	146.01	white powder
5	arsenite, acid	$KH(AsO_2)_2 \cdot H_2O$	271.94	.....
6	aurate	$KAuO_2 \cdot 3H_2O$	322.34	yellow needles
7	auricyanide	$KAu(CN)_4 \cdot 1\frac{1}{2}H_2O$	367.39	plates
8	aurocyanide	$KAu(CN)_2$	288.33	rhombic
9	azide	KN_3	81.12	tetrag.
10	benzoate	$KC_7H_5O_2 \cdot 3H_2O$	214.25	white powder
11	borate, meta-	$K_2B_2O_4$	163.83	monoclinic
12	borate, tetra-	$K_2B_4O_7 \cdot 5H_2O$	323.55	white, hex.
13	borofluoride (fluoborate)	KBF_4	125.92	colorl., cubic or rhombic
14	borotartrate	$KC_4H_4BO_7$	213.99	white crysts.
15	bromate	$KBrO_3$	167.01	trigonal
16	bromide	KBr	119.01	colorl., cubic
17	bromoaurate	$KAuBr_4$	555.96	monoclinic
18	bromoaurate	$KAuBr_4 \cdot 2H_2O$	591.99	dark brown, rhombic
19	bromoplatinate	K_2PtBr_6	752.92	red, cubic
20	bromoplatinite	K_2PtBr_4	593.09	brown, rhombic
21	carbonate	K_2CO_3	138.20	white deliq., powder
22	carbonate	$K_2CO_3 \cdot 2H_2O$	174.23	rhombic
23	carbonate (trihydrate)	$2K_2CO_3 \cdot 3H_2O$	330.45	monoclinic
24	carbonate, acid (bicarbonate)	$KHCO_3$	100.11	monoclinic
25	chlorate	$KClO_3$	122.56	colorl., monocl.
26	chloride (sylvite)	KCl	74.56	colorl., cubic
27	chloroaurate	$KAuCl_4$	378.12	yellow, monocl.
28	chlorochromate	$KOClCrO_2$	174.56	red, monocl.
29	chloroiridate	K_2IrCl_6	484.03	black, cubic
30	chloropalladate	K_2PdCl_6	397.63	red, cubic
31	chloropalladite	K_2PdCl_4	326.72	yellow, cubic
32	chloroplatinate	K_2PtCl_6	486.16	yellow, cubic
33	chloroplatinite	K_2PtCl_4	415.25	red-brown, tetrag.
34	chlororhodite	$K_3RhCl_6 \cdot 3H_2O$	486.99	red, tricl.
35	chlorostannate	K_2SnCl_6	409.63	colorl., cubic
36	chromate (tarapacaite)	K_2CrO_4	194.20	yellow, rhombic
37	citrate	$K_3C_6H_5O_7 \cdot H_2O$	324.40	colorl., crysts.
38	cobalticyanide	$K_3Co(CN)_6$	332.34	yellow, monocl.
39	cobaltinitrite	$2Co(NO_2)_3 \cdot 6KNO_2 \cdot 3H_2O$	958.60	yellow, tetrag.
40	cobaltocyanide	$K_4Co(CN)_6$	371.43	violet
41	cobaltosulfate	$K_2Co(SO_4)_2 \cdot 6H_2O$	437.35	monocl., plates
42	cyanate	$KCNO$	81.11	white, tetrag.
43	cyanide	KCN	65.11	cubic, white, deliq.
44	dichromate	$K_2Cr_2O_7$	294.21	red, tricl.
45	ferricyanide	$K_3Fe(CN)_6$	329.25	red, monocl. prisms
46	ferric oxalate	$KFe(C_2O_4)_2 \cdot 2\frac{1}{2}H_2O$	316.03	olive brown
47	ferric oxalate	$K_3Fe(C_2O_4)_3 \cdot 3H_2O$	491.25	monoclinic
48	ferrocyanide	$K_4Fe(CN)_6 \cdot 3H_2O$	422.39	yellow, monocl.
49	fluoride	KF	58.10	colorl., cubic
50	fluoride	$KF \cdot 2H_2O$	94.13	monocl. prisms

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	.....	.....	v. s.	v. s.	4 alc.	1
.....	$-H_2O$, 110	.....	s.	.....	.....	2
2.867	288	.....	18.87$^{6°}$	v. s.	i. alc.	3
.....	.....	.....	s.	.....	sl. s. alc.	4
.....	.....	.....	s.	.....	sl. s. alc.	5
.....	d.	.....	v. s.	d.	s. alc.	6
.....	d. 200	.....	s.	v. s.	s. alc.	7
.....	.....	.....	14.3	200$^{100°}$	sl. s. alc.; i. et.	8
.....	.....	.....	46.5$^{10.5°}$	.....	0.1375$^{16°}$ alc.	9
.....	$-3H_2O$, 110	.....	124$^{17.5°}$	161$^{50°}$	s. alc.	10
.....	947	.....	14.7$^{0°}$	v. s.	....	11
1.74 (anhyd.)	d.	.....	v. s.	v. s.	.....	12
2.50	500 d.	.....	1.42	6.27$^{100°}$	s. alk.; i. c. alc.	13
1.832	.....	.....	sl. s.	.....	.....	14
3.27$^{17.5°}$	370 d.	.....	3.11$^{0°}$	49.75$^{100°}$	sl. s. alc.; i. act.	15
2.75$^{25°}$	730	1380	53.5$^{0°}$	104$^{100°}$	sl. s. alc., et.	16
.....	d.	.....	s.	.....	s. alc.	17
.....	.....	.....	19.5$^{15°}$	204$^{67°}$	s. KBr; d. et.	18
4.66$^{\frac{3}{4}4°}$	>400 d.	.....	2.07$^{10°}$	10$^{100°}$	i. alc.	19
.....	.....	.....	v. s.	v. s.	.....	20
2.29	891	d.	105.5$^{9°}$	156$^{100°}$	i. alc.	21
2.043	.....	.....	183$^{0°}$	331$^{100°}$	.....	22
2.13	.....	.....	129.40$^{0°}$	268$^{100°}$	.....	23
2.17	d. 100-200	.....	22.40$^{0°}$	60$^{60°}$	i. satd. K_2CO_3; i. alc.	24
2.32	368	d. 400	3.3$^{0°}$	57$^{100°}$	0.83 alc.; s. alk.	25
1.988	790	1500	27.6$^{0°}$	56.7$^{100°}$	s. alc., alk.	26
.....	357	.....	27.7$^{10°}$	80.2$^{60°}$	25, 98% alc.	27
2.497$^{39°}$	d.	.....	s. d.	.....	s. a., act.	28
3.546	d.	.....	1.25$^{19°}$	6.67$^{100°}$	i. alc., KCl, NH_3	29
2.738	d.	.....	sl. s.	d.	sl. s. HCl; i. alc.	30
2.67	d.	.....	s.	v. s.	s. NH_4OH, KCl; i. alc.	31
3.499	d.250	.....	0.74$^{0°}$	5.2$^{100°}$	i. alc., et.	32
3.30	.....	.....	16.6	s.	i. alc.	33
3.3	d.	.....	sl. s.	d.	i. alc.	34
2.70	d.	.....	s.	.....	.....	35
2.732$^{18°}$	975	.....	58.0$^{0°}$	75.6$^{100°}$	i. alc.	36
1.98	d.230	.....	167$^{15°}$	199.7$^{31°}$	sl. s. alc.	37
1.906	d.	.....	v. s.	v. s.	i. alc.	38
.....	d. 200	.....	0.09$^{0°}$	sl. s.	i. alc., et.	39
.....	.....	.....	s.	.....	i. alc., et.	40
2.218	.....	.....	25.4$^{0°}$	108.4$^{49°}$	.....	41
2.048	.....	.....	s.	d.	v. sl. s. alc.	42
1.52$^{16°}$	634.5	.....	s.	122.2$^{103.3°}$	s. gly.; 0.9$^{19.5°}$ alc.; 1.3 h. alc.	43
2.69	398	d.	4.9$^{0°}$	80$^{100°}$	i. alc.	44
1.84	d.	.....	334.4$^{0°}$	77.5$^{100°}$	s act.; sl. s. alc.; i. NH_3	45
.....	d.	.....	92$^{21°}$	d.	.....	46
.....	$-3H_2O$, 100	d. 230	4.7$^{0°}$	117.7$^{100°}$	i. alc.	47
1.853$^{17°}$	$-3H_2O$, 70	.....	27.8$^{12.2°}$	90.6$^{96.3°}$	s. act.; i. NH_3, alc., et.	48
2.48	880	1500	92.3$^{18°}$	v. s.	s. HF; i. alc.	49
2.454	41	.....	v. s.	v. s.	s. HF; i. alc.	50

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Potassium** fluoride, acid	KHF_2	78.10	colorl., cubic
2	fluogermanate	K_2GeF_6	264.79	white, hex.
3	fluohafniate	K_2HfF_6	370.79	monoclinic
4	fluosilicate (hieratite)	K_2SiF_6	220.25	colorl., cubic or hex.
5	fluostannate	$K_2SnF_6 \cdot H_2O$	328.91	white, monocl.
6	fluotitanate	$K_2TiF_6 \cdot H_2O$	258.11	white, monocl.
7	fluozirconate	K_2ZrF_6	283.41	colorl., monocl.
8	formate	$KHCO_2$	84.11	colorl., rhombic
9	hydride	KH	40.10	crysts.
10	hydrosulfide (sulfhydrate)	KHS	72.16	white, deliq., rhombic
11	hydroxide	KOH	56.10	white, deliq., rhombic
12	hypochlorite	KClO	90.55	exists only in soln.
13	hypophosphite	KH_2PO_2	104.09	deliq., hex.
14	iodate	KIO_3	214.02	colorl., monocl.
15	iodate, acid	$KH(IO_3)_2$	389.94	rhombic or monocl.
16	iodide	KI	166.02	white, cubic
17	iodide, tri-	KI_3	419.86	dark blue, deliq., monocl.
18	iodobromide	$KBr \cdot IBr$	325.85	rhombic
19	iodochloride	$KICl_2$	236.93	monoclinic
20	iodochloride	$KCl \cdot ICl_3$	307.84	yellow, monocl.
21	iodoiridite	K_3IrI_6	1071.91	green crysts.
22	iodoplatinate	K_2PtI_6	1034.94	cubic
23	magnesium chloride (carnallite)	$MgCl_2 \cdot KCl \cdot 6H_2O$	277.88	deliq., rhombic
24	manganate	K_2MnO_4	197.12	green, rhombic
25	manganicyanide	$K_3Mn(CN)_6$	328.33	monocl., red
26	manganocyanide	$K_4Mn(CN)_6 \cdot 3H_2O$	421.47	blue
27	molybdate	K_2MoO_4	238.14	white powder, deliq.
28	nickel sulfate	$K_2Ni(SO_4)_2 \cdot 6H_2O$	437.10	green, monocl.
29	nitrate (salt peter; niter)	KNO_3	101.10	colorl., rhombic, trig.
30	nitrite	KNO_2	85.10	prisms
31	nitroprusside	$K_2Fe(CN)_5 \cdot NO \cdot 2H_2O$	330.17	red, monocl.
32	osmate	$K_2OsO_4 \cdot 2H_2O$	368.42	violet, cubic
33	osmocyanide	$K_4Os(CN)_6 \cdot 3H_2O$	556.74	colorl., monocl.
34	oxalate	$K_2C_2O_4 \cdot H_2O$	184.23	white, monocl.
35	oxalate, acid	KHC_2O_4	128.12	monoclinic
36	oxalate, acid	$KHC_2O_4 \cdot \frac{1}{2}H_2O$	137.13	trimetric
37	oxalate, tetra-	$KH_3(C_2O_4)_2 \cdot 2H_2O$	254.19	triclinic
38	oxide	K_2O	94.19	white, cubic
39	oxide, per- (see also tetroxide)	K_2O_2	110.19	white, deliq., amorph.
40	perchlorate	$KClO_4$	138.55	colorl., rhombic
41	perchromate	K_3CrO_8	297.30	brown, cubic
42	periodate	KIO_4	230.02	tetrag.
43	permanganate	$KMnO_4$	158.03	purple, rhombic
44	persulfate	$K_2S_2O_8$	270.31	white, tricl.
45	perrhenate	$KReO_4$	289.41	white, tetrag.
46	perruthenate	$KRuO_4 \cdot H_2O$	222.81	black, tetrag.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	d.	.....	$41^{21°}$	.....	s. $KC_2H_3O_2$; i. alc.	1
.....	730	835	$0.542^{18°}$	$2.58^{100°}$	.....	2
.....	.....	.....	.....	.....	37.4[20°] in 1/8 N HF	3
3.08 (hex.) 2.665[17°]	d.	.....	$0.12^{17.5°}$	$0.95^{100°}$	s. HCl; i. alc., NH_3	4
3.053	.....	.....	$6.7^{18°}$*	$43.9^{100°}$	i. alc., NH_3	5
2.992	$-H_2O$, 100	.....	$0.6^{0°}$	$1.3^{20°}$	s. HCl	6
3.58	.....	.....	$0.78^{0°}$	$25^{100°}$	i. NH_3	7
1.91	167.5	d.	$331^{18°}$	$657^{90°}$	sl. s. alc.; i. et.	8
0.80	d.	.....	d.	.....	i. et., bz., CS_2	9
2.0	455	.....	s.	s. d.	s. alc.	10
2.044	380	1320	$97^{0°}$	$178^{100°}$	v. s. alc., et.; i. NH_3	11
.....	d.	.....	v. s.	v. s. d.	.....	12
.....	ign.	.....	v. s.	.....	s. alc.; sl. s. NH_3; i. et.	13
3.89	560	.....	$4.73^{0°}$	$32.2^{100°}$	s. KI; i. alc., NH_3	14
.....	.....	.....	$1.33^{15°}$	.....	i. alc.	15
3.13	723	1330	$127.5^{0°}$	$208^{100°}$	14.3 alc.; s. NH_3; sl. s. et.	16
3.498	45	d. 225	v. s.	.....	s. KI, alc.	17
.....	60	d. 180	d.	.....	.....	18
.....	60	d. 215	d.	.....	.....	19
1.176[45°]	d.	.....	d.	.....	d. et.	20
.....	.....	.....	v. s.	v. s.	i. alc.	21
5.18	.....	.....	s.	.....	.....	22
$1.60^{\frac{1}{4}\gamma_4^{4°}}$	265	.....	$64.5^{18.8°}$	d.	d. alc.	23
.....	d. 190	.....	d.	.....	s. KOH	24
.....	.....	.....	s.	.....	.....	25
.....	.....	.....	s.	.....	.....	26
liq. $2.342^{\frac{8}{4}\gamma_4^{4°}}$	919	.....	$184.6^{25°}$	v. s.	i. alc.	27
2.237	d. <100	.....	$7^{0°}$	$60.87^{50°}$	.....	28
$2.111^{0.6°}$	tr. 129; 333	d.400	$13.3^{0°}$	$246^{100°}$	i. alc., et.	29
1.915	297	d. 350	$281^{0°}$	$413^{100°}$	v. s. NH_3; sl. s. alc.	30
.....	.....	.....	$100^{16°}$	.....	s. alc.	31
.....	$-H_2O$, >100	.....	sl. s.	s.	i. alc., et.	32
.....	d.	.....	sl. s.	s.	i. alc., et.	33
2.13	d.	.....	$28.7^{0°}$	$83.2^{100°}$	.....	34
2.0	d.	.....	$14.3^{50°}$	$48.1^{100°}$	.....	35
.....	d.	.....	$2.2^{0°}$	$51.5^{100°}$	.....	36
1.836	d.	.....	$1.8^{13°}$	.....	.....	37
$2.32^{\frac{4}{4}0°}$	.....	.....	forms KOH	v. s.	s. alc., et.	38
.....	.....	d.	d.	.....	d. alc.	39
$2.524^{\frac{11}{4}1°}$	d. 400	.....	$0.75^{0°}$	$21.8^{100°}$	i. alc., et.	40
.....	d. 170	.....	sl. s.	.....	i. alc., et.	41
3.618	582	-O, 300	$0.66^{13°}$	s.	v. sl. s. KOH	42
2.703	d. <240	.....	$2.83^{0°}$	$32.35^{75°}$	s. H_2SO_4; d. alc.	43
.....	d. <100	.....	$1.77^{0°}$	$10^{40°}$	i. alc.	44
4.887	350	.....	$1.21^{20°}$	s.	v. sl. s. alc.	45
.....	d. 400 (vac.)	.....	sl. s.	.....	.....	46

*Solubility of other modification: $3.7^{18°}$; $33^{100°}$

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Potassium** peruranate	$K_2UO_5 \cdot 3H_2O$	450.31	red crysts.
2	phosphate, ortho-	K_3PO_4	212.27	white, rhombic
3	phosphate, hydrogen	K_2HPO_4	174.18	white, deliq., amorph.
4	phosphate, dihydrogen-	KH_2PO_4	136.09	colorl., deliq., tetrag.
5	phosphate, meta-	KPO_3	118.08	white powder
6	phosphate, meta-	$K_4P_4O_{12} \cdot 2H_2O$	508.34	amorphous
7	phosphate, pyro-	$K_4P_2O_7 \cdot 3H_2O$	384.39	deliquescent
8	phosphite, ortho-	K_2HPO_3	158.18	white powder, deliq.
9	phosphite, hypo-	KH_2PO_2	104.09	wh., deliq., hex.
9.1	phthalate, acid	$KHC_8H_4O_4$	204.22	white crysts.
10	platinate	$K_2PtO_3 \cdot 3H_2O$	375.47	yellow, rhombic
11	platinocyanide	$K_2Pt(CN)_4 \cdot 3H_2O$	431.54	yellow, rhombic
12	platinonitrite	$K_2Pt(NO_2)_4$	457.45	monoclinic
13	plumbate	$K_2PbO_3 \cdot 3H_2O$	387.45	colorl., tetrag. or trig.
14	plumbichloride	K_2PbCl_6	498.14	cubic
15	ruthenate	$K_2RuO_4 \cdot H_2O$	261.91	black, rhombic
16	selenate	K_2SeO_4	221.15	rhombic
17	selenide	K_2Se	157.15	.....
18	selenocyanide	$KSeCN$	144.07	deliquescent
19	selenocyanoplatinate	$K_2Pt(SeCN)_6$	903.29	rhombic
20	silicate	K_2SiO_3	154.25	hygroscopic
21	silicate, tetra-	$K_2Si_4O_9 \cdot H_2O$	352.45	rhombic
22	silver cyanide	$KAg(CN)_2$	199.01	cubic
23	sodium carbonate	$KNaCO_3 \cdot 6H_2O$	230.20	colorl., monocl.
24	sodium cobaltinitrite	$K_2NaCo(NO_2)_6 \cdot H_2O$	454.19	yellow
25	stannate	$K_2SnO_3 \cdot 3H_2O$	298.94	colorl., trig.
26	stannibromide	K_2SnBr_6	676.39	.....
27	sulfate (arcanite)	K_2SO_4	174.25	rhombic, colorl.
28	sulfate, acid (misenite; bisulfate)	$KHSO_4$	136.16	rhombic or monocl.
29	sulfate, pyro-	$K_2S_2O_7$	254.31	colorl.
30	sulfide, mono-	K_2S	110.25	brown, deliq.
31	sulfide, mono-	$K_2S \cdot 5H_2O$	200.33	rhombic
32	sulfide, di-	K_2S_2	142.31	red-yellow
33	sulfide, tri-	K_2S_3	174.37	yellow-brown
34	sulfide, tetra-	K_2S_4	206.43	red-brown
35	sulfide, penta-	K_2S_5	238.49	orange
36	sulfite	$K_2SO_3 \cdot 2H_2O$	194.28	white, rhombic
37	sulfite, acid	$KHSO_3$	120.16	white, monocl.
38	sulfite, pyro- (metabi-)	$K_2S_2O_5$	222.31	monocl. plates
39	tartrate	$K_2C_4H_4O_6 \cdot \frac{1}{2}H_2O$	235.27	colorl., monocl.
40	tartrate, acid	$KHC_4H_4O_6$	188.18	colorl., rhombic
41	tellurate	$K_2TeO_4 \cdot 5H_2O$	359.88	deliq., rhombic
42	tellurite	K_2TeO_3	253.80	white, deliq.
43	tetroxide (peroxide)	K_2O_4	142.19	orange yellow
44	thioantimonate	$2K_3SbS_4 \cdot 9H_2O$	896.72	yellow crysts.
45	thioarsenate	K_3AsS_4	320.44	deliq. crysts.
46	thioarsenite	K_3AsS_3	288.38	.....
47	thiocarbonate	K_2CS_3	186.38	red-brown crysts.
48	thiocyanate	$KCNS$	97.17	colorl., deliq., rhombic

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	d. 100	.....	d.	.....	d. HCl	1
.....	1340	.....	sl. s.	s.	i. alc.	2
.....	d.	.....	v. s.	v. s.	v. s. alc.	3
2.338	96	$-H_2O > 204$	$33^{7°}$	s.	i. alc.	4
$2.258^{14.5°}$	tr. 450; 798	.....	s.	s.	.....	5
$2.264^{14.5°}$	$-2H_2O$, 100	d.	.....	83	s. a.	6
2.33	$-3H_2O$, 300	.....	s.	v. s.	i. alc.	7
.....	d.	.....	v. s.	v. s.	i .alc.	8
.....	d.	.....	v. s.	.....	sl. s. NH_3; i. et.	9
1.63	d.	.....	$10.2^{25°}$	36	.....	9.1
.....	d.	.....	s.	.....	i. alc.	10
$2.45^{16°}$	.....	.....	sl. s.	v. s.	s. alc., et.	11
.....	d.	.....	$3.8^{15°}$	.....	.....	12
.....	d.	.....	d.	.....	s. KOH; d. alc.	13
.....	d. 190	.....	.....	.....	s. h. HCl	14
.....	$-H_2O$, 200	.....	v. s.	.....	.....	15
$3.066^{\frac{8}{4}0°}$	.....	.....	$110.5^{0°}$	$122.2^{100°}$	.....	16
2.851	.....	.....	s.	.....	.....	17
.....	d. 100	.....	s.	s.	s. alc.; d. a.	18
$3.375^{12.5°}$	d. 80	.....	.....	.....	.....	19
.....	976	.....	s.	s.	i. alc.	20
2.417	d. 400	.....	s.	s.	i. alc.	21
.....	.....	.....	$25^{20°}$	100	4, 85% alc.	22
1.633	$-6H_2O$, 100	.....	$133^{12.5°}$	$185^{15°}$	.....	23
$1.633^{\frac{8}{4}0°}$	d. 135	.....	$0.07^{25°}$	.....	i. alc.	24
3.197	$-3H_2O$, 140	.....	$106.7^{10°}$	$110.5^{20°}$	v. sl. s. KOH; i. alc., act.	25
3.783	.....	.....	.....	.....	.....	26
2.662	tr. 588	.....	$7.35^{0°}$	$24.1^{100°}$	i. alc., act., CS_2	27
2.35	210	d.	$36.3^{0°}$	$121.6^{100°}$	d. alc.	28
2.277	300	.....	s.	d.	.....	29
1.805	471	.....	s.	v. s.	s. alc., gly., NH_3; i. et.	30
.....	60	$-3H_2O$, 150	s.	.....	s. alc., gly.; i. et.	31
.....	471	.....	s.	d.	s. alc.	32
.....	252	.....	s.	d.	s. alc.	33
.....	>145	d. 850	s.	.....	s. alc.	34
.....	206	.....	v. s.	v. s.	s. alc.	35
.....	d.	.....	100	>100	sl. s. alc.; i. NH_3	36
.....	d. 190	.....	$45.5^{15°}$	$91.5^{75°}$	i. abs. alc.	37
.....	d. 150	.....	s.	.....	sl. s. alc.; i. et.	38
1.98	.....	d.	$12.5^{17.5°}$	$278^{100°}$	sl. s. alc.	39
1.956	.....	.....	$0.37^{0°}$	$6.1^{100°}$	s. a., alk.; i. alc., ac. a.	40
.....	$-H_2O$, 200	$-O$, 200	$0.32^{0°}$	$6.95^{100°}$	sl. s. KOH; i. alc.	41
.....	$+O$, 470	.....	v. s.	v. s.	.....	42
.....	>280	.....	s. d.	.....	.....	43
.....	.....	.....	s.	.....	i. alc.	44
.....	d.	.....	v. s.	.....	i. alc.	45
.....	d.	.....	s.	.....	i. alc.	46
.....	.....	.....	v. s.	.....	sl. s. alc.	47
1.886	172.3	d. 500	$177^{0°}$	$217^{20°}$	$20.8^{22°}$ act.; s. alc.	48

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Potassium** thionate, di-	$K_2S_2O_6$	238.31	colorl., trig.
2	thionate, tri-	$K_2S_3O_6$	270.37	rhombic
3	thionate, tetra-	$K_2S_4O_6$	302.43	monoclinic
4	thionate, penta-	$2K_2S_5O_6 \cdot 3H_2O$	723.03	colorl., rhombic
5	thioplatinate	$K_2Pt_4S_6$	1051.47	blue-gray crysts.
6	thiostannate	$K_2SnS_3 \cdot 3H_2O$	347.12	dark brown oil
7	thiosulfate	$K_2S_2O_3$	190.31	colorl., cubic
8	thiosulfate	$3K_2S_2O_3 \cdot H_2O$	588.95	deliq., monocl.
9	tungstate, ortho-	$K_2WO_4 \cdot 2H_2O$	362.14	monoclinic
10	tungstate, meta-	$K_2W_4O_{13} \cdot 8H_2O$	1166.00	cubic
11	tungstate, para-	$K_6W_7O_{24} \cdot 6H_2O$	2014.11	rhombic
12	uranate	K_2UO_4	380.26	orange-yellow rhombic
13	xanthogenate	$KS_2COC_2H_5$	160.29	prisms
14	**Praseodymium**	Pr	140.92	yellow
15	ammonium sulfate	$Pr_2(SO_4)_3 \cdot (NH_4)_2SO_4 \cdot 8H_2O$	846.29	crysts.
16	bromate	$Pr_2(BrO_3)_6 \cdot 18H_2O$	1373.62	green, hex.
17	carbide	PrC_2	164.94	yellow crysts.
18	carbonate	$Pr_2(CO_3)_3 \cdot 8H_2O$	606.00	green plates
19	chloride	$PrCl_3$	247.29	green needles
20	chloride	$PrCl_3 \cdot 7H_2O$	373.40	green crysts.
21	oxalate	$Pr_2(C_2O_4)_3 \cdot 10H_2O$	726.06	monocl. prisms
22	oxide, tri-	Pr_2O_3	329.84	yellow-green
23	oxide, tetra-	PrO_4	204.92	black
24	potassium sulfate	$Pr_2(SO_4)_3 \cdot 3K_2SO_4 \cdot H_2O$	1110.82	crysts.
25	selenate	$Pr_2(SeO_4)_3$	710.72	.....
26	sulfate	$Pr_2(SO_4)_3$	570.02	light green
27	sulfate	$Pr_2(SO_4)_3 \cdot 8H_2O$	714.15	green, monocl.
28	sulfide	Pr_2S_3	378.02	brown
29	**Radium**	Ra	226.05	white, metallic
30	bromide	$RaBr_2$	385.88	white, monocl.
31	chloride	$RaCl_2$	296.96	yellow, monocl.
32	**Radon** (niton; radium emanation)	Rn	222.0	gas
33	**Rhenium**	Re	186.31	hexagonal
34	oxide, hepta-	Re_2O_7	484.62	yellow crysts.
35	oxide, tetra-	ReO_4	250.31	white, globules
36	**Rhodium**	Rh	102.91	gray-white, cubic
37	chloride	$RhCl_3$	209.28	red
38	chloride	$RhCl_3 \cdot 4H_2O$	281.35	dark red
39	hydrosulfide	$Rh(SH)_3$	202.11	brown-black
40	hydroxide, tri-	$Rh(OH)_3$	153.93	black, gelatinous
41	hydroxide, tetra-	$Rh(OH)_4$	170.94	green
42	nitrate	$Rh(NO_3)_3 \cdot 2H_2O$	324.97	red, deliq.
43	oxide, mono-	RhO	118.91	gray
44	oxide, di-	RhO_2	134.91	brown
45	oxide, sesqui-	Rh_2O_3	253.82	gray crysts.
46	sulfate	$Rh_2(SO_4)_3 \cdot 12H_2O$	710.19	light yellow crysts.
47	sulfide, mono-	RhS	134.97	blue-white
48	sulfide, sesqui-	Rh_2S_3	302.00	black plates
49	sulfite	$Rh_2(SO_3)_3 \cdot 6H_2O$	554.10	yellow crysts.
50	**Rubidium**	Rb	85.48	silvery white

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
2.278	d.	.....	$6.06^{16°}$	$63.3^{100°}$	i. alc.	1
2.304	.....	.....	v. s.	d.	i. alc.	2
$2.296^{\frac{20°}{4}}$	.....	.....	v. s.	.....	i. alc.	3
$2.112^{\frac{20°}{4}}$	d.	.....	50	d.	i. alc.	4
$6.44^{15°}$	ign.	.....	i.	.....	d. HCl	5
$1.847^{\frac{18°}{4}}$	$-3H_2O$,100	.....	s.	.....	i. alc.	6
.....	d. 400	.....	$96.1^{0°}$	$311.2^{90°}$	.....	7
2.23	$-H_2O$, 180	d.	.....	.....	i. alc.	8
$3.113^{925°}$	tr. 388; 921	tr. 555	51.5	151.5	i. alc.	9
.....	.....	.....	s.	v. s.	.....	10
.....	d.	.....	2.15	$6.6^{100°}$	i. alc.	11
.....	.....	.....	i.	i.	v. s. a.	12
$1.558^{21.5°}$	d. >200	.....	v. s.	.....	20 alc.; i. et.	13
$6.5^{20°}$	940	.....	d.	.....	.....	14
$2.531^{16.5°}$	$-8H_2O$, 170	.....	sl. s.	.....	.....	15
.....	56.5	$-14H_2O$, 100	$190^{25°}$	.....	.....	16
5.10	d.	.....	d.	.....	s. dil. a.	17
.....	$-6H_2O$, 100	.....	i.	.....	s. a.	18
$4.020^{\frac{25°}{4°}}$	823	not volt. 1000	$103.9^{14°}$	$\infty^{100°}$	s. alc.; i. et., chl.	19
$2.251^{16.2°}$	115	.....	$334.2^{14°}$	$\infty^{100°}$	s. HCl	20
.....	.....	.....	$0.098^{25°}$	.....	s. a.	21
$6.87^{25°}$	d.	.....	v. s.	.....	.....	22
$5.978^{\frac{20°}{4}}$	.....	.....	.....	.....	.....	23
$3.275^{16°}$	.....	.....	sl. s.	.....	s. HCl, HNO_3	24
$4.30^{15°}$	.....	.....	s.	.....	.....	25
$3.720^{16°}$	.....	.....	$24.68^{0°}$	$1.02^{95°}$	.....	26
$2.82^{13.2°}$	.....	.....	s.	sl. s.	.....	27
$5.042^{19°}$	d.	.....	i.	d.	s. dil. a.	28
5 ?	960	1140	d. $+H_2$	.....	d. a.	29
5.79	728	subl. 900	s.	s.	s. alc.	30
4.91	1000	.....	s.	s.	.....	31
liq. 5.5 111 (D)	−71	−62	.....	.....	.....	32
.....	3440	.....	.....	.....	i. HF, HCl; s. H_2SO_4, HNO_3	33
$8.2^{20°}$	220	450 subl.	s.	.....	s. alc.; sl. s. et.	34
8.4	150 d.	.....	s.	.....	s. a., alk.; v. sl. s. et.	35
12.5	1955	>2500	i.	i.	sl. s. aq. reg., a.	36
.....	d. 450	subl. 800 ±	i.	i.	v. sl. s. alk.; i. aq. reg., a.	37
.....	.....	.....	v. s.	.....	s. HCl, alc.; i. et.	38
.....	.....	.....	i.	d.	s. aq. Br, aq. reg.; i. a., Na_2S	39
.....	d.	.....	i.	.....	sl. s. HCl	40
.....	d.	.....	i.	.....	s. HCl	41
.....	.....	.....	s.	s.	i. alc.	42
.....	.....	.....	i.	i.	i. a.	43
.....	.....	.....	i.	i.	i. a., alk.	44
.....	d. >1100	.....	i.	i.	i. aq. reg., a., alk.	45
.....	.....	.....	v. s.	d.	i. alc.	46
.....	d.	.....	i.	i.	i. aq. reg., a.	47
.....	d.	.....	i.	i.	i. aq. Br, aq. reg., a.	48
.....	d.	.....	s.	.....	i. alc.	49
liq. $1.475^{28.5°}$ $1.53^{20°}$	38.5	700	d.	.....	s. a., alc.	50

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Rubidium** bromate	$RbBrO_3$	213.40	.....
2	bromide	RbBr	165.40	cubic
3	bromide, tri-	$RbBr_3$	325.23	rhombic
4	carbonate	Rb_2CO_3	230.97	white, deliq.
5	carbonate, bi-	$RbHCO_3$	146.50	white, rhombic
6	chlorate	$RbClO_3$	168.94	trimetric
7	chloride	RbCl	120.94	cubic
8	chloroplatinate	Rb_2PtCl_6	578.93	yellow, cubic
9	chromate	Rb_2CrO_4	286.97	yellow, rhombic
10	dichromate	$Rb_2Cr_2O_7$	386.98	red, tricl. or yellow, monocl.
11	fluoride	RbF	104.48	white, cubic
12	fluosilicate	Rb_2SiF_6	313.02	cubic
13	hydride	RbH	86.49	prismatic needles
14	hydroxide	RbOH	102.49	white, deliq.
15	iodate	$RbIO_3$	260.40	monocl. or cubic
16	iodide	RbI	212.40	colorl., cubic
17	iodide, tri-	RbI_3	466.24	rhombic
18	nitrate	$RbNO_3$	147.49	hex., cubic, rhombic or tricl.
19	oxide, mono-	Rb_2O	186.96	yellow, cubic
20	oxide, di- or per-	Rb_2O_2	202.96	yellow, cubic
21	oxide, tri-	Rb_2O_3	218.96	black
22	oxide, tetra-	Rb_2O_4	234.96	yellow
23	perchlorate	$RbClO_4$	184.94	rhombic
24	periodate	$RbIO_4$	276.40	colorl., tetrag.
25	permanganate	$RbMnO_4$	204.41	crysts.
26	selenate	Rb_2SeO_4	314.16	colorl., rhombic
27	sulfate	Rb_2SO_4	267.02	rhombic
28	sulfide	Rb_2S	203.02	red, deliq.
29	sulfide	$Rb_2S \cdot 4H_2O$	275.08	deliq. crysts.
30	sulfide, penta-	Rb_2S_5	331.26	red, deliq., rhombic
31	tartrate, acid	$RbHC_4H_4O_6$	234.56	rhombic prisms
32	**Ruthenium**	Ru	101.70	black and porous
33	**Ruthenium**	Ru	101.70	gray, hex.
34	chloride, di-	$RuCl_2$	172.61	black crysts.
35	chloride, tri-	$RuCl_3$	208.07	brown, deliq.
36	chloride, tetra-	$RuCl_4$	243.53	.....
37	hydroxide	$Ru(OH)_3$	152.72	black powder
38	nitrate	$Ru(NO_3)_3 \cdot 6H_2O$	395.82	pale yellow, tricl.
39	oxide, di-	RuO_2	133.70	violet, tetrag.
40	oxide, sesqui-	Ru_2O_3	251.40	blue-black
41	oxide, tetra-	RuO_4	165.70	yellow, rhombic
42	oxide, nono-	Ru_4O_9	550.80	black crysts.
43	oxide, penta-	Ru_2O_5	283.40	black crysts.
44	silicide	RuSi	129.76	metallic prisms
45	**Samarium**	Sm (Sa)	150.43	.....
46	acetate	$Sm(C_2H_3O_2)_3 \cdot 4H_2O$	399.63	yellow crysts.
47	bromate	$Sm_2(BrO_3)_6 \cdot 18H_2O$	1392.64	yellow, hex.
48	bromide	$SmBr_3 \cdot 6H_2O$	498.27	yellow, deliq.
49	carbide	SmC_2	174.45	yellow, hex.
50	chloride	$SmCl_3$	256.80	grn.-yel. crysts
51	chloride	$SmCl_3 \cdot 6H_2O$	364.90	green, tricl.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
3.68	430	.....	$2.92^{25°}$	$5.08^{40°}$	.....	1
3.35	682	1340	$98^{5°}$	$205.2^{113.5°}$	sl. s. act.	2
.....	d. 140	.....	.....	.....	.....	3
.....	837	d. 740	$450^{20°}$	s.	0.74 abs. alc.	4
.....	d. 175	.....	v. s.	.....	s. alc.	5
3.19	.....	.....	$2.14^{0°}$	$62.8^{99°}$	.....	6
2.76	715	1390	$77^{0°}$	$138.9^{100°}$	$0.08^{25°}$ alc.; v. sl. s. NH_3	7
$3.94^{17.5°}$	d.	.....	$0.184^{0°}$	$0.634^{100°}$	i. alc.	8
3.518	.....	.....	$62^{0°}$	$95.7^{60°}$	.....	9
3.021 (mon.) 3.125 (tri.)	.....	.....	$5.42^{18°}$ (mon.) $4.96^{18°}$ (tri.)	$28.1^{60°}$ (mon.) $27.3^{60°}$ (tri.)	.....	10
$2.88^{820°}$	760	1410	$130.6^{18°}$	.....	s. dil. HF; i. et., NH_3	11
3.332	.....	.....	$0.16^{20°}$	$1.37^{100°}$	s. a.; i. alc.	12
2.0	d. 300	.....	d.	.....	d. a.	13
$3.203^{11°}$	300	.....	$180^{15°}$	v. s.	s. alc.	14
$4.33^{19.5°}$	d.	.....	$2.1^{23°}$	.....	s. HCl	15
3.55	642	1300	$137.5^{6.9°}$	$152^{17.4°}$	i. $AsBr_3$	16
$4.03^{22°}$	190	.....	v. s.	.....	.....	17
3.11	tr. 161.4, 219; 310	.....	$19.5^{0°}$	$452^{100°}$	v. s. HNO_3; s. act.	18
3.72	d. 400	.....	s. d.	s. d.	.....	19
$3.65^{0°}$	600	.....	d.	.....	.....	20
$3.53^{0°}$	470	.....	d.	.....	.....	21
$3.05^{0°}$	280	-O, 500	d.	.....	.....	22
2.9	.....	d.	$0.59^{18.5°}$	$17.4^{99°}$	i. alc.	23
$3.918^{\frac{1}{4}0°}$	.....	.....	$0.65^{13°}$	.....	.....	24
$3.235^{10.4°}$	d. 295	.....	$0.46^{2°}$	$4.91^{60°}$	.....	25
3.90	.....	.....	$158.9^{12°}$	.....	.....	26
$3.613^{\frac{3}{4}0°}$	1060	.....	$36.4^{0°}$	$81.8^{100°}$	.....	27
2.912	.....	.....	v. s.	v. s.	.....	28
.....	$-4H_2O$, 200	.....	v. s.	v. s.	.....	29
$2.618^{15°}$	225	.....	d.	.....	s. 70% alc.; i. et., chl.	30
2.399	d.	.....	$1.18^{25°}$	$11.7^{100°}$	.....	31
8.6	>1950	.....	i.	i.	sl. s. aq. reg., a.	32
$12.2^{20°}$	2450	>2700	i.	i.	.....	33
.....	.....	.....	i.	.....	i. aq. reg., a., alk.	34
.....	.....	.....	s.	d.	sl. s. abs. alc.; i. a., CS_2	35
.....	.....	.....	s.	.....	s. alc.	36
.....	.....	.....	v. sl. s.	.....	s. a.; i. alk.	37
2.375	.....	.....	v. s.	.....	.....	38
7.2	.....	.....	i.	i.	s. fused KOH; i. a.	39
.....	.....	.....	i.	i.	i. a.	40
$5.77^{100°}$	25.5	100.8^{183mm}	sl. s.	d.	s. alk.	41
.....	-O, 440	.....	i.	.....	s. HCl	42
.....	$-\frac{1}{2}O$, 360	.....	i.	.....	s. HCl	43
5.4	.....	.....	i.	i.	s. $HNO_3 + HF$	44
7.7	>1300	.....	.....	.....	.....	45
1.94	.....	.....	$15^{25°}$	.....	.....	46
.....	75	$-14H_2O$, 100 $-18H_2O$, 150	$114^{25°}$	.....	v. sl. s. alc.	47
$2.971^{22°}$	.....	.....	.....	.....	.....	48
5.86	.....	.....	d.	.....	s. a. d.	49
$4.46^{\frac{1}{4}8°}$	686	.....	v. s.	.....	$6.4 C_5H_5N$; v. s. abs. alc.	50
2.383	.....	.....	s.	.....	.....	51

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Samarium** fluoride	$SmF_3 \cdot \frac{1}{2}H_2O$	216.44	gelatinous
2	formate	$Sm(HCO_2)_3$	285.48	colorl.
3	hydroxide	$Sm(OH)_3$	201.45	pale yellow
4	oxide	Sm_2O_3	348.86	yel.-wh. powd.
5	peroxide	Sm_4O_9 (?)	745.72	.....
6	phosphate	$SmPO_4$	245.41	.....
7	sulfate	$Sm_2(SO_4)_3 \cdot 8H_2O$	733.17	monoclinic
8	sulfide	Sm_2S_3	397.04	yellow
9	**Scandium**	Sc	45.10	.....
10	bromide	$ScBr_3$	284.85	.....
11	chloride	$ScCl_3$	151.47	white plates
12	nitrate	$Sc(NO_3)_3$	231.12	colorless
13	oxide	Sc_2O_3	138.20	white powder
14	sulfate	$Sc_2(SO_4)_3$	378.38	.....
15	**Selenic acid**	H_2SeO_4	144.98	hex. prisms
16	**Selenic acid**	$H_2SeO_4 \cdot H_2O$	162.99	needles
17	**Selenious acid**	H_2SeO_3	128.98	hexagonal
18	**Selenium**	Se_8	631.68	red powder
19	**Selenium**	Se_8	631.68	gray, trig. or red, hex.
20	**Selenium**	Se_8	631.68	steel gray
21	bromide, mono-	Se_2Br_2	317.75	brown-red liq.
22	bromide, tetra-	$SeBr_4$	398.62	orange crysts.
23	bromochloride, tri-	$SeBr_3Cl$	354.17	orange crysts.
24	bromotrichloride	$SeBrCl_3$	265.25	yel.-br. crysts.
25	chloride, mono-	Se_2Cl_2	228.83	red liquid
26	chloride, tetra-	$SeCl_4$	220.79	yellow or white deliq. crysts.
27	fluoride, tetra-	SeF_4	154.96	colorl. liq.
28	iodide, mono-	Se_2I_2	411.76	steel gray crysts.
29	iodide, tetra-	SeI_4	586.64	dark gray crysts.
30	nitride	Se_4N_4	371.87	orange-yellow
31	oxide, di-	SeO_2	110.96	white, tetrag.
32	oxybromide	$SeOBr_2$	254.79	yellow crysts.
33	oxychloride	$SeOCl_2$	165.87	yellow liquid
34	sulfide	SeS	111.02	orange-yel. scales
35	sulfoxide	$SeSO_3$	159.02	green prisms
36	**Silicic acid,** meta- (opal)	H_2SiO_3	78.08	amorphous
37	**Silicic acid,** ortho-	H_4SiO_4	96.09	amorphous
38	**Silico**-bromoform	$SiHBr_3$	268.82	colorl. liq.
39	chloroform	$SiHCl_3$	135.44	colorl. liquid
40	fluoroform	$SiHF_3$	86.07	gas
41	iodoform	$SiHI_3$	409.83	colorl. liquid
42	oxalic acid	$Si_2O_2(OH)_2$	122.14	amorphous, white
43	**Silicon,** crystalline	Si	28.06	gray, cubic
44	**Silicon,** graphitic	Si	28.06	crystalline
45	**Silicon,** amorphous	Si	28.06	brown, amorph.
46	**Silicon** boride, tri-	SiB_3	60.52	black, rhombic
47	boride, hexa-	SiB_6	92.98	black crysts.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	.....	.....	i.	.....	i. dil. a.	1
3.733	.....	.....	.....	.....	.....	2
.....	.....	.....	i.	.....	s. a.; i. alk.	3
$7.43^{15°}$	.....	.....	i.	.....	v. s. a.	4
.....	.....	.....	i.	.....	.....	5
$5.83^{17.5°}$	.....	.....	.....	.....	.....	6
2.930	$-3H_2O$, 105	$-8H_2O$, 450	$2.1^{25°}$	.....	.....	7
3.7	.....	.....	.....	.....	.....	8
2.5?	1200	2400	.....	.....	.....	9
3.91	subl. >1000	.....	.....	.....	.....	10
.....	939	.....	v. s.	v. s.	i. abs. alc.	11
.....	150	.....	s.	.....	.....	12
3.864	.....	.....	i.	i.	s.h. HNO_3, h. HCl; sl. s. c. a.	13
2.579	.....	.....	$39.9^{25°}$	v. s.	i. alc.	14
$2.950^{\frac{1}{4}5°}$	58	260	v. s.	v. s.	s. H_2SO_4; d. alc.; i. NH_3	15
$2.627^{\frac{1}{4}5°}$	26	205	v. s.	.....	.....	16
$3.004^{\frac{1}{4}5°}$	d.	.....	v. s.	v. s.	v. s. alc.; i. NH_3	17
$4.26^{25°}$	50	688	i.	i.	s. CS_2, H_2SO_4	18
4.80; 4.50	220	688	i.	i.	s. CS_2, H_2SO_4	19
$4.8^{25°}$	217	688	i.	i.	i. CS_2; s. H_2SO_4	20
$3.604^{15°}$	.....	d. 225	i.	d.	s. CS_2; sl. s. chl., C_2H_5Br	21
.....	d. 75	.....	s.	d.	s. CS_2, chl., C_2H_5Br	22
.....	d.	.....	.....	.....	v. sl. s. CS_2	23
.....	190	.....	.....	.....	i. CS_2	24
$2.906^{\frac{4}{4}0°}$	-85	145	d.	.....	v. s. CS_2, chl., CCl_4	25
.....	subl.	d. 288	d.	.....	s. $POCl_3$; v. sl. s. CS_2; d. H_2S	26
.....	-80	100	d.	.....	.....	27
.....	68-70	d. 100	d.	.....	.....	28
.....	75-80	-41, 100	d.	.....	.....	29
.....	expl. 200	.....	i.	i.	v. sl. s. CS_2, ac. a.; i. alc., et.	30
$3.954^{\frac{4}{4}0°}$	340	subl. 317	$38.4^{14°}$	v. s.	v. s. alc., ac. a.; sl. s. act.	31
$3.38^{50°}$	41.7	217^{740mm}	sl. d.	.....	s. H_2SO_4, CS_2, CCl_4, bz.	32
$2.44^{22°}$	8.5	179.4	d.	.....	d. H_2S	33
$3.056^{0°}$	d.	.....	i.	i.	s. CS_2; i. et.	34
.....	$-SO_2$, 40	.....	d.	.....	s. H_2SO_4	35
2.1-2.3	.....	.....	i.	i.	s. alk.; i. NH_4Cl	36
$1.576^{17°}$	.....	.....	sl. s.	sl. s.	s. alk.; i. NH_4Cl	37
$2.7^{17°}$	<-60	110	d.	.....	d. NH_3	38
1.34	-134	33^{758mm}	d.	.....	∞ CS_2, CCl_4, chl.	39
$2.98^{0°}$ (A)	-110	-80.2	d.	.....	s. $C_6H_5CH_3$; d. alk., alc., et.	40
$3.314^{20°}$	8	220	d.	.....	∞ CS_2, bz.	41
.....	d.	.....	i.	.....	.....	42
$2.4^{20°}$	1420	2600	i.	i.	s. HNO_3 + HF; i. HF	43
2.0-2.5	.....	2600	i.	i.	s. HNO_3 + HF, fused alk.; i. HF	44
2	.....	2600	i.	i.	s. HF, KOH	45
2.52	.....	.....	i.	.....	sl. s. HNO_3; d. H_2SO_4, KOH	46
2.47	.....	.....	i.	.....	s. HNO_3; i. KOH; d. H_2SO_4	47

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Silicon** bromide, tri-	Si_2Br_6	535.62	white, rhombic
2	bromide, tetra-	$SiBr_4$	347.72	colorl. liquid
3	bromohydride	$SiBrH_3$	111.00	colorl. gas
4	bromotrichloride	$SiBrCl_3$	214.35	.....
5	bromodichloride, di-	$SiBr_2Cl_2$	258.81	liquid
6	bromochloride tri-	$SiBr_3Cl$	303.27	colorl., fum. liq.
7	carbide (carborundum; moissanite)	SiC	40.07	yellow-blue, hex.
8	chloride, tri-	Si_2Cl_6	268.86	leaflets or liq.
9	chloride, tetra-	$SiCl_4$	169.89	color., fuming liq.
10	chlorohydride	$SiClH_3$	66.54	gas
11	chlorohydrosulfide	$SiCl_3SH$	167.50	colorl., fuming liq.
12	fluoride	SiF_4	104.06	gas
13	hydride (silane)	SiH_4	32.09	colorl., gas
14	hydride (silicoethane)	Si_2H_6	62.17	colorl., gas
15	hydride (trisilane)	Si_3H_8	92.24	colorl., liq.
16	hydride (tetrasilane)	Si_4H_{10}	122.32	colorl., liq.
17	iodide, di-	SiI_2	281.90	.....
18	iodide, tri-	Si_2I_6	817.64	colorl., hex. plates
19	iodide, tetra-	SiI_4	535.74	colorl., cubic
20	iodotrichloride	$SiICl_3$	261.35	colorl., fuming liq.
21	oxide, di- (amorphous, opal)	SiO_2	60.06	iridescent, amorphous
22	oxide, di- (cristobalite)	SiO_2	60.06	colorl., cubic or tetrag.
23	oxide, di- (lechatelierite)	SiO_2	60.06	.....
24	oxide, di- (quartz)	SiO_2	60.06	hexagonal
25	oxide, di- (tridymite)	SiO_2	60.06	trigonal
26	oxychloride	Si_2OCl_6	284.86	colorl., fuming liq.
27	sulfide	SiS	60.12	yellow needles
28	sulfide, di-	SiS_2	92.18	white or gray crysts.
29	sulfobromide	$SiSBr_2$	219.95	colorl. plates
30	sulfochloride	$SiSCl_2$	131.03	white prisms
31	**Silver**	Ag	107.88	silvery metal, cubic
32	acetate	$AgC_2H_3O_2$	166.92	needles
33	arsenate	Ag_3AsO_4	462.55	dark red, cubic
34	arsenite	Ag_3AsO_3	446.55	yellow
35	azide cf. nitride	.....	.....	.....
36	bromate	$AgBrO_3$	235.80	white, tetrag.
37	bromide (bromyrite)	$AgBr$	187.80	pale yellow, cubic
38	carbonate	Ag_2CO_3	275.77	yellow powder
39	chlorate	$AgClO_3$	191.34	white, tetrag.
40	chloride (cerargyrite)	$AgCl$	143.34	white, cubic
41	chromate	Ag_2CrO_4	331.77	dark red crysts.
42	citrate	$Ag_3C_6H_5O_7$	512.74	needles
43	cyanate	$AgCNO$	149.90	white crysts.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	95	240	d.	.....	d. KOH	1
2.82^{0}_{4}°	5	153	d.	.....	d. H_2SO_4	2
liq. 1.533^{0}_{4}°	−94	1.9	d.	.....	.....	3
.....	<−60	80	d.	.....	.....	4
.....	<−60	104	d.	.....	.....	5
2.432	−39	140.5	d.	.....	.....	6
3.17	>2700	subl. 2210	i.	i.	s. fused alk.; i. a.	7
1.580°	−1	144^{760mm}	d.	.....	d. alk.	8
1.50	−70	57.6	d.	.....	d. conc. H_2SO_4, alc.	9
liq. $1.145^{-1\frac{1}{4}}$°	−118	−10	.....	.....	.....	10
1.45	.....	100	d.	.....	d. alc.	11
3.57(A)	−95.7	-65^{1810mm}	v. s. d.	.....	s. HNO_3, alc., et.	12
liq. $0.68^{-185°}$	−185	-112^{760mm}	i.	.....	i. alc., et.; d. KOH	13
liq. $0.69^{-25°}$	−132.5	-15^{670mm}	sl. s. d.	.....	s. CS_2, alc., bz.	14
liq. 0.743°	−117	53	d.	.....	ign. in air	15
0.825°	−90	109	d.	.....	ign. in air	16
.....	expl. in air	.....	d.	.....	i. CS_2, chl., bz.	17
.....	250	d.	d.	.....	$19^{19°}$, $26^{27°}$ CS_2	18
.....	120.5	290	d.	.....	$220^{27°}$ CS_2	19
.....	<−60	113.5	d.	.....	adds to NH_3	20
$2.20^{15.6°}$	1600–1750	subl. 1750	i.	.....	s. HF, h. alk.	21
2.32	1710	2230	i.	.....	s. HF; i. alk.	22
2.20	.....	2230	i.	.....	s. HF; i. alk.	23
$2.650^{20°}$	<1425	2230	i.	.....	s. HF; i. alk.	24
2.26	1670	2230	i.	.....	s. HF; i. alk.	25
10.05(A)	−33	137	d.	.....	∞ CS_2, CCl_4, chl.; d. alc.	26
$1.853^{1\frac{5}{4}°}$	.....	subl. 940^{20mm}	d.	.....	s. dil. alk.; d. alc.	27
.....	.....	.....	d.	ign. in air	d. HNO_3, alc., et.	28
.....	93	$150^{18.3mm}$	d.	.....	s. CS_2, bz.	29
.....	75	185	d.	.....	s. CS_2	30
$10.5^{20°}$	960.5	1950	i.	i.	s. HNO_3, h. H_2SO_4; i. alk.	31
$3.259^{15°}$	d.	.....	0.72°	$2.52^{80°}$	.....	32
$6.657^{3\frac{5}{4}°}$	d.	.....	$0.00085^{20°}$	.....	s. ac. a., NH_4OH, NH_4 salts	33
.....	150 d.	.....	$0.00115^{20°}$	i.	s. ac. a., NH_4OH, NH_4 salts	34
.....	.....	.....	.....	.....	.....	35
5.206	d.	.....	$0.81^{24.5°}$	.....	s. NH_4OH; sl. s. HNO_3	36
$6.473^{3\frac{5}{4}°}$	434	d. 700	8.4×10^{-6}	$0.00037^{100°}$	$0.51^{80°}$ NH_4OH; s. KCN, $Na_2S_2O_3$	37
6.077	218 d.	.....	$0.00325^{15°}$	$0.05^{100°}$	s. NH_4OH, $Na_2S_2O_3$; i. alc.	38
4.430	230	d. 270	$10^{15°}$	$50^{80°}$	s. alc.	39
5.56	455	1550	$0.00008^{910°}$	$0.0021^{100°}$	s. NH_4OH, KCN; sl. s. HCl	40
$5.625^{25°}$	.....	.....	$0.0014^{0°}$	$0.011^{100°}$	s. NH_4OH, KCN, a.	41
.....	d.	.....	$0.028^{18°}$	d. 100	s. NH_4OH, KCN; i. alc.	42
4.00	d.	.....	$0.006^{16°}$	v. sl. s.	s. NH_4OH, KCN, HNO_3	43

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Silver** cyanide	$AgCN$	133.90	white curds
2	dichromate	$Ag_2Cr_2O_7$	431.78	red, tricl.
3	dithionate	$Ag_2S_2O_6 \cdot 2H_2O$	411.91	rhombic
4	ferricyanide	$Ag_3Fe(CN)_6$	535.60	orange
5	ferrocyanide	$Ag_4Fe(CN)_6 \cdot H_2O$	661.49	yellow
6	fluoride	AgF	126.88	yellow, deliq., cubic
7	fluosilicate	$Ag_2SiF_6 \cdot 4H_2O$	429.88	white, cubic
8	hyponitrite (silver nitrosyl)	$Ag_2(NO)_2$	275.78	bright yellow
9	iodate	$AgIO_3$	282.80	rhombic
10	iodide (iodyrite)	AgI	234.80	yellow, hex.
11	nitrate (lunar caustic)	$AgNO_3$	169.89	colorl., rhombic
12	nitride (azide)	AgN_3	149.90	white prisms
13	nitrite	$AgNO_2$	153.89	white, rhombic
14	nitroprusside	$Ag_2Fe(CN)_5NO$	431.71	pink-white
15	oxalate	$Ag_2C_2O_4$	303.78	white crysts.
16	oxide	Ag_2O	231.76	brown, cubic
17	oxide, per-	Ag_2O_2	247.76	black powder
18	perchlorate	$AgClO_4$	207.34	white, deliq.
19	permanganate	$AgMnO_4$	226.81	dark violet, monocl.
20	phosphate, acid	Ag_2HPO_4	311.75	white, trig.
21	phosphate, ortho-	Ag_3PO_4	418.62	yellow, cubic
22	phosphate, pyro-	$Ag_4P_2O_7$	605.48	white
23	potassium cyanide	$KAg(CN)_2$	199.01	colorl., cubic
24	selenide (naumannite)	Ag_2Se	294.72	gray, cubic
25	sulfate	Ag_2SO_4	311.82	white, rhombic
26	sulfide (acanthite)	Ag_2S	247.82	black, rhombic
27	sulfide (argentite)	Ag_2S	247.82	black, cubic
28	sulfite	Ag_2SO_3	295.82	white crysts.
29	tartrate	$Ag_2C_4H_4O_6$	363.83	white scales
30	telluride (hessite)	Ag_2Te	343.37	gray, cubic
31	thiocyanate	$AgCNS$	165.96	white curds
32	thiosulfate	$Ag_2S_2O_3$	327.88	white powder
33	tungstate	Ag_2WO_4	463.68	pale yellow crysts.
34	vanadate, pyro-	$Ag_4V_2O_7$	645.42	.....
35	**Sodium**	Na	22.997	silvery metal, cubic
36	acetate	$NaC_2H_3O_2$	82.04	white powder
37	acetate	$NaC_2H_3O_2 \cdot 3H_2O$	136.09	white, monocl.
38	aluminate	$NaAlO_2$	81.97	amorphous
39	aluminum silicate	$Na_2O \cdot Al_2O_3 \cdot 6SiO_2$	524.29	colorl., tricl.
40	amide	$NaNH_2$	39.02	olive green
41	ammonium phosphate (*microcosmic salt; stercorite*)	$NaNH_4HPO_4 \cdot 4H_2O$	209.09	colorl., monocl.
42	antimonate, meta-	$2NaSbO_3 \cdot 7H_2O$	511.63	cubic

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
3.95	$-(CN)_2$, 320	.....	$0.000022^{20°}$	.....	s. NH_4OH, KCN, HNO_3	1
4.77	d.	.....	$0.008315°$	d.	v. s. HNO_3, NH_4OH, KCN	2
3.61	.....	.....	.....	.....	.....	3
.....	.....	.....	$0.000066^{20°}$	.....	s. NH_4OH, h. $(NH_4)_2CO_3$	4
.....	.....	.....	i.	i.	s. KCN; i. NH_4OH	5
$5.852^{15.5°}$	435	.....	$1821^{5.5°}$	$2051^{08°}$	sl. s. NH_3	6
.....	100 d.	.....	v. s.	.....	.....	7
$5.75^{\frac{8}{4}0°}$	d. 110	.....	v. sl. s.	.....	d. HNO_3, H_2SO_4	8
$5.525^{16.5°}$	>200	d.	0.003^{100}	$0.018^{60°}$	s. HNO_3, KI; i. NH_3	9
5.67	d. 552	.....	3×10^{-7}	3×10^{-6}	s. KCN, $Na_2S_2O_3$, NH_3; i. NaCl	10
$4.352^{\frac{1}{4}0°}$	212	444 d.	$122^{0°}$	$952^{100°}$	s. gly.; v. sl. s. alc.	11
.....	250	expl. 297	i.	$0.01^{100°}$	s. KCN, dil. HNO_3; sl. s. NH_4OH	12
$4.453^{26°}$	d. 140	.....	$0.155^{0°}$	$1.363^{60°}$	v. s. NH_3; s. act.; i. alc.	13
.....	.....	.....	i.	.....	s. NH_4OH; i. HNO_3, alc.	14
$5.029^{4°}$	expl. 140	.....	$0.003^{18°}$	.....	s. KCN, NH_4OH	15
$7.143^{16.4°}$	d. 300	.....	$0.002^{20°}$	.....	s. KCN, NH_4OH; i. NH_3	16
7.44	d. >100	.....	i.	.....	s. NH_4OH, HNO_3, H_2SO_4	17
$2.806^{25°}$	d. 486	.....	s.	s.	s. alc.	18
.....	d.	.....	$0.55^{0°}$	d.	.....	19
.....	d. 110	.....	.....	.....	.....	20
$6.37^{\frac{2}{4}0°}$	849	.....	$0.0006^{19.5°}$	.....	s. NH_4OH, KCN, a.; i. NH_3	21
$5.306^{7.5°}$	585	.....	i.	i.	s. NH_4OH, KCN, HNO_3, H_2SO_4	22
.....	.....	.....	$25^{20°}$	v. s.	4, 85% alc.; i. a.	23
8.0	880	.....	i.	.....	s. h. HNO_3	24
$5.45^{\frac{2}{4}5.2°}$	652	d.	$0.57^{0°}$	$1.41^{100°}$	s. NH_4OH, HNO_3, H_2SO_4; i. alc.	25
7.326	825	d.	1.4×10^{-5}	.....	s. HNO_3; i. dil. HCl	26
7.317	tr. 175	d.	i.	i.	s. HNO_3	27
.....	d. 100	.....	v. sl. s.	d.	s. NH_4OH; i. HNO_3	28
$3.432^{15°}$	d.	.....	$0.2^{18°}$	$0.2^{25°}$	s. NH_4OH, KCN; i. alc.	29
8.5	955	.....	i.	.....	s. HNO_3, KCN	30
.....	d. >120	.....	$0.00002^{25°}$	$0.00064^{100°}$	s. NH_4OH; i. dil. a.	31
.....	d.	.....	sl. s.	.....	s. NH_4OH, $Na_2S_2O_3$	32
.....	.....	.....	$0.05^{15°}$	.....	s. NH_4OH, KCN; s. d. HNO_3	33
.....	383	.....	.....	.....	.....	34
$0.97^{20°}$	97.5	880	d.	forms NaOH	i. bz.; d. alc.	35
1.528	324	.....	$119^{0°}$	$170^{100°}$	$2.11^{8°}$ alc.	36
1.45	58; 78	.....	s.	s.	.....	37
.....	1650	.....	s.	v. s.	i. alc.	38
2.61	1100	.....	d.	.....	d. a.	39
.....	210	400	d.	.....	d. alc.	40
1.574	79d.	.....	16.7	100	i. alc.	41
.....	.....	.....	$0.031^{12.3°}$	.....	sl. s. alc., NH_4 salts; i. ac. a.	42

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Sodium** antimonate, pyro-	$Na_2H_2Sb_2O_7 \cdot H_2O$	421.55	colorl. crysts.
2	antimonide	Na_3Sb	190.75	deep blue
3	antimonite, meta-	$NaSbO_2 \cdot 3H_2O$	230.81	colorl., rhombic
4	arsenate	$Na_3AsO_4 \cdot 12H_2O$	424.09	hexagonal
5	arsenate, acid	$NaH_2AsO_4 \cdot H_2O$	181.94	rhombic
6	arsenate, acid	$Na_2HAsO_4 \cdot 7H_2O$	312.02	colorl., monocl.
7	arsenate, acid	$Na_2HAsO_4 \cdot 12H_2O$	402.10	monoclinic
8	arsenite	Na_2HAsO_3	169.91	colorl.
9	aurosulfide (thioaurite)	$NaAuS \cdot 4H_2O$	324.32	colorl., monocl.
10	benzoate	$NaC_7H_5O_2$	144.11	colorl. crysts.
11	bismuthide	Na_3Bi	277.99	blue-violet
12	borate, meta-	$Na_2B_2O_4$	131.63	hex. prisms
13	borate, meta-	$Na_2B_2O_4 \cdot 4H_2O$	203.70	monoclinic
14	borate, tetra-	$Na_2B_4O_7$	201.27	.....
15	borate, tetra-	$Na_2B_4O_7 \cdot 5H_2O$	291.35	colorl., cubic
16	borate, tetra- (borax)	$Na_2B_4O_7 \cdot 10H_2O$	381.43	white, monocl.
17	bromate	$NaBrO_3$	150.91	colorl., cubic
18	bromide	$NaBr$	102.91	colorl., cubic
19	bromide	$NaBr \cdot 2H_2O$	138.95	colorl., monocl.
20	bromoplatinate	$Na_2PtBr_6 \cdot 6H_2O$	828.82	dark red, tricl.
21	carbide	Na_2C_2	71.01	brown powder
22	carbonate	Na_2CO_3	106.00	white powder
23	carbonate (thermonatrite)	$Na_2CO_3 \cdot H_2O$	124.02	white, rhombic
24	carbonate	$Na_2CO_3 \cdot 7H_2O$	232.12	rhombic or trig.
25	carbonate (washing soda)	$Na_2CO_3 \cdot 10H_2O$	286.16	white, monocl.
26	carbonate, acid (bicarbonate; baking soda)	$NaHCO_3$	84.01	white, monocl.
27	carbonate, sesqui- (trona)	$Na_3H(CO_3)_2 \cdot 2H_2O$	226.05	monoclinic
28	chlorate	$NaClO_3$	106.45	cubic or trig.
29	chloride (halite; common salt)	$NaCl$	58.45	colorl., cubic
30	chloroaurate	$NaAuCl_4 \cdot 2H_2O$	398.06	orange-yellow, rhombic
31	chloroiridate	$Na_2IrCl_6 \cdot 6H_2O$	559.93	red, tricl.
32	chloroplatinate	$Na_2PtCl_6 \cdot 6H_2O$	562.06	red, tricl.
33	chloroplatinite	$Na_2PtCl_4 \cdot 4H_2O$	455.12	red
34	chromate	Na_2CrO_4	162.00	yellow, rhombic
35	chromate	$Na_2CrO_4 \cdot 10H_2O$	342.16	yellow, deliq., monocl.
36	citrate	$2Na_3C_6H_5O_7 \cdot 11H_2O$	714.36	white, rhombic
37	cyanide	$NaCN$	49.02	white, cubic
38	dichromate	$Na_2Cr_2O_7 \cdot 2H_2O$	298.05	red, moncol.
39	dithionate	$Na_2S_2O_6 \cdot 2H_2O$	242.15	colorl., rhombic
40	ferricyanide	$Na_3Fe(CN)_6 \cdot H_2O$	298.97	red, deliq.
41	ferric oxalate	$Na_3Fe(C_2O_4)_3 \cdot 5\frac{1}{2}H_2O$	487.99	green, monocl.
42	ferrite	$Na_2Fe_2O_4$	221.69	.....
43	ferrocyanide	$Na_4Fe(CN)_6 \cdot 10H_2O$	484.11	yellow, monocl.
44	fluoride (villiaumite)	NaF	42.00	tetragonal
45	fluoride, acid	$NaHF_2$	62.00	colorl. cryst.
46	fluosilicate	Na_2SiF_6	188.05	white, hex.
47	formate	$NaHCO_2$	68.01	white, monocl.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	.....	.....	$0.03^{12.3°}$	$0.3^{100°}$	$0.007^{12.3°}$ 26% alc.	1
.....	856	.....	d.	.....	.....	2
2.864	d.	.....	d.	.....	.....	3
1.759	86.3	.....	$26.7^{17°}$	.....	1.67 alc.	4
2.535	d. 100	.....	s.	.....	.....	5
1.871	125	$-7H_2O$, 100	$61^{15°}$	v. s.	sl. s. alc.	6
1.72	28	$-12H_2O$, 100	$17.20°$	$140.7^{30°}$	sl. s. alc.	7
1.87	.....	.....	v. s.	.....	.....	8
.....	d.	.....	s.	.....	s. alc.	9
.....	.....	.....	$62.5^{25°}$	$76.9^{100°}$	$2.32^{25°}$, $8.37^{80°}$ alc.	10
.....	775	.....	d.	.....	.....	11
.....	966	1400	s.	v. s.	.....	12
.....	57	.....	s.	v. s.	.....	13
2.367	741	.....	$1.3°$	$8.79^{40°}$	i. alc.	14
1.815	.....	.....	$22^{62°}$ (anhyd.)	$52.3^{100°}$ (anhyd.)	.....	15
1.73	75	$-10H_2O$, 200	$1.3^{9.5°}$ (anhyd.)	$20.3^{60°}$ (anhyd.)	s. gly.; i. abs. alc.	16
$3.339^{17.5°}$	381	.....	$27.5^{0°}$	$90.9^{100°}$	i. alc.	17
$3.205^{17.5°}$	755	1390	$116^{52°}$	$121^{100°}$	sl. s. alc.	18
2.176	50.7	.....	$79.5^{0°}$ (anhyd.)	$118.3^{80°}$ (anhyd.)	sl. s. alc.	19
3.323	d.	.....	v. s.	.....	v. s. alc.	20
$1.575^{15°}$	forms Na_2CO_3	.....	d.	.....	s. a.; d. alc.	21
2.533	851	d.	$7.1^{0°}$	$48.5^{104°}$	i. alc., et.	22
1.55	$-H_2O$, 100	.....	s.	s.	s. gly.; i. alc., et.	23
1.51	d. 35.1	.....	s.	s.	.....	24
1.46	.....	.....	$21.5^{0°}$	$238^{30°}$	i. alc.	25
2.20	$-CO_2$, 270	.....	$6.9^{0°}$	$16.4^{60°}$	i. alc.	26
2.112	d.	.....	$13^{0°}$	$42^{100°}$	.....	27
$2.490^{15°}$	248	d.	$79^{0°}$	$230^{100°}$	s. alc.	28
2.163	800.4	1413	$35.7^{0°}$	$39.8^{100°}$	sl. s. alc.; i. conc. HCl	29
.....	d.	.....	$150^{10°}$	$990^{60°}$	v. s. abs. alc.	30
.....	d.	.....	v. s.	v. s.	s. alc.	31
2.50	$-6H_2O$, 100	.....	v. s.	v. s.	s. alc., aq. Cl; i. et.	32
.....	100 d.	.....	.....	.....	.....	33
2.723	392	.....	v. s.	$126^{100°}$	.....	34
1.483	19.9	.....	v. s.	∞	sl. s. alc.	35
$1.857^{\frac{25}{4}°}$	$-11H_2O$, 150	d.	$91^{25°}$	$250^{100°}$	sl. s. alc.	36
.....	563.7	1496	s.	v. s.	s. NH_3; sl. s. alc.	37
$2.52^{13°}$	$-2H_2O$, 100; 320 (anhyd.)	d. 400	$238^{0°}$	$508^{80°}$	.....	38
2.189	.....	.....	$47.6^{16°}$	$90.9^{100°}$	i. alc., conc. HCl	39
.....	.....	.....	$18.9^{0°}$	$67^{100°}$	i. alc.	40
$1.973^{17.5°}$	$-4H_2O$, 100	$-5\frac{1}{2}H_2O$, 200	$32.5^{0°}$	$182^{100°}$	.....	41
.....	.....	.....	d.	.....	v. s. dil. HCl	42
1.458	.....	.....	$17.9^{20°}$ (anhyd.)	$63^{98.5°}$ (anhyd.)	i. alc.	43
2.79	992	.....	$4^{15°}$	.....	v. sl. s. alc.	44
.....	d.	.....	s. d.	v. s. d.	.....	45
2.679	d.	.....	$0.65^{17.9°}$	$2.46^{100°}$	i. alc.	46
1.919	253	.....	$44^{0°}$	$160^{100°}$	sl. s. alc.; i. et.	47

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Sodium** hydride	NaH	24.00	silvery needles
2	hydrosulfide	$NaSH \cdot 2H_2O$	92.10	colorl., deliq. needles
3	hydrosulfide	$NaSH \cdot 3H_2O$	110.11	rhombic
4	hydrosulfite	$Na_2S_2O_4 \cdot 2H_2O$	210.15	colorl. crysts.
5	hydroxide	$NaOH$	40.00	white, deliq.
6	hydroxide	$NaOH \cdot 3\frac{1}{2}H_2O$	103.06	monoclinic
7	hypochlorite	$NaOCl$	74.45	pale yellow, in soln. only
8	hyponitrite (sodium nitrosyl)	$Na_2(NO)_2$	106.01	.....
9	hypophosphate	$Na_4P_2O_6 \cdot 10H_2O$	430.11	monoclinic
10	hypophosphate, acid	$Na_2H_2P_2O_6 \cdot 6H_2O$	314.07	colorl., monocl.
11	hypophosphite	$NaH_2PO_2 \cdot H_2O$	106.04	colorl., monocl.
12	iodate	$NaIO_3$	197.92	colorl., rhombic
13	iodide	NaI	149.92	colorl., cubic
14	iodide	$NaI \cdot 2H_2O$	185.95	colorl., monocl.
15	iodoplatinate	$Na_2PtI_6 \cdot 6H_2O$	1110.84	monocl. (?)
16	lactate	$NaC_3H_5O_3$	112.07	colorl., amorph.
17	manganate	$Na_2MnO_4 \cdot 10H_2O$	345.08	green monocl.
18	molybdate	Na_2MoO_4	205.94	white
19	molybdate	$Na_2MoO_4 \cdot 2H_2O$	241.98	plates
20	molybdate, di-	$Na_2Mo_2O_7$	349.89	needles
21	molybdate, tri-	$Na_2Mo_3O_{10} \cdot 7H_2O$	619.96	needles
22	molybdate, tetra-	$Na_2Mo_4O_{13} \cdot 6H_2O$	745.89	needles
23	molybdate, octa-	$Na_2Mo_8O_{25} \cdot 4H_2O$	1285.61	powder
24	molybdate, deca-	$Na_2Mo_{10}O_{31} \cdot 12H_2O$	1717.69	white crysts.
25	nitrate (soda niter)	$NaNO_3$	85.01	colorl., trig.
26	nitride	Na_3N	83.00	gray
27	nitrite	$NaNO_2$	69.01	pale yellow, rhombic
28	nitroprusside	$Na_2Fe(CN)_5NO \cdot 2H_2O$	297.97	red, rhombic
29	oxalate	$Na_2C_2O_4$	134.01	white crysts.
30	oxalate, acid	$NaHC_2O_4 \cdot H_2O$	130.04	triclinic
31	oxide	Na_2O	61.99	white, deliq.
32	perborate	$NaBO_3 \cdot H_2O$	99.83	.....
33	perborate	$NaBO_3 \cdot 2H_2O$	117.85	transparent, monocl.
34	perchlorate	$NaClO_4$	122.45	rhombic
35	perchlorate	$NaClO_4 \cdot H_2O$	140.47	hexagonal
36	perchromate	Na_3CrO_8	249.00	orange plates
37	periodate	$NaIO_4$	213.92	tetragonal
38	periodate	$NaIO_4 \cdot 3H_2O$	267.97	trigonal
39	permanganate	$NaMnO_4 \cdot 3H_2O$	195.98	purple, deliq.
40	peroxide	Na_2O_2	77.99	yellow-white powder
41	peroxide	$Na_2O_2 \cdot 8H_2O$	222.12	white, hex.
42	perrhenate	$NaReO_4$	273.31	colorl. plates
43	perruthenate	$NaRuO_4 \cdot H_2O$	206.71	black crysts.
44	peruranate	$Na_2UO_5 \cdot 5H_2O$	454.14	red crysts.
45	phosphate, tribasic	Na_3PO_4	163.97	white
46	phosphate, tribasic	$Na_3PO_4 \cdot 12H_2O$	380.16	white, trigonal
47	phosphate, dibasic	$Na_2HPO_4 \cdot 7H_2O$	268.09	mohoclinic
48	phosphate, dibasic	$Na_2HPO_4 \cdot 12H_2O$	358.17	rhombic or monocl.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
0.92	d.	.....	d.	.....	i. bz., CS_2, CCl_4, NH_3	1
.....	d.	.....	s.	s.	s. alc.; d. a.	2
.....	22	d.	s.	s.	s. alc.; d. a.	3
.....	d.	.....	v. s.	d.	i. alc.	4
2.130	318.4	1390	$42^{0°}$	$347^{100°}$	v. s. alc., et., gly.; i. act.	5
.....	15.5	.....	s.	v. s.	.....	6
.....	d.	.....	s.	d.	.....	7
$2.466^{30°}$	300. d	.....	s.	.....	.....	8
1.832	.....	.....	3	v. s.	.....	9
1.849	$-6H_2O$, 100; 250(anhyd.)	.....	2.2	20	s. NH_4OH; i. alc.	10
.....	$-H_2O$, 200	.....	$100^{25°}$	830	v. s. alc.; sl. s. NH_3	11
4.277	d.	.....	$2.5^{0°}$	$34^{100°}$	s. ac. a.; i. alc.	12
$3.667^{0°}$	651	1300	$158.7^{0°}$	$256.8^{60°}$	v. s. alc.	13
2.448	.....	.....	v. s.	v. s.	v. s. NH_3	14
3.707	.....	.....	.....	.....	.....	15
.....	d.	.....	v. s.	.....	s. alc.; i. et.	16
.....	17	.....	s.	d.	.....	17
$q.2.590^{10\frac{3}{4}°}$	687	.....	s.	.....	.....	18
3.28	.....	.....	$56.2^{0°}$	$115.5^{100°}$	i. m. acetate	19
.....	612	.....	sl. s.	s.	.....	20
.....	$-6H_2O$, 120	.....	$3.88^{20°}$ (anhyd.)	$13.7^{100°}$ (anhyd.)	.....	21
.....	.....	.....	$28.4^{21°}$	v. s.	.....	22
.....	.....	.....	i.	i.	.....	23
.....	.....	.....	sl. s.	sl. s	.....	24
2.257	308	d. 380	$73^{0°}$	$180^{100°}$	s. NH_3; sl. s. gly., alc.	25
.....	d.	.....	d.	.....	.....	26
$2.168^{0°}$	271	d. 320	$72.1^{0°}$	$163.2^{100°}$	$0.3^{20°}$et.;0.3 abs. alc.; $4.4^{20°}$m. alc.; v.s. NH_3	27
1.72	.....	.....	$40^{16°}$	.....	.....	28
2.27	.....	.....	$3.7^{20°}$	$6.33^{100°}$	.....	29
.....	.....	.....	$1.7^{15°}$	$21^{100°}$	.....	30
2.27	subl.	.....	forms NaOH	s.	d. alc.	31
.....	d. 40	.....	sl. s.	d.	s. gly.	32
.....	.....	.....	$2.55^{15°}$	$3.78^{32°}$	s. a.	33
.....	482d.	.....	s.	v. s.	s. alc.	34
2.02	d. 130	.....	$209^{15°}$	$284^{50°}$	.....	35
.....	d. 115	.....	sl. s.	.....	i. alc., et.	36
$3.865^{16°}$	d. 300	.....	s.	s.	.....	37
$3.219^{\frac{1}{4}°}$	d.	.....	s.	s.	.....	38
2.46	d. 170	.....	v. s.	v. s.	s. NH_3; d. alk.	39
2.805	d.	.....	s.	d.	s. dil. a.	40
.....	d. 30	.....	s.	.....	.....	41
.....	300	.....	$25^{20°}$	s.	s. alc.	42
.....	.....	.....	sl. s.	.....	.....	43
.....	d. 100	.....	d.	.....	d. HCl	44
$2.537^{17.5°}$	1340	.....	$1.5^{0°}$	$108^{100°}$	.....	45
1.62	d.73.4	$-11H_2O$, 100	$28.3^{15°}$	∞	i. CS_2	46
1.679	d.	.....	$185^{40°}$	.....	.....	47
1.52	34.6	$-12H_2O$, 180	$4.3^{0°}$	$76.7^{30°}$	i. alc.	48

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Sodium** phosphate, monobasic	$NaH_2PO_4 \cdot H_2O$	138.01	rhombic
2	phosphate, monobasic	$NaH_2PO_4 \cdot 2H_2O$	156.03	rhombic
3	phosphate, meta-	$Na_4P_4O_{12}$	407.91	colorl.
4	phosphate, pyro-	$Na_4P_2O_7$	265.95	.....
5	phosphate, pyro-	$Na_4P_2O_7 \cdot 10H_2O$	446.11	monoclinic
6	phosphate, pyro- disodium	$Na_2H_2P_2O_7$	221.97	monoclinic
7	phosphate, pyro- disodium	$Na_2H_2P_2O_7 \cdot 6H_2O$	330.07	hex. plates
8	phosphite, ortho-	$Na_2HPO_3 \cdot 5H_2O$	216.06	deliq., rhombic
9	phosphite, acid	$2NaH_2PO_3 \cdot 5H_2O$	298.07	monoclinic prisms
10	platinate	$Na_2PtO_3 \cdot 3H_2O$	343.27	yellow
11	potassium carbonate	$NaKCO_3 \cdot 6H_2O$	230.20	monoclinic
12	potassium tartrate (Rochelle salt)	$NaKC_4H_4O_6 \cdot 4H_2O$	282.23	rhombic
13	salicylate	$NaC_7H_5O_3$	160.11	white crysts.
14	selenate	Na_2SeO_4	188.95	rhombic
15	selenate	$Na_2SeO_4 \cdot 10H_2O$	369.11	monoclinic
16	selenide	Na_2Se	124.95	deliq. crysts.
17	silicate, meta-	Na_2SiO_3	122.05	monoclinic
18	silicate, meta-	$Na_2SiO_3 \cdot 9H_2O$	284.20	rhombic
19	silicate, ortho-	Na_4SiO_4	184.05	hexagonal
20	silicate (water glass)	$Na_2Si_4O_9$	302.23	amorphous
21	stannate	$Na_2SnO_3 \cdot 3H_2O$	266.74	hex. tablets
22	sulfate (thenardite)	Na_2SO_4	142.05	colorl., rhombic
23	sulfate	Na_2SO_4	142.05	colorl., monocl.
24	sulfate	Na_2SO_4	142.05	colorl., hex.
25	sulfate	$Na_2SO_4 \cdot 7H_2O$	268.17	tetragonal
26	sulfate (Glauber's salt)	$Na_2SO_4 \cdot 10H_2O$	322.21	colorl., monocl.
27	sulfate (mirabilite)	$Na_2SO_4 \cdot 10H_2O$	322.21	colorl., monocl.
28	sulfate, acid (bisulfate)	$NaHSO_4$	120.06	colorl., tricl.
29	sulfide, mono-	Na_2S	78.05	pink or white, amorph.
30	sulfide, tetra-	Na_2S_4	174.23	yellow, cubic
31	sulfide, penta-	Na_2S_5	206.29	yellow
32	sulfite	Na_2SO_3	126.05	hex. prisms
33	sulfite	$Na_2SO_3 \cdot 7H_2O$	252.17	monoclinic
34	sulfite, acid (bisulfite)	$NaHSO_3$	104.06	colorl., moncl.
35	tartrate	$Na_2C_4H_4O_6 \cdot 2H_2O$	230.10	rhombic
36	thioantimonate (Schlippe's salt)	$Na_3SbS_4 \cdot 9H_2O$	481.14	yellow, cubic
37	thioarsenate	$2Na_3AsS_4 \cdot 15H_2O$	814.52	yellow or colorl. monocl.
38	thioarsenate	$Na_3AsS_4 \cdot 8H_2O$	416.27	monoclinic
39	thiocarbonate	$Na_2CS_3 \cdot H_2O$	172.20	yellow
40	thiocyanate	$NaCNS$	81.08	deliq., rhombic
41	thioplatinate	$Na_4Pt_3S_6$	870.04	red, rhombic
42	thiosulfate	$Na_2S_2O_3$	158.11	monoclinic
43	thiosulfate (hypo)	$Na_2S_2O_3 \cdot 5H_2O$	248.19	monoclinic prisms
44	tungstate, para-	$Na_6W_7O_{24} \cdot 16H_2O$	2097.68	white, tricl.
45	tungstate	Na_2WO_4	339.95	white, rhombic
46	tungstate	$Na_2WO_4 \cdot 2H_2O$	229.95	white, rhombic
47	uranate	Na_2UO_4	348.06	yellow
48	vanadate	$Na_3VO_4 \cdot 16H_2O$	472.20	colorl. needles

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
2.040	$-H_2O$, 100	d. 200	v. s.	v. s.	i. alc.	1
1.91	60	.....	$91.1^{0°}$	$308^{40°}$	.....	2
2.476	616 d.	.....	sl. s.	sl. s.	s. a., alk.	3
2.45	988	.....	$3.16^{0°}$	$40.26^{100°}$	d. a.	4
1.82	940	.....	$5.4^{0°}$	$93^{100°}$	i. alc., NH_3	5
1.862	d. 220	.....	.....	.....	.....	6
1.848	.....	.....	s. d.	.....	.....	7
.....	53	$-5H_2O$, 120	s.	v. s.	i. alc.	8
.....	42	$-5H_2O$, 100	$56^{0°}$	$193^{42°}$	.....	9
.....	$-3H_2O$, 150	.....	s.	.....	i. alc.	10
1.633	$-6H_2O$, 100	.....	$185^{15°}$	.....	.....	11
1.790	70 to 80	$-4H_2O$, 215	$26^{0°}$	$66^{26°}$	sl. s. alc.	12
.....	.....	.....	$111^{15°}$	$125^{25°}$	$17^{15°}$ alc.	13
3.098	.....	.....	$83.4^{35°}$	$72.8^{100°}$	.....	14
1.58	.....	.....	$29.8^{0°}$	$615^{30°}$	.....	15
$2.625^{10°}$	>875	.....	d.	.....	i. NH_3	16
.....	1088	.....	s.	s. d.	i. Na or K salts, alc.	17
.....	47	$-6H_2O$, 100	v. s.	v. s.	$29^{18°}$, ½ N NaOH	18
.....	1018	.....	.....	.....	.....	19
.....	.....	.....	s.	s.	i. Na or K salts, alc.	20
.....	d. 140	.....	$67.4^{0°}$	$61.3^{20°}$	i. alc., act.	21
2.698	tr. 100 to monocl.	.....	$5^{0°}$	.....	i. alc.	22
.....	tr. 500 to hex.	.....	$48.8^{40°}$	$42.5^{100°}$	d. HI	23
.....	884	.....	s.	s.	.....	24
.....	.....	.....	$44.9^{0°}$	$202.6^{25°}$	.....	25
1.464	d. 32.4	.....	$12.2^{0°}$	$412^{34°}$	i. alc.	26
1.48	.....	.....	.....	.....	.....	27
2.742	>315	.....	$50^{0°}$	$100^{100°}$	d. alc.; i. NH_3	28
1.856	.....	.....	$15.4^{10°}$	$57.3^{90°}$	sl. s. alc.; i. et.	29
.....	275	.....	s.	s.	s. alc.	30
.....	251.8	.....	s.	s.	s. alc.	31
$2.633^{\frac{1}{4}°}$	d.	.....	$13.9^{0°}$	$28.3^{84°}$	i. alc., NH_3	32
1.561	$-7H_2O$, 150	d.	$34.7^{2°}$	$67.8^{18°}$	i. alc.	33
1.48	d.	.....	sl. s.	s.	i. alc., act.	34
1.818	.....	.....	$29^{6°}$	$66^{43°}$	i. alc.	35
1.839	.....	.....	34.5	100	i. alc.	36
.....	d.	.....	v. s.	.....	i. alc.	37
.....	d.	.....	s.	.....	.....	38
.....	d.	.....	s.	d.	.....	39
.....	287	.....	v. s.	v. s.	v. s. alc.	40
.....	d.	.....	i.	d.	.....	41
1.667	.....	.....	s.	$231^{80°}$	.....	42
1.685	d. 48.0	.....	$74.7^{0°}$	$301.8^{60°}$	s. NH_3; v. sl. s. alc.	43
$3.987^{4°}$	$-16H_2O$, 300	.....	8	d.	.....	44
4.179	692	.....	$57.58^{0°}$	$97^{100°}$	.....	45
3.245	$-2H_2O$, 100	.....	$88^{0°}$	$123.5^{100°}$	sl. s. NH_3; i. a., alc.	46
.....	.....	.....	i.	i.	s. alk. carb., dil. a.	47
.....	866 (anhyd.)	.....	v. s.	d.	i. alc.	48

	Name	Formula	Formula Weight,	Crystalline Form and Color
1	**Sodium** vanadate, pyro-	$Na_4V_2O_7$	305.89	hexagonal
2	**Stannic acid,** meta- (α)	H_2SnO_3	168.72	white, amorphous
3	**Stannic acid,** meta- (β)	$H_{10}Sn_5O_{15}$	843.58	.....
4	**Stannic acid,** thio-	H_2SnS_3	216.90	gray
5	**Stannic ammonium chloride**	$SnCl_4 \cdot (NH_4Cl)_2$	367.52	pink, cubic
6	**Stannic** bromide	$SnBr_4$	438.36	white, deliq., rhombic
7	chloride	$SnCl_4$	260.53	colorl., fuming liq.
8	fluoride	SnF_4	194.70	white crysts.
9	iodide	SnI_4	626.38	red, cubic or rhombic
10	oxide (cassiterite)	SnO_2	150.70	yellow, red or gray; tetrag., hex. or rhombic
11	oxychloride	$SnOCl_2$	205.61	.....
12	phosphate	$2SnO_2 \cdot P_2O_5 \cdot 10H_2O$	623.52	.....
13	phosphide	SnP	149.68	silvery white
14	selenide	$SnSe_2$	276.62	white or brown
15	sulfate	$Sn(SO_4)_2 \cdot 2H_2O$	346.85	colorl., deliq., hex.
16	sulfide (mosaic gold)	SnS_2	182.82	soft, yellow, hex. plates
17	**Stannous** bromide	$SnBr_2$	278.53	yellow, rhombic
18	chloride	$SnCl_2$	189.61	white, rhombic
19	chloride (tin salt)	$SnCl_2 \cdot 2H_2O$	225.65	white, tricl.
20	ferricyanide	$Sn_3[Fe(CN)_6]_2$	780.02	.....
21	ferrocyanide	$Sn_2Fe(CN)_6$	449.36	.....
22	fluoride	SnF_2	156.70	white, monocl.
23	hydroxide	$Sn(OH)_2$	152.72	yellow, amorph.
24	iodide	SnI_2	372.54	red, rhombic or monocl.
25	oxalate	SnC_2O_4	206.72	white powder
26	oxide	SnO	134.70	black, red, green, cubic
27	oxychloride	$SnO \cdot SnCl_2 \cdot 3H_2O$	378.36	white
28	selenide	SnSe	197.66	steel gray prisms
29	sulfate	$SnSO_4$	214.76	white crysts.
30	sulfide	SnS	150.76	brown-black, rhombic
31	telluride	SnTe	246.31	gray crysts.
32	**Strontium**	Sr	87.63	silvery metal
33	acetate	$Sr(C_2H_3O_2)_2$	205.72	white crysts.
34	arsenate, acid	$SrHAsO_4 \cdot H_2O$	245.56	rhombic needles
35	borate	$SrB_4O_7 \cdot 4H_2O$	314.97	.....
36	boride	SrB_6	152.55	black crysts.
37	bromate	$Sr(BrO_3)_2 \cdot H_2O$	361.48	monoclinic
38	bromide	$SrBr_2$	247.46	white needles
39	bromide	$SrBr_2 \cdot 6H_2O$	355.56	colorl., crysts.
40	carbide	SrC_2	111.65	black crysts.
41	carbonate (strontianite)	$SrCO_3$	147.64	white, rhombic
42	chlorate	$Sr(ClO_3)_2$	254.54	white, rhombic

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	654	.....	s.	.....	i. alc.	1
.....	.....	.....	i.	i.	α, s. a.; β, s. KOH, i.a.	2
.....	.....	.....	i.	i.	s. KOH; i. a.	3
.....	.....	.....	i.	.....	.....	4
2.4	d.	.....	$33.3^{15°}$	.....	.....	5
liq. $3.34^{35°}$	31.0	202	s.	d.	s. H_2SO_4, $AsBr_3$, PCl_3, act.	6
2.226	−30.2	114.1	s.	d.	s. abs. alc., act., NH_3; s. ∞ CS_2	7
$4.78^{\frac{1}{4}0°}$	.....	705	v. s.	forms SnO_2	....	8
4.46	143.5	340	v. s.	forms SnO_2	$145^{15°}$ CS_2; s. alc., et., act., bz., CCl_4	9
7.0	1127	.....	i.	i.	s. conc. H_2SO_4; i. alk., NH_4OH, NH_3	10
.....	.....	.....	s.	.....	.....	11
3.98 (anhyd.)	.....	.....	i.	i.	i. HNO_3	12
6.56	forms Sn_4P_3, 415	.....	i.	.....	s. HCl; i. HNO_3	13
5.0	650	.....	i.	.....	s. alk., h. H_2SO_4; i. dil. a.	14
.....	.....	.....	v. s.	d.	s. dil. H_2SO_4, HCl; d. abs. alc.	15
4.5	d.	.....	0.00002	i.	s. aq. reg., h. alk.; i. HCl, HNO_3	16
$5.12^{17°}$	215.5	620	s.	d.	s. C_5H_5N	17
.....	246.8	623	$83.9^{0°}$	$269.8^{15°}$	s. alk., abs. alc., et.	18
$2.71^{15.5°}$	37.7	d.	$118.7^{0°}$	∞	s. tart. a., alk., alc.	19
.....	d.	.....	i.	.....	s. HCl	20
.....	.....	.....	i.	.....	s. h. HCl	21
.....	d. in air to $SnOF_2$	.....	v. s.	.....	.....	22
.....	forms SnO > 160	.....	i.	forms SnO	s. alk., dil. a.; i. NH_4OH	23
$5.21^{\frac{15}{15}°}$	320	720	$1.3^{21°}$	$4.0^{100°}$	s. dil. HCl, alk.	24
$3.56^{\frac{1}{4}0°}$	.....	.....	.....	i.	.....	25
6.95	d.	.....	i.	i.	s. a.; v. sl. s. NH_4Cl; i. alk., NH_3	26
.....	.....	.....	i.	i.	s. dil. a., alc.	27
$6.18^{0°}$	861	.....	i.	.....	s. aq. reg., alk. sulf.	28
.....	$-SO_2$, 360	.....	$19^{19°}$	$18^{100°}$	s. H_2SO_4	29
$5.080^{0°}$	880	1230	$0.00000218^{0°}$	i.	s. HCl, $(NH_4)_2Sx$	30
6.48	780	.....	.....	i.	i. HCl	31
2.6	800	1150	d.	forms $Sr(OH)_2$	s. a., alc.	32
2.099	.....	d.	$36.9^{0°}$	.....	.....	33
$3.606^{15°}$	$-H_2O$, 130	$-1\frac{1}{2}H_2O$, 360	$0.284^{15.5°}$	d.	s. a.	34
.....	.....	.....	.....	$77^{100°}$	s. HNO_3, NH_4 salts	35
3.3	.....	.....	i.	i.	s. HNO_3	36
3.773	$-H_2O$, 120	d. 240	$33^{16°}$	.....	.....	37
$4.216^{\frac{24}{4}°}$	643	d.	$85.2^{0°}$	$222.5^{100°}$	s. alc., amyl alc.	38
$2.356^{18°}$	d. 20	$-6H_2O$ > 180	$195^{0°}$	∞	.....	39
3.19	.....	.....	d.	.....	d. a.	40
3.70	1497^{60atm}	$-CO_2$, 1350	$0.0011^{18°}$	$0.065^{100°}$	s. a., NH_4 salts, aq. CO_2	41
3.152	120d.	.....	$174.9^{18°}$	v. s.	s. alc.; i. abs. alc.	42

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Strontium** chlorate	$Sr(ClO_3)_2 \cdot 8H_2O$	398.67	white needles
2	chloride	$SrCl_2$	158.54	white, cubic
3	chloride	$SrCl_2 \cdot 6H_2O$	266.64	white, trig.
4	chromate	$SrCrO_4$	203.64	yellow, monocl.
5	cyanide	$Sr(CN)_2 \cdot 4H_2O$	211.73	deliq. crysts.
6	dichromate	$SrCr_2O_7 \cdot 3H_2O$	357.70	red, monocl.
7	dithionate	$SrS_2O_6 \cdot 4H_2O$	319.81	trigonal
8	ferrocyanide	$Sr_2Fe(CN)_6 \cdot 15H_2O$	657.46	yellow, monocl.
9	fluoride	SrF_2	125.63	white, cubic
10	fluosilicate	$SrSiF_6 \cdot 2H_2O$	265.72	monoclinic
11	formate	$Sr(HCO_2)_2$	177.67	rhombic
12	formate	$Sr(HCO_2)_2 \cdot 2H_2O$	213.70	rhombic
13	hydrosulfide	$Sr(SH)_2$	153.77	colorl. crysts.
14	hydroxide	$Sr(OH)_2$	121.65	white, deliq.
15	hydroxide	$Sr(OH)_2 \cdot 8H_2O$	265.77	colorl., tetrag.
16	iodate	$Sr(IO_3)_2$	437.47	triclinic
17	iodide	SrI_2	341.47	colorl. plates
18	iodide	$SrI_2 \cdot 6H_2O$	449.57	colorl. crysts.
19	molybdate	$SrMoO_4$	247.58	tetragonal
20	nitrate	$Sr(NO_3)_2$	211.65	colorl. cubic
21	nitrate	$Sr(NO_3)_2 \cdot 4H_2O$	283.71	white, monocl.
22	nitrite	$Sr(NO_2)_2$	179.65	.....
23	nitrite	$Sr(NO_2)_2 \cdot H_2O$	197.66	colorl. crysts.
24	oxalate	$SrC_2O_4 \cdot H_2O$	193.67	colorl. crysts.
25	oxide (strontia)	SrO	103.63	colorl., cubic
26	oxide, per-	SrO_2	119.63	white powder
27	oxide, per-	$SrO_2 \cdot 8H_2O$	263.76	white crysts.
28	permanganate	$Sr(MnO_4)_2 \cdot 3H_2O$	379.54	purple, cubic
29	phosphate, acid	$SrHPO_4$	183.62	rhombic
30	salicylate	$Sr(C_7H_5O_3)_2 \cdot 2H_2O$	397.88	colorl. crysts.
31	selenate	$SrSeO_4$	230.59	rhombic
32	silicate	$SrSiO_3$	163.69	colorl. prisms
33	sulfate (celestite)	$SrSO_4$	183.69	colorl., rhombic
34	sulfate, acid	$Sr(HSO_4)_2$	281.77	colorl. granular
35	sulfide, mono-	SrS	119.69	white or gray, cubic
36	sulfide, tetra-	$SrS_4 \cdot 6H_2O$	323.97	red-white crysts.
37	sulfite	$SrSO_3$	167.69	white crysts.
38	tartrate	$SrC_4H_4O_6 \cdot 4H_2O$	307.77	monoclinic
39	thiocyanate	$Sr(CNS)_2 \cdot 3H_2O$	257.83	deliquescent
40	thiosulfate	$SrS_2O_3 \cdot 5H_2O$	289.83	monoclinic
41	tungstate	$SrWO_4$	335.55	white, tetrag.
42	**Sulfur**, amorphous	S	32.06	pale yellow powder
43	**Sulfur**, monoclinic	S_8	256.48	pale yel., monocl.
44	**Sulfur**, rhombic	S_8	256.48	pale yel., rhomb.
45	**Sulfur** bromide, mono-	S_2Br_2	223.95	red fuming liq.
46	chloride, mono-	S_2Cl_2	135.03	red-yellow liq.
47	chloride, di-	SCl_2	102.97	dark red fuming liq.
48	chloride, tetra-	SCl_4	173.89	yel.-brown liq.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	.....	.....	s.	v. s.	s. alc.	1
3.052	873	.....	$43.5^{0°}$	$100.8^{100°}$	v. sl. s. act., abs. alc.; i. NH_3	2
$1.933^{17°}$	$-4H_2O$, 61	$-6H_2O$, 100	$104^{0°}$	$198^{40°}$	.....	3
$3.895^{18°}$	.....	.....	$0.12^{15°}$	$3^{100°}$	s. HNO_3, HCl, ac. a., NH_4 salts	4
.....	d.	.....	v. s.	.....	.....	5
.....	d.110	.....	.....	.....	.....	6
2.373	d.	$-4H_2O$, 78	$22^{16°}$	$67^{100°}$	i. alc.	7
.....	.....	.....	50	100	.....	8
2.44	1190	.....	$0.011^{0°}$	$0.012^{27°}$	s. h. HCl; i. HF	9
$2.99^{17.5°}$	d.	.....	$3.2^{15°}$	d.	$0.06^{15°}$ 50% alc.; s. HCl	10
2.695	71.9	.....	s.	s.	.....	11
2.25	d.	.....	s.	s.	.....	12
.....	d.	.....	s.	d.	.....	13
3.625	375	.....	$0.41^{0°}$	$21.83^{100°}$	s. NH_4Cl	14
1.90	$-7H_2O$, in dry air	.....	$0.90^{0°}$	$47.7^{100°}$	s. NH_4Cl; i. act.	15
$5.045^{15°}$	.....	.....	s.	.....	.....	16
$4.549^{\frac{3}{4}\delta°}$	402	d.	$165.3^{0°}$	$383^{100°}$	sl. s. abs. alc.	17
4.415	.....	.....	$456^{0°}$	∞	.....	18
4.145	.....	.....	$0.0104^{17°}$	.....	.....	19
2.986	570	.....	$40.1^{0°}$	$100^{90°}$	s. NH_3; 0.012 abs. alc.	20
2.2	.....	.....	$62.2^{0°}$	$124^{20°}$	i. HNO_3	21
$2.867^{27°}$	.....	.....	s.	.....	.....	22
$2.408^{0°}_{0°}$	$-H_2O$, >100	d. 240	$58.9^{0°}$	$182^{100°}$	$0.42^{20°}$ 90% alc.	23
.....	$-H_2O$, 150	.....	$0.005^{18°}$	$5^{100°}$	s. HCl, HNO_3	24
4.7	2430	.....	forms $Sr(OH)_2$	.....	sl. s. alc.; i. et.	25
.....	d.	.....	$0.008^{20°}$	d.	s. alc., NH_4Cl; i. act.	26
.....	$-8H_2O$, 100	d.	$0.018^{20°}$	d.	s. alc.; i. NH_4OH	27
.....	d.	.....	$270^{0°}$	$291^{18°}$	.....	28
$3.544^{15°}$	.....	.....	i.	i.	s. a., NH_4 salts	29
.....	d.	.....	$5.62^{5°}$	$28.61^{100°}$	$1.52^{5°}$, $9.57^{80°}$ alc.	30
4.25	.....	.....	i.	i.	s. h. HCl; i. c. HNO_3	31
$3.65^{\frac{3}{4}\delta°}$	1580	.....	i.	i.	.....	32
3.96	1580d.	.....	$0.0113^{0°}$	$0.0114^{32°}$	sl. s. a.; i. dil. H_2SO_4, alc.	33
.....	d.	.....	d.	.....	$14^{70°}$ H_2SO_4	34
$3.70^{15°}$	.....	.....	s. d.	.....	s. alc.; i. act.; d. a.	35
.....	25	.....	s.	.....	s. alc.	36
.....	d.	.....	$0.0033^{17°}$	.....	v. s. H_2SO_3	37
$1.966^{\frac{3}{4}0°}$	.....	.....	$0.112^{0°}$	$0.755^{85°}$	.....	38
.....	$-3H_2O$, 100	d. 160	v. s.	.....	v. s. alc.	39
$2.17^{17°}$	$-4H_2O$, 100	.....	$25^{13°}$	$57^{100°}$	i. alc.	40
6.184	d.	.....	$0.14^{15°}$	.....	.....	41
2.046	120	444.6	i.	i.	sl. s. CS_2	42
1.96	119.0	444.6	i.	i.	s. CS_2, alc.	43
2.07	112.8	444.6	i.	i.	$24^{0°}$, $181^{355°}$ CS_2	44
2.635	−46	$540^{.18mm}$	d.	.....	.....	45
1.687	−80	138	d.	.....	s. CS_2, et., bz.	46
$1.621\frac{1}{18}^{0°}$	−78	59	d.	.....	d. alc.	47
.....	−30	d. >−20	d.	.....	.....	48

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Sulfur** chloroiodide	SCl_7I	407.18	red-yel. prisms
2	fluoride, hexa-	SF_6	146.06	colorl. gas
3	iodide, hexa-	SI_6	793.58	gray-blk. crysts.
4	oxide, di-	SO_2	64.06	colorl. gas
5	oxide, sesqui-	S_2O_3	112.12	blue-green crysts.
6	oxide, α-tri-	SO_3	80.06	colorl. prisms
7	oxide, β-tri-	$(SO_3)_2$	160.12	colorl., silky needles
8	oxide, hepta-	S_2O_7	176.12	needles or liq.
9	oxytetrachloride, mono-	S_2OCl_4	221.95	dark red liq.
10	oxydichloride, penta-	$SO_3{\cdot}SO_2Cl_2$	215.03	colorl. liq.
11	oxytetrachloride, tri-	$S_2O_3Cl_4$	253.95	rhombic
12	**Sulfuric acid**	H_2SO_4	98.08	colorl. liq.
13	**Sulfuric acid**	$H_2SO_4{\cdot}H_2O$	116.09	prisms or liq.
14	**Sulfuric acid**	$H_2SO_4{\cdot}2H_2O$	134.11	colorl. liq.
15	**Sulfuric acid,** pyro-	$H_2S_2O_7$	178.14	crysts.
16	**Sulfuric** oxychloride (sulfuryl chloride)	SO_2Cl_2	134.97	colorl. liq.
17	oxyfluoride	SO_2F_2	102.06	colorl. gas
18	**Sulfurous** oxybromide (thionyl bromide)	$SOBr_2$	207.89	orange-yellow liq.
19	oxychloride (thionyl chloride)	$SOCl_2$	118.97	colorl. liq.
20	oxyfluoride	SOF_2	86.06	colorl. gas
21	**Tantalum**	Ta	180.88	black-gray, cubic
22	bromide	$TaBr_5$	580.46	yellow crysts.
23	chloride	$TaCl_5$	358.17	light yellow prisms
24	fluoride	TaF_5	275.88	tetragonal
25	nitride	Ta_3N_5	612.68	red, amorph.
26	oxide, di-	Ta_2O_2 (?)	393.76	brown powder
27	oxide, tetra-	Ta_2O_4	425.76	dark gray
28	oxide, penta-	Ta_2O_5	441.76	white, rhombic
29	sulfide	Ta_2S_4	490.00	dark gray
30	**Telluric acid**	H_2TeO_4	193.63	white
31	**Telluric acid**	$H_2TeO_4{\cdot}2H_2O$	229.66	colorl., cubic or monocl.
32	**Tellurium**	Te	127.61	metallic, hex.
33	bromide, di-	$TeBr_2$	287.44	gray needles
34	bromide, tetra-	$TeBr_4$	447.27	orange prisms
35	chloride di-	$TeCl_2$	198.52	black crysts.
36	chloride, tetra-	$TeCl_4$	269.44	yellow, deliq.
37	hydride,	TeH_2	129.63	colorl. gas
38	hydroxide	$Te(OH)_6$	229.66	cubic
39	iodide, di-	TeI_2	381.45	black crysts.
40	iodide, tetra-	TeI_4	635.29	gray crysts.
41	nitrate, basic	$4TeO_2{\cdot}N_2O_5{\cdot}1\frac{1}{2}H_2O$	773.48	rhombic
42	oxide, mono-	TeO	143.61	black, amorph.
43	oxide, di- (tellurite)	TeO_2	159.61	white, tetrag. or rhombic.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
.....	d.	.....	d.	.....	.....	1
liq. 1.91	−55	−62	v. sl. s.	.....	s. KOH; sl. s. alc.	2
5.03(A)	(under press.)					
.....	.....	.....	.....	d.	s. CS_2	3
liq. 1.434$^{0°}$	−75.5	−10.0	22.8°°	4.5$^{50°}$	s. H_2SO_4, alc., ac. a.	4
2.264(A)						
.....	d. 70	.....	d.	.....	d. alc., et.	5
liq. 1.923	16.83	44.6	d.	.....	s. H_2SO_4	6
2.75(A)						
1.97$^{20°}$	50	.....	d.	.....	s. H_2SO_4	7
.....	0	subl. 10	d.	.....	s. H_2SO_4	8
1.656$^{0°}$	.....	60	d.	.....	d. alc., HCl	9
1.837	−37.5	153^{752mm}	d.	.....	d. HBr, HI	10
.....	57d.	subl.	d.	.....	.....	11
1.834$^{1\frac{1}{4}^{0°}}$	10.49	d.340	∞	∞	d. alc.	12
1.842$^{1\frac{1}{4}^{5°}}$	8.62	290	∞	∞	d. alc.	13
1.650$^{1\frac{1}{4}^{0°}}$	−38.9	167	∞	∞	d. alc.	14
1.9$^{20°}$	35	d.	d.	.....	d. alc.	15
1.667$^{\frac{3}{4}^{0°}}$	−54.1	69.1^{760mm}	d.	.....	s. ac. a.; d. alc.	16
.....	−120	−52	10$^{9°}$	.....	s. alk.; i. conc. H_2SO_4	17
2.68$^{18°}$	−50	68^{40mm}	d.	.....	s. bz., CS_2, CCl_4; d. act.	18
1.638	−104.5	78.8	d.	.....	s. bz., chl.	19
liq. 2.93	−110	−30	d.	.....	s. bz., et., $AsCl_3$	20
16.6	2850	>4100	i.	i.	s. fused alk., HF; i. HCl, HNO_3, H_2SO_4	21
4.67	240	320	d.	.....	s. alc., m. alc.	22
3.68$^{27°}$	221	242	d.	.....	s. abs. alc.; d. H_2SO_4	23
4.74	96.8	229.5^{760mm}	s.	.....	s. HF, HCl	24
.....	ign.	.....	i.	.....	s. HNO_3+HF; i. a.	25
7.35	oxidizes	.....	i.	.....	i. HNO_3+HF, a.	26
.....	oxidizes	.....	i.	.....	i. a.	27
8.735$^{0.1\frac{1}{4}^{4°}}$	1470 d.	.....	i.	i.	s. fused $KHSO_4$; i. a.	28
.....	oxidizes	.....	i.	i.	sl. s. HF, HNO_3; i. HCl	29
3.44$^{19.2°}$	d. 160	.....	slowly s.	s.	i. c. a., alk.	30
3.06	−2H_2O, 130	.....	19.7$^{0°}$	258.5$^{100°}$	s. a., alk.; i. alc.	31
(α)6.24	452	1390	i.	i.	s. H_2SO_4, HNO_3, KCN KOH, aq. reg.; i. CS_2	32
(β)6.00						
.....	280	339	d.	.....	sl. s. tart. a.	33
4.31$^{1\frac{1}{4}^{0°}}$	380	421	v. s.	d.excess aq.	s. aq. tart. a.	34
7.05	175	324	d.	.....	d. a., alk.	35
9.2(A)	224	414	d.	.....	s. dil. HCl; i. CS_2	36
2.57$^{-\frac{3}{4}^{0°}}$	−48	0^{760mm}	s.	.....	s. alk., alc.	37
3.053$^{\frac{3}{4}^{0°}}$	.....	.....	.....	.....	.....	38
.....	.....	.....	i.	i.	d. HCl, NH_4Cl	39
8.403$^{1\frac{1}{4}^{8°}}$	259	.....	sl. s.	d.	s. HI; d. alc.	40
.....	−NO, 190	.....	d.	.....	s. HNO_2	41
.....	oxidizes	.....	i.	i.	s. HCl, H_2SO_4	42
tetr. 5.66$^{0°}$ rhomb. 5.89$^{0°}$	.....	subl. 450	0.00067	.....	s. a., alk.; i. CS_2	43

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Tellurium** oxide, tri-	TeO_3	175.61	orange crysts.
2	oxysulfate	$(TeO_2)_2SO_3$	399.28	rhombic
3	**Tellurous acid**	H_2TeO_3	177.63	white, rhombic or monocl.
4	**Terbium**	Tb	159.20	.....
5	chloride	$TbCl_3$	265.57	colorl., needles
6	nitrate	$Tb(NO_3)_3 \cdot 6H_2O$	453.32	monoclinic
7	oxide	Tb_2O_3	366.40	orange, amorph.
8	**Thallium**	Tl	204.39	blue-white, tetrag.
9	acetate	$TlC_2H_3O_2$	263.43	silky needles
10	azide (ous) (nitride)	TlN_3	246.41	pale yel., tetrag.
11	bromide, mono-	TlBr	284.31	pale yel., cubic
12	bromide, di-	$TlBr_2$	364.22	yellow needles
13	bromide, tri-	$TlBr_3 \cdot 4H_2O$	516.20	yellow, deliq.
14	carbonate	Tl_2CO_3	468.79	white, monocl.
15	chlorate	$TlClO_3$	287.85	needles
16	chloride, mono-	TlCl	239.85	white, cubic
17	chloride, sesqui-	Tl_2Cl_3	515.15	yellow, hex.
18	chloride, tri-	$TlCl_3$	310.76	hex. plates
19	chloride, tri-	$TlCl_3 \cdot 4H_2O$	382.83	needles
20	chloroplatinate	Tl_2PtCl_6	816.75	pale orange
21	chromate	Tl_2CrO_4	524.79	yellow crysts.
22	cyanide	TlCN	230.41	plates
23	dichromate	$Tl_2Cr_2O_7$	624.80	red crysts.
24	dithionate	$Tl_2S_2O_6$	568.90	monoclinic
25	ferrocyanide	$Tl_4Fe(CN)_6 \cdot 2H_2O$	1065.55	yellow, tricl.
26	fluoride, mono-	TlF	223.39	colorl., cubic
27	fluoride, tri-	TlF_3	261.39	olive green
28	fluosilicate	$Tl_2SiF_6 \cdot 2H_2O$	586.87	cubic
29	hydroxide (ic), meta-	TlO·OH	237.40	red-brown crysts.
30	hydroxide (ic)	$Tl(OH)_3$	255.41	brown, hex.
31	hydroxide (ous)	Tl(OH)	221.40	pale yellow
32	iodide, mono-	TlI	331.31	yel., rhombic; red, cubic
33	iodide, sesqui-	Tl_2I_3	789.54	black needles
34	iodide, tri-	TlI_3	585.15	black, rhombic
35	nitrate (ic)	$Tl(NO_3)_3 \cdot 3H_2O$	444.46	colorl. crysts.
36	nitrate (ous) (α)	$TlNO_3$	266.40	cubic
37	nitrate (ous) (β)	$TlNO_3$	266.40	trigonal
38	nitrate (ous) (γ)	$TlNO_3$	266.40	rhombic
39	oxide (ic)	Tl_2O_3	456.78	black or brown, hex.
40	oxide (ous)	Tl_2O	424.78	yellow, deliq.
41	perchlorate	$TlClO_4$	303.85	rhombic
42	phosphate	Tl_3PO_4	708.19	white needles
43	phosphate, pyro-	$Tl_4P_2O_7$	991.52	monoclinic
44	selenate	Tl_2SeO_4	551.74	rhombic
45	selenide	Tl_2Se	487.74	dark gray leaflets
46	sulfate (ic)	$Tl_2(SO_4)_3 \cdot 7H_2O$	823.07	leaflets
47	sulfate (ous)	Tl_2SO_4	504.84	colorl., rhombic
48	sulfate, acid	$TlHSO_4$	301.46	trimorphous
49	sulfide (ic)	Tl_2S_3	504.96	black, amorph.
50	sulfide (ous)	Tl_2S	440.84	blue-black, tetrahdrl.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
$5.08^{10.5°}$	d.	.....	i.	i.	s. h. conc. KOH; i. a.	1
4.7	d. 500	.....	d.	.....	.....	2
3.05	$-H_2O$, 40	.....	sl. s.	d.	s. a., alk.	3
.....	.....	.....	.....	.....	.....	4
$4.35^{0°}_{4°}$	588	.....	s.	.....	s. alc.	5
.....	89.3	.....	s.	.....	.....	6
.....	.....	.....	i.	.....	s. dil. a.	7
11.85	303.5	1650	i.	i.	s. HNO_3, H_2SO_4; i. NH_3	8
3.68	110	.....	v. s.	.....	v. s. alc.	9
.....	334	expl. 430	sl. s.	s.	.....	10
$7.557^{17°}_{4°}$	460	815	$0.024^{0°}$	$0.042^{18°}$	i. act.	11
.....	.....	.....	d.	.....	.....	12
.....	40	d. in air	s.	v. s.	v. s. alc.	13
7.11	272	.....	$4.2^{15.5°}$	$27.2^{100°}$	i. et., act., abs. alc.	14
$5.047^{9°}$	.....	.....	$2.8^{0°}$	$57.3^{100°}$	.....	15
7.00	430	806	$0.21^{0°}$	$1.8^{100°}$	sl. s. HCl; i. alc., NH_4OH	16
5.9	400-500	d.	$0.26^{15°}$	$1.9^{100°}$	.....	17
.....	25	d.	v. s.	.....	s. alc., et.	18
.....	37	$-4H_2O$, 100	$86.2^{17°}$	d.	s. alc., et.	19
$5.76^{17°}$	.....	.....	$0.0064^{15°}$	$0.05^{100°}$	.....	20
.....	.....	.....	$0.03^{60°}$	$0.2^{100°}$	sl. s. a., alk.; i. ac. a.	21
.....	d.	.....	$16.8^{28.5°}$	.....	.....	22
.....	.....	.....	i.	.....	d. a., aq. $Na_2S_2O_3$	23
$5.57^{20°}_{4°}$	d.	.....	$41.8^{18.5°}$	.....	.....	24
4.641	.....	.....	$0.37^{18°}$	$3.93^{101°}$	.....	25
.....	.....	298 ±	$80^{15°}$	v. s.	sl. s. alc.; i. NH_3	26
.....	.....	.....	i.	.....	i. c. HCl	27
.....	.....	.....	v. s.	.....	d. NH_4OH	28
.....	$-H_2O$, 115	.....	i.	.....	s. a., NH_4 salts; i. alk.	29
.....	>340	.....	i.	.....	v. s. dil. a.	30
.....	d. 100	.....	$25.4^{0°}$	$148.3^{100°}$	s. alc.	31
$7.09^{14.7°}_{4°}$	440	824	$0.002^{0°}$	$0.120^{100°}$	s. aq. reg.; i. KI, alc., act.	32
.....	.....	.....	i.	.....	sl. s. alc.	33
.....	.....	.....	.....	.....	s. alc., et.	34
.....	d. <100	.....	s.	d. excess aq.	.....	35
.....	206	430	.....	.....	.....	36
.....	tr. to α 145	.....	.....	.....	.....	37
$5.556^{21°}_{4°}$	tr. to β 75	.....	$3.91^{0°}$	$414^{100°}$	s. act.; i. alc.	38
blk. $10.19^{22°}_{4°}$ brn. $9.65^{21°}_{4°}$	759	−2O, 875	i.	i.	s. a.; i. alk.	39
.....	300	−O, 1865	v. s.	v. s.	s. alc.; d. a.	40
4.89	501	d.	$6^{0°}$	$166.6^{100°}$	sl. s. alc.	41
$6.89^{10°}$	.....	.....	$0.5^{15°}$	$0.67^{100°}$	sl. s. NH_4 salts; i. alc.	42
$6.786^{20°}_{4°}$	>120	.....	40	.....	.....	43
6.875	>400	.....	$2.13^{9.3°}$	$10.86^{100°}$	i. alc., et.	44
.....	340	.....	i.	.....	i. a.	45
.....	$-6H_2O$, 200	d.	d.	.....	s. dil. H_2SO_4	46
6.77	632	d.	$2.70^{0°}$	$18.45^{100°}$	.....	47
.....	115 d.	.....	.....	.....	v. sl. s. dil. H_2SO_4	48
.....	12	d.	i.	i.	s. H_2SO_4; i. CS_2	49
8.0	448	d.	$0.022^{20°}$	sl. s.	s. a.; i. alk., act.	50

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Thallium** sulfite (ous)	Tl_2SO_3	488.84	pale yellow crysts.
2	telluride (ous)	Tl_2Te	536.39	.....
3	thiocyanate	TlCNS	262.47	tetrag. needles
4	vanadate	$TlVO_3$	303.34	dark gray crysts.
5	vanadate, pyro-	$Tl_4V_2O_7$	1031.46	.....
6	**Thio** cf. sulfo or sulfur	.....	.....	.....
7	**Thorium**	Th	232.12	cubic
8	boride	ThB_4	275.40	yellow prisms
9	boride	ThB_6	297.04	violet, amorph.
10	bromide	$ThBr_4$	551.78	white crysts.
11	carbide	ThC_2	256.14	yellow crysts.
12	chloride	$ThCl_4$	373.95	colorl., deliq., rhombic
13	fluoride	$ThF_4 \cdot 4H_2O$	380.18	white powder
14	hydroxide	$Th(OH)_4$	300.15	white powder or gelatinous
15	iodide	ThI_4	739.80	unstable, prisms
16	nitrate	$Th(NO_3)_4 \cdot 12H_2O$	696.34	deliquescent
17	oxalate	$Th(C_2O_4)_2$	408.16	white crysts.
18	oxide, di- (thorianite)	ThO_2	264.12	white, cubic
19	oxide, per-	Th_2O_7	576.24	white, gelatinous
20	platinocyanide	$Th[Pt(CN)_4]_2 \cdot 16H_2O$	1118.98	yellow-green, rhombic
21	sulfate	$Th(SO_4)_2$	424.24	.....
22	sulfate	$Th(SO_4)_2 \cdot 9H_2O$	586.38	monocl. prisms
23	sulfide	ThS_2	296.24	yellow, black or brown
24	**Thullium**	Tm	169.40	.....
25	**Tin**	Sn	118.70	silvery metal, tetrag.
26	**Tin** *	Sn	118.70	rhombic; stable >170°
27	**Tin**	Sn	118.70	gray, cubic (?)
28	**Tin salts** cf. stannic and stannous	.....	.....	.....
29	**Titanic acid**	H_2TiO_3	97.92	white powder
30	**Titanium**	Ti	47.90	dark gray, cubic
31	bromide, tetra-	$TiBr_4$	367.56	amber yellow, deliq.
32	carbide	TiC	59.91	metallic, cubic
33	chloride, di-	$TiCl_2$	118.81	black, deliq.
34	chloride, tri-	$TiCl_3$	154.27	violet, deliq.
35	chloride, tetra-	$TiCl_4$	189.73	colorl. liq.
36	fluoride, tri-	TiF_3	104.90	violet-red
37	fluoride, tetra-	TiF_4	123.90	white powder
38	iodide, tetra-	TiI_4	555.58	red, cubic
39	nitrate	$5TiO_2 \cdot N_2O_5 \cdot 6H_2O$	615.61	plates
40	oxalate	$Ti_2(C_2O_4)_3 \cdot 10H_2O$	540.02	yellow prisms
41	oxide, di- (anatase)	TiO_2	79.90	brown or black, tetrag.

* Mason and Pellissier reported recently the non-existence of this modification.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
$6.416^{20°}$	.....	.....	$3.34^{15°}$	v. s.	i. alc.	1
.....	412	.....	i.	.....	d. a.	2
.....	.....	.....	$0.315^{20°}$	$0.727^{40°}$	i. alc.	3
$6.09^{17°}$	424	.....	$0.0087^{11°}$	$0.021^{100°}$	.....	4
$8.21^{18.5°}_{4}$	454	.....	$0.02^{0°}$	$0.026^{100°}$	.....	5
.....	.....	.....	.....	.....	.....	6
11.2	1845	>3000	i.	i.	s. HCl, H_2SO_4; sl. s. HNO_3; i. HF, alk.	7
$7.5^{15°}$	.....	.....	i.	i.	s. HCl, HNO_3, h. H_2SO_4	8
$6.4^{15°}$	.....	.....	i.	i.	s. HNO_3; i. HCl, H_2SO_4, HF, aq. alk.	9
5.67	subl. 610	725	s.	d.	d. F_2	10
8.96	ign.	5000	d.	.....	v. sl. s. conc. a.; d. dil. a.	11
4.59	820	.....	v. s.	v. s.	s. KCl, alc., et.	12
.....	$-H_2O$, 100	$-2H_2O$, 150	i.	i.	i. HF	13
.....	d.	.....	i.	i.	s. a.; i. $H_2C_2O_4$, HF, NH_4OH, alk.	14
.....	d.	.....	s.	.....	.....	15
.....	.....	.....	v. s.	.....	v. s. alc.	16
$4.637^{16°}$	d.	.....	i.	.....	s. h. aq. $(NH_4)_2C_2O_4$	17
9.69	>2800	4400	i.	.....	s. h. H_2SO_4; i. alk.	18
.....	.....	.....	i.	.....	.....	19
2.460	.....	.....	sl. s.	s.	.....	20
$4.225^{17°}$	.....	.....	$0.74^{0°}$	$5.22^{50°}$	.....	21
2.77	$-9H_2O$, 400	.....	v. sl. s.	sl. s.	.....	22
6.8	d.	ign. in air	i.	i.	s. h. aq. reg.; sl. s. a.	23
.....	.....	.....	i.	i.	.....	24
7.31	231.85	2260	i.	i.	s. HCl, H_2SO_4, dil. HNO_3, h. KOH	25
6.53-6.56	231.9	2260	i.	i.	s. a., h. alk.	26
5.750	stable -163 to $+18$	2260	i.	i.	s. a., h. alk.	27
.....	.....	.....	.....	.....	.....	28
.....	.....	.....	i.	i.	s. alk.; v. sl. s. dil. a.; i. alc.	29
$4.50^{17.5°}$	1800	>3000	i.	d.	s. a.	30
2.6	39	230	d.	.....	s. abs. alc., abs. et.	31
$4.25^{\frac{20}{4}0°}$	3180	4300	.....	.....	s. HNO_3; i. HCl	32
.....	unstable in air	.....	d.	.....	i. CS_2, et., chl.	33
.....	d. 440	.....	s.	s.	.....	34
liq. 1.726	-30	136.4	s.	d.	s. dil. HCl	35
.....	.....	.....	s.	d.	.....	36
$2.798^{20.5°}$	.....	284	s.	.....	s. H_2SO_4, C_5H_5N, alc.; i. et.	37
.....	150	>360	v. s.	d.	HI forms H_2TiI_6	38
.....	.....	.....	s.	d.	.....	39
.....	.....	.....	s.	s.	i. alc., et.	40
3.84	.....	.....	i.	i.	.....	41

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Titanium** oxide, di- (brookite)	TiO_2	79.90	brown or black, rhombic
2	oxide, di- (rutile)	TiO_2	79.90	colorl. if pure, tetrag.
3	oxide, per-	TiO_3	95.90	yellow
4	oxide, sesqui-	Ti_2O_3	143.80	black or red, trig.
5	phosphide	TiP	78.88	gray metallic
6	sulfate	$Ti_2(SO_4)_3$	383.98	green, deliq.
7	**Tungsten**	W	183.92	gray-black, cubic
8	arsenide	WAs_2	333.74	black crysts.
9	boride	WB_2	205.56	octahdrl.
10	bromide, di-	WBr_2	343.75	blue-black powder
11	bromide, penta-	WBr_5	583.50	violet-brown needles
12	carbide	WC	195.93	gray powder cubic
13	carbide	W_2C	379.85	iron gray
14	chloride, di-	WCl_2	254.83	gray, amorph.
15	chloride, tetra-	WCl_4	325.75	gray-brown, deliq.
16	chloride, penta-	WCl_5	361.21	dark green, deliq.
17	chloride, hexa-	WCl_6	396.66	dark blue, cubic
18	fluoride	WF_6	297.92	colorl. gas
19	iodide	WI_2	437.76	brown powder
20	oxide, di-	WO_2	215.92	cubic, brown
21	oxide, tri-	WO_3	231.92	yellow, rhombic
22	oxide, tri- (tungstite)	$WO_3 \cdot H_2O$	249.94	yellow, rhombic
23	oxydibromide	WO_2Br_2	375.75	red prisms
24	oxydichloride	WO_2Cl_2	286.83	yellow tablets
25	oxytetrabromide	$WOBr_4$	519.58	deliq., black
26	oxytetrachloride	$WOCl_4$	341.75	red needles
27	oxytetrafluoride	WOF_4	275.92	colorl. plates
28	phosphide	W_4P_2	797.64	dark gray
29	phosphide	WP	214.90	gray prisms
30	phosphide	WP_2	245.88	black crysts.
31	silicide	W_2Si_3	452.02	metallic gray
32	sulfide, di- (tungstenite)	WS_2	248.04	dark gray, crysts.
33	sulfide, tri-	WS_3	280.10	black powder
34	**Tungstic acid** (tungstite)	H_2WO_4	249.94	yellow, rhombic
35	**Uranic acid**	H_2UO_4	304.09	yellow powder
36	**Uranium**	U	238.07	white, crysts.
37	bromide, tri-	UBr_3	477.82	dark brown needles

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
4.17	.....	.....	i.	i.	.....	1
4.26	1640d.	<3000	i.	i.	s. H_2SO_4, alk.	2
.....	.....	.....	.....	.....	s. a.	3
4.6	2130	oxidizes	i.	i.	s. H_2SO_4; i. HCl, HNO_3	4
$3.95^{\frac{25}{4}°}$	.....	.....	i.	i.	i. a.	5
.....	.....	.....	i.	i.	s. dil. a.; i. alc., et.	6
19.3	3370	5900	i.	i.	s. h. conc. KOH; sl. s. NH_3, HNO_3, aq. reg.	7
$6.91^{18°}$	.....	.....	i.	i.	d. h. HNO_3, h. H_2SO_4	8
10.8	.....	.....	i.	i.	s. aq. reg.	9
.....	d. 400	.....	forms WO_2	.....	.....	10
.....	276	333	d.	.....	s. HCl, alk., abs. alc., et., chl.	11
$15.71^{18°}$	2777	6000	i.	i.	s. F_2; i. a.	12
$16.061^{18°}$	2877	6000	i.	i.	s. h. HNO_3; sl. s. HCl, H_2SO_4	13
.....	unstable in air	.....	d.	.....	.....	14
4.624	d.	.....	d.	.....	.....	15
3.875	248	275.6	forms W_2O_5	.....	v. sl. s. CS_2	16
3.52	275	346.7	.....	$d.^{60°}$	v. s. CS_2, $POCl_3$	17
10(D); 1(A)	2.5	19.5	d.	.....	.....	18
$6.91^{18°}$	.....	.....	i.	d.	s. alk.carb.; i. alc., CS_2; d. fused KOH	19
12.11	ign. in air	.....	i.	i.	s. a., KOH	20
7.16	>2130	.....	i.	i.	s. alk.; i. a.	21
5.5	1473	.....	i.	.....	s. alk., HF	22
.....	.....	d.	.....	.....	.....	23
.....	266	.....	s.	d.	s. alk.; d. NH_3	24
.....	277	327	d.	.....	.....	25
11.92(A)	211	227.5	d.	.....	s. CS_2, S_2Cl_2; sl. s. bz.	26
.....	110	187	d.	.....	.....	27
5.21	oxidizes at red heat	.....	.....	.....	s. fused Na_2CO_3 + $NaNO_3$; i. a., aq. reg.	28
8.5	ign. in air	.....	i.	.....	s. HNO_3 + HF; i. HCl, alk.	29
5.8	d.	.....	i.	i.	s. HNO_3 + HF, aq. reg.; i. HCl, HF, alc., et.	30
10.9	.....	.....	i.	.....	i. a.; d. Cl_2	31
$7.51^{0°}$	d. 1250	.....	.....	.....	s. fused alk., HNO_3 + HF	32
.....	.....	.....	sl. s.	s.	s. alk., alk. sulf.	33
5.5	$-\frac{1}{2}H_2O$, 100; 1473	.....	i.	sl. s.	s. HF, alk., NH_3	34
$5.926^{15°}$	$-H_2O$, 250–300	.....	i.	i.	s. a., alk. carb; i. alk.	35
$18.485^{\frac{18}{4}°}$	<1850	3500	i.	i.	s. a.; i. alk.	36
.....	.....	volatile	s.	.....	.....	37

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Uranium** bromide, tetra-	UBr_4	557.73	black, deliq.
2	carbide	U_2C_3	512.14	crystalline
3	chloride, tri-	UCl_3	344.44	dark red needles
4	chloride, tetra-	UCl_4	379.90	gray, deliq., cubic
5	chloride, penta-	UCl_5	415.36	gray, deliq. need.
6	fluoride, tetra-	UF_4	314.07	green powder
7	fluoride, hexa-	UF_6	352.07	yellow, monocl.
8	iodide, tetra-	UI_4	745.75	black needles
9	oxide, di- (uraninite)	UO_2	270.07	black, rhombic
10	oxide (pitchblende)	U_3O_8	842.21	olive green
11	oxide, tri-	UO_3	286.07	yellow powder
12	oxide, per-	$UO_4 \cdot 2H_2O$	338.10	yellow crysts.; hygroscopic
13	sulfate (ous)	$U(SO_4)_2 \cdot 4H_2O$	502.25	green, rhombic
14	sulfide, di-	US_2	302.19	gray
15	sulfide, sesqui-	U_2S_3	572.32	gray black
16	**Uranyl** acetate	$UO_2(C_2H_3O_2)_2 \cdot 2H_2O$	424.19	yellow, rhombic
17	ammonium carbonate	$UO_2CO_3 \cdot 2(NH_4)_2CO_3$	522.26	yellow crysts.
18	bromide	UO_2Br_2	429.90	yel.-green needles
19	carbonate (rutherfordine)	UO_2CO_3	330.08	tetragonal
20	chloride	UO_2Cl_2	340.98	yellow, deliq.
21	formate	$UO_2(HCO_2)_2 \cdot H_2O$	378.12	.....
22	iodate	$UO_2(IO_3)_2$	619.91	yellow, rhombic
23	iodate	$UO_2(IO_3)_2 \cdot H_2O$	637.93	rhombic
24	iodide	UO_2I_2	523.91	red, deliq.
25	nitrate	$UO_2(NO_3)_2 \cdot 6H_2O$	502.18	yellow, rhombic
26	perchlorate	$UO_2(ClO_4)_2 \cdot 4H_2O$	541.05	.....
27	phosphate	$UO_2(HPO_4) \cdot 4H_2O$	438.12	yellow, tetrag.
28	potassium carbonate	$UO_2CO_3 \cdot 2K_2CO_3$	606.50	yellow crysts.
29	sodium carbonate	$UO_2CO_3 \cdot 2Na_2CO_3$	542.09	yellow crysts.
30	sulfate	$UO_2SO_4 \cdot 3H_2O$	420.18	yellow crysts.
31	sulfide	UO_2S	302.13	black, tetrag.
32	**Vanadic acid,** meta-	HVO_3	99.96	yellow scales
33	**Vanadic acid,** pyro-	$H_4V_2O_7$	217.93	pale, yel., amorph
34	**Vanadium**	V	50.95	light gray, cubic
35	bromide, tri-	VBr_3	290.70	dark gray, deliq.
36	carbide	VC	62.96	cryst. mass
37	chloride, di-	VCl_2	121.86	green hexagonal, deliq.
38	chloride, tri-	VCl_3	157.23	pink, tabular, deliq.
39	chloride, tetra-	VCl_4	192.78	red liquid
40	fluoride, tri-	VF_3	107.95	green, rhombic
41	fluoride, tri-	$VF_3 \cdot 3H_2O$	162.00	dark green, rhombic
42	fluoride, penta-	VF_5	145.95	colorl. or yel.
43	nitride	VN	64.96	brown
44	oxide, di-	V_2O_2	133.90	light gray crysts.
45	oxide, tri-	V_2O_3	149.90	black crysts.
46	oxide, tetra-	V_2O_4	165.90	blue crysts.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
$4.838^{21°}$	.....	volatile	s.	s.	s. act.; i. alc., et.	1
11.28	2400	.....	d.	.....	d. a.	2
$5.440^{\frac{0}{4}°}$	.....	.....	v. s.	d.	s. HCl, ac. a.	3
$4.725^{\frac{0}{4}°}$	.....	.....	v. s.	d.	s. act., alc., NH_4Cl; i. et.	4
.....	d. 120	.....	d.	.....	s. act., abs. alc., a.; i. et., bz.	5
.....	1000	.....	i.	.....	s. conc. a.; i. dil. a.	6
$4.68^{21°}$	69.2^{2atm}	56.2^{765mm}	s.	.....	s. chl., CCl_4; i. CS_2	7
$5.6^{15°}$	volt. 500 (vac.)	.....	s.	s. d.	.....	8
10.9	2176	.....	i.	i.	s. HNO_3, conc. H_2SO_4	9
7.31	d.	.....	i.	i.	s. HNO_3, H_2SO_4	10
7.29	d.	.....	i.	.....	s. HNO_3; i. K tart.	11
.....	d. 115	.....	$0.0006^{20°}$	$0.008^{90°}$	d. HCl	12
.....	$-4H_2O$, 300	.....	d.	.....	s. dil. a.	13
.....	>1100	oxidizes	d.	.....	s. conc. HCl; d. HNO_3	14
.....	ignites	.....	.....	.....	oxidized by aq. reg.; i. HCl, dil. HNO_3	15
$2.89^{15°}$	$-2H_2O$, 110	.....	$81^{5°}$	d.	v. s. alc.	16
.....	d.	.....	$5.55^{18.6°}$	d.	s. $(NH_4)_2CO_3$, aq. SO_2	17
.....	.....	.....	s.	.....	s. alc., et.	18
5.6	.....	.....	.....	.....	.....	19
.....	.....	d.	$320^{18°}$	v. s.	s. alc., et.	20
$3.69^{19°}$	d. 110	.....	$420^{15°}$	.....	.....	21
5.2	d. 250	.....	.....	.....	i. HNO_3	22
$5.05^{18°}$	.....	.....	$0.1214^{18°}$	$0.237^{100°}$	sl. s. dil. HNO_3	23
.....	d. in air	.....	.....	.....	s. alc., et., bz.	24
2.807	60.2	118	$170.3^{0°}$	$\infty^{60°}$	v. s. ac. a., alc., et.; i. dil. alk.	25
.....	110 d.	.....	.....	.....	.....	26
.....	.....	.....	i.	i.	s. aq. Na_2CO_3; i. ac. a.	27
.....	$-CO_2$, 300	.....	$7.4^{15°}$	d.	s. aq. K_2CO_3; i. alc.	28
.....	.....	.....	sl. s.	.....	i. alc.	29
$3.28^{16.5°}$	d. 100	.....	$18.9^{13.2°}$	$20.5^{15.5°}$	4, alc.; s. a.	30
.....	d. 40-50	oxidizes in air >180	sl. s.	s. d.	s. alc., dil. a.; i. abs. alc.; d. aq. alk.	31
.....	.....	.....	i.	.....	s. a., alk.; i. NH_3	32
.....	.....	.....	i.	.....	s. a., alk., NH_4OH	33
5.96	1710	3000	i.	i.	s. HNO_3, H_2SO_4; i. aq. alk.	34
.....	oxidizes	.....	s.	.....	s. alc., et.; i. HBr	35
5.36	2830	3900	i.	.....	s. HNO_3, fused KNO_3; i. HCl, H_2SO_4	36
$3.23^{18°}$	.....	.....	s.	d.	s. alc., et.	37
$3.00^{18°}$	d.	.....	s.	d.	s. abs. alc., et.	38
$1.816^{100°}$	−109	148.5^{755mm}	s. d.	.....	s. abs. alc., et., chl., ac. a.	39
$3.363^{19°}$	>800	subl.	v. sl. s.	sl. s.	i. alc., chl., CS_2	40
.....	$-3H_2O$, 130	.....	s.	v. s. d.	i. abs. alc.	41
$2.177^{19°}$	.....	111.2	s.	.....	s. alc., chl.; i. CS_2	42
5.63	2050 d.	.....	i.	.....	.....	43
3.64	ign.	.....	i.	i.	s. a.	44
$4.87^{\frac{1}{4}°}$	1970	.....	sl. s.	s.	s. HNO_3, HF, alk.	45
4.399	1967	.....	i.	i.	s. a., alk.	46

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Vanadium** oxide, penta-	V_2O_5	181.90	reddish yel., rhombic
2	oxychloride, mono-	VOCl	102.41	brown powder
3	silicide	VSi_2	107.07	metallic prisms
4	silicide	V_2Si	129.96	si.very prisms
5	sulfide, di-	V_2S_2	166.02	black plates
6	sulfide, tri-	V_2S_3	198.08	black plates
7	sulfide, penta-	V_2S_5	262.20	black powder
8	**Vanadyl** bromide, mono-	VOBr	146.87	violet, octahdrl.
9	bromide, di-	$VOBr_2$	226.78	yel. brown, deliq.
10	bromide, tri-	$VOBr_3$	306.70	red liquid
11	chloride	$(VO)_2Cl$	169.36	yellow crysts.
12	chloride, di-	$VOCl_2$	137.86	green, deliq.
13	chloride, tri-	$VOCl_3$	173.32	yellow liquid
14	sulfate (minasragrite)	$V_2O_4(SO_3)_3 \cdot 16H_2O$	694.34	blue, monocl. or tricl.
15	**Water***	H_2O	18.02	colorl. liquid
16	**Xenon**	Xe	131.30	colorl. gas
17	**Ytterbium**	Yb	173.04	.....
18	acetate	$Yb(C_2H_3O_2)_3 \cdot 4H_2O$	422.24	hexagonal plates
19	carbonate	$Yb_2(CO_3)_3 \cdot 4H_2O$	598.17	gelatinous
20	chloride	$YbCl_3 \cdot 6H_2O$	387.51	green, rhombic
21	nitrate	$Yb(NO_3)_3 \cdot 4H_2O$	431.13	deliq. crysts.
22	oxalate	$Yb_2(C_2O_4)_3 \cdot 10H_2O$	790.30	crystals
23	oxide	Yb_2O_3	394.08	colorless
24	selenate	$Yb_2(SeO_4)_3 \cdot 8H_2O$	919.09	hexagonal plates
25	selenite	$Yb_2(SeO_3)_3$	726.96	.....
26	sulfate	$Yb_2(SO_4)_3$	634.26	.....
27	sulfate	$Yb_2(SO_4)_3 \cdot 8H_2O$	778.39	prisms
28	**Yttrium**	Y	88.92	dark gray, hex.
29	bromate	$Y(BrO_3)_3 \cdot 9H_2O$	634.81	hex. prisms
30	bromide	YBr_3	328.67	.....
31	bromide	$YBr_3 \cdot 9H_2O$	490.81	deliq. tablets
32	carbonate	$Y_2(CO_3)_3 \cdot 3H_2O$	411.92	.....
33	chloride	YCl_3	195.29	white plates
34	chloride	$YCl_3 \cdot H_2O$	213.31	.....
35	chloride	$YCl_3 \cdot 6H_2O$	303.39	deliq., rhombic
36	fluoride	$YF_3 \cdot \frac{1}{2}H_2O$	154.93	white, gelatinous
37	hydroxide	$Y(OH)_3$	139.94	white, gelatinous
38	iodide	YI_3	469.68	deliquescent
39	molybdate	$Y_2(MoO_4)_3$	657.69	yellow, tetrag.
40	nitrate	$Y(NO_3)_3 \cdot 3H_2O$	328.99	prisms
41	nitrate	$Y(NO_3)_3 \cdot 6H_2O$	383.04	triclinic
42	oxalate	$Y_2(C_2O_4)_3 \cdot 9H_2O$	604.04	white powder
43	oxide	Y_2O_3	225.84	white crysts.
44	sulfate	$Y_2(SO_4)_3$	466.02	colorless
45	sulfate	$Y_2(SO_4)_3 \cdot 8H_2O$	610.15	colorl., monocl.
46	**Zinc**	Zn	65.38	silvery metal, hex.
47	acetate	$Zn(C_2H_3O_2)_2$	183.47	monoclinic

*See also special tables on Water and on Steam.

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
$3.357^{\frac{18}{4}°}$	800	d. 1750	$0.8^{20°}$	.....	s. a., alk.; i. abs. alc.	1
2.824	.....	.....	i.	.....	v. s. HNO_3	2
4.42	1655	.....	i.	i.	s. HF; i. a., alk., alc., et	3
$5.48^{17°}$	.....	.....	i.	i.	s. HF; i. alc., et., a.	4
4.20	oxidizes	.....	.....	.....	s. HNO_3, h. H_2SO_4; sl. s. KSH; i. alk.	5
$4.7^{21°}$	oxidizes	.....	.....	.....	s. h. conc. H_2SO_4, alk. sulf.; sl. s. alk.	6
3.00	oxidizes	.....	.....	.....	s. alk., alk. sulf., dil. HNO_3	7
$4.00^{18°}$	d. 480	.....	v. sl. s.	.....	.....	8
.....	d. 360	.....	s.	.....	.....	9
$2.933^{14.5°}$	d. 180	130^{100mm}	s.	.....	.....	10
3.64	d. in air	.....	i.	.....	s. HNO_3	11
$2.88^{13°}$	.....	.....	d.	.....	s. abs. alc., dil. HNO_3	12
1.829	<−15	127.19	s. d.	.....	s. alc., et., ∞ Br_2	13
.....	.....	.....	v. s.	d.	s. alc.	14
$1.00^{4°}$ **	0	100^{760mm}	.....	.....	∞ alc.; sl. s. et.	15
$2.7^{-140°}$ liq. $3.06^{-109.1°}$	−140	−109.1	$28.4^{17°}$cc.	.....	.....	16
4.53 (A)						
.....	.....	.....	.....	.....	.....	17
2.09	$-4H_2O$, 100	.....	v. s.	v. s.	.....	18
3.67	.....	.....	.....	.....	.....	19
2.575	150-5	$-6H_2O$, 180	v. s.	v. s.	s. abs. alc.	20
2.682	.....	.....	.....	.....	.....	21
2.644	.....	.....	0.000583	.....	sl. s. dil. a.	22
9.175	.....	.....	i.	i.	s. h. dil. a.	23
3.30	.....	.....	s.	.....	.....	24
.....	.....	.....	i.	.....	.....	25
3.793	d. 900	.....	$44.2^{20°}$	$4.67^{100°}$	.....	26
3.286	.....	.....	s.	.....	.....	27
5.51	1490	2500	sl.d.	d.	v. s. dil. a., h. KOH	28
.....	74	$-6H_2O$, 100	$168^{25°}$	.....	sl. s. alc.; i. et.	29
.....	.....	.....	v. s.	.....	s. alc.; i. et.	30
.....	.....	.....	v. s.	.....	s. alc.; i. et.	31
.....	$-H_2O$, 100	$-3H_2O$, 130	i.	.....	s. a., aq. $(NH_4)_2CO_3$; sl. s. aq. CO_2	32
$2.8^{\frac{18}{4}°}$	<686	.....	v. s.	.....	$60^{15°}$ abs. alc.	33
.....	160	d. 170-80	v. s.	.....	.....	34
$2.18^{18°}$	$-5H_2O$, 110	.....	v. s.	v. s.	sl. s. alc.; i. et.	35
.....	.....	.....	i.	.....	v. sl. sl. dil. a.	36
.....	d.	.....	i.	i.	s. a., NH_4Cl; i. alk.	37
.....	.....	.....	v. s.	.....	s. alc.; sl. s. et.	38
$4.79^{\frac{18}{4}°}$	1347	.....	.....	.....	.....	39
2.682	.....	.....	s.	.....	s. HNO_3	40
.....	$-3H_2O$, 100	.....	$142^{25°}$	.....	v. s. alc., et.	41
.....	d.	.....	0.000137	.....	sl. s. HCl	42
4.84	2410	4300^{760mm}	i.	i.	s. a.; i. alk.	43
2.6:2	d. 1000	.....	15.2	$5.38^{25°}$	s. satd. aq. K_2SO_4	44
2.558	$-8H_2O$, 450	d. 700	9.3	$4.6^{100°}$	v. sl. s. H_2SO_4; i. alc.	45
7.140	419.4	907	i.	i.	s. a., ac. a., alk.	46
1.840	242	subl. in vac.	$30^{25°}$	$44.6^{100°}$	$2.8^{25°}$, $166^{79°}$ alc.	47

**Sp. gr. of ice $0.917^{\frac{0}{0}°}$

	Name	Formula	Formula Weight	Crystalline Form and Color
1	**Zinc** sulfate	$ZnSO_4 \cdot H_2O$	179.46	colorl.
2	sulfate	$ZnSO_4 \cdot 6H_2O$	269.54	monoclinic
3	sulfate (goslarite)	$ZnSO_4 \cdot 7H_2O$	287.55	rhombic
4	sulfide (α) (wurzite)	ZnS	97.44	white, hex.
5	sulfide (β) (sphalerite)	ZnS	97.44	white, cubic
6	sulfide (blende)	ZnS	97.44	white, granular
7	sulfite	$ZnSO_3 \cdot 2\frac{1}{2}H_2O$	190.48	monoclinic
8	telluride	ZnTe	192.99	dark red, cubic
9	**Zirconium**	Zr	91.22	cubic
10	bromide	$ZrBr_4$	410.88	white, cryst. powder
11	carbide	ZrC	103.23	metallic gray
12	chloride	$ZrCl_4$	233.05	white crysts.
13	fluoride	ZrF_4	167.22	white, hex.
14	hydroxide	$Zr(OH)_4$	159.25	white, gelatinous
15	iodide	ZrI_4	598.90	yellow cryst. powder
16	nitrate	$Zr(NO_3)_4 \cdot 5H_2O$	429.33	deliq. prisms
17	oxalate, basic	$Zr(C_2O_4)_2 \cdot 2Zr(OH)_4$	585.76	.....
18	oxide, di- (baddeleyite)	ZrO_2	123.22	yellow or brown, monocl.
19	oxide, di- (free from Hf)	ZrO_2	123.22	white, monocl.
20	oxybromide	$ZrOBr_2 \cdot 8H_2O$	411.18	deliq., tetrag.
21	oxychloride	$ZrOCl_2 \cdot 8H_2O$	322.26	colorl., tetrag.
22	oxyiodide	$ZrI(OH)_3 \cdot 3H_2O$	323.21	amorphous
23	oxyiodide	$ZrOI_2 \cdot 8H_2O$	505.19	colorl. needles
24	sulfate	$Zr(SO_4)_2 \cdot 4H_2O$	355.40	rhombic

Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts			
			Cold Water	Hot Water	Other Reagents	
$3.28^{16.5°}_{4}$	d. 238	.....	s.	$89.5^{100°}$	.....	1
$2.072^{15°}_{4}$	tr. 70 to $1H_2O$	.....	s.	.....	sl. s. alc.; i.act., NH_3	2
$1.966^{16.5°}$	tr. 39	$-7H_2O$, 280	$115.2^{20°}$	$653.6^{100°}$	sl. s. alc.; i. act., NH_3	3
4.087	1850^{150atm}	subl. 1185	$0.00069^{18°}$	i.	v. s. a.; i. ac. a.	4
$4.102^{25°}_{4}$	tr. 1020	.....	.....	.....	.....	5
4.04	.....	.....	i.	i.	v. s. a.; i. ac. a.	6
.....	$-2½H_2O$, 100	d. 200	0.16	d.	s. H_2SO_3, NH_4OH; i. alc.	7
$5.54^{12°}_{4}$	1238.5	.....	i.	.....	d. dil. HCl, dil. HNO_3	8
6.4	1700	>2900	i.	i.	s. HF, aq. reg.; sl. s. a.	9
.....	.....	.....	d.	.....	s. et.; d. alc.	10
.....	.....	5100	i.	i.	s. dil. HF, HNO_3	11
2.8	.....	subl. >300	s.	forms $ZrOCl_2$	s. HCl, alc., et.; i. liq. Cl_2	12
4.43	subl.	.....	1.39	d.	s. HF	13
3.25	$-2H_2O$, 550	.....	0.02	i.	s. a.; i. alc., alk., NH_4OH	14
.....	.....	.....	s.	s.	s. a., abs. et.; sl. s. bz., CS_2	15
.....	d. 100	.....	s.	d.	.....	16
.....	d.	.....	i.	.....	s. $(NH_4)_2C_2O_4$	17
5.49	2700	.....	i.	i.	s. H_2SO_4, HF	18
5.73	.....	4300	i.	i.	s. H_2SO_4, HF	19
.....	d. 100	.....	s.	.....	s. h. conc. HCl	20
.....	.....	.....	s.	d.	s. h. conc. HCl, alc.	21
.....	.....	.....	v. s.	.....	s. alc.	22
.....	d.	.....	v. s.	v. s.	v. s. alc.	23
.....	$-4H_2O$, 380	.....	$110.6^{18°}$	$146^{39.5°}$	s. H_2SO_4; i. alc.	24

SHORT GLOSSARY OF ORGANIC CHEMISTRY NOMENCLATURE

The following rules for naming organic compounds and the examples given in explanation are not intended to cover all of the possible cases. For a more comprehensive and detailed description see Beilstein: *Handbuch der Organischen Chemie*, 4th edition, and Patterson: *Definitive Report of the Commission on the Reform of the Nomenclature of Organic Chemistry*, *Jour. Am. Chem. Soc. 55, 3905* (1933); *News Edition, Ind. Eng. Chem. 14, 486* (1936).

HYDROCARBONS—The saturated open-chain hydrocarbons (C_nH_{2n+2}) have names ending in *ane*. The first four are: *methane* (CH_4); *ethane* (C_2H_6); *propane* (C_3H_8); and, *butane* (C_4H_{10}). Beginning with *pentane* (C_5H_{12}) the prefix (*e.g. penta*) indicates the number of carbon atoms; for example, octane, C_8H_{18}; nonatriacontane, $C_{39}H_{80}$. See special table of *Numerical Prefixes*. Saturated monocyclic hydrocarbons (C_nH_{2n}) have the corresponding names of the open-chain hydrocarbons (C_nH_{2n+2}) preceded by the prefix *cyclo;* for example, cyclopropane (C_3H_6); cyclopentane (C_5H_{10}). The straight (unbranched) chains are termed *normal* (abbreviated: *n*); the grouping $(CH_3)_2CH-$ in a chain is termed *iso;* for example, $CH_3(CH_2)_2CH_3$ is *n*-butane; $(CH_3)_2CHCH_3$ is *iso*-butane. Branched-chain hydrocarbons are often named as derivatives of some relatively simple hydrocarbon by stating what radicals* are attached to the simple hydrocarbon; for example, $CH_3\mathbf{C}H_2CH_2CH_3$, which is *n*-butane, may also be named: methyl-ethyl-methane since a methyl radical (CH_3) and an ethyl radical (C_2H_5) are replacing the two hydrogen atoms of the original methane molecule, the carbon atom of which is printed in bold face type. Similarly $(CH_3)_2\mathbf{C}HCH_3$, which is *iso*-butane, would be named trimethyl-methane, the carbon atom printed in bold face type being the methane carbon atom corresponding to this name. In this system of naming, a compound might be given any one of several names depending upon which carbon atom is selected; for example, $CH_3CH_2CH_2CH_2CH_3$ might be given any one of the following names: diethyl-methane; methyl-propyl-methane; butyl-methane.

In 1892 an international congress of chemists assembled in Geneva, Switzerland, to devise a uniform and scientific system of nomenclature. This *Geneva system* with modifications proposed at various times is the modern *systematic naming*. According to this system a hydrocarbon is named as a derivative of the normal compound corresponding to the longest chain of carbon atoms in the molecule. The word *normal* is usually omitted, but implied, so that the simple unqualified systematic name always means the compound with the normal constitution; for example, *n*-butane, $CH_3CH_2CH_2CH_3$, is simply butane; iso-butane, $(CH_3)_2CHCH_3$, is 2-methyl-propane. The numeral 2 placed before** the word *methyl* indicates that the methyl radical is attached to the second carbon atom in the longest chain which, in this example, is of three carbons in length and, therefore, a propane. In cases where several different side chains are attached the order of stating them is either according to increasing complexity (e.g., methyl, then ethyl, then propyl, followed by butyl, etc.) or, according to alphabetical order (e.g., butyl, then ethyl, then methyl, followed by propyl, etc.) Where branching occurs in a side chain and for other cases of ambiguity, or if a simpler name would result, then a chain is selected as the fundamental unit which admits of the maximum of substitutions. A detailed discussion of this and other exceptions caused by very complicated structures is beyond the scope of this exposition and the reader is referred to the references given below the title of this section.

UNSATURATED HYDROCARBONS AND UNSATURATION—Hydrocarbons with one double bond (C_nH_{2n}) are named by adding the suffix *ene* to the name of the corresponding alkyl radical (C_nH_{2n+1})*; for example, $CH_2{:}CH_2$ is ethylene; $CH_3CH{:}CH_2$ is propylene. Just as the saturated hydrocarbons may be named as

*See Radicals in this section and also a special section Names and Formulas of Organic Radicals.

**The numbering is such that the lowest numbers are obtained; e.g., $CH_3CH_2CH_2CH(CH_3)_2$ is 2-methylpentane and not 4-methylpentane. Usage varies as to the position in the word for the numerals not only in the case of the hydrocarbons but also with other types such as alcohols, aldehydes, ketones, etc. Some writers place them before, some after, the parts of the name to which they refer. In Beilstein a combination is used wherein numbers placed after are enclosed in parenthesis and those placed before are not; e.g., primary isobutyl alcohol is named: 2-methyl-butanol-(4).

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derivatives of methane, so these C_nH_{2n} hydrocarbons may be named as derivatives of ethylene; for example, $CH_3CH{:}CHCH_3$ which is a butylene, may also be named *sym*-dimethyl-ethylene since two methyl radicals (CH_3) are replacing two hydrogen atoms of the original ethylene molecule, the carbon atoms of which are printed in bold face type. Similarly $(CH_3)_2C{:}CH_2$, also a butylene, would be named *uns*-dimethyl-ethylene. The italicized prefixes *syn* and *uns* are abbreviations for *symmetrical* and *unsymmetrical*, respectively, and refer to the symmetrical or unsymmetrical manner in which the two methyl radicals are attached to the ethylene residue.

In the systematic naming, the longest chain is selected as in the case of the saturated hydrocarbons and the compound is named by replacing the *ane* ending of the corresponding saturated hydrocarbon with the ending *ene;* for example, $CH_3CH{:}CHCH_3$ is 2-butene. The numeral 2 indicates that the double bond is between the second and third carbon atoms. Similarly $(CH_3)_2C{:}CH_2$ is 2-methyl-1-propene** or 2-methyl-propene-(1), because a methyl group is on the second carbon atom, and the double bond is between the first and second carbon atoms in a chain of three carbon atoms. Where more than one double bond occurs in the molecule a numerical prefix is added to the ending *ene;* for example, isoprene, $CH_2{:}C(CH_3)CH{:}CH_2$ is 2-methyl-1,3-butadiene because the longest chain contains four carbon atoms with a methyl radical (CH_3) on the second carbon atom and double bonds between the first and second carbon atoms, and between the third and fourth carbon atoms of the four-carbon chain Similarly benzene would be named cyclohexa-1,3,5-triene.

Hydrocarbons with one triple bond (C_nH_{2n-2}) may be named as derivatives of acetylene ($CH{:}CH$); for example, $CH_3C{:}CH$ which is allylene, may also be named methyl-acetylene. In the systematic naming the same scheme is used as with the double bond compounds except that the ending becomes *yne* or *ine*. Thus, allylene is 1-propyne or 1-propine. The Greek letter Δ is often used to indicate unsaturation; the numbers following it indicate the positions of the unsaturated linkings.

Unsaturation in compounds other than the hydrocarbons, such as alcohols, aldehydes, ketones, etc., is indicated in the same general manner by use of *ene, diene, ine*, etc.; for example, allyl alcohol, $CH_2{:}CHCH_2OH$, is Δ^1-propenol-(3)***.

ALCOHOLS—Alcohols are commonly named from the radical to which the hydroxyl radical (OH) is attached; for example, CH_3OH is methyl alcohol; $C_6H_5CH_2OH$ is benzyl alcohol. As in the case of the hydrocarbons, a complex alcohol may be named as the derivative of some relatively simple alcohol. When alcohols are named as derivatives of methyl alcohol the latter is commonly given the name of *carbinol;* for example, $(CH_3)_2CHOH$ is dimethyl carbinol because two of the hydrogen atoms in methyl alcohol have been replaced by two methyl radicals; similarly benzyl alcohol, $C_6H_5CH_2OH$, is phenyl carbinol. The adjectives *primary, secondary*, and *tertiary* are often used in connection with alcohols and refer to alcohol groupings which are of the type $-CH_2OH$, $=CHOH$, $\equiv COH$, respectively; for example, $C_3H_7CH_2OH$ is a primary butyl alcohol; $CH_3CH(OH)C_2H_5$ is a secondary butyl alcohol; $(CH_3)_3COH$ is a tertiary butyl alcohol.

In the systematic naming the hydroxyl radical is indicated by the ending *ol* and its position of attachment by an arabic numeral; for example, $C_2H_5CH_2CH_2OH$ is 1-butanol; $(CH_3)_3COH$ is 2-methyl-2-propanol because a methyl radical and an hydroxyl radical are both attached to the second carbon atom in a chain of three carbon atoms.** Two, three, etc., hydroxyl radicals in a molecule are indicated by the endings *diol, triol*, etc.; for example, glycol, CH_2OHCH_2OH is 1,2-ethandiol.

ETHERS—Ethers are most commonly named by adding the word *ether* to the name of the radicals connected by the ether oxygen atom; for example, $(C_2H_5)_2O$ is ethyl ether or diethyl ether; $CH_3OC_2H_5$ is methyl-ethyl ether. Often the name is such as to designate the presence of an alkoxy (OR) group; for example, $CH_3OC_6H_5$ is methoxy benzene.

ALDEHYDES—Aldehydes are most frequently named by dropping the ending *ic* from the name of the acid to which they are directly oxidizable and adding the suffix *aldehyde;* for example, CH_3CHO is named acetaldehyde because it is directly

***In this case the final vowel *e* of the ending *ene* has been dropped from the name because it is followed by the vowel *o* of the ending *ol* which is used to indicate the alcoholic hydroxyl radical.

oxidized to acetic acid, CH_3CO_2H; similarly C_6H_5CHO is named benzaldehyde to show its relationship to benzoic acid. Sometimes aldehydes are named in a manner to show a relationship to some simpler aldehyde such as formaldehyde, HCHO; for example, CH_3CHO is methyl formaldehyde because the methyl radical has replaced the hydrogen atom in formaldehyde; similarly C_6H_5CHO is named phenyl formaldehyde. In the systematic naming the ending *al* indicates an aldehyde radical (CHO); for example, CH_3CHO is ethanal; $(CH_3)_2CHCHO$ is 2-methyl-1-propanal.**

KETONES—Ketones are most often named by adding the word *ketone* to the names of the radicals connected to the CO radical; for example, $(CH_3)_2CO$ is dimethyl ketone; $CH_3COCH(CH_3)_2$ is methyl-isopropyl ketone. The systematic names of the ketones differ from those of the alcohols and the aldehydes (*q. v.*) only in the termination *one* which is added to the name of the hydrocarbon; for example, $(CH_3)_2CO$ is propanone; $CH_3COCH(CH_3)_2$ is 2-methyl-butanone-(3).**

ACIDS—The common names of the normal carboxylic acids are derived from words having some relation to their natural occurrence or their properties; for example, formic, from ants (*Formicidae*); butyric, from butter; tannic, from the tanning property. Sometimes acids are named in a manner to show a relationship to some simpler acid such as acetic, CH_3CO_2H; for example, pivalic acid, $(CH_3)_3CCO_2H$, is tri-methyl-acetic acid because three methyl radicals (CH_3) are replacing the three hydrogen atoms in acetic acid. The systematic names are derived by adding the suffix *oic* and the word *acid* to the root of the name for the hydrocarbon of the *same number of carbon atoms;* for example, isovaleric acid, $(CH_3)_2CHCH_2CO_2H$, is 2-methyl-butanoic-4-acid; succinic acid, $(CH_2CO_2H)_2$, is butan-1,4-dioic acid. In compounds where such a naming would be awkward the carboxyl radical (CO_2H) is considered as a substituting group and the acid named accordingly; for example, citric acid, $HO_2CCH_2C(OH)(CO_2H)CH_2CO_2H$, is 2-hydroxy-propan-1,2,3-tricarboxylic acid.**

ESTERS AND SALTS—To the name of the alcoholic (or phenolic) radical, or the metal, is added the name of the acid modified to end in *ate;* for example, the ester of ethyl (C_2H_5) alcohol and acetic acid, $CH_3CO_2C_2H_5$, is ethyl acetate; the sodium salt of acetic acid, CH_3CO_2Na, is sodium acetate. To emphasize the ester structure they are often named as follows: acetic acid ethyl ester for ethyl acetate; malonic acid diethyl ester for diethyl malonate, $CH_2(CO_2C_2H_5)_2$.

ACID DERIVATIVES—The most common types in this classification are the anhydrides $(RCO)_2O$; halides ROCl; amides $RCONH_2$; amidoximes $RC(:NOH)NH_2$; amidines $RC(:NH)NH_2$; imides $R(CO)_2NH$; nitriles RCN. They are named by adding the endings *anhydride, chloride* (or other *halide*), *amide, amidoxime, amidine, imide, nitrile,* respectively, to the name of the acid or acid radical* (e.g., acetyl, acet, or aceto for the acid radical CH_3CO); for example, acetic anhydride, $(CH_3CO)_2O$; acetyl chloride, CH_3COCl; acetamide, CH_3CONH_2; acetamidoxime, $CH_3C(:NOH)NH_2$; acetamidine, $CH_3C(:NH)NH_2$; acetonitrile, CH_3CN; succinimide, $(CH_2CO)_2NH$. In compounds where such a naming would be awkward the modified carboxyl group is considered as a substituting group and named carbonamide, carbonamidine, carbonitrile, etc.

AMINES—Amines are most often named by adding the suffix *amine* to the name of the radical (or radicals) replacing one (or more) hydrogen atoms in ammonia (NH_3); for example, CH_3NH_2 is methylamine; $CH_3NHC_2H_5$ is methyl-ethylamine. Sometimes amines are named in a manner to show a relationship to some other simpler (or well-known) amine; for example, $C_6H_5NHCH_3$ is methylaniline; $C_6H_5N(CH_3)_2$ is named dimethylaniline to show the relationship to aniline, $C_6H_5NH_2$. In the systematic names the amino (NH_2) or modified amino (NHR, and NR_2) group is considered as a substituting group of the hydrocarbon; for example, $(CH_3)_2CHNH_2$ is 2-aminopropane; $(CH_3)_2CHCH_2NHCH_3$ is 2-methyl-1-methylamino-propane.

RADICALS—Alkyl radicals (C_nH_{2n+1}) are univalent groups derived by removal of one hydrogen atom from saturated hydrocarbons. They are named by replacing the ending *ane* of the corresponding hydrocarbon with the ending *yl;* for example, C_2H_5- is ethyl derived from ethane (C_2H_6); $CH_3CH_2CH_2$- is propyl; $(CH_3)_2CH$- is isopropyl.

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Univalent radicals derived from unsaturated aliphatic hydrocarbons have the endings *enyl; ynyl; dienyl;* etc.; for example, CH_2:CH- commonly called *vinyl* is also ethenyl; CH≡C- is *ethynyl;* CH_2:CH-CH:CH- is *buta-1,3-dienyl.* In the aromatic series the corresponding *aryl* radicals are named in a similar manner; for example, C_6H_5- is *phenyl;* C_6H_4 = is phenylene; $CH_3C_6H_5$- is tolyl.

Bivalent radicals derived by removal of two hydrogen atoms from the *same carbon atom* are sometimes named in a manner similar to the corresponding aldehyde; for example, CH_3CH= is acetal; C_6H_5CH= is benzal. In the systematic naming the ending *ylidene* is used to replace the ending *ane* of the corresponding saturated hydrocarbon; for example, CH_3CH= is ethylidene; somewhat analogous is C_6H_5CH= when named benzylidene.

Acid radicals, derived by removal of OH from the carboxyl group (COOH), are named by replacing the ending *ic* of the acid name with the ending *yl;* for example, CH_3CO- is acetyl (from acetic) or ethanoyl (from ethanoic).

See also the special table NAMES AND FORMULAS OF ORGANIC RADICALS.

RING COMPOUNDS—Positions of substituting groups on the various rings are usually indicated by a system of numbering. In the benzene series of compounds disubstitution positions are often indicated by the terms *ortho* (abbreviated *o*) for the 1,2-positions; *meta* (abbreviated *m*) for the 1,3-positions; *para* (abbreviated *p*) for the 1,4-positions. In cases of trisubstitution the terms *vicinal* (*vic*), *unsymmetrical* (*uns*) and *symmetrical* (*sym*) are often employed to indicate the positions 1,2,3; 1,3,4; and 1,3,5, respectively. In the naphthalene series of compounds, especially in the older literature, disubstitution positions are sometimes indicated by the terms *ortho, meta,* and *para* with the same significance as in the benzene series, and by the terms *ana* for the 1,5-positions; *epi* for the 1,6-positions; *kata* for the 1,7-positions; *peri* for the 1,8-positions; *amphi* for the 2,6-positions; and *pros* for the 2,7-positions. See also the special table ORGANIC RING SYSTEMS.

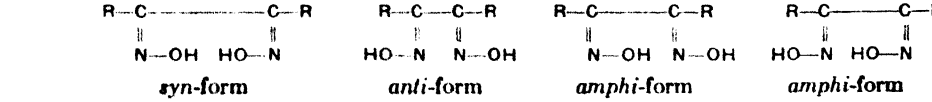
PREFIXES AND SUFFIXES

-al, a suffix indicating the presence of an *aldehyde group* (-CHO), as in chlor*al*, Cl_3C-CHO; or pent*en-al*, $CH_3(CH_2)_3$-CHO.*

allo-, a prefix indicating the compound to be a close relative, an isomer, or a variety of the compound to the name of which it is prefixed, as *allo*caffeine. In cases of ethylenic isomerism it is prefixed to the name of the more stable form into which the compound can be converted on heating: thus, fumaric acid is *allo*maleic acid since it is the stable isomer formed on heating maleic acid.

alpha-, beta-, gamma-, etc., usually written as letters of the Greek alphabet (α, β, γ, etc.) to indicate the first, second, third, etc., positions of substitution respectively, as in α-aminopropionic acid for $CH_3 \cdot CH(NH_2) \cdot CO_2H$ where the carbon atom attached to the CO_2H group is considered the α-carbon atom. See also the definition below for *omega* (ω). See also the numbering in the section ORGANIC RING SYSTEMS.

amphi-, a prefix used with disubstitution products of naphthalene to indicate the 2,6-positions. It is also used in naming certain stereoisomers of dioximes; thus,



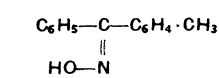
syn-form *anti*-form *amphi*-form *amphi*-form

-ane, a suffix usually indicating a saturated (paraffin) hydrocarbon, C_nH_{2n+2}, as in pent*ane*, C_5H_{12}.* It is also used to indicate saturated parent compounds in the cyclic series, as camph*ane*, $C_{10}H_{18}$; or diox*ane*, $C_4H_8O_2$.

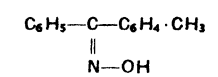
anti-, a term used in certain cases of stereoisomerism to indicate an opposed arrangement of groups or atoms, as in *anti*tartaric (mesotartaric) acid. It is often

* See this on preceding pages.

employed to distinguish stereoisomers in the case of oximes and hydrazones. See also *amphi* and *syn*.



syn-Phenyl tolyl ketoxime



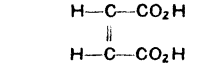
anti-Phenyl tolyl ketoxime

apo-, a prefix indicating a compound which is related to, or formed from, the compound to the name of which it is prefixed, as *apo*morphine.

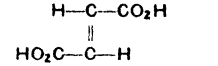
-ase, a suffix used in forming the name of an enzyme. Usually the suffix is added to the name, or a part of the name, of a substance upon which the enzyme acts; e.g., malt*ase*.

-ate, a suffix used to denote an ester or a salt; e.g., ethyl acet*ate*; or sodium acet*ate*.*

cis, a term used in cases of *cis-trans* (i.e., ethylenic) stereoisomerism to indicate that certain elements or groups are on the *same side* of the molecule; e.g.,



cis-form



trans-form

d, an abbreviation for *dextro* and usually indicating that a compound is *dextrorotatory*. Exceptions to this meaning are to be noted in certain cases of nomenclature; e.g., *d*-fructose, although levorotatory, is so named because of its relation in configuration to *d*-glucose and *d*-mannose; conversely, *l*-fructose, similarly related to *l*-glucose and *l*-mannose, is dextrorotatory.

-diene, a suffix indicating the *unsaturation* of two ethylenic (i.e., two double bond) linkages; e.g., a diolefin, C_nH_{2n}, as penta*diene*, $CH_3 \cdot CH{:}CH \cdot CH{:}CH_2$.*

-diine, or ***-diyne***, a suffix indicating the *unsaturation* of two acetylenic (i.e., two triple bond) linkages; e.g., a diacetylene, C_nH_{2n-6}, as butad*iyne*, $CH{:}C \cdot C{:}CH$.*

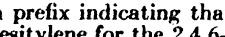
-dioic, a suffix indicating a *dicarboxylic* (two $-CO_2H$) acid; e.g., pentan*dioic* acid, $HO_2C \cdot (CH_2)_3 \cdot CO_2H$.*

-diol, a suffix indicating the presence of *two alcohol* (two hydroxyl) groups; e.g., pentan*diol*, $HO \cdot CH_2 \cdot (CH_2)_3 \cdot CH_2OH$.*

dl, an abbreviation for *dextro-levo* indicating a substance composed of equal parts of the dextro- and levo-optical isomers of a compound.

-ene, a suffix indicating the *unsaturation* of one ethylenic (i.e., one double bond) linkage; e.g., an olefin, C_nH_{2n}, as pent*ene*, $CH_2{:}CH \cdot C_3H_7$.* It is often used as a suffix in naming aromatic hydrocarbons; e.g., ben*zene*, tolu*ene*, naphthal*ene*, etc.

epi-, a prefix used with disubstitution products of naphthalene to indicate the 1,6-positions. See *RING COMPOUNDS* preceding. It is also prefixed to the name of an aldose, or related compound, to indicate an isomer that differs from the aldose only in the arrangement of the group about the α-carbon atom (the carbon atom next to the aldehyde group); thus, mannose is also called *epi*glucose. It is also used as a prefix to indicate a *bridge* or intramolecular connection, as in *epi*chlorohydrin, $O \cdot CH_2 \cdot CH \cdot CH_2Cl$.



eso-, a prefix indicating that substitution groups are *attached to the ring*, as *eso*-trinitromesitylene for the 2,4,6-trinitro derivative of mesitylene. See also *exo-*.

exo-, a prefix indicating that substitution groups are *attached to the side chain*, as *exo*-nitrotoluene for phenyl-nitromethane, $C_6H_5 \cdot CH_2 \cdot NO_2$. See also *omega-* and *eso-*.

homo-, a prefix indicating a homologue of the compound to the name of which it is prefixed and usually differing by having one more CH_2 in the formula; e.g., *homo*salicylic acid, $CH_3 \cdot C_6H_3(OH)CO_2H$.

i or in, an abbreviation for *inactive* and indicating that the substance exhibits no activity towards polarized light. See also *dl*.

-ic, -oic.

* See this on preceding pages.

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-in, a suffix used in forming the names of fats (i.e., the glycerides or esters of glycerol), the suffix being used to replace the *ic* ending of the name of the fatty acid forming the glyceride; e.g., tributyr*in*, $(C_3H_7CO)_3C_3H_5O_3$. It is often used as a suffix in the names of proteins and of glucosides; e.g., album*in* and amygdal*in*, resp. See also *i* above.

-ine, a suffix often used in forming the names of basic compounds such as amines, alkaloids, and amino acids; e.g., anil*ine*, quin*ine*, and glyc*ine*, resp. See also *-yne*.

-ite, a suffix used in various ways; thus, for esters of the *ous* acids, e.g., amyl nitr*ite*, $C_5H_{11}O \cdot NO$; for polyhydric alcohols, e.g., mann*ite* (mannitol), $C_6H_8(OH)_6$; for explosives, e.g., cord*ite*, a smokeless powder.

l, an abbreviation for *l(a)evo* and indicating that a compound is levorotatory. See also *d*.

N-, a letter used in the names of certain nitrogen compounds to indicate that the group to which the letter is prefixed has replaced a hydrogen directly attached to a nitrogen atom; e.g., *N*-methylpyrrole, $C_4H_4{:}N \cdot CH_3$. Sometimes the letter is erroneously used to indicate a *normal* compound, as *N*-butane, $CH_3 \cdot CH_2 \cdot CH_2 \cdot CH_3$, instead of a lower case letter for this meaning, as *n*-butane.

N. F., an abbreviation for the publication *National Formulary* which is issued by the *American Pharmaceutical Association* and quoted in Federal and State laws as having equal authority with the *United States Pharmacopoeia*. See also *U. S. P.*

nor-, a prefix indicating the parent compound from which another may be regarded as derived, as *nor*camphor (of which camphor is the 7-methyl derivative). The prefix has also been used to indicate a *normal* compound which is isomeric with the one to the name of which it is prefixed, as *nor*valine which is α-amino-*n*-valeric acid, whereas valine is α-amino-*iso*-valeric acid.

O-, a letter used in names of certain oxygen compounds to indicate that the group to which the letter is prefixed has replaced a hydrogen directly attached to an oxygen atom; e.g., *O*-ethyl phenol (phenetole), $C_2H_5 \cdot O \cdot C_6H_5$.

-oic, a suffix indicating a carboxylic (CO_2H) *acid;* e.g., pentan*oic* acid.* Often the suffix *-ic* is used in forming the name of an acid; e.g., acet*ic* acid.

-ol, a suffix indicating an *hydroxyl group* (OH) as in an alcohol,* e.g., pentan*ol;* or in a phenol, e.g., resorcin*ol*,* $C_6H_4(OH)_2$.

-ole, a suffix used in various ways; thus, for phenolic ethers, e.g., phenet*ole*,† $C_2H_5 \cdot O \cdot C_6H_5$; for certain aldehydes, e.g., oenanth*ole*, $CH_3(CH_2)_5 \cdot CHO$; for five-membered rings, usually heterocyclic, e.g., pyrr*ole*, C_4H_5N, or oxaz*ole*, C_3H_3ON.

omega-, a prefix indicating a substitution group *on the last carbon* of a side chain, as *omega*-nitrostyrene for $C_6H_5 \cdot CH{:}CH \cdot NO_2$. It is most often indicated by the Greek letter omega (ω), as ω-nitrostyrene.

-one, a suffix indicating the presence of a *ketone group* (:CO), as in propan*one*,* $CH_3 \cdot CO \cdot CH_3$; or acetophen*one*, $CH_3 \cdot CO \cdot C_6H_5$.

-ose, a suffix usually indicating a *carbohydrate;* e.g., gluc*ose*, $C_6H_{12}O_6$; cellul*ose*, $(C_6H_{10}O_5)_x$. It is also used in naming the primary alteration or hydrolytic products of proteins; e.g., album*ose*.

par(a)-, a prefix or an adjective used to indicate that the substance is related in some way, as a polymer, an isomer, etc., of the compound to whose name it is attached; e.g., *para*ldehyde, *para*lactic acid. See also its significance when used in showing position of substituents in naming *RING COMPOUNDS.**

poly-, a prefix indicating a polymer of the compound to the name of which it is prefixed, as *poly*styrene, $(C_8H_8)_x$.

prim., an abbreviation for *primary* and indicating a replacement to the first degree; e.g., a primary amine ($R \cdot NH_2$) where only one of the three hydrogens in ammonia has been replaced by a group (R) of atoms. It is frequently used in the designation of certain *alcohols.**

pseudo-, a prefix indicating an isomerism with, or some other relation to, the compound to the name of which it is prefixed, as *pseudo*tropine. It is sometimes indicated by the Greek letter *psi* (ψ); e.g., ψ-tropine.

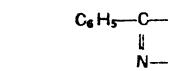
* See this on preceding pages.

S-, a letter used in the names of certain sulfur compounds to indicate that the group to which the letter is prefixed has replaced a hydrogen directly attached to a sulfur atom; e.g., *S*-methyl thioglycolic acid, $CH_3 \cdot S \cdot CH_2 \cdot CO_2H$.

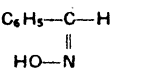
sec., an abbreviation for *secondary* and indicating a replacement to the second degree; e.g., a secondary amine (R_2:NH) where two of the hydrogens in ammonia have been replaced by two groups (R_2) of atoms. It is frequently used in the designation of certain *alcohols.**

sym., an abbreviation for *symmetrical* and used to indicate a symmetrical arrangement of substitution on a parent compound. See also under *RING COMPOUNDS.**

syn-, a term used in certain cases of isomerism to indicate that certain groups or atoms are on the same side of the molecule. See also *amphi* and *anti*.



Benz-*syn*-aldoxime



Benz-*anti*-aldoxime

tert., an abbreviation for *tertiary* and indicating a replacement to the third degree; e.g., a tertiary amine (R_3:N) where three of the hydrogens in ammonia have been replaced by three groups (R_3) of atoms. It is frequently used in the designation of certain *alcohols.**

-thiol, a suffix indicating a mercaptan or thio-alcohol (-SH) group; e.g., pentan*thiol*, $C_5H_{11} \cdot SH$.

trans, a term used in cases of cis-trans stereoisomerism. See also *cis*.

uns., an abbreviation for *unsymmetrical* and used to indicate an unsymmetrical arrangement of substituents on a parent compound. See also under *RING COMPOUNDS.**

U. S. P., an abbreviation for *United States Pharmacopoeia* and indicating that a compound conforms to the standards of purity, and other requirements, set by this publication which has been recognized in the United States as a standard in administering laws relating to the U. S. Food and Drugs Act of 1906. The Roman numeral often employed with this abbreviation indicates the revision (i.e., the edition of the publication) to which reference is being made; e.g., *U. S. P. (IX)* refers to the 9th revision.

vic., an abbreviation for *vicinal*. See under *RING COMPOUNDS.**

x-, a symbol for *unknown*. The unknown number of monomers composing a polymeric compound is often indicated by using this symbol as a subscript in the formula; e.g., starch, $(C_5H_{10}O_5)_x$. It is sometimes used to indicate the unknown position of attachment of a substituting group; e.g., in 3,*x*,3′,*x*′-tetranitro-4,4′-diphenol where the positions of substitution of two of the four nitro groups are unknown.

-yl, a suffix used in forming the names of radicals, usually univalent radicals; e.g., alkyl, C_nH_{2n+1}; acyl, R·CO-.

-ylene, a suffix used in forming the names of unsaturated hydrocarbons *; e.g., eth*ylene*, CH_2:CH_2. It is frequently used in forming the names of bivalent radicals with the free valences on different carbon atoms; e.g., phen*ylene*, $-C_6H_4-$.

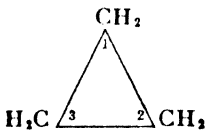
-yne, a suffix indicating *unsaturation* * of one acetylenic (i.e., one triple bond) linkage; e.g., pent*yne*, $CH{:}CH \cdot C_3H_7$. In this sense modern nomenclature prefers this suffix to that of *-ine*.

* See this on preceding pages.

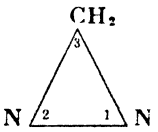
ORGANIC RING SYSTEMS

The rings given in the following pages are numbered as in Chemical Abstracts beginning with Volume 31 (1937). In all but a few cases (especially anthracene, phenanthrene and purine) the numberings are in accordance with the "Proposed International Rules for Numbering Organic Ring Systems"; cf. Patterson: Jour. Am. Chem. Soc. 47, 543-61 (1925). For a more complete listing of ring systems see the annual subject index of Chemical Abstracts; and, Richter: Lexikon der Kohlenstoff-Verbindungen, 3d Edition (1910), Volume I, p. 14, published by Leopold Voss, Hamburg and Leipzig.

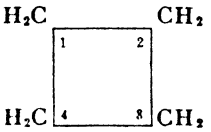
When numbering positions in the case of substitution derivatives of benzoic acid, aniline, phenol, toluene, etc., the characteristic radical of each of these substances (i. e., CO_2H, NH_2, OH, CH_3, etc., respectively) is regarded as in position 1.



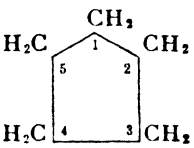
Cyclopropane



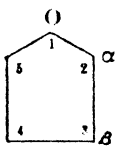
Diazomethane
Azimethylene



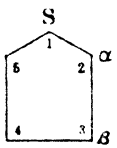
Cyclobutane



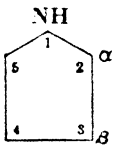
Cyclopentane



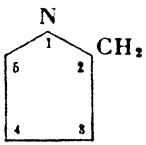
Furan
Furfuran



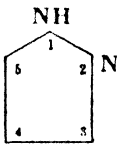
Thiophene
Thiofuran



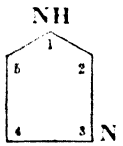
Pyrrole
Azole



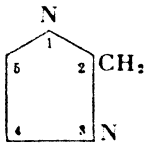
Isopyrrole
Isoazole



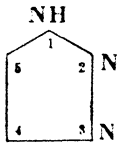
Pyrazole
1,2 -Diazole



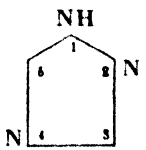
Imidazole
1,3-Diazole
Glyoxaline



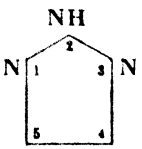
2-Isoimidazole
1,3-Isodiazole



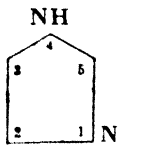
1,2,3-Triazole



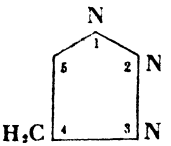
1,2,4-Triazole



2,1,3-Triazole
Osotriazole
Pyrro[aa_1]diazole

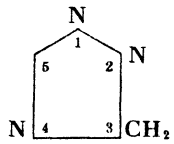


4,1,2-Triazole
Pyrro[bb_1]diazole

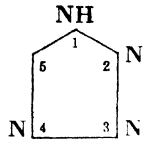


1,2,3-Isotriazole

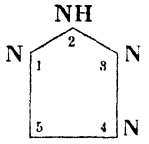
ORGANIC RING SYSTEMS



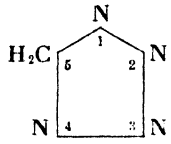
1,2,4-Isotriazole



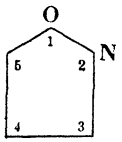
1,2,3,4-Tetrazole



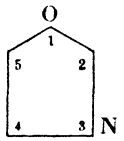
2,1,3,4-Tetrazole



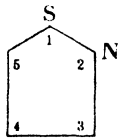
Isotetrazole



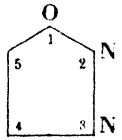
Isoxazole
Furo[*a*]monazole



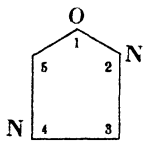
Oxazole
Furo[*b*]monazole



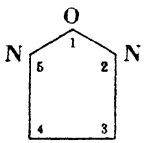
Isothiazole



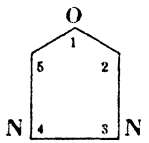
1,2,3-Oxadiazole



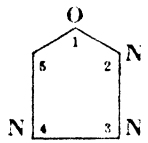
1,2,4-Oxadiazole
Azoxime
Furo[ab_1]diazole



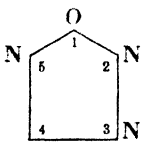
Furazan
1,2,5-Oxadiazole



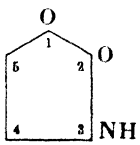
1,3,4-Oxadiazole
Furo[bb_1]diazole



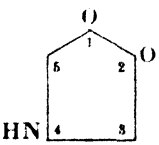
1,2,3,4-Oxatriazole



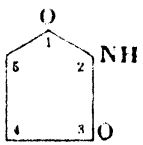
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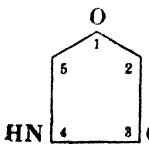
1,2,3-Dioxazole



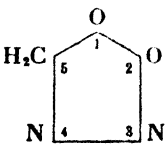
1,2,4-Dioxazole



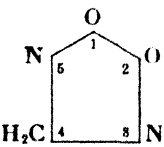
1,3,2-Dioxazole



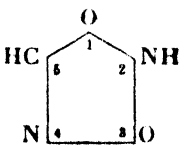
1,3,4-Dioxazole



1,2,3,4,5-Dioxadiazole

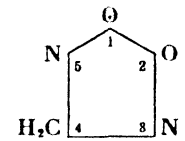


1,2,3,5,4-Dioxadiazole

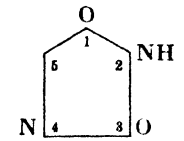


1,3,2,4-Dioxadiazole

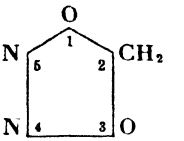
ORGANIC RING SYSTEMS



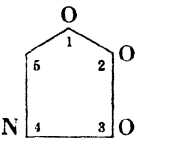
1,2,3,5,4-Dioxadiazole



1,3,2,4-Dioxadiazole

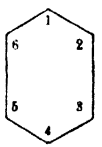


1,3,4,5-Dioxadiazole

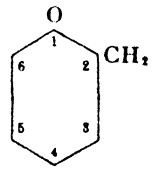


1,2,3,4-Trioxazole

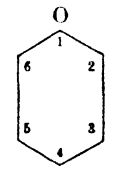
Sulfur replacing oxygen in these five-membered rings forms the corresponding thiazoles; thiatriazoles; dithiazoles; dithiadiazoles; and trithiazoles.



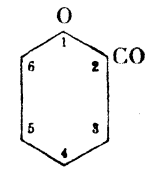
Benzene



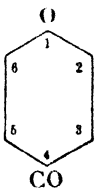
1,2-Pyran



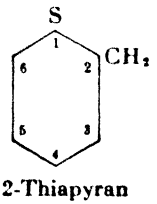
1,4-Pyran



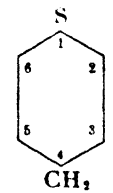
1,2-Pyrone
α-Pyrone
Coumalin



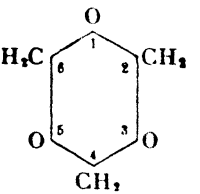
1,4-Pyrone
γ-Pyrone



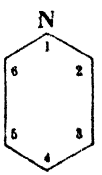
1,2-Thiapyran



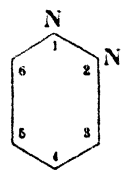
1,4-Thiapyran
Phenanthiophene



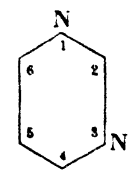
s-Trioxane
1,3,5-Trioxane



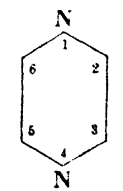
Pyridine
Azine



Pyridazine
1,2-Diazine
Orthodiazine

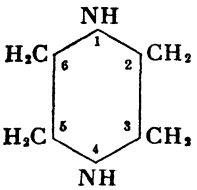


Pyrimidine
1,3-Diazine
Metadiazine
Miazine

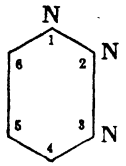


Pyrazine
1,4-Diazine
Paradiazine
Piazine

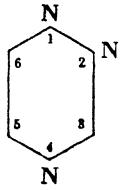
ORGANIC RING SYSTEMS



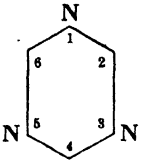
Piperazine
Hexahydro-
1,4-diazine



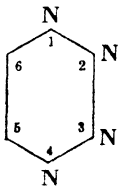
v-Triazine
1,2,3-Triazine



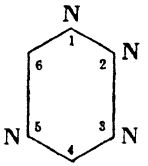
as-Triazine
1,2,4-Triazine



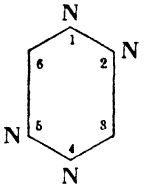
s-Triazine
1,3,5-Triazine
Cyanidine



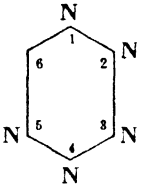
v-Tetrazine
1,2,3,4-Tetrazine



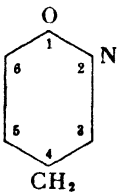
as-Tetrazine
1,2,3,5-Tetrazine



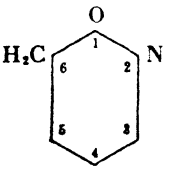
s-Tetrazine
1,2,4,5-Tetrazine



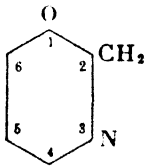
Pentazine



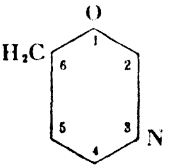
1,2,4-Oxazine



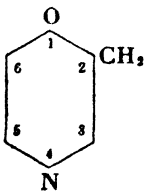
1,2,6-Oxazine



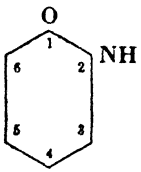
1,3,2-Oxazine



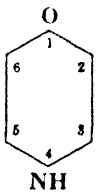
1,3,6-Oxazine
Pentoxazole



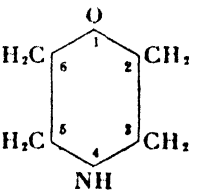
1,4-Oxazine



o-Isoxazine



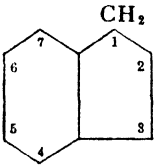
p-Isoxazine



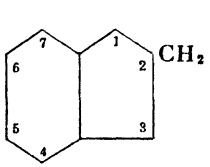
Morpholine
Tetrahydro-
p-isoxazine

In a similar manner are derived:- oxadiazine; oxatriazine; oxatetrazine; dioxazine; dioxadiazine; dioxatriazine; trioxazine; trioxadiazine; tetroxazine. Sulfur replacing oxygen in these rings forms the corresponding thia derivatives.

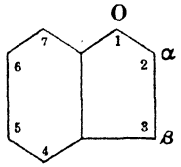
ORGANIC RING SYSTEMS



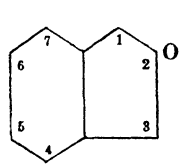
Indene



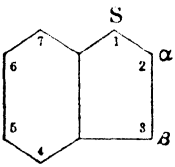
Isoindene



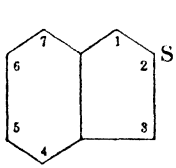
Benzofuran
Coumarone



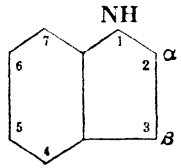
Isobenzofuran



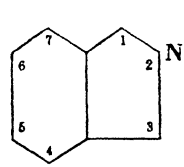
Thionaphthene
Benzothiofuran
Benzothiophene



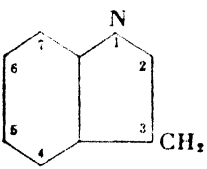
Isothionaphthene
Isobenzothiofuran



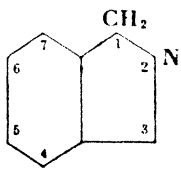
Indole
1-Benzazole
Benzopyrrole



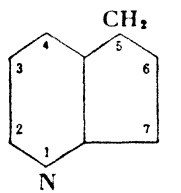
Isoindole
2-Benzazole



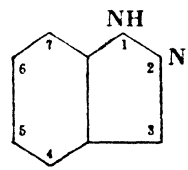
Indolenine
3-Pseudoindole
1-Isobenzazole



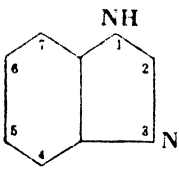
Pseudoisoindole
2-Isobenzazole



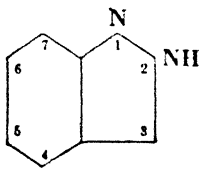
4-Pyrindine
4-Isobenzazole
4-Indenazine



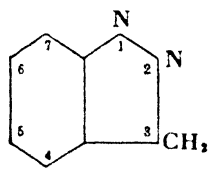
Isoindazole
1,2-Benzodiazole
Benzpyrazole



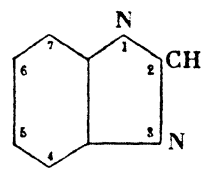
Benzimidazole
1,3-Benzodiazole



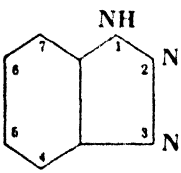
Indazole
2,1-Benzodiazole
Benzopyrazole



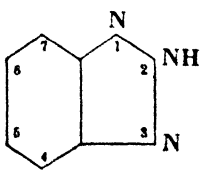
Indiazene
Benzisodiazole



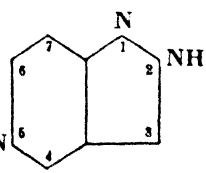
1,3-Benzisodiazole



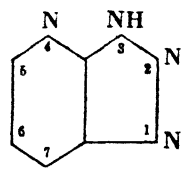
1,2,3-Benzotriazole
Benzisotriazole
Azimidobenzene



2,1,3-Benzotriazole
Pseudoazimido-
benzene

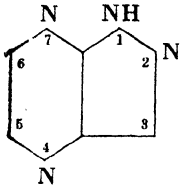


2-Pyrazolo-
[4,3-*c*]-pyridine

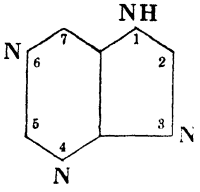


3-*s*-Triazolo-
[4,5-*b*]pyridine

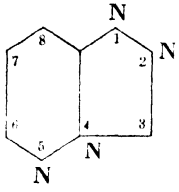
ORGANIC RING SYSTEMS



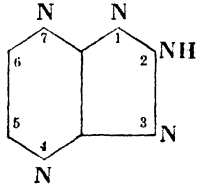
1-Pyrazolo-[3,4-*b*]pyrazine



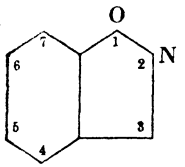
1,3,4,6-Benzotetrazole
See also Purine



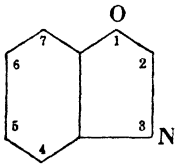
s-Triazolo-[4,3-*b*]pyridazine



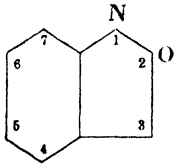
2-*v*-Triazolo-[4,5-*b*]-pyrazine



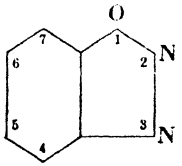
Benzisoxazole
Indoxazine



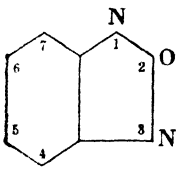
Benzoxazole
Benzothiazole
when S replaces O



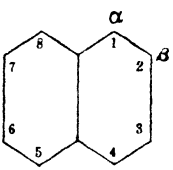
Anthranil
Benzpseudoox-azole



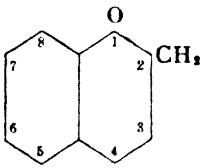
Benzoxadiazole



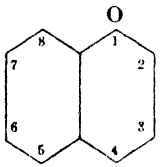
Benzofurazan
Benzisoxadiazole



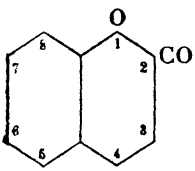
Naphthalene



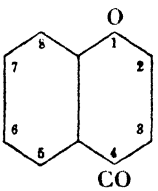
1,2-Benzopyran
1,2-Coumaran



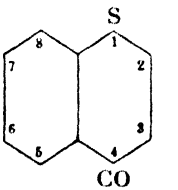
1,4-Benzopyran
1,4-Coumaran



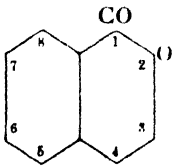
Coumarin
1,2-Benzopyrone



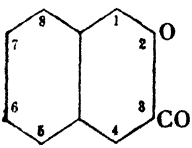
Chromone
1,4-Benzopyrone



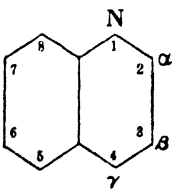
Thiochromone
1,4-Benzothiopyrone



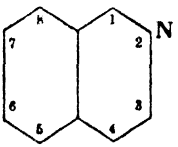
Isocoumarin
2,1-Benzopyrone



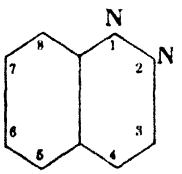
2,3-Benzopyrone



Quinoline
1-Benzazine

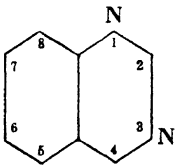


Isoquinoline
2-Benzazine
Leucoline

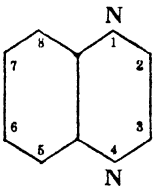


Cinnoline
1,2-Bezodiazine
α-Phenodiazine

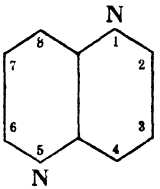
ORGANIC RING SYSTEMS



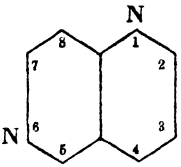
Quinazoline
1,3-Benzodiazine
Phenmiazine



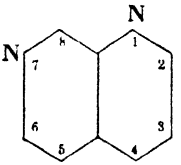
Quinoxaline
1,4-Benzodiazine
Phenpiazine



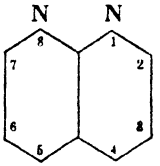
Pyrido[3,2-*b*]-
pyridine



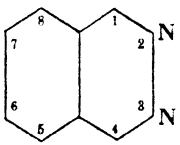
Pyrido[4,3-*b*]-
pyridine



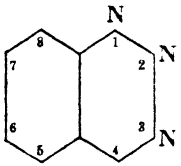
Pyrido[3,4-*b*]-
pyridine



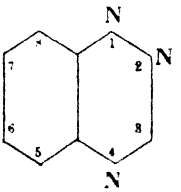
Naphthyridine



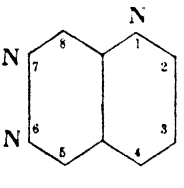
Phthalazine
2,3-Benzodiazine
a-Phenodiazine



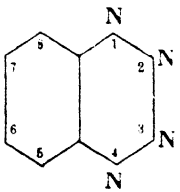
1,2,3-Benzotriazine
Phenotriazine



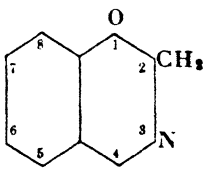
1,2,4-Benzotriazine



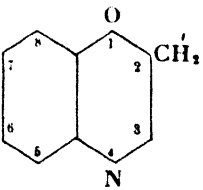
Pyrido[2,3-*d*]-
pyridazine



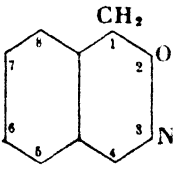
1,2,3,4-Benzotetrazine



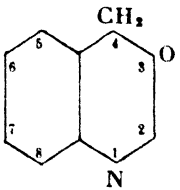
1,3,2-Benzoxazine



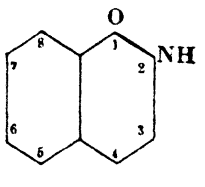
1,4,2-Benzoxazine



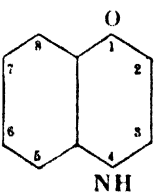
2,3,1-Benzoxazine



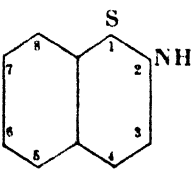
3,1,4-Benzoxazine



1,2-Benzisoxazine



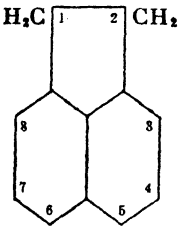
1,4-Benzisoxazine



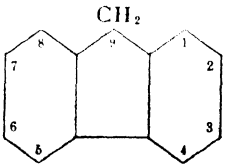
1,2-Benzisothiazine
Also a 1,4-Form

In a similar manner are derived:- benzoxadiazine; benzoxatriazine; etc.; benzodioxazine; etc.; benzotrioxazine; etc.

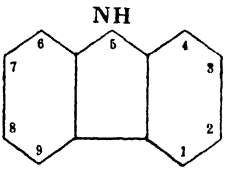
ORGANIC RING SYSTEMS



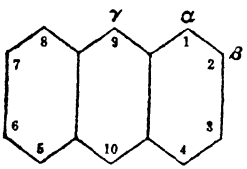
Acenaphthene



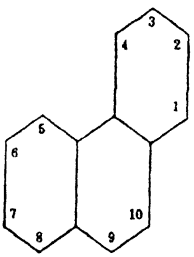
Fluorene
Diphenylenemethane



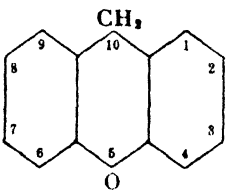
Carbazole
Dibenzopyrrole
Diphenyleneimide



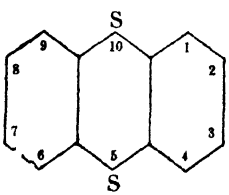
Anthracene



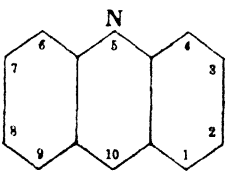
Phenanthrene



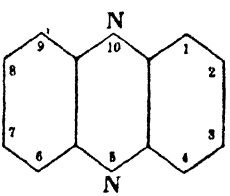
Xanthene



Thianthrene

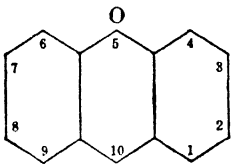


Acridine

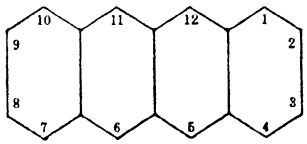


Phenazine

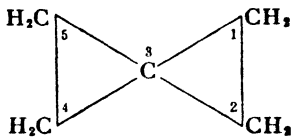
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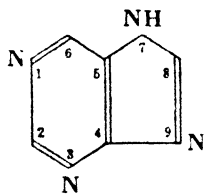
Phenoxazine
S replacing O = Phenothiazine



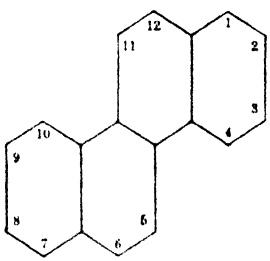
Naphthacene



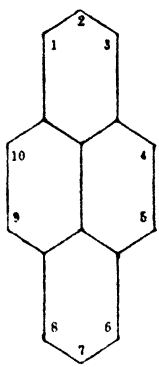
Spiropentane
Rings with but one atom in common are known as "spiro compounds".



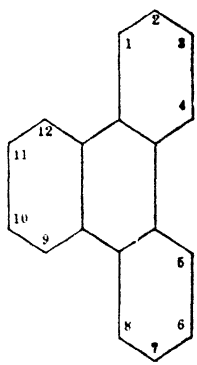
Purine



Chrysene



Pyrene



Triphenylene

NAMES AND FORMULAS OF ORGANIC RADICALS

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Name	Formula
Acenaphthenyl (from acenaphthene)	$C_{12}H_9$-
Acetamido	CH_3CONH-
Acetenyl cf. ethinyl	.....
Acetimido	$CH_3C(:NH)$-
Acetonyl	CH_3COCH_2-
Acetonylidene	CH_3COCH:
Acetoxy	$CH_3CO{\cdot}O$-
Acetyl	CH_3CO-
Acetylene	:CHCH:
Acridyl (from acridine)	$C_{13}H_8N$-
Acrylyl	CH_2:CHCO-
Adipyl	$-OC(CH_2)_4CO-$
Alanyl	CH_3CHNH_2CO-
Alkoxy (any alkyl radical attached by oxygen)	$C_nH_{2n+1}O$-
Allyl	CH_2:$CHCH_2$-
β-allyl cf. isopropenyl	.....
Amidoxalyl cf. oxamyl	.....
Amino (amido)	H_2N-
Amoxy	$CH_3(CH_2)_4O$-
Amyl	$CH_3(CH_2)_4$-
tert-Amyl	$(C_2H_5)(CH_3)_2C$-
Amylidene	$CH_3(CH_2)_3CH$:
Anilino	C_6H_5NH-
Anisal	*p*-$CH_3OC_6H_4CH$:
Anisoyl	*p*-$CH_3OC_6H_4CO$-
Anisyl	(*o*, *m* or *p*)$CH_3OC_6H_4$-
Anisylidene cf. anisal	.....
Anthranilo	*o*-$C_6H_4CO{\cdot}N$-
Anthranoyl	*o*-$H_2NC_6H_4CO$-
Anthraquinonyl (from anthraquinone)	two isomers
Anthryl (from anthracene)	five isomers
Anthrylene (from anthracene)	$C_{14}H_8$:(11 isomers)
Antipyryl (from antipyrene)	$CO{\cdot}N(C_6H_5){\cdot}N(CH_3){\cdot}C(CH_3)$:C-
Arseno	-As:As-
Arsino (from arsinic acid)	(HO)OAs:
Arsinoso	O:As-
Arsono (from arsonic acid)	$(HO)_2OAs$-
Arsyl	H_2As-
Arsylene	HAs:
Asaryl	(2,4,5)$(CH_3O)_3C_6H_2$-
Asparagyl	$H_2NCOCH_2CHNH_2{\cdot}CO$-

Name	Formula
Aspartyl	$-COCH_2CHNH_2CO-$
Auro	Au-
Azimino (azimido)	-N:NNH-
Azido cf. triazo	.....
Azino	:N·N:
Azo	-N:N-
Azoxy	-NO:N-
Benzal	C_6H_5CH:
Benzamido	C_6H_5CONH-
Benzenyl	C_6H_5C:
Benzidino (from benzidine)	$H_2NC_6H_4C_6H_4NH$-
Benzilyl	$(C_6H_5)_2C(OH)CO$-
Benzimidazolyl (from benzimidazole)	$C_7H_5N_2$-
Benzimido	$C_6H_5C(:NH)$-
Benzofuryl (from benzofuran)	C_8H_5O
Benzohydryl	$(C_6H_5)_2CH$-
Benzohydrylidene cf. diphenylmethylene	.....
Benzopyranyl (from benzopyran)	C_9H_7O(2-α-, etc.)
Benzoxazolyl (from benzoxazole)	C_7H_4NO-
Benzoxy	$C_6H_5CO{\cdot}O$-
Benzoyl	C_6H_5CO-
Benzoylene	$-C_6H_4CO-$
Benzyl	$C_6H_5CH_2$-
Benzylidene cf. benzal	.....
Biphenylene	$-C_6H_4{\cdot}C_6H_4-$
Biphenylenedisazo	$-N:NC_6H_4C_6H_4N:N-$
Bornyl (from borneol)	$C_{10}H_{17}$-
Boryl	O:B-
Bromo	Br-
Δ^1-Butenyl	CH_3CH_2CH:CH-
Δ^2-Butenyl	CH_3CH:$CHCH_2$-
Δ^3-Butenyl	CH_2:$CH(CH_2)_2$-
Butoxy	$CH_3(CH_2)_2O$-
Butyl	$CH_3(CH_2)_3$-
sec-Butyl	$(C_2H_5)(CH_3)CH$-
tert-Butyl	$(CH_3)_3C$-
Butylene	$-CH_2CH_2CH_2CH_2-$ (1, 4-form)
Butylidene	$CH_3(CH_2)_2CH$:
Butyryl	$CH_3(CH_2)_2CO$-
Camphanyl (from camphane)	$C_{10}H_{17}$-(3 isomers)
Camphoroyl (from camphoric acid)	$C_{10}H_{14}O_2$:
Camphoryl (from camphor)	$C_{10}H_{15}O$-
Camphorylidene (from camphor)	$C_{10}H_{14}O$:

NAMES AND FORMULAS OF ORGANIC RADICALS

Name	Formula
Carbamido	$H_2NCONH-$
Carbamyl	H_2NCO-
Carbanilino cf. phenylcarbamyl	.....
Carbazyl (from carbazole)	$C_{12}H_8N-$ (5 isomers)
Carbethoxy	$C_2H_5O{\cdot}CO-$
Carbomethoxy	$CH_3O{\cdot}CO-$
Carbonyl	OC:
Carbonyldioxy	$-O{\cdot}CO{\cdot}O-$
Carboxy	$-CO{\cdot}OH$
Carvacryl	$(CH_3)[(CH_3)_2CH]:C_6H_3-$ (1,4;2)
Cetyl	$CH_3(CH_2)_{14}CH_2-$
Chloro	Cl–
Chloromercuri	$ClHg-$
Cinnamal	$C_6H_5CH{:}CHCH:$
Cinnamenyl cf. styryl	.....
Cinnamyl	$C_6H_5CH{:}CHCO-$
Cinnamylidene cf. cinnamal	.....
Cresotyl (from cresotinic acid)	$(HO)(CH_3)C_6H_3CO-$ (2,3)
Cresoxy cf. toloxy	.....
Cresyl (10 isomers)	$(o,m,p)(HO)(CH_3):C_6H_3-$
Cresylene cf. tolylene	.....
Crotonyl	$CH_3CH{:}CHCO-$
Cumal	$p-(CH_3)_2CHC_6H_4CH:$
Cumenyl	$(CH_3)_2CHC_6H_4-$
Cumidino	$(CH_3)_2CHC_6H_4NH-$
Cuminal cf. cumal	.....
Cyano	NC–
Cyclobutyl	$CH_2CH_2CH_2CH-$
Cyclohexenyl (from cyclohexene)	C_6H_9- (3 isomers)
Cyclohexyl (from cyclohexane)	$C_6H_{11}-$
Cyclohexylidene	$CH_2CH_2CH_2CH_2{\cdot}CH_2C:$
Cyclopentenyl (from cyclopentane)	C_5H_7-
Cyclopentyl (from cyclopentane)	C_5H_9-
Cyclopropyl	CH_2CH_2CH-
Cymyl (from cymene)	$C_{10}H_{13}-$
2-*p*-cymyl cf. carvacryl	.....
3-*p*-cymyl cf. thymyl	.....
Desyl	$(C_6H_5)(C_6H_5CO)CH-$
Diazo	$-N{:}N-$
Diazoamino cf. azimino	.....
Diazoxy	$-N(:O){:}N-$

Name	Formula
Duryl	$(CH_3)_4C_6H-$ (2,3,5,6)
Durylene	$(CH_3)_4C_6{:}$ (2,3,5,6)
Epoxy	–O– (to different radicals already united in some other way)
Ethene cf. ethylene	.....
Ethenyl	$CH_3C{:}$
Ethinyl	$HC{:}\,C-$
Ethoxalyl	$C_2H_5O{\cdot}OC{\cdot}CO-$
Ethoxy	C_2H_5O-
Ethyl	$CH_3{\cdot}CH_2-$
Ethylene	$-CH_2CH_2-$
Ethylenedioxy	$-O(CH_2)_2O-$
Ethylidene	$CH_3CH:$
Fenchyl (from fenchyl alcohol)	$C_{10}H_{17}-$ (:2-fenchanyl)
Fluoro	F–
Fluoryl (from fluorene)	$C_{13}H_9-$ (5 isomers)
Fluorylidene	$C_{13}H_8{:}$
Formamido	HCONH–
Formazyl	$(C_6H_5N{:}N{\cdot})(C_6H_5{\cdot}NHN{:})C-$
Formyl	$H{\cdot}CO-$
Fural (2 isomers)	$OCH{:}CH{\cdot}CH{:}C{\cdot}OH:$
Furfural cf. fural	.....
Furfuryl cf. furyl	.....
Furfurylidene cf. fural	.....
2-Furoyl cf. pyromucyl	.....
3-Furoyl	$CH{:}CH{\cdot}O{\cdot}CH{:}C{\cdot}CO-$
Furyl (2 isomers)	$O{\cdot}CH{:}CH{\cdot}CH{:}C-$
Furylidene 3(2)-form	$CH{:}CH{\cdot}O{\cdot}CH_2{\cdot}C:$ (also a 2(3)-form)
Geranyl (from geraniol)	$C_{10}H_{17}-$
Glutamyl	$-OCCHNH_2(CH_2)_2{\cdot}CO-$
Glutaryl	$-OC(CH_2)_3CO-$
Glyceryl	$-CH_2(CH{-})CH_2-$
Glycolyl	$HOCH_2CO-$
Glycyl	H_2NCH_2CO-
Glyoxyl	$OCH{\cdot}CO-$
Guaiacyl cf. *o*-anisyl	.....
Guanido	$H_2NC(:NH)NH-$
Guanyl	$H_2NC(:NH)-$
Hendecyl	$CH_3(CH_2)_{10}-$
Heptyl	$CH_3(CH_2)_6-$
Hexadecyl cf. cetyl	.....
Hexyl	$CH_3(CH_2)_5-$
Hippuryl	$C_6H_5CONHCH_2CO-$
Homopiperonyl	$(3,4)(CH_2O_2)C_6H_3{\cdot}CH_2CH_2-$
Hydrazi	$-NH{\cdot}NH-$ (both valences to same atom)
Hydrazino	H_2NNH-

NAMES AND FORMULAS OF ORGANIC RADICALS

Name	Formula
Hydrazo	–NH·NH–(to different atoms)
Hydrazono	$H_2N·N$:
Hydroxamino	HONH–
Hydroximino cf. isonitroso	.....
Hydroxy (hydroxyl)	HO–
–idene (added to any radical usually means a double bond at point of attachment)	.....
Imidazolyl (from imidazol)	$C_3H_3N_2$–(4 isomers)
Imino (imido)	HN:
Indanyl (from indan)	C_9H_9–(4 isomers)
Indenyl (from indene)	C_9H_7–(7 isomers)
Indyl (from indole)	C_8H_6N–(7 isomers)
Indylidene	$C_6H_4·NH·CH_2·C$: 3(2)–, etc.
Iodo	I–
Iodoso	OI–
Iodoxy	O_2I–
Isoallyl cf. propenyl	.....
Isoamoxy	$(CH_3)_2CHCH_2CH_2O$–
Isoamyl	$(CH_3)_2CHCH_2CH_2$–
Isoamylidine	$(CH_3)_2CHCH_2CH$:
Isobutenyl	$(CH_3)_2C:CH$–
Isobutoxy	$(CH_3)_2CHCH_2O$–
Isobutyl	$(CH_3)_2CHCH_2$–
Isobutyryl	$(CH_3)_2CHCO$–
Isocyano	C:N–
Isodiazo	–NH·N: (to the same atom)
Isohexyl	$(CH_3)_2CH(CH_2)_3$–
Isoindyl (from isoindole)	C_8H_6N– (4 isomers)
Isoleucyl	$CH_3CH_2CH(CH_3)·CHNH_2CO$–
Isonitro	HOON:
Isonitroso	HON:
Δ^1–Isopentenyl	$(CH_3)_2CHCH:CH$–
Isophthalal	:HC·C_6H_4·CH:(*m*)
Isophthalylidene cf. isophthalal	.....
Isopropenyl	$CH_2:C(CH_3)$–
Isopropoxy	$(CH_3)_2CH·O$–
Isopropyl	$(CH_3)_2CH$–
Isopropylidene	$(CH_3)_2C$:
Isoquinolyl (from isoquinoline)	C_9H_6N– (9 isomers)
Isothiocyano	S:C:N–
Isovaleryl	$(CH_3)_2CHCH_2CO$–
Isoxazolyl (from isoxazole)	C_3H_2ON– (5 isomers)
Keto	O: (to same atom)
Leucyl	$(CH_3)_2CHCH_2CHNH_2CO$–
Malonyl	–OC·CH_2·CO–
Menthyl (from menthane): as, 2-*p*-menthyl	$CH_3·CH(CH_2)_2CH·$ $(i\text{–}C_3H_7)CH_2CH$–
Mercapto	HS–
Mercuri	–Hg–
1-Mesityl	$(CH_3)_2C_6H_3CH_2$– (1, 3, 5)
2-Mesityl	$(CH_3)_3C_6H_2$–(2,4,6)
Methene cf. methylene	.....
Methenyl	HC:
Methionyl	$CH_2(SO_2)_2$:
Methoxy	CH_3O–
Methyl	CH_3–
Methylene	H_2C:
Methylenedioxy	–O·CH_2·O–
Methylol cf. hydroxymethyl	.....
Naphthal	$C_{10}H_7CH$:
Naphthalimido (from naphthalic acid)	$C_{10}H_6(CO)_2N$–
Naphthenyl	$C_{10}H_7C$:
Naphthobenzyl	$C_{10}H_7CH_2$–
Naphthoxy	$C_{10}H_7O$–
Naphthoyl	$C_{10}H_7CO$–
Naphthyl (1 or 2)	$C_{10}H_7$–
Naphthylene	$C_{10}H_6$:
Naphthylidene	$C_6H_4CH_2CH:CH·C$: (1(4)–), etc.
Nitramino	$O_2N·NH$–
Nitrilo	N:
Nitro	O_2N–
aci-Nitro cf. isonitro	.....
Nitroso	ON–
Norcamphanyl (from norcamphane)	C_7H_{11}–
Octyl	$CH_3(CH_2)_7$–
Oxalyl	–OC·CO–
Oxamido	$H_2NCO·CONH$–
Oxamyl	$H_2NCO·CO$–
Oximido cf. isonitroso	.....
Oxy cf. epoxy and keto	–O– (used as a connective)
Pentamethylene	$–CH_2(CH_2)_3CH_2$–
Pentazyl	N:N·N:N·N–
Pentenyl (like butenyl)	C_5H_9–
Pentyl cf. amyl	.....
Perimidyl (from perimidine)	$C_{11}H_7N_2$–(8 isomers)
Perthio	S:S:
Phenacyl	$C_6H_5COCH_2$–
Phenacylidene	C_6H_5COCH:
Phenanthryl (from phenanthrene)	$C_{14}H_9$–(5 isomers)

NAMES AND FORMULAS OF ORGANIC RADICALS

Name	Formula
Phenanthrylene	$C_{14}H_8$:(several isomers)
Phenenyl	C_6H_3: (*s*-,*as*-,*v*-)
Phenethyl	$C_6H_5CH_2CH_2$–
Phenetidino	$C_2H_5OC_6H_4NH$–
Phenetyl	$C_2H_5OC_6H_4$–(*o*,*m*, or *p*)
Phenoxy	C_6H_5O–
Phenyl	C_6H_5–
Phenylazo	$C_6H_5N{:}N$–
Phenylcarbamido	$C_6H_5NHCONH$–
Phenylene	C_6H_4:(*o*, *m*, or *p*)
Phenylenedisazo	–N:NC_6H_4N:N–(*o*,*m*,*p*)
Phenylidene (*p*)	CH:CH·CH_2·CH:CH·C |_____| (also *o*-isomer)
Phenylureido cf. phenylcarbamido	. . . . .
Phosphazo	–N:P–
Phosphono	H_2O_3P–
Phthalal	:HC·C_6H_4·CH:
Phthalamido (*o*)	HO_2C·C_6H_4·CONH–
Phthalidene (from phthalide)	C_6H_4·CO·O·C: |_____|
Phthalidyl	C_6H_4·CO·O·CH– |_____|
Phthalimido (*o*)	$C_6H_4(CO)_2N$–
Phthalyl (*o*)	–OC·C_6H_4·CO–
Picryl	$(NO_2)_3C_6H_2$–(2,4,6)
Piperidyl (from piperidine)	$C_5H_{10}N$– (4 isomers)
Piperonyl	$(CH_2O_2)C_6H_3CH_2$– (3, 4)
Piperonylidine	$(CH_2O_2)C_6H_3CH$:(3,4)
Pivalyl (from pivalic acid)	$(CH_3)_3C$·CO–
Prolyl (from proline)	NH·$CH_2CH_2CH_2$CH· |_____| CO–
Propargyl	HC:C·CH_2–
Propenyl	CH_3CH:CH–
Propenylidene	CH_3CH:C:
Propiolyl	HC:C·CO–
Propionyl	CH_3CH_2CO–
Propoxy	$CH_3CH_2CH_2O$–
Propyl (*n*)	$CH_3CH_2CH_2$–
Propylene	–CH(CH_3)CH_2–
Propylidene	CH_3CH_2CH:
Pseudoallyl cf. isopropenyl	. . . . .
as-Pseudocumyl	$(CH_3)_3C_6H_2$–(2,3,5)
s-Pseudocumyl	$(CH_3)_3C_6H_2$–(2,4,5)
v-Pseudocumyl	$(CH_3)_3C_6H_2$–(2,3,6)
Pseudoindyl (from pseudoindole)	C_8H_6N– (7 isomers)
Pyranyl (2-α, 2-γ, 3-α, etc.)	C_5H_5O–
Pyrazolyl (from pyrazole)	$C_3H_3N_2$–(4 isomers)
Pyridyl (from pyridine)	C_5H_4N–(3 isomers)
Pyridylidene 4(1)–	CH:CH·NH·CH:CH·C: |_____|
Pyrimidyl (from pyrimidine)	$C_4H_3N_2$–
Pyromucyl	O·CH:CH·CH:C·CO– |_____|
Pyrrolidyl (from pyrrolidine)	C_4H_8N– (3 isomers)
Pyrroyl	CH:CH·CH:CH·N·CO– |_____|
Pyrryl (from pyrrole)	C_4H_4N– (3 isomers)
Quinolyl (from quinoline)	C_9H_6N– (7 isomers)
Quinonyl (from quinone)	$C_6H_3O_2$–
Quinoxalyl (from quinoxaline)	$C_8H_5N_2$–
Salicyl (*o*)	HO·C_6H_4–
Salicylal (*o*)	HO·C_6H_4·CH:
Salicylyl (*o*)	HO·C_6H_4·CO–
Selenino	(HO)OSe–
Seleno	Se:
Selenocyano	NCSe–
Selenono	HO_3Se–
Selenonyl	$–SeO_2$–
Selenyl	HSe–
Semicarbazido	$H_2NCONHNH$–
Silicono	(HO)OSi–
Silicyl	H_3Si–
Silicylene	H_2Si:
Stannyl	H_3Sn–
Stearyl	$CH_3(CH_2)_{16}CO$–
Stibono	$(HO)_2OSb$–
Styrene	–CH(C_6H_5)CH_2–
Styrolene cf. styrene	. . . . .
Styryl	C_6H_5CH:CH–
Succinamyl	$H_2NCOCH_2CH_2CO$–
Succinyl	$–OCCH_2CH_2CO$–
Sulfamino	HO_3SNH–
Sulfamyl	H_2NO_2S–
Sulfhydryl cf. mercapto	. . . . .
Sulfino	HO_2S–
Sulfinyl	OS:
Sulfo	HO_3S–
Sulfonamido	$–SO_2NH$–
Sulfonyl	$–SO_2$–
Sulfuryl cf. sulfonyl	. . . . .
Tauryl	$H_2NCH_2CH_2SO_2$–
Telluro	Te:
Terephthalal (*p*)	:HC·C_6H_4·CH:
Tetramethylene cf. 1, 4-butylene	. . . . .
Tetrazyl (from tetrazole)	CHN_4– (2 isomers)
Thiazyl (from thiazole)	C_3H_2NS– (3 isomers)
Thienyl (from thiophene)	C_4H_3S– (2 isomers)

NAMES AND FORMULAS OF ORGANIC RADICALS

Name	Formula
Thio	–S–
Thiocarbonyl	SC:
Thiocyano	NCS–
Thiohydroxy cf. mercapto	.....
Thiol (S replacing *O* in *OH*)	Used in place of "Thio" only when required for distinction
Thiono (S replacing *O* in *CO*)	
Thionyl cf. sulfinyl	.....
Thujyl (from sabinane)	$C_{10}H_{17}$– (attached at 2 positions)
Thymyl (from thymol)	HC:C(CH$_3$)·CH:CH· |_____ C(*i*-C$_3$H$_7$):C– _____|
Toloxy (*o*, *m*, or *p*)	$CH_3C_6H_4O$–
Toluino (*o*, *m*, or *p*)	$CH_3C_6H_4NH$–
Toluyl (*o*, *m*, or *p*)	$CH_3C_6H_4CO$–
α–Toluyl	$C_6H_5CH_2CO$–
Tolyl (*o*, *m*, or *p*)	$CH_3C_6H_4$–
α–Tolyl cf. benzyl	.....
Tolylene	$CH_3C_6H_3$: (6 isomers)
α–Tolylene cf. benzal	.....
Triazeno	$H_2NH:N$–
Triazinyl (from triazine)	$C_3H_2N_3$–
Triazo	N:N·N– |___|
Triazolyl (from triazole)	$C_2H_2N_3$–
Trimethylene	$-CH_2CH_2CH_2$–
Tryptophyl (from tryptophan)	$C_{11}H_{11}ON_2$–
Tyrosyl (from tyrosine)	*p*-HOC$_6$H$_4$CH$_2$CHNH$_2$·CO–
Undecyl cf. hendecyl (in sense $C_{11}H_{23}$–)	.....
Uramino cf. carbamido	.....
Ureido (by some used synonymously with carbamido)	–NHCONH–
Valeryl	CH$_3$(CH$_2$)$_3$CO–
Valyl (from valine)	(CH$_3$)$_2$CHCHNH$_2$CO–
Vanillal	(CH$_3$O)(HO)C$_6$H$_3$CH: (3, 4)
Vanilloyl	(CH$_3$O)(HO)C$_6$H$_3$CO– (3, 4)
Vanillyl	(CH$_3$O)(HO)C$_6$H$_3$CH$_2$ – (3, 4)
Veratral	(CH$_3$O)$_2$C$_6$H$_3$CH: (3, 4)
Veratroyl	(CH$_3$O)$_2$C$_6$H$_3$CO–(3,4)
Veratryl	(CH$_3$O)$_2$C$_6$H$_3$CH$_2$– (3, 4)
Veratrylidene cf. veratral	.....
Vinyl	H_2C:CH–
Vinylene	–CH:CH–
Vinylidene	H_2C:C:
Xanthyl (from xanthene)	$C_{13}H_9O$– (6 isomers)
Xyloyl (from xylic acid)	(CH$_3$)$_2$C$_6$H$_3$CO– (7 isomers)
Xylyl (dimethylphenyl)	(CH$_3$)$_2$C$_6$H$_3$–
Xylylene	–H$_2$C·C$_6$H$_4$·CH$_2$–

NUMERICAL PREFIXES

See also *Greek Alphabet*

½ – Hemi
1 – Mono
1½ – Sesqui
2 – Di or Bi
3 – Tri
4 – Tetra
5 – Penta
6 – Hexa
7 – Hepta
8 – Octa
9 – Nona or Ennea
10 – Deca
11 – Undeca or Henadeca
12 – Dodeca
13 – Trideca
14 – Tetradeca
15 – Pentadeca
16 – Hexadeca
17 – Heptadeca
18 – Octadeca
19 – Nonadeca
20 – Eicosa
21 – Henicosa
22 – Docosa
23 – Tricosa
24 – Tetracosa
25 – Pentacosa
26 – Hexacosa
27 – Heptacosa
28 – Octacosa
29 – Nonacosa
30 – Triaconta
31 – Hentriaconta
32 – Dotriaconta
33 – Tritriaconta
34 – Tetratriaconta
35 – Pentatriaconta
36 – Hexatriaconta
37 – Heptatriaconta
38 – Octatriaconta
39 – Nonatriaconta
40 – Tetraconta
41 – Hentetraconta
42 – Dotetraconta
43 – Tritetraconta
44 – Tetratetraconta
45 – Pentatetraconta
46 – Hexatetraconta
47 – Heptatetraconta
48 – Octatetraconta
49 – Nonatetraconta
50 – Pentaconta
51 – Henpentaconta
52 – Dopentaconta
53 – Tripentaconta
54 – Tetrapentaconta
55 – Pentapentaconta
56 – Hexapentaconta
57 – Heptapentaconta
58 – Octapentaconta
59 – Nonapentaconta
60 – Hexaconta

FORMULA INDEX

For finding compounds listed in the table: PHYSICAL CONSTANTS OF ORGANIC COMPOUNDS.

The system used in this formula index is essentially the same as that employed in *Richter's Lexikon der Kohlenstoff Verbindungen*. The succession of the elements combined with carbon is as follows: H, O, N, S, F, Cl, Br, I. All the other elements are placed in alphabetical order according to their symbols. The arrangement depends (1) on the number of carbon atoms, (2) on the number of the other elements, which in addition to carbon, are contained in the compounds, (3) on the kind of elements, which in addition to carbon are contained in the molecule, in accordance with the order as stated above, and (4) on the number of atoms of each element which, in addition to carbon, is contained in the compound. Thus 2 III means two carbon atoms combined with three other elements; *e.g.*, $C_2H_2O_2F_2$ 2239, is a compound with 2 carbon atoms and *3* other elements, and it is the 2239th compound in the table to which this formula index is a part.

1 I

CH_4 4061
CO 1239
CO_2 1237
CN 1589
CS_2 1238
CF_4 1244
CCl_4 1243
CBr_4 1242
CI_4 1245

1 II

CHN 3714
CHF_3 3287
$CHCl_3$ 1477
$CHBr_3$ 1016
CHI_3 3887
CH_2O 3288; 3290
CH_2O_2 3301
CH_2N_2 1577; 1772
CH_2N_4 5870
CH_2S_3 6349
CH_2F_2 4433
CH_2Cl_2 4429
CH_2Br_2 4428
CH_2I_2 4434
CH_3N_3 4134
CH_3F 4240
CH_3Cl 4183
CH_3Br 4147
CH_3I 4287
CH_4O 4100
CH_4N_2 3297
CH_4S 4298
CH_5N 4105
CH_5N_3 3488
CH_5As 4132
CH_5P 4341
CH_6N_2 4269
CH_6N_4 322
COS 1248
$COCl_2$ 1247
$COBr_2$ 1246
CO_6N_4 5853
CNCl 1591
CNBr 1590
CNI 1592
$CSCl_2$ 5916
$CSCl_4$ 5089
$CFCl_3$ 3286
CF_2Cl_2 2246
$CClBr_3$ 1472
CCl_2Br_2 1983
CCl_2I_2 1986
CCl_3Br 6143
CCl_3I 6157
$CBrI_3$ 1004

1 III

CHON 1576; 1579
CHO_2Na 3302
CHO_2Tl 3303
CHO_6N_3 6300
CHNS 5897
$CHFCl_2$ 3271
$CHClBr_2$ 1361
$CHClI_2$ 1363
$CHCl_2Br$ 1970
$CHCl_2I$ 2006
$CHBrI_2$ 928
$CHBr_2I$ 1849
$CH_2O_3N_2$ 4323
$CH_2O_4N_2$ 2636
CH_2FCl 3267
CH_2ClBr 1344
CH_2ClI 1393
CH_2BrI 950
CH_3ON 3294; 3296
CH_3OCl 4281
CH_3OAs 4131
CH_3O_2N 1228; 4316; 4765
CH_3O_3N 4315
$CH_3O_3N_3$ 4863
CH_3NS 5901
CH_3NS_2 2819
CH_3Cl_2As 4214
CH_4ON_2 3298; 3307; 6386
$CH_4O_2N_2$ 3842; 4314
$CH_4O_2N_4$ 4743
CH_4O_2Si 5615
CH_4O_3S 4382
CH_4O_4S 4384
$CH_4O_6S_2$ 4432
CH_4N_2S 5920
CH_4N_2Se 5608
CH_5ON 4279
CH_5ON_3 5609
CH_5O_3As 4130
$CH_5O_4N_3$ 6389
CH_5N_3S 5919
CH_6ON_4 1236
$CH_6O_3N_4$ 3492
CH_6NCl 4106
CH_6N_3Cl 3491
CO_2NCl_3 4697
CO_2NBr_3 4688
CO_6N_3Br 1005
CO_6N_3I 3908

1 IV

CHO_2NBr_2 1854
CHFClBr 3266
CH_2ONCl 1229
CH_2O_2NBr 966
$CH_2O_5S_2Na_2$ 3293
CH_3O_2SCl 4383
CH_3O_3SNa 3295
CH_3O_4SNa 3292
CH_5ON_2Cl 6388
CH_6ONCl 4280
CH_6ON_3Cl 5610
$CH_8O_4N_2S$ 4270
$CH_8O_4N_4S$ 324

2 I

C_2H_2 130
C_2H_4 3192
C_2H_6 2904
C_2N_2 1588
C_2Cl_4 5741
C_2Cl_6 3564
C_2Br_2 1796

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C_2Br_4 5721
C_2Br_6 3562
C_2I_2 2382
C_2I_4 5812

2 II

C_2HCl 1305
C_2HCl_3 6155
C_2HCl_5 5054
C_2HBr 891
C_2HBr_3 6105
C_2HBr_5 5050
C_2HI_5 5072
C_2H_2O 3933
$C_2H_2O_2$ 3478
$C_2H_2O_3$ 3480
$C_2H_2O_4$ 5006-7
$C_2H_2N_2$ 3715
$C_2H_2N_4$ 5869
$C_2H_2F_2$ 2250
$C_2H_2Cl_2$ 135-6; 1998
$C_2H_2Cl_4$ 5739-40
$C_2H_2Br_2$ 131-3
$C_2H_2Br_4$ 5719-20
$C_2H_2I_2$ 137-8
C_2H_3N 49; 4195
$C_2H_3N_3$ 6080
C_2H_3F 6439
C_2H_3Cl 6435
$C_2H_3Cl_3$ 6151-2
C_2H_3Br 6434
$C_2H_3Br_3$ 6103
C_2H_3I 6442
$C_2H_3I_3$ 6237
C_2H_4O 5; 3210; 6429
$C_2H_4O_2$ 36; 3470; 4242
$C_2H_4O_3$ 3468
$C_2H_4N_4$ 2080
$C_2H_4N_6$ 1761
$C_2H_4S_2$ 2818
$C_2H_4F_2$ 2249
$C_2H_4Cl_2$ 1993-4
$C_2H_4Br_2$ 1836-7
$C_2H_4I_2$ 2390-1
C_2H_5N 6430
C_2H_5F 3046
C_2H_5Cl 3015
C_2H_5Br 2989
C_2H_5I 3077
C_2H_5Na 5622
C_2H_6O 2478; 2946
$C_2H_6O_2$ 3444
$C_2H_6N_2$ 15
C_2H_6S 2560; 3083
$C_2H_6S_2$ 3209; 4222
C_2H_6Cd 1186
C_2H_6Hg 4044
C_2H_6Se 2553; 3071
C_2H_6Te 2566
C_2H_6Zn 6504
C_2H_7N 2429; 2950
$C_2H_7N_3$ 4258
C_2H_7As 2456; 2970
C_2H_7P 2529; 3135
$C_2H_8N_2$ 2494-5; 3064; 3196-9
C_2OCl_4 6129
$C_2O_2Cl_2$ 5011
$C_2O_2Cl_4$ 6159
$C_2O_4Na_2$ 5008
$C_2O_6N_4$ 6288
C_2N_2S 1593
C_2FCl_3 3285
C_2FCl_5 3276
C_2FBr_5 3275
$C_2F_2Cl_2$ 2245
$C_2F_2Cl_4$ 2253-4
$C_2F_2Br_4$ 2252
C_2F_3Cl 6203
$C_2F_3Cl_3$ 6206
$C_2F_3Br_3$ 6205
C_2ClBr_5 1423
$C_2Cl_2Br_4$ 2073
$C_2Cl_3Br_3$ 6170
$C_2Cl_4Br_2$ 5736-7

2 III

C_2HOCl_3 1281; 1931
C_2HOBr_3 876
C_2HO_2N 5012
$C_2HO_2Cl_3$ 6128
$C_2HO_2Br_3$ 6088
$C_2HO_2I_3$ 6232
C_2HFCl_4 3278
C_2HFBr_4 3277
$C_2HF_2Br_3$ 2255
$C_2HF_3Br_2$ 6204
C_2HClBr_4 1465
$C_2HCl_2Br_3$ 2075-6
$C_2HCl_3Br_2$ 6150
$C_2H_2OCl_2$ 1304; 1926
$C_2H_2OBr_2$ 890
$C_2H_2O_2F_2$ 2239
$C_2H_2O_2Cl_2$ 1928
$C_2H_2O_2Br_2$ 1795
$C_2H_2O_2I_2$ 2381
C_2H_2NCl 1399
C_2H_2NBr 954
C_2H_2NI 3890
$C_2H_2N_2S_3$ 5898
$C_2H_2FCl_3$ 3284
$C_2H_2FBr_3$ 3282-3
$C_2H_2F_2Cl_2$ 2244
$C_2H_2F_2Br_2$ 2242-3
$C_2H_2F_3Cl$ 6202
$C_2H_2ClBr_3$ 1471
$C_2H_2Cl_2Br_2$ 1980-2
$C_2H_2Cl_3Br$ 6142
$C_2H_2Cl_3As$ 1473
C_2H_3ON 3474; 4194
C_2H_3OF 89
C_2H_3OCl 81; 1293
$C_2H_3OCl_3$ 6154
C_2H_3OBr 75
$C_2H_3OBr_3$ 6104
C_2H_3OI 92
$C_2H_3O_2N_3$ 6078
$C_2H_3O_2F$ 3255
$C_2H_3O_2Cl$ 1299; 4187
$C_2H_3O_2Cl_3$ 1286
$C_2H_3O_2Br$ 883
$C_2H_3O_2Br_3$ 877
$C_2H_3O_2I$ 3874
$C_2H_3O_3N$ 5016
$C_2H_3O_4N$ 405; 4592
$C_2H_3O_6N_3$ 6299
C_2H_3NS 4387-8
$C_2H_3FBr_2$ 3268-9
$C_2H_3F_2Cl$ 2241
$C_2H_3F_2Br$ 2240
$C_2H_3F_2I$ 2251
$C_2H_3ClBr_2$ 1359-60
$C_2H_3Cl_2Br$ 1968-9
$C_2H_3Cl_2I$ 2005
C_2H_4OS 5885
$C_2H_4OCl_2$ 1997; 2008
$C_2H_4O_2N_2$ 2256; 3479; 5009
$C_2H_4O_2N_4$ 603; 2851
$C_2H_4O_2S$ 5905
$C_2H_4O_3N_2$ 3105
$C_2H_4O_4N_2$ 2630; 3463
$C_2H_4N_2S_2$ 2821
$C_2H_4O_5S$ 5675
$C_2H_4O_6N_2$ 3462
$C_2H_4N_6Cl_2$ 1949
C_2H_4ClBr 1342-3
C_2H_4ClI 1390-1
C_2H_4BrI 948-9
C_2H_5ON 10; 14
C_2H_5OCl 1400; 3076; 3194
C_2H_5OBr 3193
C_2H_5OI 3208
$C_2H_5O_2N$ 3097; 3437; 3472; 4175; 4733
$C_2H_5O_2N_3$ 859; 5017
$C_2H_5O_3N$ 3096; 4735
C_2H_5NS 5882
C_2H_5SNa 5624
$C_2H_5Cl_2As$ 3040
$C_2H_6ON_2$ 2513; 3438; 4414
$C_2H_6ON_4$ 2081
C_2H_6OS 2563; 5904
$C_2H_6O_2N_4$ 3689
$C_2H_6O_2S$ 2562; 2905
$C_2H_6O_3S$ 2561; 2906
$C_2H_6O_4S$ 2559; 3069
$C_2H_6O_6S_2$ 3206
$C_2H_6N_2S$ 4390-1

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$C_2H_6N_4S$ 3494
C_2H_6ClAs 1179
$C_2H_6Cl_3As$ 1181
C_2H_7ON 8; 2907; **3074-5**
$C_2H_7O_2As$ 1182
$C_2H_7O_3As$ 2971
$C_2H_7O_4N_3$ 4415
$C_2H_7N_2Cl$ 16
$C_2H_8O_3N_4$ 323; 4259
C_2H_8NCl 2430; 2952
C_2H_8NBr 2951
$C_2H_9N_2Cl$ 2496
$C_2H_{10}ON_2$ 3199
$C_2H_{10}N_2Cl_2$ 3198
$C_2H_{10}N_2Br_2$ 3197
$C_2O_2N_2Ag_2$ 5620
$C_2O_2N_2Hg$ 4040

2 IV

$C_2HFCl_2Br_2$ 3270
$C_2H_2ONCl_3$ 6126
$C_2H_2ONBr_3$ 6086
$C_2H_3ONCl_2$ 1927; 2032
$C_2H_3ONBr_2$ 1793-4
$C_2H_3O_2NCl_2$ 2027
C_2H_4ONCl 1294-5; **1422**
$C_2H_4ONCl_3$ 1283
C_2H_4ONBr 879
$C_2H_4O_2NCl$ 1416-7
$C_2H_4O_2NBr$ 965
$C_2H_5O_2SCl$ 3155
$C_2H_5O_3SCl$ 3022
$C_2H_5O_4SNa$ 13
$C_2H_7O_3NS$ 5696
$C_2H_{12}O_4N_6S$ 3493
$C_2H_{14}O_4N_8S$ 325

3 I

C_3H_4 183; 225
C_3H_6 1621; 5459
C_3H_8 5338
C_3O_2 1240
C_3S_2 1241
C_3Cl_8 4936

3 II

C_3HCl_7 3506
C_3H_2O 5349
$C_3H_2O_2$ 5348
$C_3H_2N_2$ 4006
$C_3H_2Br_2$ 1871
C_3H_3N 151
C_3H_3Cl 5343
C_3H_3Br 5342
C_3H_3I 3903; 5344
C_3H_4O 146; 226; **5341**
$C_3H_4O_2$ 149
$C_3H_4O_3$ 5525
$C_3H_4O_4$ 4002; **4329**
$C_3H_4O_5$ 5695
$C_3H_4O_6$ 4055
$C_3H_4N_2$ 3851; 5478
$C_3H_4Cl_2$ 2058-61
$C_3H_4Br_2$ 1869-70
C_3H_5N 3029; 5363
C_3H_5Cl 202; 5345-6
$C_3H_5Cl_3$ 6166-7
C_3H_5Br 199; 988-90
$C_3H_5Br_3$ 6112
C_3H_5I 208
C_3H_6O 56; 193; 5352; 5468-9
$C_3H_6O_2$ 55; 3048; 3436; 3454; 3942; 4087; 5351
$C_3H_6O_3$ 2292; 2468; 3289; 3380; 3456; 3682; 3939-40; 4063; 4255
$C_3H_6O_4$ 3379
$C_3H_6N_2$ 5479
$C_3H_6N_6$ 4019
C_3H_6S 210
$C_3H_6S_3$ 3309
$C_3H_6Cl_2$ 2050-3
$C_3H_6Br_2$ 1863-6
$C_3H_6I_2$ 2397-9
C_3H_7N 194
C_3H_7F 5406-7
C_3H_7Cl 5400-1
C_3H_7Br 5388-9
C_3H_7I 5417-8
C_3H_8O 4230; 5368-9
$C_3H_8O_2$ 3460; 4424; 5465; 6286
$C_3H_8O_3$ 3381
C_3H_8S 4238; 5424-5
$C_3H_8S_2$ 6284
C_3H_8Se 5448
C_3H_9N 4226; 5371-2; **6248**
$C_3H_9N_3$ 2491
C_3H_9Al 231
C_3H_9As 6252
C_3H_9B 872
C_3H_9Bi 856
C_3H_9P 6269
C_3H_9Sb 6274
$C_3H_{10}N_2$ 5464; 6282
$C_3N_3Cl_3$ 6172

3 III

C_3HOBr_5 5048.1
$C_3H_2OCl_4$ 5728-9
$C_3H_2O_3N_2$ 5036
$C_3H_2O_3Br_2$ 1875
$C_3H_2O_4Br_2$ 1851
$C_3H_2O_4Ca$ 4003
C_3H_3ON 5527
$C_3H_3O_2N$ 1583
$C_3H_3O_2Cl$ 1306-7
$C_3H_3O_2Cl_3$ 4403
$C_3H_3O_3N_3$ 1594; **3313**
$C_3H_3O_3Cl_3$ 6158
$C_3H_3O_4N$ 4762
$C_3H_3O_4Cl$ 1397
$C_3H_3O_4Br$ 952
C_3H_3NS 5878
$C_3H_3NCl_2$ 2056
$C_3H_3N_3S_3$ 5899
$C_3H_4ON_2$ 1581; 5480
$C_3H_4OCl_2$ 1444; 1929-30
$C_3H_4OBr_2$ 982
$C_3H_4O_2N_2$ 3679
$C_3H_4O_2Cl_2$ 1382; 2054-5
$C_3H_4O_2Br_2$ 1867-8
$C_3H_4O_3N_2$ 182
$C_3H_4O_4N_2$ 5013
$C_3H_4N_2S$ 377
C_3H_5ON 148; **3027-8**; **3195**; 3944
$C_3H_5ON_5$ **396**
C_3H_5OF 5361
C_3H_5OCl 1301; 2879; 5360
$C_3H_5OCl_3$ 6168
C_3H_5OBr 886; 892; 5359
C_3H_5OI 2881; 5362
$C_3H_5O_2N$ 3927; **4829**; **4873**; 5526
$C_3H_5O_2Cl$ 1398; 1442-3; **3019**; 4184
$C_3H_5O_2Br$ 955; **980-1**; **4148**
$C_3H_5O_2I$ 3901-2
$C_3H_5O_3N_3$ 5014
$C_3H_5O_4N$ 328
$C_3H_5O_6N_3$ 3429
$C_3H_5O_9N_3$ 3428
C_3H_5NS 3158-9
$C_3H_6ON_2$ 3212; **3216**
$C_3H_6OS_2$ 6448
$C_3H_6OCl_2$ 3393-4
$C_3H_6OBr_2$ 3388-9
$C_3H_6OI_2$ 3401
$C_3H_6O_2N_2$ 123; 4004
$C_3H_6O_2S$ 5908; 5910
$C_3H_6O_3N_2$ 3678
$C_3H_6O_4N_2$ 2658-9; **4864**
$C_3H_6O_7N_2$ 3405-6
C_3H_6ClBr 6279
C_3H_7ON 61; 235; 3047; **4085**; 5353; 5356
$C_3H_7ON_3$ 12
C_3H_7OCl 4186; 5461-2; 6280
C_3H_7OBr 5460; 6278
C_3H_7OI 6287
$C_3H_7O_2N$ 158-60; 3291; **3943**; 4107; 4827-8; **5428**; 5600; 6392
$C_3H_7O_2N_3$ 3442
$C_3H_7O_2Cl$ 3395-6
$C_3H_7O_2I$ 3402
$C_3H_7O_3N$ 5427; **5611-4**

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$C_3H_7O_3As$ 197
$C_3H_7O_3Na$ 5623
$C_3H_7O_5N$ 3407-8
C_3H_7NS 5917
$C_3H_7NS_2$ 3157
$C_3H_7N_6Cl$ 4020
$C_3H_8ON_2$ 2572-3; 3183
$C_3H_8O_2N_2$ 5429
$C_3H_8O_2S$ 4239; 5903
$C_3H_8N_2S$ 2568; 3162
C_3H_9ON 4111; 5339; 5416
$C_3H_9O_2N$ 3385
$C_3H_9O_2N_3$ 3489
$C_3H_9O_3As$ 5376
$C_3H_9O_3B$ 6262
$C_3H_9O_4P$ 6268
$C_3H_9O_6P$ 3411
$C_3H_{10}ON_2$ 3384
$C_3H_{10}NCl$ 4227; 6249
$C_3H_{12}O_3N_6$ 3490

3 IV

$C_3H_2ONCl_3$ 1284
$C_3H_3ONS_2$ 5560
$C_3H_3O_2NS$ 2369
$C_3H_4ON_2S$ 5907
$C_3H_4O_2NCl_3$ 1285
$C_3H_5O_2NCl_2$ 2031
$C_3H_5O_3NCl_2$ 2028
$C_3H_6ON_2S$ 122
$C_3H_6O_2NCl$ 1420-1
$C_3H_6NS_2Na$ 2477
C_3H_7ONS 5921; 6450
$C_3H_7O_2NS$ 1625
$C_3H_7O_4SNa$ 64
$C_3H_7O_6PNa_2$ 3412
$C_3H_8O_2NCl$ 5601

3 V

$C_3H_8O_2NSCl$ 1626

4 I

C_4H_2 1679
C_4H_6 1018-9; 1156-7
C_4H_8 1147-9; 1595; 4210
C_4H_{10} 1021-2

4 II

$C_4H_2O_3$ 3996
$C_4H_2O_4$ 134
C_4H_4O 3327
$C_4H_4O_2$ 5871
$C_4H_4O_3$ 5657
$C_4H_4O_4$ 3314; 3475; 3995
$C_4H_4N_2$ 5477; 5482; 5513; 5661
C_4H_4S 5923
C_4H_5N 204-5; 1563; 5521
$C_4H_5N_3$ 3853
C_4H_5Cl 1345
C_4H_6O 1559; 2499; 4058; 4348; 6436
$C_4H_6O_2$ 207; 1557-8; 1667; 3304; 4095-6; 5655; 6426-7
$C_4H_6O_3$ 37-8; 3934; 4366; 6440
$C_4H_6O_4$ 106; 2521; 3066; 3455; 5652-3
$C_4H_6O_5$ 2261; 3473; 3997-8; 4000
$C_4H_6O_6$ 5688; 5690-1
$C_4H_6O_8$ 2367
$C_4H_6N_2$ 4257
C_4H_6S 2852
C_4H_7N 1175-6; 5404-5; 5524
C_4H_7Cl 1566-7; 4060
$C_4H_7Br_3$ 6100-1
C_4H_7I 1568
C_4H_8O 1155; 1160; 1163; 1565; 4059; 4104; 4232; 4422; 5773; 6437-8
$C_4H_8O_2$ 43; 169; 1166-7; 2237; 2935; 3207; 4349; 5408-9; 6285
$C_4H_8O_3$ 2912; 3060; 3397; 3446; 3753-7; 4076; 4229; 4294
$C_4H_8O_4$ 4253
$C_4H_8N_2$ 9; 4256
C_4H_8S 3190
$C_4H_8S_2$ 2228
$C_4H_8Cl_2$ 1971-6
$C_4H_8Br_2$ 1821-5
$C_4H_8I_2$ 2389
C_4H_9N 4102; 5523
C_4H_9F 1085
C_4H_9Cl 1072-5
C_4H_9Br 1057-60
C_4H_9I 1095-8
$C_4H_{10}O$ 1034-7; 2911; 4353-4
$C_4H_{10}O_2$ 1154; 1265; 2196; 2329-32; 2415; 3061; 3459
$C_4H_{10}O_3$ 3404; 3453; 4077
$C_4H_{10}O_4$ 2894
$C_4H_{10}N_2$ 2225-6
$C_4H_{10}S$ 1103-5; 2214
$C_4H_{10}S_2$ 2166
$C_4H_{10}Be$ 845
$C_4H_{10}Cd$ 1185
$C_4H_{10}Hg$ 4043
$C_4H_{10}Se$ 2207
$C_4H_{10}Se_2$ 2208
$C_4H_{10}Sn$ 5949
$C_4H_{10}Te$ 2219
$C_4H_{10}Zn$ 6503
$C_4H_{11}N$ 1039-42; 2109; 2482; 4350
$C_4H_{11}P$ 2197
$C_4H_{12}N_2$ 2178; 5474
$C_4H_{12}As_2$ 1178
$C_4H_{12}Pb$ 3958
$C_4H_{12}Si$ 5617
$C_4H_{12}Sn$ 5951
$C_4H_{13}N_3$ 2238
C_4OCl_{10} 5088

4 III

C_4HNI_4 5817
$C_4H_2O_2Cl_2$ 3316
$C_4H_2O_3Cl_2$ 4442
$C_4H_2O_3Br_2$ 4441
$C_4H_2O_4N_2$ 184-6
$C_4H_2O_4Cl_2$ 2007
$C_4H_2O_4Br_2$ 1840; 1850
$C_4H_2SI_2$ 2400
C_4H_3OBr 942
$C_4H_3O_3N$ 4740
$C_4H_3O_4N_3$ 4862; 6445
$C_4H_3O_4Cl$ 1384, 1396
$C_4H_3O_4Br$ 941; 951
$C_4H_3O_5N_3$ 4632
$C_4H_4O_2N_2$ 6383
$C_4H_4O_2Cl_2$ 5658
$C_4H_4O_3N_2$ 621
$C_4H_4O_3N_4$ 1774
$C_4H_4O_3Cl_2$ 1300
$C_4H_4O_4N_2$ 1686
$C_4H_4O_4Br_2$ 1877-8
$C_4H_4O_4Na_2$ 5654
$C_4H_4O_5N_2$ 186-7
$C_4H_4O_6Ca$ 5689
$C_4H_4O_6Na_2$ 2368
$C_4H_4O_{10}N_2$ 4842
$C_4H_4N_2S_2$ 3211
C_4H_5ON 2880
C_4H_5OCl 1562
$C_4H_5OCl_3$ 1158
$C_4H_5O_2N$ 1587; 3032; 4196; 5660
$C_4H_5O_2N_3$ 386
$C_4H_5O_2Cl$ 1358
$C_4H_5O_2Cl_3$ 3179; 6153
$C_4H_5O_2Br$ 925
$C_4H_5O_2Br_3$ 3178
$C_4H_5O_3N_3$ 6384
$C_4H_5O_4Cl$ 1464
$C_4H_5O_4Br$ 997
C_4H_5NS 219-20; 378
$C_4H_6ON_2$ 4360
$C_4H_6O_2N_2$ 3035; 3315; 3439; 4267-8
$C_4H_6O_2N_4$ 139
$C_4H_6O_2S_2$ 85
$C_4H_6O_2Cl_2$ 1448; 1978-9; 1988; 3039
$C_4H_6O_2Br_2$ 1826-7; 3036

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$C_4H_6O_3N_4$ 181
$C_4H_6O_4S$ 5911
$C_4H_6O_6Ca$ 3469
C_4H_6NCl 1351
$C_4H_6N_2S$ 329
$C_4H_6O_{12}N_4$ 2895
C_4H_7ON 57; 1560; 3758; 3936
$C_4H_7ON_3$ 1540
C_4H_7OCl 1173-4; 1401; 4223
$C_4H_7OCl_3$ 6145
$C_4H_7OBr_3$ 6102
$C_4H_7O_2N$ 1662; 4888
$C_4H_7O_2N_3$ 3177
$C_4H_7O_2Cl$ 1347-50; 1377; 3016; 5402-3
$C_4H_7O_2Cl_3$ 1159; 1282
$C_4H_7O_2Br$ 917-8; 936; 2990
$C_4H_7O_2I$ 3078; 3886
$C_4H_7O_3N$ 90; 4880; 5015; 5651
$C_4H_7O_3N_3$ 74
$C_4H_7O_3Cl$ 4075
$C_4H_7O_4N$ 589-90; 3098; 3852
$C_4H_7O_5N$ 5693
C_4H_7NS 5450-1
$C_4H_8ON_2$ 223
C_4H_8OS 3156
$C_4H_8OS_2$ 3087
$C_4H_8OCl_2$ 1977; 1995-6
$C_4H_8O_2N_2$ 2490; 2522-3; 4091; 5656
$C_4H_8O_2S$ 3160-1
$C_4H_8O_3N_2$ 588; 2947; 3476; 4001; 4891
$C_4H_8O_4N_2$ 5692
$C_4H_8O_4N_4$ 5005
$C_4H_8O_7N_2$ 2230
$C_4H_8N_2S$ 221
$C_4H_8SCl_2$ 1985
C_4H_9ON 1161; 1168-9; 2235; 2416; 2933; 4233
$C_4H_9ON_3$ 63; 5354-5
C_4H_9OCl 1151-3; 1362
C_4H_9OBr 939
$C_4H_9O_2N$ 86; 277-80; 1108-9; 3057; 3059; 4118; 4416; 4690-3; 5398
$C_4H_9O_2N_3$ 1539
$C_4H_9O_2Cl$ 2260; 4254
$C_4H_9O_3N$ 1107; 4694-5; 5932-4
$C_4H_9O_4N$ 4689
$C_4H_9O_5N$ 4859
C_4H_9NS 5884
$C_4H_{10}ON_2$ 2191; 5453; 6276
$C_4H_{10}OS$ 2217
$C_4H_{10}O_2S$ 2216; 5900
$C_4H_{10}O_3S$ 2215; 2567
$C_4H_{10}O_4S$ 2213
$C_4H_{10}O_6N_4$ 6390-1
$C_4H_{10}S_2Hg$ 4051
$C_4H_{11}ON$ 1023-4; 2443; 2957
$C_4H_{11}O_2N$ 1020; 2090
$C_4H_{11}O_3N$ 6230
$C_4H_{11}O_3As$ 1048
$C_4H_{11}O_4P$ 2198
$C_4H_{12}ON_2$ 3771
$C_4H_{12}OAs_2$ 1183
$C_4H_{12}NCl$ 2110; 5822
$C_4H_{12}NBr$ 5821
$C_4H_{12}NI$ 5826
$C_4H_{12}SAs_2$ 1180
$C_4H_{13}ON$ 5823-5
$C_4H_{14}N_2Cl_2$ 5475

4 IV

$C_4H_2O_4N_3Na$ 6446
$C_4H_2O_3N_2Cl_2$ 1951
$C_4H_2O_3N_2Br_2$ 1810
$C_4H_3O_2NS$ 4843
$C_4H_4O_2NCl$ 5659
$C_4H_4O_2N_2S$ 5887
C_4H_6ONCl 3764
$C_4H_7O_2NCl_2$ 171
$C_4H_7O_3N_2I$ 179
$C_4H_{10}O_2NCl$ 3058
$C_4H_{14}O_4N_4S_3$ 4391
$C_4H_{14}O_6N_6S$ 2082
$C_4H_{16}O_4N_6S$ 4260

4 V

$C_4H_3O_4SAuNa_2$ 4447
$C_4H_{16}O_4N_8Cl_2Ca$ 6387

5 I

C_5H_6 1618; 6415
C_5H_8 4154-5; 4168; 5064-5; 5086-7
C_5H_{10} 498-502; 1619; 4198
C_5H_{12} 5083-5

5 II

$C_5H_2O_5$ 1556
$C_5H_4O_2$ 3317-8; 5518
$C_5H_4O_3$ 1511; 3339-40
$C_5H_4O_4$ 140
$C_5H_4N_4$ 5473
C_5H_5N 5483
C_5H_6O 4245
$C_5H_6O_2$ 3137; 3332; 5340; 6428
$C_5H_6O_4$ 1510; 3370; 3928; 4243; 6425
$C_5H_6O_5$ 59
$C_5H_6O_6$ 1659
$C_5H_6N_2$ 360-2; 3377; 5463
C_5H_6S 4389
C_5H_7N 192; 4362-4
C_5H_8O 1620; 2427; 3136; 3213
$C_5H_8O_2$ 68; 189-90; 2424-6; 2942-3; 3846; 3968; 4193
$C_5H_8O_3$ 67; 1672; 3150; 3967; 4088
$C_5H_8O_4$ 2502-3; 3082; 3376; 4236; 4430; 5520
$C_5H_8O_5$ 1514; 3398; 3773-4; 3815; 3929
$C_5H_8O_7$ 6228-9
$C_5H_8N_2$ 2534
C_5H_9N 1083; 4365; 6246; 6405; 6413
$C_5H_9N_3$ 3667
$C_5H_{10}O$ 2180; 2949; 3189; 4103; 4224; 4355; 4357; 6243; 6400; 6407
$C_5H_{10}O_2$ 1086; 1088-9; 3138; 4169-71; 5081; 5365-6; 5775; 6245; 6277; 6399; 6406
$C_5H_{10}O_3$ 2138; 3063; 3079; 3843-5; 4182; 5413; 5467
$C_5H_{10}O_4$ 3056; 3382
$C_5H_{10}O_5$ 570; 3991-2; 5564; 6480
$C_5H_{10}O_6$ 573
$C_5H_{10}N_2$ 2143
$C_5H_{10}Cl_2$ 2033-41
$C_5H_{10}Br_2$ 1856-8
$C_5H_{10}I_2$ 2396
$C_5H_{11}N$ 5322
$C_5H_{11}Cl$ 442-8
$C_5H_{11}Br$ 427-31
$C_5H_{11}I$ 459-63
$C_5H_{12}O$ 404-11; 3142-3; 4161-2
$C_5H_{12}O_2$ 503-4; 2172
$C_5H_{12}O_3$ 3403; 4177; 5069
$C_5H_{12}O_4$ 5066
$C_5H_{12}O_5$ 156; 572; 6478
$C_5H_{12}S$ 467-9; 4167
$C_5H_{13}N$ 412-8; 4156-7; 4215
$C_5H_{14}N_2$ 1184

5 III

C_5H_3ON 3345
$C_5H_3O_2Cl$ 3344
$C_5H_3O_3Cl$ 1385
$C_5H_3O_3Br$ 943
$C_5H_3O_5N$ 4741
$C_5H_3NBr_2$ 1872-4
C_5H_4OS 5925
$C_5H_4O_2N_4$ 6449
$C_5H_4O_2S$ 5926-7
$C_5H_4O_3N_4$ 6393
C_5H_4NCl 1450-2
C_5H_4NBr 991-2
C_5H_5ON 3812-4
C_5H_5OCl 3335
$C_5H_5O_2N$ 2362-3; 3322-3; 3341-2; 5522

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$C_5H_5O_3N$ 6231
C_5H_6OS 3337; 5924
$C_5H_6O_2N_2$ 4410-3
C_5H_6NCl 5484
C_5H_7ON 3333
$C_5H_7O_2N$ 3030
$C_5H_7NCl_2$ 5485
$C_5H_8O_2N_2$ 66
$C_5H_8O_2Cl_2$ 45
$C_5H_8O_3N_2$ 1678
$C_5H_8O_3Cl_2$ 1984
C_5H_9OCl 6404; 6412
$C_5H_9O_2N$ 1674; 4890; 5335
$C_5H_9O_2Cl$ 1077-8; 1445-7; 3020-1
$C_5H_9O_2Br$ 983-4; 1006-7; 2995-6
$C_5H_9O_3N$ 3808-9
$C_5H_9O_3Cl$ 2923
$C_5H_9O_4N$ 3371-2
$C_5H_9O_5N$ 3772
C_5H_9NS 1131-6
$C_5H_{10}ON_2$ 4898
$C_5H_{10}OS_2$ 2163-4
$C_5H_{10}O_3N_2$ 3374-5; 4886
$C_5H_{10}N_2S_2$ 1249
$C_5H_{11}ON$ 2173; 4356; 4358; 6244; 6401-2; 6408-9
$C_5H_{11}ON_3$ 1164; 4234
$C_5H_{11}O_2N$ 387-9; 391-5; 473; 846; 1067-8; 3184; 4790-3
$C_5H_{11}O_3N$ 472; 2922
$C_5H_{11}O_4N$ 4789
$C_5H_{11}NS$ 6275
$C_5H_{11}NS_2$ 2162
$C_5H_{11}N_3Cl_2$ 3668
$C_5H_{12}ON_2$ 1138-9; 2222-3; 5845
$C_5H_{12}O_2N_2$ 5000
$C_5H_{12}N_2S$ 2220
$C_5H_{13}ON$ 4584
$C_5H_{13}O_2N$ 243; 2444
$C_5H_{14}N_2S_2$ 2449
$C_5H_{15}O_2N$ 1488

5 IV

$C_5H_5O_3NS$ 5505
$C_5H_6O_2N_2S$ 121
$C_5H_8O_3NCl_3$ 1288
$C_5H_{10}O_4NCl$ 3373
$C_5H_{11}O_2NS$ 4062
$C_5H_{12}O_2NCl$ 390; 847; 2945
$C_5H_{14}ONCl$ 1489

6 I

C_6H_6 656; 2768
C_6H_8 1599; 1600
C_6H_{10} 1609; 2769; 3573-4
C_6H_{12} 1601; 3655-61; 4209
C_6H_{14} 3603-7
C_6O_6 1604
C_6Cl_6 3563
C_6Br_6 3561
C_6I_6 3589

6 II

C_6HCl_5 5053
C_6HBr_5 5049
C_6HI_5 5071
$C_6H_2Cl_4$ 5733-5
$C_6H_2Br_4$ 5715-6
$C_6H_2I_4$ 5809-11
$C_6H_3Cl_3$ 6134-6
$C_6H_3Br_3$ 6095-7
$C_6H_3I_3$ 6233-5
$C_6H_4O_2$ 5541-2
$C_6H_4O_4$ 2364
$C_6H_4O_6$ 5808
$C_6H_4Cl_2$ 1952-4
$C_6H_4Br_2$ 1811-3
$C_6H_4I_2$ 2386-8
$C_6H_5N_3$ 252; 6079
C_6H_5F 3258
C_6H_5Cl 1324
C_6H_5Br 902
C_6H_5I 3879
C_6H_6O 5118
$C_6H_6O_2$ 2312-4; 4244
$C_6H_6O_3$ 150; 848; 4246; 6216-9
$C_6H_6O_4$ 4443; 5802-3
$C_6H_6O_6$ 141; 3588
C_6H_6S 5915
$C_6H_6S_2$ 2820; 2822
$C_6H_6Cl_6$ 668-9
$C_6H_6Br_6$ 666
C_6H_6Se 5607
C_6H_7N 513; 5300-2
C_6H_7P 5219
C_6H_8O 2488
$C_6H_8O_2$ 2285; 5625; 5798
$C_6H_8O_4$ 209; 2487; 2501; 3945
$C_6H_8O_6$ 96; 586-7; 6123
$C_6H_8O_7$ 1515-6; 5578
$C_6H_8N_2$ 155; 2533; 5196; 5256; 5258; 5260
$C_6H_8N_4$ 4425
C_6H_8S 5928-31
C_6H_9N 2535-8; 3149
$C_6H_9N_3$ 6059-60; 6062
$C_6H_9N_{11}$ 4018
$C_6H_{10}O$ 191; 206; 1606; 4053; 4225
$C_6H_{10}O_2$ 65; 216; 1564; 3024-6; 3086
$C_6H_{10}O_3$ 2937; 3417; 3765-6; 4296; 5357
$C_6H_{10}O_4$ 153; 2193; 2554-8; 2940; 3154; 3214; 3445; 3926; 4235; 4251-2; 5422-3
$C_6H_{10}O_5$ 622; 1267; 1661; 2500; 3443; 3872; 3948; 3966; 3969; 5630
$C_6H_{10}O_6$ 2564-5; 3070; 3361; 3368
$C_6H_{10}O_8$ 4438-40; 5577
$C_6H_{10}N_4$ 5079
$C_6H_{10}S$ 1684
$C_6H_{10}S_3$ 222
$C_6H_{11}N$ 453; 1217-8; 1680; 2104
$C_6H_{11}N_5$ 5048
$C_6H_{11}Cl$ 1613
$C_6H_{11}Br$ 1612
$C_6H_{11}I$ 1614
$C_6H_{12}O$ 1212; 1605; 2099; 3144-5; 3614-5; 4163-6
$C_6H_{12}O_2$ 454-5; 1029-32; 1208-11; 1663; 2101; 2481; 3006-7; 4404; 4420-1; 5350; 5441-2
$C_6H_{12}O_3$ 7; 1266; 3073; 3759-60; 5419-20
$C_6H_{12}O_4$ 2924; 3413
$C_6H_{12}O_5$ 1608; 3312; 4423; 5558; 5561
$C_6H_{12}O_6$ 1602-3; 3616-20
$C_6H_{12}O_7$ 3359; 3946
$C_6H_{12}N_2$ 3681; 3932
$C_6H_{12}N_4$ 3599
$C_6H_{12}S_3$ 5879-81
$C_6H_{12}Cl_2$ 2001-2
$C_6H_{12}Br_2$ 1842-7
$C_6H_{12}I_2$ 2393
$C_6H_{13}N$ 326; 4344-7
$C_6H_{13}Cl$ 3644-7
$C_6H_{13}Br$ 3641-3
$C_6H_{13}I$ 3650-1
$C_6H_{14}O$ 2783-5; 3000-2; 3624-38; 4120-1
$C_6H_{14}O_2$ 4; 1071; 2139; 2346; 3598; 3662; 4332; 5312
$C_6H_{14}O_3$ 1232; 2808; 3471
$C_6H_{14}O_4$ 6199
$C_6H_{14}O_5$ 2259; 5557
$C_6H_{14}O_6$ 3608-9; 3611
$C_6H_{14}S$ 2799-800; 3005; 3652
$C_6H_{14}S_2$ 2782
$C_6H_{14}Hg$ 4046
$C_6H_{14}Zn$ 6505-6
$C_6H_{15}N$ 2772-3; 3639-40; 6180
$C_6H_{15}Al$ 230
$C_6H_{15}As$ 6183
$C_6H_{15}B$ 871

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$C_6H_{15}Bi$ 855
$C_6H_{15}P$ 6189
$C_6H_{15}Sb$ 6198
$C_6H_{16}N_2$ 3596
$C_6H_{16}Si$ 6196
$C_6H_{18}N_4$ 6201
$C_6H_{26}O_8$ 5313
C_6OCl_6 3565-6
$C_6O_2Cl_4$ 5746
$C_6O_2Br_4$ 5726

6 III

C_6HOCl_5 5057
C_6HOBr_5 5051
$C_6HO_2Cl_3$ 6169
$C_6H_2OCl_4$ 5743
$C_6H_2O_2Cl_2$ 2070-1
$C_6H_2O_2Cl_4$ 5742
$C_6H_2O_8N_2$ 4586
$C_6H_2O_9N_4$ 5857
$C_6H_2NCl_5$ 5052
$C_6H_3OCl_3$ 6162-4
$C_6H_3OBr_3$ 6108
$C_6H_3OI_3$ 6238
$C_6H_3O_2Cl_3$ 6156
$C_6H_3O_2Br_3$ 6114
$C_6H_3O_6N_3$ 6292-4
$C_6H_3O_7N_3$ 6307-10
$C_6H_3O_8N_3$ 6312
$C_6H_3NCl_4$ 5730-2
$C_6H_3NBr_4$ 5714
$C_6H_4OCl_2$ 2042
$C_6H_4OBr_2$ 1859-62
$C_6H_4O_2Cl_2$ 2003-4
$C_6H_4O_3N_2$ 4896
$C_6H_4O_4N_2$ 2602-4
$C_6H_4O_5N_2$ 2646-7; 2649-52
$C_6H_4O_6N_2$ 2660-1
$C_6H_4O_6N_4$ 6289
$C_6H_4NCl_3$ 6130-3
$C_6H_4NBr_3$ 6089-93
$C_6H_4N_2Cl_2$ 5544
C_6H_4FCl 3263-5
C_6H_4FBr 3262
C_6H_4FI 3272
C_6H_4ClBr 1340-1
C_6H_4ClI 1387-9
C_6H_4BrI 945-7
C_6H_5ON 4876
C_6H_5OCl 1427-9
C_6H_5OBr 972-4
C_6H_5OI 3898-900; 3910
C_6H_5ONa 5119
$C_6H_5O_2N$ 4646; 5486; 5488; 5496; 5546
$C_6H_5O_2Cl$ 1386; 1460
$C_6H_5O_2Br$ 944
$C_6H_5O_2I$ 3912
$C_6H_5O_3N$ 3791-2; 4799; 4802-3; 4900
$C_6H_5O_3N_3$ 1767
$C_6H_5O_4N$ 4836
$C_6H_5O_4N_3$ 2587-92
$C_6H_5O_5N_3$ 5303
$C_6H_5O_6N_5$ 6311
$C_6H_5NCl_2$ 1932-7
$C_6H_5NBr_2$ 1798-802
$C_6H_5NI_2$ 2385
$C_6H_5N_2Cl$ 1765
$C_6H_5N_2Br_3$ 1768
C_6H_5ClHg 4037
$C_6H_5Cl_2P$ 5270
$C_6H_5Cl_3Si$ 5618
$C_6H_6ON_2$ 4875; 5493
C_6H_6OS 5909
$C_6H_6O_2N_2$ 4618-20; 5212; 5545
$C_6H_6O_2S$ 672
$C_6H_6O_2Si$ 5616
$C_6H_6O_3N_2$ 4610-6
$C_6H_6O_3N_4$ 4417-9
$C_6H_6O_3S$ 675
$C_6H_6O_4N_4$ 2657
$C_6H_6O_4S$ 5123-5
$C_6H_6O_5N_2$ 5490
$C_6H_6O_6S_2$ 664
$C_6H_6O_9S_3$ 686
C_6H_6NF 3256
C_6H_6NCl 1309-11
C_6H_6NBr 893-5
C_6H_6NI 3875-7
$C_6H_6N_2Cl_2$ 2044; 2048
$C_6H_6N_3Cl_9$ 1287
C_6H_7ON 113; 345; 347; 349; 4082; 5200-1
$C_6H_7ON_3$ 4897
$C_6H_7O_2N$ 372
$C_6H_7O_2N_3$ 4813; 4815
$C_6H_7O_3As$ 5158
$C_6H_7O_4As$ 3797
$C_6H_7N_2Cl$ 1433
$C_6H_7N_2Cl_3$ 2049
$C_6H_7N_2Br$ 975
$C_6H_8ON_2$ 1723; 1725-7
$C_6H_8O_2Cl_2$ 154
$C_6H_8O_3N_2$ 521
$C_6H_8O_5Na_2$ 2268
$C_6H_8O_{18}N_6$ 4011
C_6H_8NCl 520
C_6H_8NBr 519
$C_6H_9ON_3$ 6068
$C_6H_9O_2N_3$ 1574; 3669
$C_6H_9O_2Cl_3$ 6144
$C_6H_9O_3N$ 6055
$C_6H_9O_3N_3$ 4197; 5267
$C_6H_9O_3Cl$ 3017-8
$C_6H_9O_3Br$ 2991
$C_6H_9O_4N$ 88
$C_6H_9N_2Cl$ 5197
$C_6H_9N_2Cl_3$ 1434
$C_6H_{10}O_2Br_2$ 3037
$C_6H_{10}O_2S_2$ 2165
$C_6H_{10}O_6Ca$ 3941
$C_6H_{10}N_2Cl_2$ 5257; 5259; 5261
$C_6H_{11}ON$ 1607
$C_6H_{11}OCl$ 1216
$C_6H_{11}O_2N$ 2956
$C_6H_{11}O_2Cl$ 449-50; 1076
$C_6H_{11}O_2Cl_3$ 6124-5
$C_6H_{11}O_2Br$ 920; 2992-3
$C_6H_{11}O_3N$ 1111
$C_6H_{11}O_4N_3$ 1517; 2262
$C_6H_{11}NS$ 490-3
$C_6H_{11}N_3Cl_2$ 6061
$C_6H_{11}N_3Cl_4$ 6067
$C_6H_{12}OCl_2$ 1991-2
$C_6H_{12}O_2N_2$ 152; 2194
$C_6H_{12}O_2Cl_2$ 1925; 6207
$C_6H_{12}O_3N_2$ 3477
$C_6H_{12}O_4N_2$ 2631
$C_6H_{12}N_2S_4$ 5843
$C_6H_{12}N_3Cl_3$ 6063
$C_6H_{13}ON$ 1213; 1664; 2100
$C_6H_{13}ON_3$ 2181; 4359
$C_6H_{13}O_2N$ 282-7; 439-41; 2236; 3496; 3653; 4749-51; 5454
$C_6H_{13}O_2Cl$ 1292
$C_6H_{13}O_3N_3$ 1521
$C_6H_{13}O_5N$ 3311
$C_6H_{13}O_6N$ 3369
$C_6H_{13}NS_2$ 5875
$C_6H_{14}ON_2$ 494-5; 2790-1
$C_6H_{14}O_2N_2$ 3986; 3988
$C_6H_{14}O_2N_4$ 575
$C_6H_{14}O_2S$ 2802-3
$C_6H_{14}O_3S$ 2801
$C_6H_{14}O_4S$ 2798
$C_6H_{15}ON$ 2112
$C_6H_{15}OP$ 6190
$C_6H_{15}O_2N$ 2767
$C_6H_{15}O_3N$ 6178
$C_6H_{15}O_3Al$ 229
$C_6H_{15}O_3B$ 6186
$C_6H_{15}O_3P$ 6192
$C_6H_{15}O_4P$ 6188
$C_6H_{15}SP$ 6191
$C_6H_{16}OSi$ 6194
$C_6H_{16}NCl$ 6182
$C_6H_{16}NBr$ 6181

6 IV

$C_6H_2ONCl_3$ 2072
$C_6H_2O_6N_2Cl$ 5308
$C_6H_3O_2NCl_2$ 2022-6
$C_6H_3O_2SCl_3$ 1956
$C_6H_3O_3NCl_2$ 2029-30

FORMULA INDEX ORGANIC COMPOUNDS

$C_6H_3O_3NBr_2$ 1855
$C_6H_3O_4N_2Cl$ 1364-9
$C_6H_3O_4N_2Br$ 930-1
$C_6H_3O_5N_2Cl$ 1372
$C_6H_3O_5N_2Na$ 2648
C_6H_4ONCl 5543
$C_6H_4O_2NF$ 3274
$C_6H_4O_2NCl$ 1412-4
$C_6H_4O_2NBr$ 960-2
$C_6H_4O_2NI$ 3893-5
$C_6H_4O_2NNa$ 5547
$C_6H_4O_2N_2Cl_2$ 2021
$C_6H_4O_3NCl$ 4698-706
$C_6H_4O_3NK$ 4801
$C_6H_4O_3NNa$ 4800; 4804-5
$C_6H_4O_3N_2S$ 1769-71
$C_6H_4O_3SCl_2$ 1955
$C_6H_4O_4SI_2$ 5626
$C_6H_4O_4S_2Cl_2$ 663
$C_6H_4O_5N_3Na$ 5304
$C_6H_4O_6S_2Na_2$ 665
$C_6H_4O_7N_2S$ 2605
$C_6H_5ONBr_2$ 1797
C_6H_5OClHg 4034-5
$C_6H_5O_2N_2Cl$ 1407-10
$C_6H_5O_2SCl$ 678
$C_6H_5O_2SNa$ 673
$C_6H_5O_3NHg$ 4038
$C_6H_5O_3SCl$ 1326
$C_6H_5O_3SBr$ 903-4
$C_6H_5O_3SNa$ 676
$C_6H_5O_4SCl$ 1430
$C_6H_5O_4SNa$ 5126
$C_6H_5O_5NS$ 4654-5
$C_6H_5O_6NS$ 4806-7
$C_6H_5O_6S_2Cl$ 1325
$C_6H_6O_2NCl$ 5487; 5489
$C_6H_6O_2N_2Cl_2$ 1408; 1411
$C_6H_6O_4AsNa$ 3798
$C_6H_6O_5NAs$ 4810
$C_6H_6O_5N_2S$ 4621-2
$C_6H_7O_2NS$ 677
$C_6H_7O_3NS$ 523-5; 674
$C_6H_7O_4NS$ 353-5
$C_6H_7O_6NS_2$ 517-8
$C_6H_7NSCl_2$ 1308
C_6H_7NClBr 896
C_6H_8ONCl 346; 348; 350
$C_6H_8O_2NCl$ 373
$C_6H_8O_2N_2S$ 527
$C_6H_8O_2N_3Cl$ 4814; 4816
$C_6H_8O_3NAs$ 515
$C_6H_8O_3N_2S$ 5198; 5262
$C_6H_8N_2ClBr$ 976
$C_6H_{10}ON_2Cl_2$ 1724
$C_6H_{10}O_2N_3Cl$ 3671
$C_6H_{10}O_4N_2Cl_2$ 5804
$C_6H_{11}O_2N_2Br$ 1009
$C_6H_{11}O_2N_3Cl_2$ 3670
$C_6H_{12}ONBr$ 2131
$C_6H_{12}O_4N_2S_2$ 1627
$C_6H_{15}O_2N_2Cl$ 2865
$C_6H_{15}O_2N_4Cl$ 576
$C_6H_{16}O_2N_2Cl_2$ 3987; 3989-90
$C_6H_{16}O_3NCl$ 6179
$C_6H_{20}O_4N_6S$ 2491

6 V

$C_6H_2ONClBr_2$ 1876
$C_6H_2O_4SI_2Hg$ 5628
$C_6H_3O_4SI_2Na$ 5627
$C_6H_3O_7N_2SNa$ 2606
$C_6H_4O_2SClBr$ 905
$C_6H_4O_4NSCl$ 4657
$C_6H_4O_4SClNa$ 1431
$C_6H_4O_5NSCl$ 1415
$C_6H_4O_5NSBr$ 963
$C_6H_4O_5NSNa$ 4656
$C_6H_5O_3NSCl_2$ 1938
$C_6H_6O_3NSNa$ 526
$C_6H_6O_3N_2SCl_2$ 2045
$C_6H_7O_2NClAs$ 4013
$C_6H_{10}O_3N_2SCl_2$ 5263

7 I

C_7H_8 5960
C_7H_{10} 2286-8
C_7H_{12} 1598; 3510; 3558; 4207-8
C_7H_{14} 1596; 3554-6; 4199
C_7H_{16} 3512-9

7 II

$C_7H_4O_7$ 4016
C_7H_5N 716; 5178
$C_7H_5N_3$ 1766
$C_7H_5Cl_3$ 735
C_7H_6O 642
$C_7H_6O_2$ 711; 3347; 3733-5; 6001
$C_7H_6O_3$ 761; 2310-1; 3350-1; 3742; 3745-6
$C_7H_6O_4$ 2315-20
$C_7H_6O_5$ 6220-3
$C_7H_6N_2$ 267-9; 708; 1578
C_7H_6S 5888-9
$C_7H_6Cl_2$ 635; 1339
$C_7H_6Br_2$ 634; 912; 1880
$C_7H_7N_3$ 263; 788
C_7H_7F 3279-81
C_7H_7Cl 796; 1466-8
C_7H_7Br 793; 999-1001
C_7H_7I 813; 3905-7
C_7H_8O 537; 782; 1545-7
$C_7H_8O_2$ 2370-4; 3750-2; 4079-81; 4998
$C_7H_8O_3$ 3050-1; 3331; 4381; 6396
$C_7H_8N_2$ 649
C_7H_8S 816; 5894-6
C_7H_9N 783; 3146-8; 3981-4; 4125; 5995; 5997; 5999
$C_7H_{10}O_2$ 5772
$C_7H_{10}O_3$ 1668
$C_7H_{10}O_4$ 2469; 2498; 2504; 2939; 5700-1
$C_7H_{10}O_5$ 58; 2195; 3084
$C_7H_{10}N_2$ 808; 1682; 4336; 4338; 4340; 5311; 6003; 6005; 6007; 6022; 6024; 6026
$C_7H_{11}N_3$ 6069
$C_7H_{12}O$ 1597; 4204-6
$C_7H_{12}O_2$ 200; 3042; 3577
$C_7H_{12}O_3$ 3081; 3085; 3587; 5367; 5774
$C_7H_{12}O_4$ 1102; 2184-5; 2489; 3054-5; 4097-9; 4237; 5309-10; 5449; 5466; 6281
$C_7H_{12}O_5$ 3383
$C_7H_{12}O_6$ 2160; 5536
$C_7H_{13}N$ 3648
$C_7H_{14}O$ 2786-7; 3003-4; 3521; 3557; 4122-3; 4200-3
$C_7H_{14}O_2$ 397-403; 1123-5; 3185-6; 3520; 3649; 4173; 5392-5
$C_7H_{14}O_3$ 1099-1100; 2780; 3793
$C_7H_{14}O_4$ 2926; 3392; 4178
$C_7H_{14}O_5$ 2411
$C_7H_{14}O_6$ 4250; 4286; 4297
$C_7H_{14}O_7$ 3358; 4012
$C_7H_{15}Cl$ 3546-7
$C_7H_{15}Br$ 3545
$C_7H_{15}I$ 3549
$C_7H_{16}O$ 2961-2; 3527-43
$C_7H_{16}O_2$ 3511; 5458
$C_7H_{16}O_3$ 3049; 3391
$C_7H_{16}O_7$ 5090
$C_7H_{16}S$ 3525
$C_7H_{17}N$ 3544

7 III

$C_7H_3O_2Cl_3$ 6137-41
$C_7H_3O_2Br_3$ 6098-9
$C_7H_3O_2I_3$ 6236
$C_7H_3O_7N_3$ 6291
$C_7H_3O_8N_3$ 6295
$C_7H_4OCl_2$ 1334-6
$C_7H_4OBr_2$ 910
$C_7H_4OBr_4$ 5717
$C_7H_4O_2N_2$ 4667-9
$C_7H_4O_2Cl_2$ 1959-64
$C_7H_4O_2Br_2$ 1814-9
$C_7H_4O_3N_2$ 1773; 4811
$C_7H_4O_3I_2$ 2394-5
$C_7H_4O_4S$ 5679

FORMULA INDEX ORGANIC COMPOUNDS

$C_7H_4O_5N_2$ 2600-1
$C_7H_4O_5Br_2$ 1841
$C_7H_4O_6N_2$ 2607-11
$C_7H_4O_7N_2$ 2662
C_7H_4NCl 1330
C_7H_4NBr 909
C_7H_5ON 544; 3748; 5177
$C_7H_5ON_3$ 653
C_7H_5OF 757
C_7H_5OCl 755; 1318-20
$C_7H_5OCl_3$ 6146-9
C_7H_5OBr 753
$C_7H_5OBr_3$ 6094
C_7H_5OI 762
$C_7H_5O_2N_3$ 4662
$C_7H_5O_2F$ 3259-61
$C_7H_5O_2Cl$ 1327-9; 1461
$C_7H_5O_2Br$ 906-8
$C_7H_5O_2I$ 3880-2
$C_7H_5O_2Na$ 712
$C_7H_5O_3N$ 4637; 4639-40; 4877-9
$C_7H_5O_3Br$ 993
$C_7H_5O_3I$ 3904; 3911
$C_7H_5O_3Na$ 3744
$C_7H_5O_4N$ 4663-4; 4666; 5497-502
$C_7H_5O_5N$ 4753-60
$C_7H_5O_6N_3$ 2594; 6313-7
$C_7H_5O_7N_3$ 6290; 6298
$C_7H_5O_8N_3$ 6306
$C_7H_5O_9N_5$ 5873
C_7H_5NS 5241
$C_7H_5NS_2$ 4033
$C_7H_5NCl_2$ 5168
$C_7H_6ON_2$ 709
$C_7H_6OBr_2$ 1831
C_7H_6OS 5891
$C_7H_6OS_2$ 2823
$C_7H_6O_2S$ 5918
$C_7H_6O_3N_2$ 4642-4
$C_7H_6O_4N_2$ 2666-71; 4604-9
$C_7H_6O_5N_2$ 2593; 2616-7
$C_7H_6O_5S$ 5676-8
$C_7H_6O_6S$ 5681
$C_7H_6N_2S$ 273
C_7H_6ClBr 913-4; 1337-8
C_7H_7ON 254-6; 643-4; 713; 3299; 4903-5
C_7H_7OF 3257
C_7H_7OCl 1314; 1354-7
C_7H_7OBr 897-8
C_7H_7OI 3878
$C_7H_7O_2N$ 264-6; 710; 3348-9; 3736; 3738-40; 4844-6; 4881; 5167; 5213
$C_7H_7O_2N_3$ 4739
$C_7H_7O_3N$ 374-6; 4623-5; 4678-80; 4710
$C_7H_7O_3N_3$ 4658-60
$C_7H_7O_4N$ 3352; 4742
$C_7H_7O_5As$ 651
$C_7H_7O_5P$ 730
C_7H_7NS 5902
$C_7H_7N_3S$ 734
C_7H_7ClHg 4039
$C_7H_8ON_2$ 257-61; 688; 760; 3308; 4887; 5253
$C_7H_8O_2N_2$ 1700-5; 3684; 4767-9; 4849-58
$C_7H_8O_2S$ 5964
$C_7H_8O_3N$ 352
$C_7H_8O_3N_2$ 4601-3
$C_7H_8O_3N_4$ 1250
$C_7H_8O_3S$ 5966-8
$C_7H_8O_6S_2$ 5962
C_7H_8NCl 1469-70
C_7H_8NBr 1002-3
$C_7H_8N_2S$ 5244
C_7H_9ON 292-3; 295-9; 534-6; 810-1; 4115; 6028-30
$C_7H_9ON_3$ 5236-7
$C_7H_9O_2N_3$ 6064-6
$C_7H_9O_3N$ 1584
$C_7H_9O_3As$ 787
$C_7H_9N_3S$ 5243
$C_7H_{10}ON_2$ 1687
$C_7H_{10}O_4Br_2$ 2155
$C_7H_{10}NCl$ 5996; 5998; 6000
$C_7H_{11}O_4Br$ 2133
$C_7H_{11}O_6N$ 4763
$C_7H_{11}N_2Cl$ 6023; 6025; 6027
$C_7H_{12}O_3Cl_2$ 2057
$C_7H_{12}N_2Cl_2$ 4337; 6004; 6006; 6008
$C_7H_{13}ON$ 112
$C_7H_{13}O_2Br$ 2997-8
$C_7H_{14}N_3Cl_3$ 6070
$C_7H_{15}ON$ 2931; 3522-3; 4124
$C_7H_{15}ON_3$ 5314
$C_7H_{15}O_2N$ 1140-1; 3551; 4744-8
$C_7H_{16}ON_2$ 2806-7
$C_7H_{16}O_4S_2$ 5683
$C_7H_{17}ON$ 2117-8
$C_7H_{17}O_2N$ 2113

7 IV

$C_7H_3O_5N_2Cl$ 2613
$C_7H_3O_6N_2Cl$ 1370-1
$C_7H_3O_6N_2Br$ 932
C_7H_4ONCl 1333
C_7H_4OClBr 911
C_7H_4OClI 3883
$C_7H_4O_3NCl$ 4673-5
$C_7H_4O_4NBr$ 964
$C_7H_4O_4NNa$ 4665
C_7H_4NSCl 1332
$C_7H_5O_2NCl_2$ 4635-6
$C_7H_5O_2NBr_2$ 1804; 4634
$C_7H_5O_2NI_2$ 2383
$C_7H_5O_3NS$ 5579
$C_7H_5O_3NHg$ 4057
$C_7H_5O_4N_2Cl$ 2615
$C_7H_5O_6SNa$ 5682
C_7H_6ONCl 1321-3
C_7H_6ONNa 3300
$C_7H_6O_2NCl$ 1315; 4682-4
$C_7H_6O_2NBr$ 4681
$C_7H_6O_6S_2Na_2$ 5963
$C_7H_7O_2SCl$ 5974-5
$C_7H_7O_2SNa$ 5965
$C_7H_7O_3SNa$ 5969
$C_7H_7O_4NS$ 5671-3
$C_7H_7O_5NS$ 4847
C_7H_8ONCl 1312
$C_7H_9ONCl_2$ 1313
$C_7H_9O_2NS$ 5970-1
$C_7H_9O_3NS$ 379-83
$C_7H_9O_4N_2As$ 1230
$C_7H_{10}O_2N_2Cl_2$ 1705
$C_7H_{10}O_2N_4S$ 5666
$C_7H_{12}ON_2Cl_2$ 1688-9
$C_7H_{12}O_2N_3Cl_3$ 6066
$C_7H_{12}O_4N_2S$ 6009
$C_7H_{14}ONBr$ 4580
$C_7H_{14}O_4N_2S_2$ 2854
$C_7H_{16}ONBr$ 6264
$C_7H_{16}O_2NCl$ 83
$C_7H_{16}O_2NBr$ 82

7 V

$C_7H_4O_3NSNa$ 5580
$C_7H_6O_4NSCl$ 4848
$C_7H_7O_2NSCl_2$ 2074

7 VI

$C_7H_7O_2NSClNa$ 1290

8 I

C_8H_6 5146
C_8H_8 5646
C_8H_{10} 2973; 6454; 6457; 6462
C_8H_{12} 2289-91
C_8H_{14} 1530; 2493; 4991
C_8H_{16} 1617; 1923; 2471-3; 4984-90
C_8H_{18} 4944-58

8 II

$C_8H_4O_3$ 5282
$C_8H_4N_2$ 5288-9
$C_8H_5Cl_5$ 5055
C_8H_6O 1538
$C_8H_6O_2$ 5278-80; 5290
$C_8H_6O_3$ 162-4; 758; 5323
$C_8H_6O_4$ 165-8; 5274; 5276-7; 5327

FORMULA INDEX ORGANIC COMPOUNDS

$C_8H_6O_5$ 3802-7
$C_8H_6O_6$ 3719
$C_8H_6N_2$ 5534; 5548
C_8H_6S 5912
C_8H_7N 800; 3864; 5992-4
C_8H_7Cl 1462-3
C_8H_7Br 994-6
C_8H_8O 51; 5139; 5648; 5985-7; 6443-4
$C_8H_8O_2$ 531-2; 754; 807; 2549-51; 3319; 3721-3; 4138; 4379; 5141-2; 5982-4
$C_8H_8O_3$ 114; 3777; 3794-6; 3832-41; 4008; 4067-9; 4248; 4274; 4380; 5130; 5325; 5550; 6418; 6421
$C_8H_8O_4$ 1656; 2280-3; 3673; 4247; 5001; 6211; 6417
$C_8H_8O_5$ 4249
$C_8H_8N_2$ 274; 799; 4136-7
$C_8H_8Cl_2$ 6494-6
$C_8H_8Br_2$ 1882; 5647; 6491-3
C_8H_9N 218; 639
C_8H_9Cl 1378-80; 1474-6; 5191; 6488-90
C_8H_9Br 937-8; 1010-5; 6485-7
C_8H_9I 3909
$C_8H_{10}O$ 3114-6; 4145; 4399-401; 5111; 5186-7; 6016-8; 6465-70
$C_8H_{10}O_2$ 530; 1543; 2375-80; 2406-8; 2927-9; 4072; 5136; 6479; 6497-9
$C_8H_{10}O_3$ 1561; 3238; 3338; 5411; 5515; 6422
$C_8H_{10}O_4$ 1683; 3399; 5796
$C_8H_{10}O_8$ 5662
$C_8H_{10}N_2$ 11
$C_8H_{10}S$ 3132; 4402
$C_8H_{11}N$ 161; 319-21; 1524-6; 2450; 2965; 4396-8; 5188-9; 5443-5; 6471-5; 6477; 6482-4
$C_8H_{12}O_2$ 2475
$C_8H_{12}O_3$ 3033
$C_8H_{12}O_4$ 2174; 2183; 3034; 3583-6; 5702
$C_8H_{12}O_5$ 2192
$C_8H_{12}N_2$ 305-7; 2527; 3127-8; 3597; 6500-2
$C_8H_{13}N$ 1126
$C_8H_{14}O$ 2403; 3141; 4262
$C_8H_{14}O_2$ 78; 224; 1081-2; 1610; 5650
$C_8H_{14}O_3$ 1033; 1170-1; 2423; 2938; 5421; 5783
$C_8H_{14}O_4$ 465-6; 2211-2; 2224; 2428; 2792-3; 2944; 3465; 5649; 5779; 5842
$C_8H_{14}O_5$ 2182; 2229
$C_8H_{14}O_6$ 2218
$C_8H_{15}N$ 1226
$C_8H_{16}O$ 195; 1222; 2963-4; 3062; 4266; 5391
$C_8H_{16}O_2$ 483-5; 1062-4; 1150; 1177; 1220-1; 2470; 2770; 3009; 3548; 3621-3; 4263; 5315; 5455-7
$C_8H_{16}O_3$ 464; 1094; 3761-2
$C_8H_{16}O_4$ 6; 170; 1233; 2925
$C_8H_{17}F$ 4978
$C_8H_{17}Cl$ 4975-6
$C_8H_{17}Br$ 4973-4
$C_8H_{17}I$ 4980
$C_8H_{18}O$ 1898-9; 4264; 4961-9
$C_8H_{18}O_2$ 4943
$C_8H_{18}O_3$ 2232-3; 2936; 3387
$C_8H_{18}O_5$ 5768
$C_8H_{18}S$ 1914-6
$C_8H_{18}S_2$ 1897
$C_8H_{18}Hg$ 4042
$C_8H_{19}N$ 1884-6; 4970-2
$C_8H_{20}N_2$ 5832
$C_8H_{20}As_2$ 579
$C_8H_{20}Ge$ 3357
$C_8H_{20}Pb$ 3957
$C_8H_{20}Si$ 5619
$C_8H_{20}Sn$ 5950
$C_8H_{23}N_5$ 5770
$C_8O_3Br_4$ 5725
$C_8O_3I_4$ 5816

8 III

$C_8H_2O_4Cl_4$ 5745
$C_8H_3O_5N$ 4823
$C_8H_4O_2Cl_2$ 5283-6
$C_8H_4O_4N_2$ 4761; 4825-6
$C_8H_4O_6N_4$ 2614
$C_8H_4N_2Cl_2$ 2062
C_8H_5ON 756
$C_8H_5O_2N$ 645; 1585; 3919; 5287
$C_8H_5O_2Br_3$ 6109
$C_8H_5O_3N$ 3922
$C_8H_5O_4N$ 4824
$C_8H_5O_4Cl$ 1441
$C_8H_5O_4Br$ 978-9
$C_8H_5O_4Na$ 5275
$C_8H_5O_5N$ 4676
$C_8H_5O_6N$ 4819-22; 5506-9
$C_8H_6ON_2$ 3850; 3935
$C_8H_6OBr_2$ 967
$C_8H_6O_2N_2$ 779; 3923; 4685-7
$C_8H_6O_6N_2$ 2653
$C_8H_6O_7N_2$ 2632
$C_8H_6O_8N_4$ 188
C_8N_6NCl 1586
C_8H_7ON 2908; 3870; 4010; 5021; 6019-21
C_8H_7OCl 1302-3; 5145
C_8H_7OBr 887-8
$C_8H_7O_2N$ 2686; 4838-41; 4874
$C_8H_7O_2N_3$ 359
$C_8H_7O_2Cl$ 4071; 4185; 5169
$C_8H_7O_2Br$ 4149-51; 5166
$C_8H_7O_2I$ 4288-90
$C_8H_7O_3N$ 3921; 4594-5; 5018; 5272
$C_8H_7O_3Cl$ 1432
$C_8H_7O_3Na$ 4009
$C_8H_7O_4N$ 4317-9; 4808-9; 6398
$C_8H_7O_5N_3$ 2586
$C_8H_7O_6N_3$ 6323-5
C_8H_7NS 838; 2909; 6041-3
$C_8H_7NS_2$ 4299
$C_8H_8O_2N_2$ 778; 5281
$C_8H_8O_2Hg$ 4036
$C_8H_8O_3N_2$ 4588-90; 6385
$C_8H_8O_4N_2$ 2673-81; 4812
$C_8H_8O_5N_2$ 2645
$C_8H_8O_6N_6$ 4445
C_8H_9ON 17; 53; 236-9; 4135; 4241; 5140; 5988-90
C_8H_9OCl 1424-6
C_8H_9OBr 969-71
C_8H_9OI 3896-7
$C_8H_9O_2N$ 33-5; 356-7; 795; 3095; 4108-10; 4736-7; 4865-70; 5131; 5194
$C_8H_9O_3N$ 3800; 4112-3 4796-8
$C_8H_9O_5N$ 351
C_8H_9NS 5240; 5883
$C_8H_9N_2Cl$ 275
$C_8H_{10}ON_2$ 107-8; 111; 844; 4883; 4885; 6048-50
$C_8H_{10}O_2N_2$ 358; 4720-2
$C_8H_{10}O_2N_4$ 1569
$C_8H_{10}O_2S$ 3133
$C_8H_{10}O_3N_2$ 4795
$C_8H_{10}O_3S$ 2974; 4395; 6455; 6458; 6463
$C_8H_{10}O_4Br_2$ 2154
$C_8H_{10}NBr$ 929
$C_8H_{10}N_2S$ 839-40; 6045-7
$C_8H_{10}O_{10}Ca$ 3999
$C_8H_{11}ON$ 1544; 2445-6; 2930; 2958-60; 3799; 5105-7
$C_8H_{11}O_2N$ 514; 2404
$C_8H_{11}O_3N$ 5510
$C_8H_{11}O_4Cl$ 2140-1

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$C_8H_{11}O_4Br$ 2132
$C_8H_{11}O_6Cl_3$ 1289
$C_8H_{11}N_3S$ 6044
$C_8H_{12}O_3N_2$ 2124
$C_8H_{12}O_4Br_2$ 2156
$C_8H_{14}O_5N_4$ 6208
$C_8H_{15}OCl$ 1225
$C_8H_{15}O_2N$ 79; **4889**
$C_8H_{15}O_2Br$ 2994
$C_8H_{15}O_5N$ 1665
$C_8H_{16}O_3N_2$ 3965
$C_8H_{16}O_3OI_2$ 5771
$C_8H_{16}O_4N_2$ 3215
$C_8H_{17}ON$ 1223
$C_8H_{17}O_2N$ 288; **4437**; **4786-8**; 4982
$C_8H_{17}O_2Br$ 1026
$C_8H_{17}O_3N$ 4981
$C_8H_{18}O_2S$ 1918
$C_8H_{18}O_3S$ 1917
$C_8H_{18}O_4S$ 1913
$C_8H_{18}O_4S_7$ 6326
$C_8H_{19}O_2N$ 1084
$C_8H_{20}OSi$ 6195
$C_8H_{20}O_4Si$ 3152
$C_8H_{20}NCl$ 5755
$C_8H_{20}NBr$ 5754
$C_8H_{20}NI$ 5757
$C_8H_{21}ON$ 5756
$C_8H_{21}O_5N$ 5753

8 IV

C_8H_4ONCl 3920
$C_8H_4O_2N_2Cl_2$ 1967
$C_8H_4O_2N_2Br_2$ 1820
$C_8H_5ON_2Cl$ 1394
$C_8H_6ONCl_3$ 6127
$C_8H_6ONBr_3$ 6087
$C_8H_6O_2N_2S$ 3325
$C_8H_7O_2NBr_2$ 4212
C_8H_8ONCl 1296-8
C_8H_8ONBr 880-2
C_8H_8ONI 3873
C_8H_8ONNa 5621
$C_8H_8ON_2S$ 774
$C_8H_9O_2SCl$ 6461
$C_8H_9O_3SNa$ 6456; **6459**; **6464**
$C_8H_{10}ONCl$ 240
$C_8H_{10}O_4NAs$ 577
$C_8H_{10}O_5NAs$ 128
$C_8H_{11}ON_2Cl$ 109
$C_8H_{11}O_2NS$ 5979
$C_8H_{11}O_3NS$ 2451-2; **2966**
$C_8H_{11}O_3N_2Na$ 2125
$C_8H_{11}O_4N_2As$ 582
$C_8H_{11}N_2SCl$ 841
$C_8H_{12}ONCl$ 5109
$C_8H_{12}O_2N_2Cl_2$ 1728
$C_8H_{13}O_3NCl$ 5511
$C_8H_{14}O_4N_2S$ 308
$C_8H_{15}O_2NCl$ 100
$C_8H_{15}O_2NBr$ 99
$C_8H_{15}O_2NI$ 101

8 V

$C_8H_8O_4NSNa$ 21
$C_8H_9O_4NAsNa$ 578
$C_8H_9O_4N_2AsNa_2$ 583
$C_8H_{10}O_3NSNa$ 2967

9 I

C_9H_8 3855
C_9H_{10} 3695; 5223-5
C_9H_{12} 3166-8; 5378-9; 6253-5
C_9H_{16} 2492; 4325
C_9H_{18} 3578; 3581; 4930
C_9H_{20} 4910-7

9 II

$C_9H_6O_2$ 1490; 1534-5; 3854; 5220
$C_9H_6O_3$ 6369
$C_9H_6O_4$ 1628; 2898; 6239
$C_9H_6O_5$ 5291
$C_9H_6O_6$ 683-5
$C_9H_6O_7$ 5128
C_9H_7N 5538; 5540
C_9H_8O 1501; 3698-9
$C_9H_8O_2$ 72; 591; 1497-8; 1500
$C_9H_8O_3$ 69; 70-1; 738; 1531-3; 1537
$C_9H_8O_4$ 73; 115; 759; 2333-5; 3674; 6397
$C_9H_8O_5$ 5583
$C_9H_8N_2$ 365-71
$C_9H_9Br_3$ 6106
C_9H_9N 2284; 3709; 4282-5
$C_9H_{10}O$ 211; 214; 1507; 3129; 3706; 4089; 4146; 6431-3
$C_9H_{10}O_2$ 781; 1552-3; 2458-63; 2914; 2975-8; 3683; 3704; 3810-1; 4065; 4335; 4392-4; 5132; 5221; 6010-2; 6441
$C_9H_{10}O_3$ 2405; 2915-7; 3053; 3072; 3151; 3188; 3481; 3711-3; 3776; 4300-1; 6361; 6424
$C_9H_{10}O_4$ 3052; 3230; 3466; 4078; 6423
$C_9H_{10}O_5$ 3321; 5686
$C_9H_{11}N$ 196; 5797
$C_9H_{11}Br$ 953; 985-6; 5222
$C_9H_{12}O$ 2526; 2986; 3122-3; 3173-5; 3705; 5430-5; 5438; 6265-6
$C_9H_{12}O_2$ 3449; 4054
$C_9H_{12}O_3$ 147; 1090; 3334; 3410; 5266; 5517
$C_9H_{12}N_2$ 62
$C_9H_{12}S$ 3176
$C_9H_{13}N$ 654; 2465; 2569-71; 3170-2; 4228; 5040-1; 5374-5; 6250-1
$C_9H_{14}O$ 5268-9
$C_9H_{14}O_3$ 2948
$C_9H_{14}O_4$ 2142; 2175; 2179; 2186
$C_9H_{14}O_5$ 87; 2103
$C_9H_{14}O_6$ 1201-2; 3418
$C_9H_{14}O_7$ 6263
$C_9H_{14}N_2$ 597
$C_9H_{16}O_2$ 201
$C_9H_{16}O_3$ 1101; 3139-40; 5777
$C_9H_{16}O_4$ 596; 2161; 2169; 2176; 2789
$C_9H_{16}O_6$ 60
$C_9H_{17}N$ 1633; 5047
$C_9H_{18}O$ 1900-1; 4265; 5043
$C_9H_{18}O_2$ 432-5; 1142-5; 3108; 3526; 4174; 4979; 5042; 5396
$C_9H_{18}O_3$ 1892-4
$C_9H_{18}O_5$ 2094
$C_9H_{18}N_2$ 1895
$C_9H_{19}N$ 4114
$C_9H_{19}Cl$ 4928
$C_9H_{19}Br$ 4927
$C_9H_{19}I$ 4929
$C_9H_{20}O$ 4918-25
$C_9H_{20}O_3$ 6193
$C_9H_{20}O_4$ 3012
$C_9H_{21}N$ 4926; 6348

9 III

$C_9H_5O_2Cl$ 1353
$C_9H_5O_4N$ 4817-8
$C_9H_5NCl_2$ 2063-9
$C_9H_6O_2N_2$ 4831-5
$C_9H_6O_2Br_2$ 1829
C_9H_6NCl 1453-9
C_9H_7ON 742; 3820-6
C_9H_7OCl 1505
$C_9H_7O_2N$ 4291-3
$C_9H_7O_2Br$ 921-4
$C_9H_7O_2Na$ 1499
$C_9H_7O_3N$ 3871
$C_9H_7O_4N$ 4707-9
$C_9H_7O_4Br$ 76
$C_9H_7O_4I$ 93-4
$C_9H_7O_4Li$ 117
$C_9H_7O_4Na$ 119
$C_9H_8ON_2$ 1582
$C_9H_8O_2N_2$ 4141-2
$C_9H_8O_2Br_2$ 1830
$C_9H_8O_3I_2$ 3041

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$C_9H_8O_5N_2$ 4752
$C_9H_8O_6N_2$ 3043
C_9H_9ON 1502; 3703
C_9H_9OCl 3708
C_9H_9OBr 4333
$C_9H_9O_2N$ 289-91; 4899; 5586
$C_9H_9O_2Cl$ 797
$C_9H_9O_3N$ 125-7; 3664
$C_9H_9O_4N$ 2539; 3099-101; 4677; 5195
$C_9H_9O_6N_3$ 6318-20
$C_9H_9O_7N_3$ 2672
$C_9H_{10}O_3N_2$ 4597; 4766
$C_9H_{10}O_4N_2$ 2635; 4591
$C_9H_{10}O_5N_2$ 4860
$C_9H_{11}ON$ 26-8; 780; 2435-6; 2457; 2972; 3305; 3707; 4086; 5358
$C_9H_{11}OBr$ 987
$C_9H_{11}O_2N$ 18-20; 97-8; 2440-1; 2953-5; 4302; 4711-3; 4764; 5148-50; 5254
$C_9H_{11}O_3N$ 6367
$C_9H_{11}O_4N$ 2361
$C_9H_{12}ON_2$ 330; 3134
$C_9H_{12}O_2N_2$ 5112
$C_9H_{12}O_3S$ 3169
$C_9H_{13}O_2N$ 2882
$C_9H_{13}O_3N$ 157; 5512
$C_9H_{14}O_3N_4$ 1251
$C_9H_{14}NI$ 6267
$C_9H_{16}O_2N_2$ 217; 4906
$C_9H_{17}ON$ 2107; 6056
$C_9H_{17}OCl$ 5046
$C_9H_{17}O_5N$ 5033-4
$C_9H_{17}N_4I$ 3600
$C_9H_{19}ON$ 5044-5; 6414
$C_9H_{19}O_2N$ 4784-5
$C_9H_{20}ON_2$ 1922; 5767
$C_9H_{20}O_4S_2$ 5872
$C_9H_{20}N_2S$ 1921
$C_9H_{21}O_3N$ 6347
$C_9H_{22}N_2S_2$ 2120

9 IV

$C_9H_5ONBr_2$ 1848
$C_9H_7O_4NS$ 3828
$C_9H_8O_3NNa$ 3666
$C_9H_9O_2N_3S_2$ 5670
$C_9H_9O_3NCl_2$ 2077
$C_9H_9O_3NBr_2$ 1881
$C_9H_9O_3NI_2$ 2401-2
$C_9H_{10}ONBr$ 889
$C_9H_{10}O_2N_2S$ 5242
$C_9H_{11}O_3SCl$ 1383
$C_9H_{13}O_2NS$ 5977-8
$C_9H_{14}O_2NCl$ 4582
$C_9H_{14}O_3NCl$ 1523
$C_9H_{15}O_2N_3S$ 2890
$C_9H_{15}O_3N_2Br$ 84
$C_9H_{24}ON_2I_2$ 3591

9 V

C_9H_5ONCl 1392
$C_9H_6O_4NSI$ 3888
$C_9H_9O_2SHgNa$ 4052

10 I

$C_{10}H_8$ 4458
$C_{10}H_{10}$ 2278; 3120
$C_{10}H_{12}$ 2089; 5786
$C_{10}H_{14}$ 1049-52; 1622-4; 2126-8; 2483-6; 3582; 4351-2; 5827-9
$C_{10}H_{16}$ 870; 1189; 3232; 3972-3; 5092-3; 5318; 5576; 5684; 5704-5; 5709
$C_{10}H_{18}$ 1188; 1258; 1630-2; 2514-5; 4023; 5317
$C_{10}H_{20}$ 1650-3; 3579
$C_{10}H_{22}$ 1635-8

10 II

$C_{10}H_5Cl_3$ 6160-1
$C_{10}H_6O_2$ 4520-1; 4523
$C_{10}H_6O_3$ 3786-9
$C_{10}H_6O_4$ 1536; 3328; 4477-8
$C_{10}H_6O_5$ 3343
$C_{10}H_6O_8$ 680-2
$C_{10}H_6Cl_2$ 2009-18
$C_{10}H_6Br_2$ 1852
$C_{10}H_7F$ 3273
$C_{10}H_7Cl$ 1402-3
$C_{10}H_7Br$ 956-7
$C_{10}H_7I$ 3891-2
$C_{10}H_8O$ 4489-90
$C_{10}H_8O_2$ 2348-57; 4192
$C_{10}H_8O_3$ 743; 4406
$C_{10}H_8O_4$ 510; 638; 1504; 3336; 3346; 5604
$C_{10}H_8N_2$ 2810-3; 6051-3
$C_{10}H_8S$ 5913-4
$C_{10}H_8Cl_4$ 4473
$C_{10}H_9N$ 4367; 4369-70; 4372; 4374-5; 4529-30; 5229
$C_{10}H_{10}O$ 626
$C_{10}H_{10}O_2$ 198; 741; 4191; 5175-6; 5581-2
$C_{10}H_{10}O_3$ 637; 771; 2980; 4139; 5094
$C_{10}H_{10}O_4$ 763; 815; 2530-2; 3067; 3236-7; 3716; 4017; 4090; 5239; 5552
$C_{10}H_{10}O_5$ 837; 4993
$C_{10}H_{10}O_6$ 3502
$C_{10}H_{10}N_2$ 2809; 4563; 4565; 4571-9
$C_{10}H_{11}Cl$ 4188
$C_{10}H_{11}Br$ 4152
$C_{10}H_{12}O$ 511; 2901; 2987; 5377; 5439-40; 5787-90
$C_{10}H_{12}O_2$ 829; 1280; 3118-9; 3163-5; 3218; 3223; 4126; 5185; 5380-5; 5831; 5943; 6256-61; 6481
$C_{10}H_{12}O_3$ 814; 1529; 2968; 5412; 5415; 5446-7; 6419
$C_{10}H_{12}O_4$ 3187; 6226-7
$C_{10}H_{12}O_5$ 3414; 6240-2
$C_{10}H_{12}N_2$ 6363
$C_{10}H_{13}N$ 3930; 5792-5
$C_{10}H_{13}Cl$ 1572
$C_{10}H_{13}Br$ 915; 926
$C_{10}H_{14}O$ 1116; 1119-20; 1255; 1261; 1571; 2466; 5436-7; 5938
$C_{10}H_{14}O_2$ 1070; 2091-3; 5937
$C_{10}H_{14}O_3$ 457; 1200
$C_{10}H_{14}O_4$ 2188; 3400
$C_{10}H_{15}N$ 1046-7; 1256; 2121; 5818-20; 5946
$C_{10}H_{16}O$ 1191; 1257; 1512; 2275; 3233; 5320; 5472; 5935-6
$C_{10}H_{16}O_2$ 585
$C_{10}H_{16}O_4$ 1197-9; 2108; 2788
$C_{10}H_{16}O_5$ 2105
$C_{10}H_{16}O_8$ 1673
$C_{10}H_{16}N_2$ 303; 5606; 5839
$C_{10}H_{16}Cl_2$ 1192-4
$C_{10}H_{17}Cl$ 864; 5319
$C_{10}H_{18}O$ 860; 1260; 1518; 2274; 2516-8; 3217; 3234-5; 3974; 4026; 5471; 5706-8
$C_{10}H_{18}O_2$ 1190
$C_{10}H_{18}O_3$ 2102; 6403; 6410
$C_{10}H_{18}O_4$ 1905-6; 2106; 2187; 2203-4; 2796-7; 3450; 3550; 5605
$C_{10}H_{18}O_6$ 2804-5; 6200
$C_{10}H_{19}N$ 862; 1203-4; 1207
$C_{10}H_{20}O$ 1206; 1259; 1519; 4024-5; 4326; 5414
$C_{10}H_{20}O_2$ 496-7; 1065; 1205; 1219; 3010; 3553; 4331; 4959-60; 5703
$C_{10}H_{20}O_4$ 1069
$C_{10}H_{21}N$ 2145; 4029
$C_{10}H_{21}Cl$ 1646
$C_{10}H_{21}I$ 1647
$C_{10}H_{22}O$ 1640-4; 1740-1; 2519-20; 3106
$C_{10}H_{22}O_2$ 1634; 1654

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$C_{10}H_{22}O_3$ 5410; 5703
$C_{10}H_{22}O_5$ 5769
$C_{10}H_{22}S$ 1751-2
$C_{10}H_{22}S_2$ 1753-4
$C_{10}H_{23}N$ 1645; 1734-6

10 III

$C_{10}H_4O_2Cl_2$ 2020
$C_{10}H_4O_8N_4$ 5854-6
$C_{10}H_5OCl_5$ 5056
$C_{10}H_5OBr_3$ 6107
$C_{10}H_5O_6N_3$ 6301-4
$C_{10}H_5O_7N_3$ 6305
$C_{10}H_5O_{10}N$ 5503-4
$C_{10}H_6OCl_2$ 2019
$C_{10}H_6OBr_2$ 1853
$C_{10}H_6O_2N_2$ 5514
$C_{10}H_6O_3S$ 4524
$C_{10}H_6O_4N_2$ 2637-40
$C_{10}H_6O_4Cl_4$ 3068
$C_{10}H_6O_5N_2$ 2641-3
$C_{10}H_6NBr_3$ 6113
$C_{10}H_7OCl$ 1404-6
$C_{10}H_7OBr$ 958-9
$C_{10}H_7O_2N$ 4772-3; 4892-4; 5533
$C_{10}H_7O_3N$ 95; 3937; 4775-9
$C_{10}H_8ON_2$ 4895
$C_{10}H_8O_2N_2$ 4780-3; 4830
$C_{10}H_8O_2S$ 4465-6
$C_{10}H_8O_3S$ 4470-1
$C_{10}H_8O_4N_2$ 3329-30
$C_{10}H_8O_4S$ 4498; 4502-5; 4507; 4510
$C_{10}H_8O_5N_4$ 5305
$C_{10}H_8O_6S_2$ 4461-4
$C_{10}H_8O_7S_2$ 4491
$C_{10}H_8O_8N_2$ 2633
$C_{10}H_8O_8S_2$ 2359
$C_{10}H_8NCl$ 1395
$C_{10}H_8NI$ 3889
$C_{10}H_9ON$ 91; 332-4; 336; 3816-9; 4083; 4179-80; 4567
$C_{10}H_9O_2N$ 3865
$C_{10}H_9O_4N$ 4320-2
$C_{10}H_9O_6N$ 2512
$C_{10}H_{10}ON_2$ 5202
$C_{10}H_{10}O_2N_2$ 2414; 2464; 2981-2
$C_{10}H_{10}O_2Br_2$ 4213
$C_{10}H_{10}O_5N_2$ 4598
$C_{10}H_{10}O_8N_6$ 1541
$C_{10}H_{10}NCl$ 4531-2
$C_{10}H_{11}ON$ 3111; 5134
$C_{10}H_{11}OCl$ 2524
$C_{10}H_{11}O_2N$ 40; 1670
$C_{10}H_{11}O_2N_3$ 4581
$C_{10}H_{11}O_2Br$ 3121
$C_{10}H_{11}O_3N$ 110; 129; 744-5; 1669; 3110
$C_{10}H_{11}N_2Cl$ 4564; 4566
$C_{10}H_{12}ON_2$ 215
$C_{10}H_{12}O_2N_2$ 1676-7
$C_{10}H_{12}O_3N_2$ 129; 1681; 4734; 4871
$C_{10}H_{12}O_4N_2$ 4596
$C_{10}H_{12}O_5N_2$ 2665
$C_{10}H_{13}ON$ 102-4; 1172; 2417-22; 2913; 2934; 5203; 5386; 5874
$C_{10}H_{13}OCl$ 1346; 5939
$C_{10}H_{13}OBr$ 916
$C_{10}H_{13}OI$ 5940
$C_{10}H_{13}O_2N$ 23-5; 2448; 3125; 4714; 4902; 5373
$C_{10}H_{13}O_2Cl$ 5135
$C_{10}H_{13}O_3N$ 4405
$C_{10}H_{13}O_4N_3$ 2619
$C_{10}H_{13}N_2Cl$ 6364
$C_{10}H_{14}ON_2$ 318; 4882
$C_{10}H_{14}OBr_2$ 1828
$C_{10}H_{14}O_2N_2$ 4717-9; 5115
$C_{10}H_{14}O_3N_2$ 5370
$C_{10}H_{14}O_3S$ 5452
$C_{10}H_{14}O_4S$ 5942
$C_{10}H_{14}NBr$ 927
$C_{10}H_{15}ON$ 1262; 2115-6; 2877-8; 3124; 3675
$C_{10}H_{15}OCl$ 1352
$C_{10}H_{15}OBr$ 919
$C_{10}H_{15}O_2N$ 5181; 6476
$C_{10}H_{15}O_3N$ 2345; 4696
$C_{10}H_{16}O_3N_2$ 2776; 2999
$C_{10}H_{16}O_4S$ 1196
$C_{10}H_{16}O_4Br_2$ 2781
$C_{10}H_{17}ON$ 281; 1195
$C_{10}H_{17}N_2Cl$ 304
$C_{10}H_{18}O_5N_4$ 6209
$C_{10}H_{18}N_2Cl_2$ 5840
$C_{10}H_{21}O_2N$ 1649; 4715-6
$C_{10}H_{21}O_3N$ 1648
$C_{10}H_{22}O_2S$ 1756
$C_{10}H_{22}O_3S$ 1755
$C_{10}H_{23}ON$ 1887

10 IV

$C_{10}H_5O_5N_2Na$ 2642
$C_{10}H_5O_5SNa$ 4522
$C_{10}H_6O_2NCl$ 1418-9
$C_{10}H_6O_4SNa$ 4512
$C_{10}H_6O_7S_2Ca$ 4492
$C_{10}H_6O_7S_2K_2$ 4493; 4495
$C_{10}H_6O_7S_2Na_2$ 4494; 4496
$C_{10}H_6O_8N_2S$ 3240
$C_{10}H_7O_2NS$ 4475
$C_{10}H_7O_2SCl$ 4468-9
$C_{10}H_7O_3SNa$ 4472
$C_{10}H_7O_4SK$ 4500; 4509
$C_{10}H_7O_4SNa$ 4501; 4511
$C_{10}H_8ON_2S$ 641
$C_{10}H_8O_2NBr$ 940
$C_{10}H_8O_2N_2S$ 773; 5589
$C_{10}H_9O_2NS$ 4467
$C_{10}H_9O_2NCl_2$ 42
$C_{10}H_9O_3NS$ 4541; 4543-53
$C_{10}H_9O_4NS$ 337-40
$C_{10}H_9O_6NS_2$ 4533-5; 4537
$C_{10}H_9O_7NS_2$ 342; 344
$C_{10}H_9O_9NS_3$ 4554
$C_{10}H_{10}ONCl$ 335
$C_{10}H_{10}O_2NCl$ 41
$C_{10}H_{10}O_2NBr$ 884
$C_{10}H_{10}O_2N_4S$ 5665; 5667
$C_{10}H_{10}O_4N_2S$ 5680
$C_{10}H_{13}O_3N_2Br$ 5390
$C_{10}H_{13}O_3SCl$ 1449
$C_{10}H_{15}O_2N_2Cl$ 5116
$C_{10}H_{15}O_3NS$ 2122
$C_{10}H_{16}O_3N_2S$ 853
$C_{10}H_{17}O_6N_3S$ 3378

10 V

$C_{10}H_4O_8NS_3Na_3$ 4476
$C_{10}H_4O_8N_2SNa_2$ 3241
$C_{10}H_5O_8NS_2Na_2$ 4901
$C_{10}H_6O_9NS_3Na$ 4555
$C_{10}H_7O_6NS_2Na_2$ 4540
$C_{10}H_7O_7NS_2Na_2$ 343
$C_{10}H_8O_3NSNa$ 4542
$C_{10}H_8O_4NSNa$ 341
$C_{10}H_8O_6NS_2K$ 4536; 4538
$C_{10}H_8O_6NS_2Na$ 4539

11 I

$C_{11}H_{10}$ 4304-5
$C_{11}H_{16}$ 421-4; 2221; 4158-60; 5074
$C_{11}H_{20}$ 6382
$C_{11}H_{22}$ 6373-4
$C_{11}H_{24}$ 6370

11 II

$C_{11}H_6O_{10}$ 671
$C_{11}H_7N$ 4487-8
$C_{11}H_8O$ 4482-3
$C_{11}H_8O_2$ 4306; 4480-1
$C_{11}H_8O_3$ 3778-85; 4275
$C_{11}H_9N$ 5226-8
$C_{11}H_{10}O$ 4311-2
$C_{11}H_{10}O_2$ 3131
$C_{11}H_{10}O_4$ 3696-7; 3971
$C_{11}H_{11}N$ 832; 2540-1; 2544; 2546-8; 4309-10; 6035-7
$C_{11}H_{12}O_2$ 52; 528; 3023; 5151-2
$C_{11}H_{12}O_3$ 739; 6416
$C_{11}H_{12}O_4$ 636; 834; 2941; 3225
$C_{11}H_{14}O$ 1117-8; 6247

FORMULA INDEX ORGANIC COMPOUNDS

$C_{11}H_{14}O_2$ 794; 1053-4; 3065; 3222; 3224; 5347
$C_{11}H_{14}O_3$ 1091-3; 5944; 6507
$C_{11}H_{16}O$ 476; 478-9; 1056; 1079-80; 1115; 5078
$C_{11}H_{16}O_3$ 2231
$C_{11}H_{17}N$ 419-20; 4216-8; 5073
$C_{11}H_{18}O_2$ 3356
$C_{11}H_{18}N_2$ 480
$C_{11}H_{20}O_2$ 6376
$C_{11}H_{20}O_3$ 5778
$C_{11}H_{20}O_4$ 1904; 2134-6; 2158; 2202; 6283
$C_{11}H_{21}N$ 6381
$C_{11}H_{22}O$ 1743-4; 3107; 4324; 6375; 6378
$C_{11}H_{22}O_2$ 436-7; 3113; 4172; 5397; 6377
$C_{11}H_{22}O_3$ 1737-8
$C_{11}H_{22}O_6$ 4386
$C_{11}H_{24}O$ 6371-2
$C_{11}H_{24}O_3$ 3390

11 III

$C_{11}H_7ON$ 4558-9
$C_{11}H_7OCl$ 4486
$C_{11}H_7O_4N$ 4774
$C_{11}H_7NS$ 4570
$C_{11}H_9ON$ 4484-5
$C_{11}H_9O_2N$ 4308; 5528-32
$C_{11}H_9O_3N$ 4278; 5537
$C_{11}H_{10}ON_2$ 3324
$C_{11}H_{11}ON$ 3013
$C_{11}H_{11}O_2N$ 3867
$C_{11}H_{11}O_4N$ 3102-4
$C_{11}H_{12}ON_2$ 565; 2497
$C_{11}H_{12}O_2N_2$ 3126; 6365
$C_{11}H_{12}NI$ 5539
$C_{11}H_{13}O_4N$ 29; 2205
$C_{11}H_{13}O_6N_3$ 6296
$C_{11}H_{15}ON$ 2111; 5364; 6411
$C_{11}H_{15}O_2N$ 1043; 1045
$C_{11}H_{15}O_3N$ 3949; 4064
$C_{11}H_{16}O_3N_2$ 1038
$C_{11}H_{16}O_3S$ 1137
$C_{11}H_{16}O_4N_2$ 571; 5565
$C_{11}H_{18}O_3N_2$ 505
$C_{11}H_{19}ON_3$ 1513
$C_{11}H_{19}N_2Cl$ 302
$C_{11}H_{23}ON$ 6379-80
$C_{11}H_{23}O_2N$ 3038; 4861
$C_{11}H_{25}ON$ 1888-9

11 IV

$C_{11}H_{11}ON_2Br$ 901
$C_{11}H_{11}O_2N_3S$ 5668
$C_{11}H_{15}O_3N_2Br$ 1061
$C_{11}H_{17}O_2NS$ 5673
$C_{11}H_{17}O_3N_2Na$ 506; 4583
$C_{11}H_{18}O_3N_2S$ 854

11 V

$C_{11}H_{10}O_2N_3SNa$ 5669

12 I

$C_{12}H_8$ 3
$C_{12}H_{10}$ 2; 2695
$C_{12}H_{12}$ 2507-9; 3089-90
$C_{12}H_{16}$ 5179
$C_{12}H_{18}$ 2777-8; 3590; 4119; 6184-5
$C_{12}H_{22}$ 2083; 2864
$C_{12}H_{24}$ 2863; 6122
$C_{12}H_{26}$ 2856-7
$C_{12}Cl_{10}$ 1629

12 II

$C_{12}H_6O_3$ 4474
$C_{12}H_6O_{12}$ 667
$C_{12}H_6Cl_4$ 5738
$C_{12}H_8O$ 2763
$C_{12}H_8O_4$ 4459-60; 5037
$C_{12}H_8N_2$ 5101-4
$C_{12}H_8S_2$ 5877
$C_{12}H_8F_2$ 2247-8
$C_{12}H_8Cl_2$ 1989-90
$C_{12}H_8Br_2$ 1833
$C_{12}H_9N$ 1231
$C_{12}H_9Cl$ 1291; 1373-5
$C_{12}H_9Br$ 878; 933-4
$C_{12}H_9I$ 3884-5
$C_{12}H_{10}O$ 2719; 4313; 5216-8
$C_{12}H_{10}O_2$ 48; 2338-43; 3770; 4526-8
$C_{12}H_{10}O_4$ 2817; 5321; 5535
$C_{12}H_{10}N_2$ 599; 2279
$C_{12}H_{10}S$ 2749
$C_{12}H_{10}S_2$ 2715
$C_{12}H_{10}I_2$ 2729
$C_{12}H_{10}Hg$ 4047
$C_{12}H_{10}P_2$ 5271
$C_{12}H_{10}Se$ 2742
$C_{12}H_{11}N$ 830-1; 2698; 5153-5
$C_{12}H_{11}N_3$ 247-9; 1762
$C_{12}H_{12}O$ 3093-4
$C_{12}H_{12}O_2$ 203
$C_{12}H_{12}O_6$ 3775; 5516
$C_{12}H_{12}O_{12}$ 3580
$C_{12}H_{12}N_2$ 313-4; 1710-4; 2725; 2727; 3685
$C_{12}H_{12}N_4$ 1696-9
$C_{12}H_{13}N$ 2505-6; 3091-2; 6270-3
$C_{12}H_{13}N_3$ 262; 1717-8
$C_{12}H_{13}N_5$ 6058
$C_{12}H_{14}O_3$ 3219; 5776
$C_{12}H_{14}O_4$ 569; 1122; 2199-201; 5784
$C_{12}H_{14}N_4$ 1722; 2269-70
$C_{12}H_{16}O$ 481-2; 1615-6; 4181
$C_{12}H_{16}O_2$ 425; 1113-4; 5075; 5945
$C_{12}H_{16}O_3$ 458; 486-7; 584; 1106; 3117; 3487
$C_{12}H_{16}O_8$ 1270
$C_{12}H_{18}O$ 426; 452; 477; 4066
$C_{12}H_{18}O_2$ 1112; 3654
$C_{12}H_{18}O_3$ 5265
$C_{12}H_{18}O_6$ 2146-51
$C_{12}H_{18}O_8$ 2152
$C_{12}H_{19}N$ 2775
$C_{12}H_{20}O_2$ 861; 3354; 3975; 5710
$C_{12}H_{20}O_4$ 1903
$C_{12}H_{20}O_6$ 1666; 2095; 3432
$C_{12}H_{20}O_7$ 6187
$C_{12}H_{22}O_2$ 1520; 4027-8; 4407
$C_{12}H_{22}O_3$ 1214
$C_{12}H_{22}O_4$ 1745; 1910-2; 2171; 2210; 2552; 2771
$C_{12}H_{22}O_5$ 1902
$C_{12}H_{22}O_6$ 1919-20; 2410
$C_{12}H_{22}O_{11}$ 3947; 4007; 5663; 6054
$C_{12}H_{23}N$ 2085; 3956
$C_{12}H_{24}O$ 3952
$C_{12}H_{24}O_2$ 1066; 1639; 3008; 3950
$C_{12}H_{24}O_3$ 1162; 1165
$C_{12}H_{25}Cl$ 2861
$C_{12}H_{25}Br$ 2860
$C_{12}H_{26}O$ 2859
$C_{12}H_{27}N$ 6115-6
$C_{12}H_{30}Sn_2$ 5953

12 III

$C_{12}H_5O_{12}N_7$ 2764
$C_{12}H_6O_8N_4$ 5847-9
$C_{12}H_6O_9N_4$ 5851
$C_{12}H_6O_{10}N_4$ 5846
$C_{12}H_7O_3N$ 4732; 5554
$C_{12}H_7O_4N$ 5551
$C_{12}H_8OS$ 5129
$C_{12}H_8OBr_2$ 1834
$C_{12}H_8O_4N_2$ 2620-3
$C_{12}H_8O_5N_2$ 2627-8
$C_{12}H_8O_5N_4$ 2598
$C_{12}H_8O_9N_4$ 5492
$C_{12}H_9OCl$ 1436-8
$C_{12}H_9OBr$ 885; 935; 977
$C_{12}H_9O_2N$ 3869; 4587; 4723-5
$C_{12}H_9O_3N$ 4729-31
$C_{12}H_9O_4N_3$ 2624-6; 4650-1
$C_{12}H_9O_4N_5$ 2618
$C_{12}H_9O_5N_3$ 2634
$C_{12}H_9O_8N_5$ 5495
$C_{12}H_9NS$ 5138

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$C_{12}H_9N_3S$ 5922
$C_{12}H_{10}ON_2$ 615; 2733; 3727-9; 4884
$C_{12}H_{10}OS$ 2752
$C_{12}H_{10}O_2N_2$ 609-11; 662; 4726-7
$C_{12}H_{10}O_2S$ 2750
$C_{12}H_{10}O_2S_2$ 2716
$C_{12}H_{10}O_3N_2$ 4593
$C_{12}H_{10}N_2Cl_2$ 1957
$C_{12}H_{10}ClAs$ 2712
$C_{12}H_{10}Cl_2Se$ 2743
$C_{12}H_{11}ON$ 46-7; 3767-9
$C_{12}H_{11}OI$ 2728
$C_{12}H_{11}O_2N$ 31-2; 3031
$C_{12}H_{11}O_2N_3$ 4661
$C_{12}H_{11}O_4P$ 2735-6
$C_{12}H_{12}ON_2$ 1720
$C_{12}H_{12}O_3N_2$ 5113
$C_{12}H_{12}NCl$ 2699
$C_{12}H_{12}N_2S$ 5886
$C_{12}H_{12}N_2Cl_4$ 1958
$C_{12}H_{12}N_3Cl$ 250
$C_{12}H_{13}O_2N$ 3866
$C_{12}H_{13}O_3N$ 5476
$C_{12}H_{13}O_6N$ 2190
$C_{12}H_{13}N_2Cl$ 315; 2726
$C_{12}H_{13}N_4Cl$ 1699
$C_{12}H_{14}O_2N_2$ 2098; 2129
$C_{12}H_{14}O_8N_4$ 232
$C_{12}H_{14}NI$ 4368; 4371; 4373
$C_{12}H_{14}N_2Cl_2$ 1715
$C_{12}H_{15}ON$ 770
$C_{12}H_{15}O_2N$ 39
$C_{12}H_{15}O_6N_3$ 6297
$C_{12}H_{16}OCl_2$ 1381
$C_{12}H_{16}O_3N_2$ 3231; 5091
$C_{12}H_{16}O_8N_2$ 2528
$C_{12}H_{17}ON$ 77; 1215
$C_{12}H_{17}O_4N$ 2474
$C_{12}H_{17}O_5N$ 2116
$C_{12}H_{17}O_7N$ 5110
$C_{12}H_{18}O_4N_2$ 5559
$C_{12}H_{18}O_5N_2$ 3366-7
$C_{12}H_{19}ON$ 2114
$C_{12}H_{20}O_4Br_2$ 1896
$C_{12}H_{22}O_{14}Ca$ 3360
$C_{12}H_{23}OCl$ 3955
$C_{12}H_{25}ON$ 3953
$C_{12}H_{27}O_2N$ 3951
$C_{12}H_{27}O_3B$ 6117
$C_{12}H_{27}O_4P$ 6121
$C_{12}H_{28}O_4N_2$ 3200
$C_{12}H_{28}NI$ 5866
$C_{12}H_{30}OSi_2$ 6197
$C_{12}H_{30}N_6Cl_2$ 5685

12 IV

$C_{12}H_4O_{12}N_6S$ 2765
$C_{12}H_6O_3SCl_4$ 2043
$C_{12}H_6O_8N_4S_2$ 5850
$C_{12}H_8ON_2Cl_2$ 1950
$C_{12}H_8O_2SBr_2$ 1835
$C_{12}H_8O_3SCl_2$ 5180
$C_{12}H_8O_4N_2S_2$ 2655-6
$C_{12}H_9O_3SCl$ 5170
$C_{12}H_9O_3SNa$ 2751
$C_{12}H_{10}O_4N_2S$ 3730
$C_{12}H_{10}O_5N_2S$ 2307; 4728
$C_{12}H_{11}ONS$ 5906
$C_{12}H_{11}O_3NS$ 2701
$C_{12}H_{11}O_3N_2Na$ 5114
$C_{12}H_{12}ON_2S_2$ 2437
$C_{12}H_{12}O_3N_2S$ 696
$C_{12}H_{12}O_6N_2S_2$ 695
$C_{12}H_{13}O_4NS$ 2700
$C_{12}H_{14}ON_4S$ 5893
$C_{12}H_{14}O_4N_2S$ 1716
$C_{12}H_{16}O_2NCl$ 2413
$C_{12}H_{16}O_4N_2S$ 522
$C_{12}H_{19}O_2N_2Br$ 5470
$C_{12}H_{24}O_6N_6Cu$ 1522

12 V

$C_{12}H_6O_4N_2S_2Cl_2$ 1987
$C_{12}H_6O_8S_2I_4Zn$ 5629
$C_{12}H_9O_4N_2SNa$ 3731
$C_{12}H_9O_5N_2SNa$ 2308
$C_{12}H_{14}O_2N_2Cl_2As_2$ 5592
$C_{12}H_{14}O_2N_5SCl$ 5337
$C_{12}H_{18}ON_4SCl_2$ 5876
$C_{12}H_{19}O_3N_2Na$ 5002

13 I

$C_{13}H_{10}$ 3246
$C_{13}H_{12}$ 2731; 5245-7
$C_{13}H_{26}$ 6175
$C_{13}H_{28}$ 6173

13 II

$C_{13}H_8O$ 3248
$C_{13}H_8O_2$ 6451
$C_{13}H_8O_4$ 3227
$C_{13}H_8O_5$ 2891
$C_{13}H_9N$ 142; 4517-9
$C_{13}H_{10}O$ 724; 3247; 6447
$C_{13}H_{10}O_2$ 3320; 3749; 5159-62; 6453
$C_{13}H_{10}O_3$ 2321-8; 2711; 5133; 5235
$C_{13}H_{10}O_4$ 4276; 6224-5
$C_{13}H_{10}O_6$ 5070
$C_{13}H_{10}N_2$ 690; 1234-5; 4334
$C_{13}H_{10}Cl_2$ 726
$C_{13}H_{11}N$ 632; 2271
$C_{13}H_{12}O$ 691; 823-4; 4073-4
$C_{13}H_{12}O_2$ 2344; 3718
$C_{13}H_{12}N_2$ 646; 2721
$C_{13}H_{13}N$ 693; 786; 4219-20
$C_{13}H_{13}N_3$ 2723; 4211
$C_{13}H_{14}O_3$ 625
$C_{13}H_{14}O_4$ 740
$C_{13}H_{14}O_6$ 5584
$C_{13}H_{14}N_2$ 826; 1721; 4271-3; 4431
$C_{13}H_{15}N$ 5426
$C_{13}H_{16}O_3$ 2983
$C_{13}H_{18}O$ 1611
$C_{13}H_{18}O_3$ 3483
$C_{13}H_{18}O_4$ 1028
$C_{13}H_{20}O$ 3663; 3913-5
$C_{13}H_{20}O_8$ 5067
$C_{13}H_{24}O_4$ 2123; 2168
$C_{13}H_{25}N$ 2862
$C_{13}H_{26}O$ 2267; 4408
$C_{13}H_{26}O_2$ 438; 3181; 4295; 6176
$C_{13}H_{28}O$ 6118; 6174
$C_{13}H_{28}O_3$ 1087; 3386
$C_{13}H_{28}O_4$ 5399

13 III

$C_{13}H_7O_3Br_3$ 6110
$C_{13}H_8OCl_2$ 1965-6
$C_{13}H_8O_5N_2$ 2612
$C_{13}H_8O_8N_4$ 5852
$C_{13}H_9ON$ 145; 2714; 3249; 4525
$C_{13}H_9OCl$ 1331
$C_{13}H_9O_2N$ 4738
$C_{13}H_9O_3N$ 4670-2
$C_{13}H_9O_5N$ 4837
$C_{13}H_9O_5N_3$ 4652
$C_{13}H_9NS$ 687; 2755
$C_{13}H_{10}O_3N_2$ 4645
$C_{13}H_{10}O_4N_2$ 2629
$C_{13}H_{10}NCl$ 4519
$C_{13}H_{11}ON$ 270-2; 631; 715; 728; 3306
$C_{13}H_{11}O_2N$ 3741; 5157
$C_{13}H_{11}O_2N_3$ 4638
$C_{13}H_{11}O_4N_3$ 4649
$C_{13}H_{11}NS$ 5890
$C_{13}H_{12}ON_2$ 657-8; 767-8; 828; 1706-8; 2759-60; 3737
$C_{13}H_{12}ON_4$ 2709
$C_{13}H_{12}O_2N_2$ 4771
$C_{13}H_{12}O_2S$ 5252
$C_{13}H_{12}O_3S$ 5248
$C_{13}H_{12}O_5N_6$ 2654
$C_{13}H_{12}N_2S$ 5892
$C_{13}H_{12}N_4S$ 2753
$C_{13}H_{13}ON$ 22; 784; 5791
$C_{13}H_{13}ON_3$ 246; 2744-7
$C_{13}H_{14}ON_4$ 2710
$C_{13}H_{14}O_3N_2$ 5336

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$C_{13}H_{14}N_4S$ 2754
$C_{13}H_{15}ON$ 2479
$C_{13}H_{15}N_2Cl$ 827
$C_{13}H_{16}NI$ 2543; 2545
$C_{13}H_{17}ON_3$ 363
$C_{13}H_{18}O_3N_4$ 3602
$C_{13}H_{19}ON$ 2774
$C_{13}H_{20}O_2N_2$ 4934-5
$C_{13}H_{25}O_2Br$ 4153
$C_{13}H_{27}ON$ 6177

13 IV

$C_{13}H_8O_5N_3Na$ 4653
$C_{13}H_9O_3SBr_3$ 6111
$C_{13}H_{10}ONCl$ 2708
$C_{13}H_{10}O_3SCl_2$ 2047
$C_{13}H_{11}O_3SCl$ 1439-40
$C_{13}H_{13}O_2NS$ 5972
$C_{13}H_{13}O_4N_3S$ 5328
$C_{13}H_{14}ONCl$ 785
$C_{13}H_{15}O_3N_2Cl_3$ 567
$C_{13}H_{18}O_2NBr$ 1008
$C_{13}H_{21}O_2N_2Cl$ 4934

13 V

$C_{13}H_{16}O_6NHgNa$ 5591

13 VI

$C_{13}H_{13}O_4N_2SAs_2Na$ 5593

14 I

$C_{14}H_{10}$ 538; 5095; 5954
$C_{14}H_{12}$ 2272; 5642-3
$C_{14}H_{14}$ 842-3; 2717-8; 2825-9
$C_{14}H_{16}$ 3576
$C_{14}H_{22}$ 5758-9
$C_{14}H_{26}$ 5752
$C_{14}H_{28}$ 5751
$C_{14}H_{30}$ 5748

14 II

$C_{14}H_6O_8$ 2872
$C_{14}H_8O_2$ 548-50; 5097
$C_{14}H_8O_3$ 3724-6
$C_{14}H_8O_4$ 2297-304; 3747
$C_{14}H_8O_5$ 6212-5
$C_{14}H_8O_6$ 5799-801
$C_{14}H_8O_8$ 5575
$C_{14}H_8Cl_2$ 1939-40
$C_{14}H_8Br_2$ 1803
$C_{14}H_9Br$ 968
$C_{14}H_{10}O$ 545; 561-2; 2730; 5098-100
$C_{14}H_{10}O_2$ 697; 2293-4; 2360; 5019; 5096
$C_{14}H_{10}O_3$ 714; 750-2; 2295-6
$C_{14}H_{10}O_4$ 766; 2688-91
$C_{14}H_{10}O_5$ 5585
$C_{14}H_{10}O_9$ 5687
$C_{14}H_{11}N$ 542-3; 4092-4; 4514-6
$C_{14}H_{12}O$ 1660; 2273; 5144; 5249-51
$C_{14}H_{12}O_2$ 717; 789-92; 2697; 4070; 6013-5
$C_{14}H_{12}O_3$ 694; 699; 809; 833; 3482; 6038-40
$C_{14}H_{12}O_4$ 2347; 2358; 3486
$C_{14}H_{12}N_2$ 633; 5182
$C_{14}H_{13}N$ 3011
$C_{14}H_{14}O$ 806; 2918; 4221; 5164
$C_{14}H_{14}O_2$ 2079; 2693; 3202; 3701-2
$C_{14}H_{14}O_3$ 3931
$C_{14}H_{14}O_8$ 5841
$C_{14}H_{14}N_2$ 54; 612-4; 1729-31; 2696
$C_{14}H_{14}S$ 1791; 2842
$C_{14}H_{14}S_2$ 805; 2836; 3204
$C_{14}H_{14}Hg$ 4048-50
$C_{14}H_{15}N$ 1783; 2830-2; 3044; 4144
$C_{14}H_{15}N_3$ 309-12; 1764; 2431-2
$C_{14}H_{15}P$ 3045
$C_{14}H_{16}N_2$ 1719; 2720; 3692-4; 5955; 5959
$C_{14}H_{17}N$ 2189
$C_{14}H_{18}O$ 451
$C_{14}H_{18}O_4$ 2130; 2794-5; 4231
$C_{14}H_{18}O_6$ 2412
$C_{14}H_{18}O_9$ 1269
$C_{14}H_{20}O_6$ 5781
$C_{14}H_{22}O$ 3918
$C_{14}H_{22}O_4$ 2087
$C_{14}H_{22}O_6$ 5785
$C_{14}H_{22}O_8$ 5764
$C_{14}H_{23}N$ 1891
$C_{14}H_{24}O_2$ 3355
$C_{14}H_{24}N_2$ 300
$C_{14}H_{26}O_3$ 3524
$C_{14}H_{26}O_4$ 1748-50; 1883; 2167; 2177; 2206; 3451
$C_{14}H_{26}O_6$ 1757; 2920
$C_{14}H_{27}N$ 4456
$C_{14}H_{28}O$ 3182; 4451
$C_{14}H_{28}O_2$ 2858; 3080; 3552; 4450
$C_{14}H_{29}Br$ 4457
$C_{14}H_{30}O$ 2264; 5750
$C_{14}H_{30}S$ 2266

14 III

$C_{14}H_4O_{12}N_4$ 1491
$C_{14}H_6O_2Cl_2$ 1941-8
$C_{14}H_6O_2Br_2$ 1805-9
$C_{14}H_6O_6N_2$ 2595-7; 2644
$C_{14}H_7O_2Cl$ 1316-7
$C_{14}H_7O_2Br$ 899-900
$C_{14}H_7O_4N$ 4627-8; 4794
$C_{14}H_7O_6N$ 4599-600
$C_{14}H_8O_5S$ 559
$C_{14}H_8O_7S$ 177
$C_{14}H_8O_8S_2$ 556
$C_{14}H_9O_2N$ 244-5; 4626; 5273
$C_{14}H_9O_3N$ 172-3; 327
$C_{14}H_9O_4N$ 241-2
$C_{14}H_{10}O_2N_2$ 1690-5; 5163
$C_{14}H_{10}O_2S_2$ 1779
$C_{14}H_{10}O_4N_2$ 600-2; 2663-4
$C_{14}H_{10}O_5N_2$ 616-8
$C_{14}H_{10}O_6Ca$ 3743
$C_{14}H_{11}ON$ 80
$C_{14}H_{11}OCl$ 5215
$C_{14}H_{11}OBr$ 5214
$C_{14}H_{11}O_2N$ 703-5; 1776; 5587
$C_{14}H_{11}O_3N$ 746-8
$C_{14}H_{12}O_2N_2$ 700-2; 5010
$C_{14}H_{12}O_3N_2$ 546
$C_{14}H_{12}O_4N_2$ 3686-8
$C_{14}H_{13}ON$ 84.1; 630; 775-7; 5143
$C_{14}H_{13}OCl$ 1376
$C_{14}H_{13}O_2N$ 720-1; 825
$C_{14}H_{14}ON_2$ 533; 4176
$C_{14}H_{14}OS$ 836; 2919
$C_{14}H_{14}O_2N_2$ 598
$C_{14}H_{14}O_2S$ 835; 2843
$C_{14}H_{14}O_3S$ 1554
$C_{14}H_{14}O_4S_2$ 3203
$C_{14}H_{15}ON$ 1786; 5137
$C_{14}H_{16}O_2N_2$ 1759
$C_{14}H_{16}O_6N_2$ 352; 5201
$C_{14}H_{16}N_3Cl$ 2432
$C_{14}H_{17}O_6N$ 3856
$C_{14}H_{18}ON_6$ 1709
$C_{14}H_{18}N_2Cl_2$ 5956
$C_{14}H_{19}O_8N$ 5108
$C_{14}H_{19}O_9Cl$ 44
$C_{14}H_{21}O_4N$ 2159
$C_{14}H_{21}ON_3$ 3916-7
$C_{14}H_{26}N_2Cl_2$ 301
$C_{14}H_{27}OCl$ 4455
$C_{14}H_{29}ON$ 4452
$C_{14}H_{29}ON_3$ 4409

14 IV

$C_{14}H_6O_8S_2Na_2$ 553-5; 557
$C_{14}H_7O_5SNa$ 558; 560
$C_{14}H_7O_7NS$ 4630-1
$C_{14}H_7O_7SNa$ 178
$C_{14}H_{10}OClBr$ 1435
$C_{14}H_{13}O_3SCl$ 4189
$C_{14}H_{14}O_6N_2S_2$ 1732
$C_{14}H_{15}O_2NS$ 5980-1
$C_{14}H_{16}O_2N_3As$ 2433
$C_{14}H_{16}O_3N_3As$ 2434
$C_{14}H_{16}O_6N_2S_2$ 5958
$C_{14}H_{17}O_4N_3S_2$ 6368

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$C_{14}H_{18}O_4N_2S$ 5957
$C_{14}H_{20}O_6N_2S$ 294; 4116-7
$C_{14}H_{22}O_2NCl$ 5644
$C_{14}H_{22}O_4N_4S$ 4339
$C_{14}H_{23}O_2N_2Cl$ 6366

14 V

$C_{14}H_{14}O_3N_3SNa$ 4328

14 VI

$C_{14}H_{14}O_8N_2S_2As_2Na_2$ 5674

15 I

$C_{15}H_{10}$ 3245
$C_{15}H_{12}$ 4127-8
$C_{15}H_{16}$ 2985
$C_{15}H_{18}$ 470
$C_{15}H_{24}$ 1263
$C_{15}H_{32}$ 5060

15 II

$C_{15}H_8O_4$ 551-2
$C_{15}H_8O_6$ 176; 2305-6
$C_{15}H_{10}O_2$ 539-41; 640; 3243; 4129
$C_{15}H_{10}O_3$ 2758
$C_{15}H_{10}O_4$ 1494-5; 4101
$C_{15}H_{10}O_5$ 727; 769; 772; 2874
$C_{15}H_{10}O_6$ 5806
$C_{15}H_{10}O_7$ 5806-7
$C_{15}H_{11}N$ 5230-3
$C_{15}H_{12}O$ 627
$C_{15}H_{12}O_2$ 1781; 3763; 5172-4
$C_{15}H_{12}O_3$ 1492; 2258; 4140; 6002
$C_{15}H_{12}O_4$ 120; 4143
$C_{15}H_{13}N$ 2510-1
$C_{15}H_{13}N_3$ 5199
$C_{15}H_{14}O$ 1787; 2838
$C_{15}H_{14}O_2$ 2739; 5190
$C_{15}H_{14}O_3$ 2409; 2833-5
$C_{15}H_{14}O_4$ 180; 4307
$C_{15}H_{14}O_5$ 3484; 5264 5594
$C_{15}H_{16}O$ 1573
$C_{15}H_{16}O_2$ 2694
$C_{15}H_{16}O_3$ 3409
$C_{15}H_{16}O_9$ 2899
$C_{15}H_{17}N$ 2984
$C_{15}H_{17}N_3$ 2837
$C_{15}H_{18}O$ 471
$C_{15}H_{18}O_3$ 5598
$C_{15}H_{20}O_2$ 3497
$C_{15}H_{20}O_4$ 2170; 5597; 5599
$C_{15}H_{20}N_4$ 5713
$C_{15}H_{22}O_{10}$ 4385
$C_{15}H_{24}O$ 5595
$C_{15}H_{24}O_8$ 5765
$C_{15}H_{26}O_2$ 867; 869
$C_{15}H_{26}O_6$ 3421
$C_{15}H_{28}O_2$ 4032
$C_{15}H_{28}O_4$ 2157
$C_{15}H_{30}O$ 2265
$C_{15}H_{30}O_2$ 4303
$C_{15}H_{31}Br$ 5063
$C_{15}H_{32}O$ 5062
$C_{15}H_{33}N$ 6074-6

15 III

$C_{15}H_9O_4N$ 4770
$C_{15}H_{11}O_3N$ 4633
$C_{15}H_{11}O_4N$ 4641
$C_{15}H_{12}ON_2$ 2722
$C_{15}H_{12}OBr_2$ 628-9
$C_{15}H_{12}O_2N_2$ 2724
$C_{15}H_{12}O_3N_2$ 3326
$C_{15}H_{12}O_5N_2$ 3353
$C_{15}H_{12}N_2S$ 317
$C_{15}H_{13}ON$ 30
$C_{15}H_{14}O_2N_2$ 4005
$C_{15}H_{15}ON$ 812; 2442
$C_{15}H_{15}O_2N$ 2761; 5588
$C_{15}H_{15}O_2N_3$ 4376
$C_{15}H_{16}ON_2$ 2467; 2847-9
$C_{15}H_{16}N_2S$ 2844-6
$C_{15}H_{17}N_4Cl$ 4585
$C_{15}H_{25}O_2Br$ 863
$C_{15}H_{31}ON$ 5059
$C_{15}H_{33}O_3B$ 6077

15 IV

$C_{15}H_6O_5NCl$ 4629
$C_{15}H_{11}O_4NI_4$ 5947
$C_{15}H_{11}O_4N_3S$ 679
$C_{15}H_{14}ON_2Cl$ 144
$C_{15}H_{14}O_2N_3Na$ 4377-8
$C_{15}H_{20}ONI$ 2480
$C_{15}H_{25}O_2NS$ 5976
$C_{15}H_{25}O_2N_2Cl$ 5032

16 I

$C_{16}H_{10}$ 5481
$C_{16}H_{12}$ 5204-5
$C_{16}H_{14}$ 2453-5; 2525; 2969
$C_{16}H_{16}$ 2277
$C_{16}H_{26}$ 1739; 5068
$C_{16}H_{30}$ 3571-2
$C_{16}H_{32}$ 3570
$C_{16}H_{34}$ 3569

16 II

$C_{16}H_{10}N_2$ 4513
$C_{16}H_{12}O_3$ 5324
$C_{16}H_{12}O_5$ 874
$C_{16}H_{12}O_8$ 3498
$C_{16}H_{12}O_7$ 5556
$C_{16}H_{13}N$ 5206-7
$C_{16}H_{13}N_3$ 660-1
$C_{16}H_{14}O_2$ 798
$C_{16}H_{14}O_3$ 718; 2257; 2979; 3485; 5991
$C_{16}H_{14}O_4$ 2748; 3447
$C_{16}H_{14}O_5$ 875
$C_{16}H_{14}O_6$ 3500; 3559; 3672; 5326
$C_{16}H_{14}N_2$ 3242
$C_{16}H_{16}O_2$ 719; 1782
$C_{16}H_{16}O_6$ 1264
$C_{16}H_{18}O$ 1121
$C_{16}H_{18}O_2$ 3448
$C_{16}H_{18}O_3$ 2692
$C_{16}H_{18}O_4$ 3457
$C_{16}H_{18}O_6$ 3710
$C_{16}H_{18}O_{10}$ 3310
$C_{16}H_{18}N_2$ 2738
$C_{16}H_{19}N$ 2988
$C_{16}H_{20}O_{10}$ 1268
$C_{16}H_{20}N_2$ 5830
$C_{16}H_{21}N_3$ 5833
$C_{16}H_{22}O_4$ 1908
$C_{16}H_{22}O_6$ 2096
$C_{16}H_{22}O_8$ 1528
$C_{16}H_{22}O_{11}$ 3362-3
$C_{16}H_{24}O_4$ 2086
$C_{16}H_{26}O_2$ 1742
$C_{16}H_{28}O_2$ 3680; 5029
$C_{16}H_{30}O$ 4446
$C_{16}H_{30}O_2$ 3849
$C_{16}H_{30}O_3$ 1224
$C_{16}H_{31}N$ 5028
$C_{16}H_{32}O$ 5023
$C_{16}H_{32}O_2$ 2263; 3088; 5022; 5749
$C_{16}H_{32}O_4$ 2234
$C_{16}H_{33}Br$ 1276
$C_{16}H_{33}I$ 1277
$C_{16}H_{34}O$ 1275; 2684
$C_{16}H_{34}O_3$ 456

16 III

$C_{16}H_{10}O_2N_2$ 3857; 3862
$C_{16}H_{10}O_4N_2$ 850
$C_{16}H_{11}O_2N$ 5234
$C_{16}H_{11}O_3N_3$ 4648
$C_{16}H_{12}O_2N_2$ 3863
$C_{16}H_{13}O_{15}N_9$ 1542
$C_{16}H_{14}O_3N_2$ 1509
$C_{16}H_{15}O_3N$ 3848
$C_{16}H_{16}O_2N_2$ 1671; 1780
$C_{16}H_{17}ON_3$ 124
$C_{16}H_{17}O_2N$ 5165
$C_{16}H_{18}O_2N_2$ 606-8
$C_{16}H_{18}O_3N_2$ 851
$C_{16}H_{20}N_3Cl$ 253
$C_{16}H_{27}O_5N_3$ 737
$C_{16}H_{31}OCl$ 5027
$C_{16}H_{33}ON$ 5024-5
$C_{16}H_{36}NI$ 5727

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16 IV

$C_{16}H_9O_2NI_2$ 2384
$C_{16}H_{10}O_5N_2S$ 3861
$C_{16}H_{10}O_8N_2S_2$ 3860
$C_{16}H_{11}O_{10}N_3S$ 5491
$C_{16}H_{12}O_9N_4S$ 5494
$C_{16}H_{13}O_3NS$ 5208
$C_{16}H_{13}O_3N_3S$ 331
$C_{16}H_{18}O_6S_2Ca$ 6460
$C_{16}H_{18}N_3SCl$ 4427
$C_{16}H_{19}ON_3S$ 4426
$C_{16}H_{24}O_2NCl$ 764; 2119
$C_{16}H_{24}O_6N_2S$ 2447
$C_{16}H_{27}O_2N_2Cl$ 276; 736

16 V

$C_{16}H_8O_8N_2S_2Na_2$ 3858
$C_{16}H_9O_9N_4S_2Na_3$ 5694
$C_{16}H_9O_{10}N_3S_2Na_2$ 4647
$C_{16}H_{11}O_4N_2SNa$ 4994-5
$C_{16}H_{14}O_4N_2As_2Na_2$ 581

17 I

$C_{17}H_{14}$ 817-8
$C_{17}H_{28}$ 3180
$C_{17}H_{36}$ 3508

17 II

$C_{17}H_{11}N$ 547
$C_{17}H_{12}O$ 5210-1
$C_{17}H_{12}O_2$ 4556-7
$C_{17}H_{12}O_3$ 4568-9
$C_{17}H_{14}O$ 819-20; 1506; 1775; 5209
$C_{17}H_{14}N_2$ 689
$C_{17}H_{15}N$ 6031-4
$C_{17}H_{15}N_3$ 5961
$C_{17}H_{16}O_2$ 5192
$C_{17}H_{16}O_3$ 3220; 5387
$C_{17}H_{16}O_6$ 4277
$C_{17}H_{16}O_7$ 3229
$C_{17}H_{19}N_3$ 143
$C_{17}H_{21}N_3$ 592
$C_{17}H_{22}O_3$ 866
$C_{17}H_{22}N_2$ 5834
$C_{17}H_{24}O_2$ 4030; 4977
$C_{17}H_{24}O_3$ 4031
$C_{17}H_{28}O_4$ 868
$C_{17}H_{32}O_3$ 5780
$C_{17}H_{34}O$ 2685; 4015
$C_{17}H_{34}O_2$ 4014; 4330; 5061
$C_{17}H_{36}O$ 3509

17 III

$C_{17}H_9O_4N$ 174
$C_{17}H_{11}O_5N$ 3801
$C_{17}H_{12}O_5N_2$ 2599
$C_{17}H_{13}ON$ 765
$C_{17}H_{20}ON_2$ 2137; 4436
$C_{17}H_{20}O_3N_2$ 2687
$C_{17}H_{20}O_5N_2$ 5117
$C_{17}H_{20}O_6N_4$ 5563
$C_{17}H_{22}ON_2$ 4435

17 IV

$C_{17}H_{19}ON_2Cl$ 5519
$C_{17}H_{24}O_3N_3Cl_3$ 364

17 V

$C_{17}H_{11}O_{10}NS_2Na_2$ 175

18 I

$C_{18}H_{12}$ 650; 1493
$C_{18}H_{14}$ 2703-5
$C_{18}H_{18}$ 5555
$C_{18}H_{20}$ 2476
$C_{18}H_{30}$ 3575; 5867
$C_{18}H_{34}$ 4942
$C_{18}H_{36}$ 4941
$C_{18}H_{38}$ 4938

18 II

$C_{18}H_{10}O_2$ 1496
$C_{18}H_{12}O_4$ 1658
$C_{18}H_{12}N_2$ 2814-6
$C_{18}H_{14}O$ 821
$C_{18}H_{14}O_3$ 1503
$C_{18}H_{14}O_4$ 3790; 5020
$C_{18}H_{15}N$ 6328
$C_{18}H_{15}N_3$ 659
$C_{18}H_{15}As$ 580
$C_{18}H_{15}Bi$ 857
$C_{18}H_{15}P$ 6342
$C_{18}H_{15}Sb$ 563
$C_{18}H_{16}O_2$ 1508
$C_{18}H_{16}O_4$ 1785; 1788; 3924-5
$C_{18}H_{16}O_7$ 6394-5
$C_{18}H_{16}N_2$ 6336
$C_{18}H_{17}N_3$ 2438-9
$C_{18}H_{18}O_2$ 2883-4; 2886-8
$C_{18}H_{18}O_3$ 1055
$C_{18}H_{18}O_4$ 1790; 2921
$C_{18}H_{18}O_6$ 1792
$C_{18}H_{20}O_2$ 2209
$C_{18}H_{22}O_2$ 2903
$C_{18}H_{23}N_3$ 4133
$C_{18}H_{24}O_2$ 2900
$C_{18}H_{24}O_3$ 2902
$C_{18}H_{26}O_4$ 1746-7
$C_{18}H_{26}O_{12}$ 3610; 3612
$C_{18}H_{28}O_4$ 2873
$C_{18}H_{30}O_2$ 3977
$C_{18}H_{30}O_4$ 2084
$C_{18}H_{32}O_2$ 1279; 2871; 3976; 5639
$C_{18}H_{32}O_3$ 5569
$C_{18}H_{32}O_4$ 5641
$C_{18}H_{32}O_6$ 3434-5
$C_{18}H_{32}O_7$ 6119
$C_{18}H_{32}O_{16}$ 5549
$C_{18}H_{34}O_2$ 2870; 3495; 4992
$C_{18}H_{34}O_3$ 5566; 5568
$C_{18}H_{34}O_4$ 1909; 3452
$C_{18}H_{34}O_6$ 2097
$C_{18}H_{35}N$ 5638
$C_{18}H_{36}O$ 5633
$C_{18}H_{36}O_2$ 1274; 2683; 3112; 5631
$C_{18}H_{36}O_3$ 3829-31
$C_{18}H_{36}O_4$ 2365-6
$C_{18}H_{37}I$ 4940
$C_{18}H_{38}O$ 4939
$C_{18}H_{39}N$ 6210

18 III

$C_{18}H_{10}O_6N_2$ 3859
$C_{18}H_{12}ON_2$ 670
$C_{18}H_{12}O_4N_2$ 3205
$C_{18}H_{14}O_2N_4$ 1778
$C_{18}H_{14}O_8Ca$ 116
$C_{18}H_{14}O_8Mg$ 118
$C_{18}H_{15}O_3P$ 6343
$C_{18}H_{15}O_4P$ 6341
$C_{18}H_{15}ClSn$ 5948
$C_{18}H_{15}Cl_2Bi$ 858
$C_{18}H_{15}Cl_2Sb$ 564
$C_{18}H_{16}O_2N_2$ 508; 5171
$C_{18}H_{17}O_3Na$ 5120
$C_{18}H_{18}O_4N_2$ 5590
$C_{18}H_{22}O_4N_4$ 5193
$C_{18}H_{27}O_3N$ 1227
$C_{18}H_{33}O_3Na$ 5567
$C_{18}H_{35}OCl$ 5637
$C_{18}H_{37}ON$ 5634
$C_{18}H_{39}O_2N$ 5632

18 IV

$C_{18}H_{12}O_4Cl_2P$ 6165
$C_{18}H_{13}O_4Cl_2P$ 2046
$C_{18}H_{14}O_4ClP$ 2713
$C_{18}H_{15}OS_3P$ 6350
$C_{18}H_{15}O_3SP$ 6346
$C_{18}H_{16}O_6N_2S$ 3827
$C_{18}H_{16}O_6N_2Ca$ 3665
$C_{18}H_{23}O_2N_2Cl$ 2910
$C_{18}H_{28}O_4N_2S$ 655
$C_{18}H_{32}O_5N_2S$ 5031
$C_{18}H_{32}O_{10}N_2Ca$ 5035

18 V

$C_{18}H_{14}O_3N_3SNa$ 4056; 4996

19 I

$C_{19}H_{15}$ 6339
$C_{19}H_{16}$ 802-3; 6337
$C_{19}H_{40}$ 4908

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19 II

$C_{19}H_{12}O_2$ 4479
$C_{19}H_{13}N$ 5147
$C_{19}H_{14}O$ 2741
$C_{19}H_{14}O_2$ 652; 5255
$C_{19}H_{14}O_3$ 593
$C_{19}H_{14}O_5$ 2766
$C_{19}H_{15}N$ 725
$C_{19}H_{15}Cl$ 6333
$C_{19}H_{15}Br$ 6330
$C_{19}H_{16}O$ 6331
$C_{19}H_{16}O_3$ 3963
$C_{19}H_{16}N_2$ 729
$C_{19}H_{17}N$ 384-5; 804
$C_{19}H_{17}N_3$ 6334-5
$C_{19}H_{18}O$ 2824
$C_{19}H_{18}O_3$ 1758; 3221
$C_{19}H_{18}N_2$ 1733
$C_{19}H_{19}N_3$ 6071-3
$C_{19}H_{22}O_3$ 5004
$C_{19}H_{28}O_2$ 1657; 5711-2
$C_{19}H_{30}O_2$ 509
$C_{19}H_{36}O_2$ 4327
$C_{19}H_{38}O$ 2682; 4261
$C_{19}H_{38}O_2$ 4381; 4909

19 III

$C_{19}H_{13}O_6N_3$ 6322
$C_{19}H_{13}O_7N_3$ 6321
$C_{19}H_{14}O_5S$ 5127
$C_{19}H_{15}O_2N$ 212
$C_{19}H_{17}O_2N$ 3130
$C_{19}H_{18}N_3Cl$ 5039
$C_{19}H_{19}ON_3$ 5038
$C_{19}H_{20}O_4N_2$ 568
$C_{19}H_{21}O_5N$ 6420
$C_{19}H_{24}O_2Br_2$ 865

19 IV

$C_{19}H_{10}O_5SBr_4$ 5724
$C_{19}H_{10}O_5SI_4$ 5815
$C_{19}H_{10}O_{13}N_4S$ 5858
$C_{19}H_{14}ONCl$ 3980
$C_{19}H_{16}O_2NCl$ 213

20 I

$C_{20}H_{14}$ 2574-5; 5156
$C_{20}H_{16}$ 2756-7
$C_{20}H_{38}$ 5293
$C_{20}H_{40}$ 5297
$C_{20}H_{42}$ 1017; 2868; 5294

20 II

$C_{20}H_{12}O_3$ 3244
$C_{20}H_{12}O_5$ 3250; 3720
$C_{20}H_{14}O$ 4560-2
$C_{20}H_{14}O_2$ 2336-7; 5292
$C_{20}H_{14}O_4$ 2737; 5121; 5553
$C_{20}H_{14}O_5$ 3254
$C_{20}H_{14}N_2$ 604-5
$C_{20}H_{14}S$ 2583-4
$C_{20}H_{14}Hg$ 4045
$C_{20}H_{15}N$ 2576
$C_{20}H_{15}N_3$ 251; 1763
$C_{20}H_{16}O_2$ 6327; 6338
$C_{20}H_{16}O_3$ 5573
$C_{20}H_{16}O_4$ 5122
$C_{20}H_{16}N_2$ 3690-1
$C_{20}H_{16}N_4$ 4872
$C_{20}H_{18}O$ 6332
$C_{20}H_{18}O_2$ 529; 3717
$C_{20}H_{19}N$ 1784
$C_{20}H_{20}N_2$ 2839-40
$C_{20}H_{21}N_3$ 3962
$C_{20}H_{24}O_4$ 1555
$C_{20}H_{26}O_3$ 2209
$C_{20}H_{26}O_4$ 2088
$C_{20}H_{30}O_2$ 1
$C_{20}H_{30}O_6$ 1027
$C_{20}H_{32}N_2$ 3961
$C_{20}H_{36}O_2$ 3014
$C_{20}H_{38}O_2$ 3109
$C_{20}H_{40}O$ 5298
$C_{20}H_{40}O_2$ 574; 3153
$C_{20}H_{42}O$ 2869; 5295

20 III

$C_{20}H_8O_5Br_4$ 2875-6
$C_{20}H_8O_5I_4$ 2896-7
$C_{20}H_{10}O_3Cl_2$ 3252
$C_{20}H_{10}O_4Cl_4$ 5744
$C_{20}H_{10}O_4Br_4$ 5722
$C_{20}H_{10}O_4I_4$ 5813
$C_{20}H_{10}O_5Cl_2$ 1999; 2000
$C_{20}H_{10}O_5Br_2$ 1838-9
$C_{20}H_{10}O_5I_2$ 2392
$C_{20}H_{10}O_5Na_2$ 3251
$C_{20}H_{14}ON_2$ 619-20
$C_{20}H_{18}ON_2$ 722-3
$C_{20}H_{20}O_5N_2$ 566
$C_{20}H_{20}N_3Cl$ 5571
$C_{20}H_{21}ON_3$ 5570
$C_{20}H_{22}O_4N_2$ 5307
$C_{20}H_{33}ON$ 4454
$C_{20}H_{41}ONa$ 5296

20 IV

$C_{20}H_6O_5Br_4Na_2$ 2876
$C_{20}H_6O_5I_4Na_2$ 2897
$C_{20}H_8O_4Br_4Na_2$ 5723
$C_{20}H_8O_4I_4Na_2$ 5814
$C_{20}H_{14}O_8S_2Ca$ 4499; 4506; 4508
$C_{20}H_{30}O_2N_3Cl$ 1025
$C_{20}H_{32}O_6N_2S$ 3676-7

20 V

$C_{20}H_8O_6Br_2HgNa_2$ 4041
$C_{20}H_8O_{10}S_2Br_4Na_2$ 998
$C_{20}H_{11}O_{10}N_2S_3Na_3$ 3732

21 I

$C_{21}H_{16}$ 822; 2580-2; 4190
$C_{21}H_{20}$ 5183
$C_{21}H_{42}$ 3504
$C_{21}H_{44}$ 3503

21 II

$C_{21}H_{14}O$ 2577-9
$C_{21}H_{16}N_2$ 3978
$C_{21}H_{18}O$ 2078; 2740
$C_{21}H_{18}N_2$ 233; 3700
$C_{21}H_{20}O_6$ 1575
$C_{21}H_{20}O_9$ 227
$C_{21}H_{21}N$ 6084
$C_{21}H_{21}N_3$ 512
$C_{21}H_{24}O_4$ 2153
$C_{21}H_{30}O_2$ 5333-4
$C_{21}H_{30}N_2$ 5761
$C_{21}H_{32}O_2$ 4084
$C_{21}H_{32}O_{11}$ 3365
$C_{21}H_{36}O_2$ 5329-32
$C_{21}H_{38}O_6$ 3423
$C_{21}H_{40}O_3$ 5782
$C_{21}H_{42}O_4$ 3415-6

21 III

$C_{21}H_{15}ON$ 698
$C_{21}H_{15}O_3N$ 6081
$C_{21}H_{16}ON_2$ 2585
$C_{21}H_{18}O_5S$ 1550-1
$C_{21}H_{20}O_4N_2$ 228
$C_{21}H_{21}O_3P$ 6354-5
$C_{21}H_{21}O_4P$ 6351-3
$C_{21}H_{24}O_5N_2$ 2779
$C_{21}H_{28}ON_2$ 5760

21 IV

$C_{21}H_{14}O_5SBr_4$ 5718
$C_{21}H_{16}O_5SBr_2$ 1832
$C_{21}H_{21}O_3SP$ 6356-8

22 I

$C_{22}H_{14}$ 1777; 5299
$C_{22}H_{46}$ 2855

22 II

$C_{22}H_{15}N_3$ 5572
$C_{22}H_{16}O_3$ 6082-3
$C_{22}H_{16}O_5$ 4999
$C_{22}H_{18}O_4$ 1548; 1789; 2841
$C_{22}H_{20}O_4$ 1549
$C_{22}H_{22}O_8$ 5306
$C_{22}H_{28}O_3$ 5596
$C_{22}H_{32}O_3$ 507
$C_{22}H_{34}O_2$ 2932
$C_{22}H_{40}O_2$ 624
$C_{22}H_{42}O_2$ 873; 1110; 2892
$C_{22}H_{42}O_3$ 1127-8
$C_{22}H_{42}O_4$ 1924; 3201
$C_{22}H_{44}O$ 2893

FORMULA INDEX ORGANIC COMPOUNDS

$C_{22}H_{44}O_2$ 623; 1129-30
$C_{22}H_{44}O_4$ 2309

22 III

$C_{22}H_{16}ON_4$ 5664
$C_{22}H_{21}O_2N$ 5603
$C_{22}H_{23}O_4P$ 2707
$C_{22}H_{40}O_4N_8$ 3601

22 IV

$C_{22}H_{24}O_4N_2S$ 2542

23 I

$C_{23}H_{48}$ 6171

23 II

$C_{23}H_{17}N$ 50
$C_{23}H_{18}O$ 2732
$C_{23}H_{22}O_6$ 1655; 5574
$C_{23}H_{22}O_7$ 5699
$C_{23}H_{26}N_2$ 3964
$C_{23}H_{27}N_3$ 5844
$C_{23}H_{32}O_6$ 5645
$C_{23}H_{44}O_2$ 475
$C_{23}H_{46}O$ 2850
$C_{23}H_{46}O_2$ 488-9

23 III

$C_{23}H_{23}N_2I$ 2144
$C_{23}H_{25}O_2N_3$ 5838
$C_{23}H_{25}N_2Cl$ ($ZnCl_2$) 3993
$C_{23}H_{26}ON_2$ 5835

23 IV

$C_{23}H_{26}O_3N_3Cl$ 1760

24 I

$C_{24}H_{18}$ 6329
$C_{24}H_{50}$ 5747

24 II

$C_{24}H_{16}O_7$ 3253
$C_{24}H_{20}O_6$ 3420
$C_{24}H_{20}N_2$ 2706; 5863
$C_{24}H_{20}Pb$ 3959
$C_{24}H_{20}Sn$ 5952
$C_{24}H_{28}O_4$ 4931-2
$C_{24}H_{28}N_2$ 5837
$C_{24}H_{40}O_2$ 5238
$C_{24}H_{40}O_4$ 1479
$C_{24}H_{40}O_5$ 1487
$C_{24}H_{44}O_6$ 3425
$C_{24}H_{44}O_3$ 3954
$C_{24}H_{48}O_2$ 3970

24 III

$C_{24}H_{19}O_4P$ 2762
$C_{24}H_{19}O_5N$ 1675
$C_{24}H_{20}BrAs$ 5859
$C_{24}H_{21}O_3N_3$ 801
$C_{24}H_{25}ON_3$ 749
$C_{24}H_{28}ON_2$ 5836
$C_{24}H_{28}N_3Cl$ 5077
$C_{24}H_{29}ON_3$ 5076
$C_{24}H_{41}ON$ 5636

24 IV

$C_{24}H_{14}O_2N_2S_2$ 3868
$C_{24}H_{26}O_4N_4S$ 316

24 V

$C_{24}H_{20}O_6N_2S_2Ba$ 2702

25 I

$C_{25}H_{20}$ 5864
$C_{25}H_{52}$ 5058

25 II

$C_{25}H_{21}N_3$ 5862
$C_{25}H_{22}O_3$ 2885
$C_{25}H_{26}O_9$ 3226
$C_{25}H_{30}O_4$ 4933
$C_{25}H_{31}N_3$ 3595
$C_{25}H_{50}O_2$ 3847

25 III

$C_{25}H_{20}ON_2$ 5866
$C_{25}H_{25}N_2I$ 5316
$C_{25}H_{27}N_2I$ 5003
$C_{25}H_{30}N_3Cl$ 3593
$C_{25}H_{31}ON_3$ 3592

25 IV

$C_{25}H_{29}ON_2I$ 2144

26 I

$C_{26}H_{18}$ 2734
$C_{26}H_{20}$ 5861
$C_{26}H_{22}$ 5860
$C_{26}H_{52}$ 1271
$C_{26}H_{54}$ 3567-8

26 II

$C_{26}H_{20}O$ 731
$C_{26}H_{22}O$ 692
$C_{26}H_{22}O_2$ 732; 2853
$C_{26}H_{22}N_4$ 706-7
$C_{26}H_{42}O_{11}$ 3364
$C_{26}H_{50}O_4$ 3458
$C_{26}H_{52}O_2$ 1272; 4883
$C_{26}H_{54}O$ 1273

26 III

$C_{26}H_{31}O_4P$ 1907
$C_{26}H_{33}N_3Cl_2$ 3594
$C_{26}H_{43}O_6N$ 3440

26 IV

$C_{26}H_{42}O_6NNa$ 3441
$C_{26}H_{45}O_7NS$ 5697

26 V

$C_{26}H_{44}O_7NSNa$ 5698

27 I

$C_{27}H_{18}$ 6362
$C_{27}H_{56}$ 3507

27 II

$C_{27}H_{26}O_7$ 6085
$C_{27}H_{36}O_4$ 595
$C_{27}H_{38}O_4$ 594
$C_{27}H_{44}O_3$ 5602
$C_{27}H_{44}O_4$ 1478
$C_{27}H_{46}O$ 1480-2
$C_{27}H_{48}O$ 2276
$C_{27}H_{50}O_6$ 3424

27 III

$C_{27}H_{34}ON_2$ 5762

27 IV

$C_{27}H_{28}O_5SBr_2$ 1879
$C_{27}H_{34}O_4N_2S$ 5763

28 I

$C_{28}H_{58}$ 4937

28 II

$C_{28}H_{18}O_4$ 4497
$C_{28}H_{20}N_2$ 234
$C_{28}H_{30}O_4$ 5941
$C_{28}H_{34}O_{15}$ 3560
$C_{28}H_{44}O$ 1187; 2889; 3879
$C_{28}H_{54}O_3$ 4453
$C_{28}H_{54}O_4$ 2227

28 III

$C_{28}H_{24}O_7N_2$ 4997
$C_{28}H_{33}O_{11}N_5$ 1044

28 IV

$C_{28}H_{31}O_3N_2Cl$ 5766

29 I

$C_{29}H_{60}$ 4907

29 II

$C_{29}H_{48}O_2$ 1483

29 III

$C_{29}H_{35}N_2I$ 1580

30 I

$C_{30}H_{60}$ 4021
$C_{30}H_{62}$ 6057

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30 II

$C_{30}H_{48}O_2$ 4444
$C_{30}H_{50}O_2$ 1486
$C_{30}H_{58}O_4$ 3461

30 III

$C_{30}H_{23}O_4P$ 5184
$C_{30}H_{39}O_4P$ 6120

31 I

$C_{31}H_{64}$ 3505

31 II

$C_{31}H_{46}O_2$ 4342
$C_{31}H_{62}O$ 5030
$C_{31}H_{62}O_2$ 4022
$C_{31}H_{64}O$ 4449

31 III

$C_{31}H_{43}ON_3$ 3191

32 I

$C_{32}H_{66}$ 2866

32 II

$C_{32}H_{52}O_2$ 2867
$C_{32}H_{62}O_3$ 5026
$C_{32}H_{64}O_2$ 1278

32 III

$C_{32}H_{36}O_6N_4$ 851
$C_{32}H_{36}O_8N_4$ 852

32 V

$C_{32}H_{22}O_6N_6S_2Na_2$ 1527

33 I

$C_{33}H_{68}$ 6369

33 II

$C_{33}H_{62}O_6$ 3422
$C_{33}H_{66}O_2$ 4448

34 I

$C_{34}H_{70}$ 5868

34 II

$C_{34}H_{50}O_2$ 1484-5
$C_{34}H_{66}O_4$ 3464

34 IV

$C_{34}H_{33}O_5N_4Fe$ 3499

34 V

$C_{34}H_{26}O_6N_6S_2Na_2$ 733
$C_{34}H_{26}O_{14}N_6S_4Na_4$ 3228
$C_{34}H_{32}O_4N_4ClFe$ 3501

35 I

$C_{35}H_{72}$ 5080

35 II

$C_{35}H_{28}O_2$ 647-8
$C_{35}H_{40}O_{12}$ 3239
$C_{35}H_{52}O_4$ 4343
$C_{35}H_{70}O$ 5640

36 I

$C_{36}H_{74}$ 3613

36 II

$C_{36}H_{54}O_6$ 849
$C_{36}H_{70}O_3$ 5635

36 III

$C_{36}H_{27}O_4P$ 6360
$C_{36}H_{43}O_4P$ 1146

36 IV

$C_{36}H_{62}O_8N_4S$ 1890

37 V

$C_{37}H_{27}O_9N_3S_3Na_2$ 6345

38 II

$C_{38}H_{30}O_2$ 6340
$C_{38}H_{74}O_4$ 3467

38 III

$C_{38}H_{32}N_3Cl$ 516

39 II

$C_{39}H_{74}O_6$ 3426

40 I

$C_{40}H_{56}$ 1262-4; 3985

40 II

$C_{40}H_{50}O_2$ 5562
$C_{40}H_{56}O$ 1570
$C_{40}H_{56}O_2$ 6452

42 IV

$C_{42}H_{84}O_9NP$ 3960

45 II

$C_{45}H_{86}O_6$ 3427

51 II

$C_{51}H_{98}O_6$ 3431

52 III

$C_{52}H_{54}O_{12}N_4$ 3994

57 II

$C_{57}H_{104}O_6$ 3430
$C_{57}H_{110}O_6$ 3433

63 II

$C_{63}H_{122}O_6$ 3419

69 IV

$C_{69}H_{75}N_6Cl_7Zn_2$ 3993

76 IV

$C_{76}H_{64}O_4N_6S$ 6344

MELTING POINTS OF ORGANIC COMPOUNDS

The compounds below are arranged in the order of the ascending values of the melting points, an arrangement intended to serve as an aid in the identification of organic compounds. The values given may be uncertain by one or more units in the last figure and consequently are not to be used as fixed points for calibration. See special table for *Calibration of Thermometers and Thermocouples*. The numbers listed under a temperature-interval heading refer to the compounds with corresponding numerical listings in the table *Physical Constants of Organic Compounds*. Thus, under the temperature interval *186° to 190° C.* is listed *No. 31* which is *acetamino-α-naphthol*, m. p. 187° C.

Below −140° C.

183; 872; 1022; 1239; 1772; 2246; 2904; 3192; 3604; 3656; 3933; 4061; 4209; 5084; 5338; 5459; 6203; 6435

−130° to −139° C.

202; 499; 501; 1021; 1074; 1147; 1156; 1248; 2478; 3015; 3517; 3957; 5083; 5346; 6434

−120° to −129° C.

5; 193; 502; 990; 1072; 1621; 1631; 2783; 2911; 3083; 3271; 3515; 3606; 4154; 4155; 4199; 4298; 5083; 5368; 5400; 6248

−110° to −119° C.

81; 199; 406; 988; 1035; 1057; 1059; 1103; 1175; 2245; 2911; 2946; 2989; 3210; 3280; 3513; 3514; 3516; 3518; 3556; 3607; 3657; 4154; 4917; 4946; 4949; 4956; 5388; 5401; 5424; 5950; 6180

−100° to −109° C.

225; 415; 1019; 1036; 1040; 1095; 1238; 1240; 1247; 1400; 1609; 1923; 2778; 2782; 3062; 3077; 3096; 4238; 4424; 4827; 4916; 4947; 5087; 5372

−90° to −99° C.

56; 75; 208; 1031; 1089; 1097; 1142; 1160; 1174; 1599; 1619; 1898; 1993; 2214; 2429; 2499; 2973; 3006; 3186; 3288; 3512; 3603; 3605; 3655; 3973; 4087; 4100; 4105; 4147; 4169; 4183; 4242; 4357; 4429; 4733; 4828; 4953; 4960; 4986; 5086; 5345; 5360; 5363; 5365; 5378; 5379; 5392; 5408; 5417; 5418; 5960; 6348

−80° to −89° C.

130; 135; 146; 151; 220; 1041; 1049; 1050; 1064; 1104; 1173; 1246; 1378; 1684; 2472; 2473; 2560; 2935; 2950; 3007; 3019; 3142; 3158; 3279; 3285; 4088; 4164; 4170; 4171; 4232; 4349; 4422; 4735; 4911; 5352; 5369; 5371; 5389; 5418; 6121

−70° to −79° C.

37; 421; 432; 447; 483; 989; 1029; 1034; 1104; 1125; 1265; 1379; 1624; 1636; 1825; 1886; 1914; 2051; 2240; 3048; 3138; 3279; 3418; 3421; 3449; 3474; 3558; 3658; 4182; 4355; 4965; 4991; 5300; 5366; 5441; 6155

−60° to −69° C.

89; 1042; 1083; 1141; 1163; 1380; 1477; 1559; 1740; 1821; 2172; 2502; 2569; 2769; 2784; 2965; 3029; 3108; 3194; 3266; 3628; 3708; 4287; 4697; 4910; 5046; 5773; 6426

−50° to −59° C.

132; 136; 412; 724; 781; 886; 1039; 1052; 1171; 1218; 1237; 1281; 1344; 1595; 1638; 1864; 1870; 1970; 2133; 2184; 2242; 2407; 2471; 3269; 3459; 3624; 4053; 4125; 4163; 4166; 4214; 4289; 4387; 4392; 4428; 4944; 5318; 5380; 5710; 6159; 6255; 6399; 6407; 6448

−40° to −49° C.

49; 319; 994; 1167; 1179; 1180; 1301; 1324; 1467; 1606; 1663; 1735; 2138; 2180; 2184; 2193; 2749; 2772; 2937; 3010; 3113; 3114; 3257; 3258; 3263; 3521; 3631; 3637; 3944; 4174; 4195; 4694; 4980; 5146; 5317; 5357; 5483; 6254; 6255; 6285; 6457; 6504

−30° to −39° C.

537; 796; 843; 902; 1000; 1209; 1466; 1565; 1588; 1635; 1824; 1857; 1865; 1883; 1994; 2053; 2109; 2121; 2128; 2195; 2772; 2786; 2863; 2975; 3026; 3047; 3084; 3318; 3406; 3445; 3527; 3529; 3530; 3631; 3637; 4184; 4384; 4711; 4737; 4919; 4959; 4962; 5111; 5646; 5739; 5786; 5923; 5997; 6122; 6152; 6198; 6206; 6382; 6399; 6406; 6427

−20° to −29° C

68; 91; 211; 306; 470; 642; 735; 800; 916; 926; 933; 948; 986; 999; 1014; 1028; 1053; 1075; 1140; 1152; 1162; 1183; 1185; 1233; 1243; 1340; 1346; 1361; 1377; 1381; 1402; 1442; 1459; 1474; 1475; 1623; 1635; 1783; 1823; 1880; 1905; 1910; 1953; 1981; 2106; 2126; 2127; 2195; 2211; 2213; 2483; 2484; 2485; 2486; 2559; 2718; 2771; 2879; 3016; 3030; 3035; 3057; 3084; 3089; 3168; 3265; 3272; 3377; 3393; 3411; 3423; 3462; 3519; 3544; 3683; 3846; 3879; 3958; 3968; 4025; 4196; 4201; 4237; 4265; 4282; 4304; 4372; 4407; 4729; 4736; 4765; 4891; 4920; 4964; 5054; 5068; 5085; 5105; 5224; 5241; 5351; 5375; 5429; 5828; 5895; 5993; 5995; 6017; 6042, 6103; 6116; 6119; 6143; 6167; 6253; 6370; 6454; 6503

−10° to −19° C.

55; 57; 137; 190; 230; 409; 493; 535; 544; 635; 716; 782; 915; 936; 1012; 1060; 1310; 1314; 1343; 1391; 1538; 1596; 1952; 2101; 2109; 2230; 2481; 2507; 2517; 2636; 2831; 3049; 3080; 3090; 3163; 3166; 3170; 3223; 3272; 3444; 3463; 3520; 3547; 3629; 3638; 3639; 3647; 3705; 3714; 3756; 3846; 3955; 3976; 4010; 4080; 4126; 4138; 4172; 4181; 4229; 4265; 4266; 4311; 4403; 4788; 4844; 4961; 4973; 5011; 5249; 5341; 5538; 5741; 5751; 5885; 5905; 5992; 5995; 6157; 6166; 6471

0° to −9° C.

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25; 47; 50; 59; 96; 115; 233; 257; 262; 273; 299; 542; 606; 710; 717; 836; 874; 922; 924; 1061; 1194; 1322; 1397; 1498; 1503; 1513; 1616; 1696; 1706; 1719; 1759; 1779; 1957; 2017; 2159; 2309; 2310; 2347; 2417; 2460; 2474; 2578; 2633; 2651; 2696; 2727 2916; 3041; 3212; 3340; 3363; 3619; 3685; 3694; 3741; 3749; 3854; 3867; 3993; 3995; 4002; 4012; 4093; 4133; 4227; 4274; 4292; 4415; 4446; 4523; 4528; 4615; 4700; 4727; 4833; 4856; 5282; 5319; 5493; 5605; 5625; 5652; 5825; 5862; 6088; 6156; 6160; 6216; 6225; 6335; 6386; 6396; 6409

136° to 140° C.

96; 101; 115; 257; 529; 592; 637; 703; 717; 729; 874; 884; 951; 1038; 1139; 1482; 1503; 1657; 1701; 1733; 1829; 1851; 1962; 2119; 2181; 2310; 2339; 2345; 2352; 2354; 2365; 2375; 2419; 2525; 2532; 2578; 2589; 2590; 2633; 2641; 2721; 2727; 2732; 2798; 2839; 2916; 3240; 3346; 3367; 3369; 3370; 3457; 3500; 3691; 3701; 3738; 3842; 3916; 3946; 3966; 4582; 4602; 4610; 4664; 4672; 4771; 4856; 5173; 5220; 5260; 5370; 5384; 5486; 5649; 5688; 5735; 5809; 5817; 5857; 5902; 5927; 5937; 5971; 6002; 6217; 6224; 6239; 6317; 6325; 6409

141° to 145° C.

58; 95; 213; 264; 298; 512; 564; 598; 614; 688; 728; 775; 825; 858; 951; 1139; 1321; 1327; 1502; 1701; 1722; 1855; 1962; 1966; 2003; 2257; 2321; 2345; 2360; 2409; 2422; 2458; 2557; 2628; 2637; 2646; 2721; 2776; 2798; 2873; 3058; 3104; 3231; 3240; 3308; 3312; 3313; 3341; 3350; 3367; 3380; 3691; 3737; 3794; 3832; 3946; 3966; 4000; 4048; 4112; 4113; 4268; 4270; 4371; 4513; 4582; 4611; 4633; 4643; 4661; 4664; 4779; 4780; 4782; 4807; 4824; 4884; 5167; 5291; 5326; 5384; 5550; 5561; 5649; 5676; 5677; 5727; 5817; 5841; 5937; 6044; 6049; 6058; 6072; 6126; 6172; 6217; 6224; 6241; 6334; 6336; 6339; 6388; 6493

146° to 150° C.

34; 97; 99; 213; 227; 229; 295; 506; 561; 699; 727; 745; 775; 835; 837; 841; 844; 906; 1269; 1287; 1432; 1441; 1480; 1484; 1502; 1592; 1657; 1669; 1776; 1814; 1817; 1841; 1922; 1990; 2078; 2144; 2261; 2318; 2325; 2344; 2470; 2475; 2660; 2680; 2697; 2723; 2754; 2798; 3240; 3290; 3308; 3600; 3618; 3794; 3796; 3802; 3811; 3814; 3917; 3960; 3971; 4036; 4054; 4234; 4259; 4280; 4467; 4598; 4620; 4626; 4663; 4669; 4689; 4704; 4753; 4778; 4832; 4895; 4900; 4993; 5018; 5032; 5096; 5253; 5271; 5272; 5481; 5550; 5585; 5659; 5810; 5817; 5843; 5863; 5911; 5988; 6044; 6072; 6073; 6232; 6259; 6339; 6449; 6493

151° to 155° C.

28; 153; 229; 367; 495; 505; 506; 561; 571; 598; 646; 720; 722; 727; 745; 792; 835; 907; 1008; 1009; 1188; 1236; 1269; 1287; 1441; 1464; 1480; 1515; 1669; 1678; 1816; 1950; 1961; 2002; 2070; 2144; 2280; 2311; 2318; 2584; 2591; 2739; 2747; 2754; 2798; 3216; 3247; 3290; 3361; 3440; 3673; 3729; 3762; 3763; 3787; 3802; 3839; 3960; 4034; 4423; 4479; 4524; 4589; 4616; 4638; 4645; 4659; 4766; 4769; 4809; 4837; 4863; 4895; 5032; 5073; 5100; 5156; 5244; 5355; 5386; 5476; 5532; 5565; 5586; 5695; 5711; 5838; 5844; 5870; 5892; 6045; 6107; 6229; 6261; 6304; 6330; 6385; 6389; 6480

156° to 160° C.

46; 93; 229; 289; 292; 362; 389; 495; 505; 510; 545; 570; 608; 629; 646; 650; 668; 677; 722; 777; 792; 801; 923; 997; 1048; 1201; 1328; 1371; 1560; 1718; 1763; 1793; 1950; 2001; 2070; 2256; 2318; 2341; 2344; 2355; 2358; 2574; 2592; 2624; 2653; 2709; 2798; 2843; 2844; 2889; 3290; 3366; 3729; 3742; 3778; 3848; 3869; 3872; 3960; 4001; 4267; 4277; 4322; 4423; 4440; 4479; 4480; 4579; 4738; 4815; 4817; 4863; 4881; 4902; 4934; 4936; 5031; 5056; 5113; 5140; 5158; 5161; 5242; 5255; 5314; 5476; 5510; 5533; 5539; 5559; 5651; 5695; 5700; 5877; 5970; 6238; 6387

161° to 165° C.

12; 60; 107; 122; 140; 163; 292; 324; 336; 527; 545; 662; 694; 702; 715; 737; 744; 751; 765; 773; 839; 862; 864; 993; 997; 1316; 1353; 1513; 1542; 1574; 1833; 1960; 2079; 2258; 2270; 2318; 2326; 2341; 2462; 2480; 2579; 2610; 2738; 2746; 2798; 2880; 2889; 3059; 3305; 3328; 3617; 3620; 3692; 3703; 3740; 3799; 3836; 3848; 3865; 3880; 3928; 3960; 4130; 4250; 4322; 4480; 4614; 4722; 4752; 4776; 4820; 4823; 4830; 4859; 4893; 4902; 5037; 5161; 5174; 5218; 5288; 5480; 5516; 5536; 5574; 5671; 5700; 5803; 5835; 5847; 5918; 5990; 6071; 6123; 6138; 6139; 6140; 6306; 6331; 6338

166° to 170° C.

16; 35; 76; 94; 122; 163; 185; 186; 527; 545; 547; 587; 620; 662; 702; 708; 736; 744; 768;

774; 787; 827; 854; 882; 993; 1202; 1235; 1423; 1542; 1570; 1726; 1727; 1847; 1877; 1959; 2004; 2209; 2270; 2271; 2314; 2318; 2430; 2432; 2462; 2463; 2464; 2639; 2640; 2741; 2746; 2798; 2867; 3013; 3229; 3230; 3236; 3328; 3329; 3342; 3349; 3562; 3590; 3609; 3617; 3739; 3797; 3833; 3928; 3960; 4004; 4250; 4308; 4439; 4502; 4752; 4759; 4859; 4880; 5098; 5104; 5110; 5113; 5239; 5303; 5560; 5597; 5598; 5601; 5645; 5663; 5671; 5691; 5847; 5888; 6102; 6123; 6169; 6242; 6257; 6264; 6321; 6329; 6390

171° to 175° C.

66; 70; 100; 110; 121; 251; 265; 291; 293; 297; 323; 345; 587; 609; 695; 764; 785; 1199; 1230; 1290; 1298; 1479; 1504; 1513; 1569; 1626; 1655; 1658; 1681; 1707; 1815; 1835; 1847; 2209; 2350; 2420; 2430; 2432; 2439; 2576; 2604; 2640; 2662; 2710; 2779; 2814; 2824; 2900; 3230; 3674; 3678; 3739; 3797; 3837; 3850; 3895; 3960; 3985; 4136; 4197; 4275; 4373; 4410; 4436; 4439; 4650; 4871; 4875; 5071; 5091; 5103; 5104; 5112; 5113; 5171; 5172; 5236; 5332; 5535; 5597; 5601; 5602; 5610; 5644; 5645; 5663; 5693; 5701; 5852; 6102; 6211; 6230; 6329; 6390; 6425; 6451

176° to 180° C.

121; 134; 166; 291; 294; 603; 648; 695; 731; 749; 841; 978; 1191; 1254; 1290; 1298; 1323; 1385; 1392; 1523; 1626; 1729; 1760; 1847; 2073; 2281; 2296; 2350; 2353; 2420; 2607; 2608; 2686; 2745; 2814; 2816; 2837; 2846; 3203; 3244; 3275; 3305; 3358; 3479; 3595; 3674; 3678; 3827; 3834; 3835; 3841; 3850; 3856; 3920; 3960; 4033; 4091; 4110; 4129; 4136; 4190; 4197; 4376; 4444; 4475; 4632; 4642; 4757; 5001; 5332; 5336; 5390; 5470; 5663; 5716; 5920; 5984; 6050; 6102; 6170; 6179; 6227; 6312; 6423

181° to 185° C.

1; 21; 124; 125; 143; 240; 261; 290; 349; 509; 548; 603; 631; 731; 732; 746; 850; 932; 941; 1253; 1528; 1575; 1676; 1742; 1842; 1964; 2573; 2629; 2656; 2729; 2743; 2766; 2840; 3239; 3261; 3358; 3502; 3835; 3873; 3920; 3960; 4069; 4110; 4376; 4406; 4473; 4481; 4607; 4628; 4732; 4741; 4760; 4818; 5072; 5138; 5147; 5157; 5331; 5578; 5663; 5865; 5919; 5920; 6050; 6235; 6320; 6324; 6340; 6423

186° to 190° C.

29; 31; 63; 124; 125; 240; 266; 349; 521; 548; 603; 604; 683; 732; 899; 941; 964; 1198; 1252; 1289; 1536; 1639; 1676; 1700; 1720; 1845; 1847; 1942; 2357; 2413; 2575; 2588; 2612; 2760; 2882; 2910; 3330; 3358; 3375; 3378; 3502; 3564; 3608; 3664; 3710; 3782; 3786; 3881; 3960; 3987; 4038; 4286; 4293; 4406; 4573; 4760; 4818; 4872; 5006; 5057; 5090; 5108; 5307; 5497; 5570; 5587; 5626; 5653; 5663; 5666; 5812; 5842; 5848; 6047; 6048; 6098; 6110; 6137; 6289; 6305; 6311; 6340; 6452

191° to 195° C.

30; 63; 141; 179; 217; 228; 278; 388; 521; 586; 595; 603; 638; 752; 849; 851; 859; 1196; 1384; 1485; 1487; 1495; 1532; 1700; 1797; 1847; 2020; 2021; 2082; 2124; 2301; 2316; 2335; 2363; 2503; 2528; 2598; 2634; 2643; 2655; 2744; 2815; 2917; 2947; 3249; 3378; 3583; 3710; 3724; 3782; 3788; 3823; 3960; 3989; 4249; 4297; 4485; 4577; 4818; 4826; 4892; 5005; 5199; 5274; 5307; 5490; 5495; 5522; 5583; 5664; 5668; 5685; 5692; 5830; 5842; 5851; 5854; 6048; 6321; 6368; 6395; 6452

196° to 200° C.

71; 160; 228; 276; 357; 388; 520; 562; 603; 638; 734; 1182; 1196; 1370; 1582; 1702; 1830; 1849; 2299; 2316; 2317; 2319; 2327; 2335; 2528; 2621; 2634; 2657; 2917; 2982; 3126; 3226; 3371; 3490; 3588; 3677; 3696; 3747; 3820; 3861; 3904; 3919; 3960; 4249; 4278; 4644; 4651; 4708; 4933; 5069; 5070; 5243; 5307; 5572; 5608; 5614; 5687; 5699; 5736; 5842; 5851; 5899; 5907; 6395

201° to 205° C.

33; 71; 279; 280; 284; 336; 388; 546; 577; 603; 605; 610; 706; 900; 1197; 1492; 1509; 1521; 1944; 1963; 2299; 2315; 2335; 2402; 2453; 2609; 2611; 2865; 3253; 3373; 3499; 3676; 3686; 3730; 3745; 3747; 3789; 3803; 3821; 3911; 3919; 3923; 3947; 4243; 4484; 4604; 4612; 4644; 4662; 4708; 5039; 5193; 5243; 5273; 5307; 5571; 5604; 5608; 5670; 5686; 5690; 5713; 5736; 5757; 5855; 5858; 5907; 6127; 6141; 6394

206° to 210° C.

90; 157; 317; 327; 388; 508; 541; 549; 630; 651; 701; 706; 860; 1308; 1317; 1492; 1517; 1521; 1531; 1533; 1703; 1805; 1940; 1941; 1948; 2080; 2295; 2328; 2334; 2335; 2447; 2556; 2663; 2887; 3780; 3826; 3838; 3840; 3925; 4128; 4438; 4608; 4649; 4660; 4877; 5016; 5075; 5097; 5307; 5487; 5511; 5690; 5717; 5860; 6054; 6081; 6082; 6219; 6220; 6295; 6319; 6417

211° to 215° C.

157; 388; 549; 594; 611; 630; 666; 681; 706; 778; 1315; 1394; 1517; 1521; 1548; 1686; 1948; 1987; 2279; 2282; 2335; 2401; 2522; 2626; 2661; 2663; 2705; 2981; 3238; 3373; 3476; 3492; 3584; 3746; 3784; 3819; 3935; 4438; 4590; 4649; 4774; 4816; 4825; 5075; 5307; 5487; 5600; 5802; 5860; 6082; 6219; 6260; 6295; 6322; 6366

216° to 220° C.

119; 123; 275; 351; 375; 393; 538; 549; 647; 681; 684; 1521; 1541; 1549; 1585; 1819; 1951; 2337; 2356; 2497; 2522; 2625; 2638; 2663; 2690; 2848; 2981; 3309; 3476; 3584; 3592; 3679; 3684; 3746; 3783; 4360; 4578; 4590; 4825; 5162; 5195; 5234; 5281; 5307; 5321; 5335; 5473; 5487; 5504; 5562; 5712; 5802; 5813; 5846; 5849; 5893; 5996; 6082; 6219; 6221; 6231; 6260; 6295; 6303

221° to 225° C.

232; 263; 358; 576; 681; 707; 1200; 1521; 1778; 1803; 2294; 2542; 2545; 2618; 2625; 2687; 2885; 2887; 2900; 3237; 3372; 3672; 3679; 3684; 3697; 3822; 3852; 3988; 4005; 4035; 4112; 4179; 4812; 4819; 5017; 5051; 5122; 5289; 5335; 5487; 5492; 5579; 5712; 5813; 5846; 5861; 5889; 5893; 5933; 6061; 6106; 6208; 6231; 6236; 6369; 6445

226° to 230° C.

152; 348; 576; 588; 671; 681; 707; 847; 853; 1250; 1521; 1704; 1731; 1840; 2110; 2305; 2383; 2394; 2542; 2543; 2545; 2618; 2687; 2688; 2765; 3237; 3489; 3559; 3563; 3720; 3817; 3852; 3959; 4005; 4106; 4627; 4629; 4754; 4755; 4758; 4812; 4878; 5051; 5306; 5327; 5492; 5500; 5508; 5579; 5612; 5889; 5893; 5932; 5933; 5952; 5998; 6083; 6231; 6267; 6369

231° to 235° C.

32; 167; 181; 374; 515; 576; 588; 681; 700; 707; 853; 1250; 1496; 1506; 1608; 1704; 1804; 1810; 1818; 2305; 2383; 2394; 2622; 3205; 3437; 3563; 3720; 3726; 3779; 3817; 3818; 3824; 3852; 3990; 4035; 4039; 4368; 4411; 4648; 4754; 4999; 5052; 5109; 5150; 5274; 5330; 5488; 5528; 5645; 5742; 5821; 5826; 5887; 5947; 6083; 6087; 6099; 6223; 6318

MELTING POINTS OF ORGANIC COMPOUNDS

236° to 240° C.

32; 98; 181; 543; 575; 600; 618; 671; 680; 681; 700; 1250; 1496; 1704; 1708; 1804; 2320; 2333; 2437; 2441; 2490; 2599; 2734; 2759; 3227; 3437; 3443; 3668; 3779; 3800; 3824; 3852; 3922; 3924; 3990; 4050; 4260; 4609; 4666; 4860; 5197; 5287; 5329; 5499; 5528; 5545; 5672; 5742; 6239

241° to 245° C.

98; 129; 168; 234; 539; 618; 621; 680; 1231; 1329; 1675; 1697; 1809; 1832; 1881; 2333; 2437; 2455; 2490; 2706; 2764; 3668; 3670; 3689; 3800; 3804; 3965; 4045; 4142; 4391; 4459; 4599; 4666; 4707; 5036; 5197; 5507; 5529; 5545; 5623; 5656; 5696; 5941; 6000

246° to 250° C.

6; 126; 165; 173; 234; 616; 621; 670; 680; 747; 875; 1780; 1881; 2077; 2262; 2333; 2437; 2454; 2490; 2764; 3309; 3325; 3498; 3560; 3668; 3671; 3689; 3980; 4019; 4101; 4117; 4743; 4761; 4879; 5010; 5337; 5491; 5498; 5506; 5529; 5611; 5613; 5934; 5941; 6181

251° to 260° C.

127; 244; 335; 356; 539; 589; 641; 848; 908; 1251; 1493; 1522; 1540; 1602; 1603; 1627; 1628; 1705; 1780; 1878; 1939; 1943; 2077; 2333; 2351; 2362; 2437; 2691; 2847; 2874; 2884; 2886; 2888; 2903; 3252; 3254; 3325; 3374; 3560; 3671; 3781; 3791; 3888; 4019; 4037; 4101; 4117; 4405; 4497; 4498; 4652; 4794; 4821; 4932; 5066; 5264; 5337; 5501; 5531; 5589; 5665; 5667; 5678; 5745; 5811; 5856; 5876; 5934; 6182; 6213; 6364

261° to 270° C.

174; 355; 376; 589; 682; 1478; 1690; 1692; 1777; 1808; 1946; 2122; 2293; 2298; 2343; 2362; 2437; 2451; 2452; 2594; 2597; 2654; 2849; 2851; 2891; 2898; 2903; 3315; 3785; 3808; 3809; 3816; 3882; 3888; 4141; 4412; 4460; 4544; 4605; 4606; 4770; 4822; 5121; 5494; 5509; 5514; 5531; 5724; 6209; 6327

271° to 280° C.

109; 174; 286; 287; 355; 359; 376; 525; 540; 582; 589; 590; 748; 1494; 2300; 2343; 2361; 2395; 2614; 2883; 2888; 2898; 2902; 3439; 3591; 3690; 3828; 3978; 4118; 4412; 4474; 4478; 4606; 5148; 5149; 5316; 5489; 5537; 5673; 5722; 5724; 5725; 5801; 5866; 6249; 6398

281° to 290° C.

109; 164; 277; 352; 355; 359; 519; 525; 540; 550; 552; 589; 667; 1555; 1807; 1839; 1947; 2297; 2302; 2491; 2664; 2883; 2890; 2902; 2932; 3314; 3669; 3801; 3806; 3937; 4062; 4600; 4709; 5149; 5163; 5198; 5530; 5563; 5722; 5746; 5806; 5859; 5864; 5866; 6365; 6397; 6398

291° to 300° C.

139; 158; 159; 282; 285; 354; 359; 387; 391; 525; 551; 669; 690; 772; 846; 979; 1539; 1838; 1967; 2336; 2384; 2585; 2664; 2724; 2854; 2890; 2966; 3250; 3586; 4443; 5049; 5475; 5726; 6367; 6397

301° to 310° C.

139; 176; 241; 245; 283; 350; 354; 394; 593; 709; 730; 1677; 1694; 1820; 1838; 2644; 2817; 2854; 3586; 3725; 3792; 3805; 4931; 5556; 5573; 5744; 6212

311° to 320° C.

392; 395; 617; 709; 1691; 1693; 1694; 2596; 2854; 3561; 5496; 5669; 5680; 5807; 5816; 6367

321° to 330° C.

602; 1671; 1693; 1695; 2306; 2722; 2854; 4413; 5502; 5816; 6205

331° to 340° C.

601; 602; 1629; 1671; 1695; 2303; 2304; 2595; 2854; 3589; 3807; 6383

341° to 360° C.

145; 601; 779; 2689; 2854; 3589; 4335; 5276; 5956

361° to 380° C.

685; 1594; 4417; 4418; 4562; 5299; 5800; 5805; 6214; 6215; 6362

Above 380° C.

676; 3857; 5009; 6384

PHYSICAL CONSTANTS OF

See also special tables on FOODS, FATS AND OILS, ALKALOIDS, GLUCOSIDES, RESINS, NOMENCLATURE, ORGANIC RADICALS, COMMON OR TRADE NAMES OF CHEMICALS, and DYESTUFF INTERMEDIATES.

Names of the compounds in the table below are arranged alphabetically. The names were selected in such a manner as to bring isomers and closely related compounds in close sequence to enable a convenient means of comparison. In general, names with prefixes such as *iso* or *tertiary* are placed with the normal compounds; thus, *isopropyl* will be found listed under *propyl*. Indented words are suffixes of the word in bold face type immediately preceding; thus, compound No. 8 is acetaldehyde ammonia. No compound is listed more than once in the table and each compound is given a number.

Synonyms are listed in two ways. In the column headed "Synonym" will be found a different name for the same compound. At the bottom of each page is an alphabetical listing for compounds which are to be found in the main body of the table but under a different name; the number following the name refers to the numerical place of this compound in the table; thus, *acetaldazine* 9 indicates that this compound is the 9th compound in the table where it will be found listed under the name *acetaldehyde azine*. Alkaloids which are listed in another table are indicated by *alkd.*; thus, *quinine, cf. alkd.*, means that this compound does not appear in the table below but will be found in a special table of alkaloids. Similarly, glucosides are indicated by *glcde.*; thus, *absinthin, cf. glcde.* indicates that the compound is listed in the table of glucosides.

Formulas are presented in a semi-structural form. To indicate the position of substituents on aromatic rings, position numbers are given in the same sequence as they appear in the formula; thus, in the formula "$HO{\cdot}C_6H_3(CHO){\cdot}CO_2H$ (2;5,1)", the CO_2H group is at position 1, the CHO at 5 and the OH at 2.

Beil. Ref. In the column so headed will be found the reference to the volume and page numbers of the 4th edition of Beilstein: *Handbuch der Organischen Chemie* (published by Springer, Berlin). Where the Roman numeral, which indicates the volume number, is preceded by an asterisk, reference is made to the first supplementary volumes. Thus, "*I-23", indicates that the compound will be found listed in the supplement to volume 1 and on page 23.

Formula Weights are based upon the International Atomic Weights of 1941 and are computed to the nearest hundredth.

Crystalline Form and Color. In addition to the crystalline form and color, the solvent used in purification is often given; thus, "rhb./al." indicates that rhombic

Abbreviations used in the table

a., acid
abs., absolute
ac., acetic acid
Ac, acetyl (i. e. CH_3CO)
act., acetone
al., ethyl alcohol
alk., alkali (i. e. aqueous NaOH or KOH)
alkd., an alkaloid; see alkaloids
Am, amyl (i. e. C_5H_{11})
amor., amorphous
anh., anhydrous
anhyd., anhydride
art., artificial
atm., atmosphere
aq., aqueous; water
Beil. Ref., reference to 4th ed. Beilstein
b., blue
bl., black
b. p., boiling point
brn., brown
bz., benzene, C_6H_6
c., cold
carb., carbonate
chl., chloroform, $CHCl_3$
col., colorless or white
conc., concentrated
cr., crystals or crystalline
d, dextro-rotatory
d., decomposes or decomposed
delq., deliquescent
dil., dilute
diss., dissociates
dl, inactive (i. e. 50% *d* and 50% *l*)
eff., effloresces
et., ether ($C_2H_5OC_2H_5$)
Et, ethyl (C_2H_5)
expl., explodes
fl., flakes
gly., glycerol
gn., green
gr., gray
h., hot
hex., hexagonal
hyg., hygroscopic
i., insoluble

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1	**Abietic acid**	sylvic acid	$C_{20}H_{30}O_2$	.....	302.44
2	**Acenaphthene**	naphthylene ethylene	$C_{10}H_6(CH_2)_2$	V-586	154.20
3	**Acenaphthylene**	.....	$C_{12}H_8$	V-625	152.18

Abalyn 4084
Abasin 84
Abietin, cf. glcde.
Abrastol 4506

ORGANIC COMPOUNDS

crystals were obtained when the compound was crystallized from alcohol. Where no color is stated it may generally be inferred that the material is colorless.

Specific Gravity values are given at room temperatures (15 to 20°C.) unless otherwise indicated by the small figures which follow the value; thus, "1.069^{25}_{25}°" indicates a specific gravity of 1.069 for the substance at 95°C. referred to water at 95°C. Specific gravity of gases with the notation "(A)" or "(D)" indicate the density of the gas referred to (A) air = 1 or (D) hydrogen = 1 respectively. See also special tables.

Melting Point is recorded in a certain case as "82 d." and in some other case as "d. 82", the distinction being made in this manner to indicate that the former is a melting point with decomposition at 82°C., while in the latter decomposition only occurs at 82°C. Where a value such as "$-2H_2O$, 82" is given it indicates loss of two moles of water per formula weight of the compound at a temperature of 82°C.

Boiling Point is given at atmospheric pressure (760 mm of mercury) unless otherwise indicated; thus, "82^{15mm}" indicates the boiling point is 82°C. when the pressure is 15 mm.

Solubility is given in parts by weight (of the formula shown at the extreme left) per 100 parts by weight of the solvent; the small exponent indicates the temperature in degrees C. In the case of gases the solubility is often expressed in some manner as "$5^{10°}$ cc." which indicates that at 10°C., 5 cc. of the gas are soluble in 100 grams of the solvent.

References. The information given in the table has been collected mainly from the following sources:—

Beilstein: *Handbuch der Organischen Chemie*, 4th edition, Published by Springer, Berlin.

The Merck Index, 5th edition, Published by Merck and Co., Inc., Rahway, N. J.

Heilbron: *Dictionary of Organic Compounds*. Published by Oxford Press, New York.

Tables Annuelles Internationales de Constants et Donnes Numeriques. Published by McGraw-Hill Book Co., New York.

International Critical Tables, Vol. 1. Published by McGraw-Hill Book Co., New York.

Seidell: *Solubilities of Inorganic and Organic Compounds*. Published by Van Nostrand and Co., New York.

ign., ignites
K_2CO_3, aqueous potassium carbonate
l, levo-rotatory
lf., leaves or leaflets
lg., ligroin
lq., liquid
lt., light
m, meta position
Me, methyl (CH_3)
Me al., methyl alcohol
met., metallic
mn., monoclinic
m. p., melting point
n, normal
NaOAc, aqueous sodium acetate
nd., needles
o, ortho position
or., orange
p, para position
pa., pale
pd., powder
pet., petroleum ether
Ph, phenyl (C_6H_5)
pl., plates
pr., prisms
pyr., pyridine
r., red
rhb., rhombic
s., soluble
sc., scales
sec, secondary
silv., silvery
sl., slight or slightly
soln., solution
subl., sublimes
sym, symmetrical
syr., syrup
tert, tertiary
tet., tetragonal
tri., triclinic
trig., trigonal
uns, unsymmetrical
v., very
vl., violet
v. s., very soluble
v. sl. s., very slightly soluble
vac., vacuo or vacuum
wh., white
yel., yellow
∞, soluble in all proportions; i. e., miscible
>, greater than
<, less than
42±, about or near to 42
$-3H_2O$, 100, loses 3 molecules of water at 100° C.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1	lf.	.....	182	.....	i.	v. s.	v. s.
2	rhb./al.	$1.069^{25°}_{25°}$	95	278-9	i.	s. h.	s. chl.
3	rhb.	$0.899^{19°}_{4}$	92-3	265-75(sl.d.)	i.	v. s.	v. s.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4	**Acetal**	acetaldehyde-diethylacetal	$CH_3{\cdot}CH(OC_2H_5)_2$	I-603	118.17
5	**Acetaldehyde**	ethanal	$CH_3{\cdot}CHO$	I-594	44.05
6	**Acetaldehyde,** meta-	metaldehyde	$(C_2H_4O)_4$	I-602	176.21
7	**Acetaldehyde,** par-	paraldehyde	$(C_2H_4O)_3$	XIX-385	132.16
8	ammonia	.....	$CH_3{\cdot}CH(OH){\cdot}NH_2$	.....	61.08
9	azine	acetaldazine	$CH_3CH{:}N{\cdot}N{:}CHCH_3$	I-609	84.12
10	oxime	acetaldoxime	$CH_3CH{:}NOH$	I-608	59.07
11	phenylhydrazone	.....	$C_6H_5NHN{:}CHCH_3$	XV-127	134.18
12	semicarbazone	.....	$CH_3CH{:}NNHCONH_2$	III-101	101.11
13	sodium bisulfite	.....	$CH_3CHO{\cdot}NaHSO_3{\cdot}\frac{1}{2}H_2O$	I-605	157.13
14	**Acetamide**	ethanamide	$CH_3{\cdot}CO{\cdot}NH_2$	II-175	59.07
15	**Acetamidine**	.....	$CH_3{\cdot}C(NH)NH_2$	II-185	58.08
16	hydrochloride	.....	$CH_3{\cdot}C(NH)NH_2{\cdot}HCl$	II-185	94.55
17	**Acet**-anilide	antifebrin	$C_6H_5NH{\cdot}COCH_3$	XII-237	135.16
18	anisidide (*o*)	acetyl-*o*-anisidine	$CH_3O{\cdot}C_6H_4NH{\cdot}COCH_3$	XIII-371	165.19
19	anisidide (*m*)	acetyl-*m*-anisidine	$CH_3O{\cdot}C_6H_4NH{\cdot}COCH_3$	XIII-416	165.19
20	anisidide (*p*)	methacetin; *p*-methoxy-acetanilide	$CH_3O{\cdot}C_6H_4NH{\cdot}COCH_3$	XIII-461	165.19
21	metanilic acid (Na)	.....	$CH_3CO{\cdot}NH{\cdot}C_6H_4{\cdot}SO_3Na{\cdot}2H_2O$ (1,3)	XIV-691	273.24
22	methyl-α-naphthylamide	.....	$CH_3CO{\cdot}(CH_3)N{\cdot}C_{10}H_7$	XII-1231	199.24
23	*o*-phenetidide	*o*-ethoxyacetanilide	$CH_3CONH{\cdot}C_6H_4{\cdot}OC_2H_5$	XIII-371	179.21
24	*m*-phenetidide	acetyl-*m*-phenetidine	$CH_3CONH{\cdot}C_6H_4{\cdot}OC_2H_5$	XIII-416	179.21
25	*p*-phenetidide	phenacetin	$CH_3CONH{\cdot}C_6H_4{\cdot}OC_2H_5$	XIII-461	179.21
26	toluidide (*o*)	*N*-tolylacetamide	$CH_3C_6H_4NH{\cdot}COCH_3$	XII-792	149.19
27	toluidide (*m*)	*N*-tolylacetamide	$CH_3C_6H_4NH{\cdot}COCH_3$	XII-860	149.19
28	toluidide (*p*)	*N*-tolylacetamide	$CH_3C_6H_4NH{\cdot}COCH_3$	XII-920	149.19
29	**Acetamino**-ethyl-salicylic acid (5;2,1)	benzacetin	$CH_3CONH{\cdot}C_6H_3{\cdot}(OC_2H_5)CO_2H$	XIV-583	223.22
30	fluorene(2)	.....	$C_{13}H_9NH{\cdot}COCH_3$	XII-1331	223.26
31	α-naphthol (4,1)	naphthacetol	$CH_3CO{\cdot}NH{\cdot}C_{10}H_6OH$	XIII-669	201.22
32	β-naphthol (1,2)	.....	$CH_3CO{\cdot}NH{\cdot}C_{10}H_6OH$	XIII-679	201.22
33	phenol (*o*)	*o*-hydroxyacetanilide	$CH_3CONHC_6H_4OH$	XIII-370	151.16
34	phenol (*m*)	acetyl-aminophenol	$CH_3CONHC_6H_4OH$	XIII-415	151.16
35	phenol (*p*)	.....	$CH_3CONHC_6H_4OH$	XIII-460	151.16
36	**Acetic** acid	ethanoic acid	$CH_3{\cdot}COOH$	II-96	60.05
37	anhydride	.....	$(CH_3CO)_2O$	II-166	102.09
38	**Acetoacetic** acid	acetyl acetic acid	$CH_3CO{\cdot}CH_2CO_2H$	III-630	102.09
39	β-anil	Et β-anilinocrotonate	$CH_3C(:NC_6H_5){\cdot}CH_2{\cdot}CO_2C_2H_5$	XII-518	205.25

Acetaldazine 9
Acetaldehyde-cyanohydrin 3944
Acetaldehyde-ethylene-acetal 3207
Acetaldol 169
Acetaldoxime 10
Acetarsone 128
Acet-bromamide 879
Acet-dibromamide 1794
Acet-dimethylamide 2416

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4	lq.	$0.821^{22°}_{4°}$	.....	102.2	$6^{25°}$	∞	∞
5	col. lq.	$0.783^{18°}_{4°}$	−123.5	20.2	∞	∞	∞
6	nd.	.....	246.2*	.....	i.; s. chl.	2 h.; s. bz.	$0.5^{35°}$; v. sl. s. h.
7	col. cr.	$0.994^{20°}_{4°}$	10.5-12	124. 4^{752mm}	$12^{13°}$ $6^{100°}$	∞; ∞ chl.	∞
8	col. cr.	.....	97	100-10(sl.d.)	v. s.	v. s.	sl. s.
9	lq.	$0.832^{17°}$	.....	95-6	.....	.....	.....
10	nd. or lq.	$0.965^{20°}_{4°}$	47(13)	114-5	s.	∞	∞
11	col. nd.	.....	(α)98-101 (β)57	$236-7^{20mm}$ $133-6^{20mm}$	.....	.....	s. pet.
12	nd. / aq. or al.	.....	162-3	.....	$3^{17°}$	s.	.....
13	col. nd.	.....	.....	.....	s.; d. a.	i.	i.
14	col. cr.	1.159	81(69.4)	222	s.	s.	v. sl. s.
15	in aq. soln.	.....	.....	.....	d. h.	.....	.....
16	col. cr.	.....	166-7	.....	s.	v. s.	i.
17	rhb./al.	$1.21^{4°}$	113-4	305	$0.53^{6°}$; $3.5^{80°}$	$21^{20°}$; $46^{60°}$	$7^{25°}$
18	cr./aq.	.....	87-8	303-5	v. s. h.	$55.3^{21°}$	v. s. ac.
19	cr./aq.	.....	80-1	.....	.....	$80^{21°}$	.....
20	pl./aq.	.....	127	.....	$0.2^{15°}$; $8^{100°}$	$12.7^{21°}$; s. act.	s. chl.; s. dil. alk.
21	nd./aq.	.....	184-5	.....	v. s. h.	v. sl. s.	i.
22	pr./aq.	.....	94-5	.....	v. sl. s.	s.	s.
23	lf./aq. al.	.....	79	>250	i.	s.	.....
24	lf./aq.	.....	96-7	.....	sl. s.	s.	.....
25	col. mn.	.....	134-5	d.	$0.7^{20°}$	7.4 c.; 40 h.	$1.6^{25°}$; s. gly.
26	rhb.	$1.168^{15°}$	110	296	$0.86^{19°}$	s.; s. bz.	s.; s. chl.
27	mn./aq.	$1.141^{15°}$	65.5	303	$0.44^{13°}$	v. s.	v. s.
28	rhb. or mn.	$1.212^{15°}$	153	306-7	$0.09^{22°}$	$10.2^{25°}$ abs.	s.; i. lg.
29	col. nd. aq.	.....	189-90	.....	sl. s.	s.	.....
30	cr./50% ac.	.....	191	.....	.....	.....	.....
31	nd./al.	.....	187	.....	s. h.	s; s. NH_4OH	s. Na_2CO_3
32	lf./aq. al.	.....	235.5	subl. sl. d.	v. s. aq. NaOH	s; s. bz.	s.; s. h. ac.
33	lf./aq. al.	.....	203	.....	s. h.	s.	s. KOH
34	nd./aq.	.....	148-9	.....	s.	s.; sl. s. chl.	sl. s.; sl. s. bz.
35	mn./al.	$1.293^{21°}$	168-9	.....	v. s. h.	v. s.	sl. s.
36	col. lq.	$1.049^{20°}_{4°}$	16.7	118.1	∞	∞	∞
37	col. lq.	$1.082^{20°}_{4°}$	−73	139.6	12 c.; d. h.	∞; d. h.	∞
38	col. oil	.....	.....	d. <100	∞	∞	s.
39	oil	.....	.....	d. 240	i.	s.	s.

* In sealed tube; subl. 112-6; partly depolymerized.

Acet-methylamide 4085
Acet-oxime 61
Acet-phenetidide 23-5
Acetamino-, cf. also acetylamino.
Acetic ester 2935
Acetic ether 2935
Acetin 3382
Aceto-acetic ester 2937

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
40	**Acetoacetic** anilide	acetoacetanilide	$CH_3COCH_2CONH\cdot C_6H_5$	XII-518	177.20
41	2-chloroanilide	*o*-chloroaceto-acetanilide	$CH_3CO\cdot CH_2CO\cdot NH\cdot C_6H_4Cl$	*XII-300	211.65
42	2,5-dichloroanilide	.....	$CH_3CO\cdot CH_2CO\cdot NH\cdot C_6H_3Cl_2$	.....	246.09
43	**Acetoin**	methylacetyl carbinol	$CH_3CHOH\cdot CO\cdot CH_3$	I-827	88.10
44	**Aceto**-chloroglucose	tetraacetyl-α-glucosyl chloride	$Cl\cdot CH(CHO_2CCH_3)_3\cdot CH\cdot(CH_2O_2CCH_3)\cdot O$	.....	366.75
45	dichlorohydrin	dichloropropyl acetate (β,γ)	$CH_3CO_2CH_2CHCl\cdot CH_2Cl$	II-129	171.03
46	naphthalide (α)	acetyl naphthylamine	$C_{10}H_7NH\cdot COCH_3$	XII-1230	185.22
47	naphthalide (β)	.....	$C_{10}H_7NH\cdot COCH_3$	XII-1284	185.22
48	naphthol (1,2)	hydroxy-aceto-naphthone	$HO\cdot C_{10}H_6\cdot COCH_3$	VIII-149	186.20
49	nitrile	methyl cyanide	$CH_3\cdot CN$	II-183	41.05
50	phenine	.....	$C_{23}H_{17}N$	.....	307.37
51	phenone	methyl-phenyl ketone	$CH_3\cdot CO\cdot C_6H_5$	VII-271	120.14
52	phenone acetone	phenacyl acetone	$C_6H_5\cdot CO\cdot C_2H_4\cdot COCH_3$	VII-687	176.21
53	phenone oxime	.....	$C_6H_5(CH_3)C{:}NOH$	VII-278	135.16
54	phenone phenyl-hydrazone	.....	$C_6H_5NH\cdot N{:}C(CH_3)\cdot C_6H_5$	XV-139	210.27
55	**Acetol**	acetyl carbinol	$CH_3CO\cdot CH_2OH$	I-821	74.08
56	**Acetone**	propanone	$CH_3\cdot CO\cdot CH_3$	I-635	58.08
57	cyanohydrin	.....	$(CH_3)_2C(OH)\cdot CN$	III-316	85.10
58	diacetic acid	.....	$CO{:}(C_2H_4\cdot CO_2H)_2$	III-804	174.15
59	dicarboxylic acid	β-ketoglutaric acid	$CO{:}(CH_2CO_2H)_2$	III-789	146.10
60	glucose, mono	glucose diMe-ketal	$(CH_3)_2C{:}(HCO)_2\cdot(CHOH)_2\cdot CH\cdot(CH_2OH)\cdot O$	.....	220.22
61	oxime	acetoxime	$(CH_3)_2C{:}NOH$	I-649	73.09
62	phenylhydrazone	.....	$C_6H_5NH\cdot N{:}C(CH_3)_2$	XV-129	148.20
63	semicarbazone	.....	$(CH_3)_2C{:}N\cdot NH\cdot CONH_2$	III-101	115.14
64	sodium bisulfite	.....	$(CH_3)_2CO\cdot NaHSO_3$	I-649	162.14
65	**Acetonyl** acetone	.....	$(CH_3\cdot CO\cdot CH_2)_2$	I-788	114.14
66	urea	dimethyl hydantoin	$(CH_3)_2{:}CNHCONHCO$	XXIV-289	128.13
67	**Acetoxy acetone**	acetol acetate	$CH_3CO_2CH_2COCH_3$	II-155	116.11
68	**Acetyl**-acetone	diacetylmethane	$(CH_3CO)_2CH_2$	I-777	100.11
69	benzoic acid (*o*)	acetophenone carboxylic acid	$CH_3CO\cdot C_6H_4\cdot CO_2H$	X-690	164.15
70	benzoic acid (*m*)	.....	$CH_3CO\cdot C_6H_4\cdot CO_2H$	X-694	164.15
71	benzoic acid (*p*)	.....	$CH_3CO\cdot C_6H_4\cdot CO_2H$	X-694	164.15
72	benzoyl	Me-Ph-diketone	$CH_3CO\cdot CO\cdot C_6H_5$	VII-677	148.15

Aceto-acetanilide 40
Aceto-aniside 18-20
Aceto-anisole 5132
Aceto-chloramide 1295
Aceto-cymene 4181
Aceto-mesitylene 6247
Aceto-naphthone 4313
Aceto-phen 115
Aceto-phenone alcohol 754
Aceto-phenone carboxylic acid 69-71
Aceto-propionic acid 3967
Aceto-pyrine 566
Aceto-sal(in) 115
Aceto-thioamide 5882
Aceto-vanillone 3776

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
40	lf.	.....	85	.....	sl. s.; s. alk.	s.	s.; s. h. bz.
41	col. nd.	.....	105	.....	i.	s.	i.; i. lg.
42	col. nd.	.....	94-5	.....	i.	sl. s.	i.
43	lq.	$1.011^{\frac{\circ}{15}}_{15}$	15	148	∞	v. s.	sl. s.; i. lg.
44	col. mn. nd./et.-lg.	.....	70-1 (d.)	.....	d. h.; i. pet.	s.; s. act.	s.; s. CCl_4
45	col. lq.	$1.168^{15°}$	.....	191-2^{755mm}	.....	.....	.....
46	cr./al.	.....	159-60	.....	s. h.	$4^{25°}$	.....
47	lf./al.	.....	134	.....	s. h.	s. h.	.....
48	yel. nd./lg.	.....	103(98)	325(sl. d.)	i.; v. s. bz.	v. sl. s. c.	s. ac.; s. CS_2
49	col. lq.	$0.783^{20°}_{4}$	−41	81.6-2.0	∞	∞	∞
50	nd./al.	.....	135	.....	.....	s.	.....
51	cr. lf.	$1.033^{\frac{15°}{15}}$	20.5	202.3^{749mm}	i.	s.	s.
52	yel. oil	>1	.....	162^{12}(sl. d.)	sl. s.	.....	i. alk.
53	nd./aq.	.....	59	d.	.....	v. s.	v. s.
54	col. nd.	.....	105-6	.....	sl. s.	sl. s. c.	s.
55	col. lq.	$1.082^{20°}_{20}$	−17	145-6	∞	∞	∞
56	col. lq.	$0.792^{20°}_{4}$	−94.6	56.5	∞	∞	∞
57	col. lq.	$0.932^{19°}$	−19	82^{23mm}	v. s.	v. s.	v. s.; v. sl. s. pet.
58	rhb./aq.	.....	142-3	.....	s. h.	s.	sl. s.; i. bz.
59	nd./et.	.....	135 d.	.....	v. s.	v. s.	sl. s.; i. bz.
60	col. mn. nd./aq.	.....	162	.....	s.	s.; s. h. EtOAc	i.
61	pr.	$0.973^{20°}_{20}$	60-1	136.3	v. s.	v. s.	v. s.; s. lg.
62	oil	.....	26.6	163^{50mm}	s. c. dil. a.	.....	.....
63	nd./aq.	.....	190-1(d.)	.....	s. c.	sl. s. c.	i.
64	col. lf.	.....	.....	.....	s.; d. a.	sl. s.	i.
65	col. lq.	$0.974^{20°}_{4}$	−9	194^{754mm}	∞; i. KOH	∞	∞
66	tri. pr./al.	.....	175	subl.	s.	s.	s.
67	col. oil	$1.075^{20°}_{4}$	.....	174-5	v. s.	v. s.	v. s.
68	lq.	$0.976^{20°}_{4}$	−23.2(−9)	139^{746mm}	12.5	∞	∞; ∞ chl.
69	cr./aq.	.....	114-5	.....	s. h.	.....	.....
70	nd./aq.	.....	172	.....	s. h.	s.; sl. s. chl.	s.; sl. s. bz.
71	nd./h. aq.	.....	200-5(d.)	.....	s. h.	sl. s.	sl. s.; i. lg.
72	yel. oil	$1.101^{20°}_{4}$	.....	216-8	$0.3^{20°}$	.....	.....

Aceto-xylidide 2417-22
Acetozone 73
Acetol acetate 67
Acetol phenyl ether 5132
Acetone azine 3932
Acetone bromoform 6102
Acetone chloride 2053
Acetone chloroform 6145
Acetone chloroform acetate 6144
Acetone diethylsulfone 5683
Acetone oxalic ester 2939
Acetonic acid 3757
Acetonyl-acetophenone 52
Acetonyl-amine 235
Acetonyl anisole 4126

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Acetyl				
73	benzoyl peroxide	acetozone	$C_6H_5CO{\cdot}O_2{\cdot}COCH_3$	IX-179	180.15
74	biuret	.....	$CH_3CO(NHCO)_2NH_2$	III-72	145.12
75	bromide	ethanoyl bromide	$CH_3CO{\cdot}Br$	II-174	122.96
76	5-bromosalicylic acid (2;5,1)	5-bromoaspirin	$CH_3CO_2{\cdot}C_6H_3(Br){\cdot}CO_2H$	X-108	259.06
77	*n*-butylaniline	.....	$CH_3CO{\cdot}N(C_4H_9){\cdot}C_6H_5$	XII-247	191.26
78	caproyl	octandione-2,3	$CH_3(CH_2)_4CO{\cdot}COCH_3$	I-795	142.19
79	caproyl oxime	isonitroso-*n*-amyl-ketone	$C_8H_{15}O_2N$	I-795	157.21
80	carbazole (*N*)	.....	$CH_3CO{\cdot}NC_{12}H_8$	XX-436	209.24
81	chloride	ethanoyl chloride	$CH_3CO{\cdot}Cl$	II-173	78.50
82	choline bromide	pragmoline	$(CH_3)_3N(Br)(CH_2)_2{\cdot}O_2C{\cdot}CH_3$	*IV-428	226.12
83	choline chloride	acecoline	$(CH_3)_3N(Cl)C_2H_4{\cdot}O_2C{\cdot}CH_3$	IV-281	181.66
84	diethylbromo-acetyl-urea (*N,N'*)	abasin; acetylcar-bromal	$(C_2H_5)_2CBr{\cdot}CO{\cdot}NH{\cdot}CO{\cdot}NH{\cdot}COCH_3$	*III-30	279.14
84.1	diphenylamine	*N*-diPh acetamide	$(C_6H_5)_2N{\cdot}COCH_3$	XII-247	211.25
85	disulfide	diacetyl disulfide	$(CH_3CO)_2S_2$	II-232	150.21
86	ethanolamine (*N*)	.....	$HO(CH_2)_2NH{\cdot}COCH_3$	.....	103.12
87	ethylmalonate	.....	$CH_3CO{\cdot}CH{\cdot}(CO_2C_2H_5)_2$	III-796	202.20
88	ethyloxamate	.....	$(CH_3CO)NHC_2O_2{\cdot}OC_2H_5$	II-545	159.14
89	fluoride	ethanoyl fluoride	$CH_3CO{\cdot}F$	II-172	62.04
90	glycine	aceturic acid	$CH_3CO{\cdot}NH{\cdot}CH_2{\cdot}CO_2H$	IV-354	117.10
91	indole (1)(*N*)	.....	$CH_3CO{\cdot}NC_8H_6$	XX-309	159.18
92	iodide	ethanoyl iodide	$CH_3CO{\cdot}I$	II-174	169.96
93	iodosalicylic acid	4-iodoaspirin (2;4,1)	$CH_3CO_2C_6H_3(I)CO_2H$	*X-49	306.07
94	iodosalicylic acid	5-iodoaspirin (2;5,1)	$CH_3CO_2C_6H_3(I)CO_2H$	*X-49	306.07
95	isatin (*N*)	.....	$CH_3CO{\cdot}N(CO)_2C_6H_4$	XXI-447	189.16
96	malic acid	.....	$C_2H_3O_2{\cdot}C_2H_3(CO_2H)_2$	III-429	176.12
97	*o*-methylamino-phenol	.....	$CH_3CO{\cdot}N(CH_3)C_6H_4{\cdot}OH$	XIII-372	165.19
98	*p*-methylamino-phenol	.....	$CH_3CO{\cdot}N(CH_3)C_6H_4{\cdot}OH$	XIII-466	165.19
99	β-methylcholine bromide	mecholyl bromide	$(CH_3)_3N(Br)CH_2{\cdot}CH(CH_3)O_2C{\cdot}CH_3$	.....	240.15
100	β-methylcholine chloride	mecholyl; mecholin	$(CH_3)_3N(Cl)CH_2{\cdot}CH(CH_3)O_2C{\cdot}CH_3$	.....	195.69
101	β-methylcholine iodide	mecholyl iodide	$(CH_3)_3N(I)CH_2{\cdot}CH(CH_3)O_2C{\cdot}CH_3$	.....	287.15
102	methyl-*o*-toluidine	*N*-Me-acet-*o*-toluidide	$CH_3CO{\cdot}N(CH_3)C_6H_4{\cdot}CH_3$	XII-793	163.21
103	methyl-*m*-toluidine	*N*-Me-acet-*m*-toluidide	$CH_3CO{\cdot}N(CH_3)C_6H_4{\cdot}CH_3$	XII-861	163.21
104	methyl-*p*-toluidine	*N*-Me-acet-*p*-toluidide	$CH_3CO{\cdot}N(CH_3)C_6H_4{\cdot}CH_3$	XII-922	163.21
105	nitrate	.....	$CH_3CO_2NO_2$	II-171	105.05
106	peroxide	diacetyl peroxide	$(CH_3CO)_2O_2$	II-170	118.09
107	*p*-phenylenedi-amine	amino-acetanilide (*p*)	$C_2H_3O{\cdot}NHC_6H_4NH_2$	XIII-94	150.18

Acetoxy-acetophenone 5094
Aceturic acid 90
Acetyl, cf. also aceto or acet.
Acetyl-acetic acid 38
Acetyl-anisidine 18-20
Acetyl-anisole 4065
Acetyl-anthranilic acid (*N*) 125
Acetyl-arsanilic acid 577
Acetyl-benzoin 718
Acetyl-benzoylaconine, cf. alkd.
Acetyl-benzylamine 760
Acetyl-carbinol 55

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
73	col. nd./lg.	.....	37-9	130^{19mm}	$0.06^{25°}$ d.	s. oils	s.; s. chl.
74	nd.	.....	107	.....	s. bz.	v. s.	s.
75	col. lq.	$1.663^{\frac{1}{4}6°}$	−96.5	76^{750mm}	d.	d.; ∞ bz.	∞; ∞ chl.
76	cr./al.	.....	168	.....	i.; i. bz.	$16^{25°}$; i. CCl_4	$10^{25°}$
77	lq.	.....	.....	$273-5^{718mm}$	.....	.....	.....
78	lq.	.....	.....	$172-3^{733mm}$	.....	.....	.....
79	cr.	.....	39	139^{16mm}	.....	.....	.....
80	nd./aq.	.....	69	>360 d.	v. sl. s. h.	v. s.	v. s.; s. bz.
81	col. lq.	$1.105^{\frac{20}{4}°}$	−112.0	51-2	d.	d.; ∞ bz.	∞; ∞ chl.
82	hyg. pr./ abs. al.	.....	.....	.....	v. s.; d. h.	s.	i.
83	hyg. col. pr.	.....	.....	.....	v. s.; d. h.	s.	i.
84	col. cr./aq.	.....	108-9	.....	sl. s.	s.	s. EtOAc
84.1	rhb./aq.	.....	103	subl.	sl. s.	s.	sl. s.
85	cr.	.....	20	d.	i.; s. CS_2	v. s.	v. s.
86	col. syr.	.....	.....	.....	sl. s.	s.	s.
87	lq.	$1.083^{\frac{20}{5}°}$	.....	120^{17mm}	s. dil. alk.	.....	.....
88	nd.	.....	54	.....	d. h.	s.	s.
89	lg or gas	$0.993^{20°}$	<−60	20.8^{770mm}	5; d.	∞; ∞ bz.	∞
90	cr./aq.	.....	206	.....	$2.7^{15°}$	s. abs.	i.
91	lq.	$1.071^{0°}$	<−20	239	v. sl. s.	v. s.	v. s.; v. s. bz.
92	col. lq.	$1.98^{17°}$	.....	108	d.	d.	s.
93	col. cr.	.....	156	.....	i.	s.	s.
94	col. cr.	.....	166	.....	i.	s.	s.
95	yel. nd./bz.	.....	141	.....	sl. s. c.; d. h.	s.	d. h. HCl
96	col. cr. pd.	.....	132-9 d.	.....	s.; d. h.	.....	i. bz.
97	nd./MeOH	.....	150	.....	sl. s.	s.	s.
98	sc./aq.	.....	240-1	.....	v. sl. s.	v. s.	s.
99	col. delq. cr.	.....	148-9	.....	v. s.	70	i.; d. alk.
100	col. delq. cr./al.	.....	172-3	.....	v. s.	v. s.	i.; d. alk.
101	col. cr.	.....	138-9	.....	v. s.	75	i.
102	col. cr.	.....	55-6	260	.....	s.	.....
103	col. cr.	.....	66	.....	.....	s.	.....
104	lf./al.-et.	.....	80	283	.....	s.	s. h. lg.
105	col. lq.	$1.24^{15°}$	expl.	22^{70mm}	.....	.....	.....
106	col. cr.	.....	30	$63^{21°}$; expl.	sl. s. c.; d.	.....	.....
107	nd./aq.	.....	162	.....	s. h.	v. s.	v. s.

Acetyl-carbromal 84
Acetyl-cyanide 5527
Acetyl-diethylamine 2100
Acetyl-ethylanilide 2934
Acetyl-formic acid 5525
Acetyl-guaiacol 3481
Acetyl-methylurea 4091
Acetyl-naphthalene 4313
Acetyl-naphthylamine 46-7
Acetyl-phenetidine 23-5
Acetyl-phenol 5141

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Acetyl				
108	*m*-phenylenediamine	aminoacetanilide (*m*)	$C_2H_3O{\cdot}NHC_6H_4NH_2$	XIII-45	150.18
109	*m*-phenylene diamine HCl	.....	$C_2H_3ONHC_6H_4NH_2{\cdot}HCl$	XIII-45	186.64
110	phenylglycine	*N*-Ph-aceturic acid	$C_6H_5N(COCH_3)CH_2{\cdot}CO_2H$	XII-476	193.20
111	phenylhydrazine (*β*)	hydracetin	$CH_3CO{\cdot}NH{\cdot}NHC_6H_5$	XV-241	150.18
112	piperidine	.....	$CH_3CO{\cdot}NC_5H_{10}$	XX-45	127.18
113	pyrrol (*N*)	.....	$CH_3CO{\cdot}NC_4H_4$	XX-165	109.12
114	resorcinol (1,3)	euresol; eurisol	$CH_3CO_2{\cdot}C_6H_4{\cdot}OH$	VI-816	152.14
115	*o*-salicylic acid	aspirin	$CH_3CO_2{\cdot}C_6H_4{\cdot}CO_2H$	X-67	180.15
116	*o*-salicylic acid (Ca)	aspirin soluble	$(C_9H_7O_4)_2Ca{\cdot}2H_2O$	*X-29	434.40
117	*o*-salicylic acid (Li)	litmopyrin	$C_9H_7O_4Li$	X-68	186.09
118	*o*-salicylic acid (Mg)	magnespirin	$(C_9H_7O_4)_2Mg$†	*X-29	382.61
119	*o*-salicylic acid (Na)	hydropyrin	$C_9H_7O_4Na$	X-68	202.14
120	salol	spiroform; vesipyrin	$CH_3CO_2{\cdot}C_6H_4{\cdot}CO_2C_6H_5$	X-79	256.25
121	2-thiohydantoin	.....	$CH_3CO{\cdot}N{\cdot}CH_2{\cdot}$ 	*XXIV-293	158.17
122	thiourea	.....	$CH_3CO{\cdot}NHCSNH_2$	III-191	118.15
123	urea	.....	$CH_3CO{\cdot}NHCONH_2$	III-61	102.09
124	**Acetylamino-** azotoluene	azodermin (4-NH_2; 3,2′-diMe)	$CH_3{\cdot}C_6H_4{\cdot}N{:}N{\cdot}C_6H_3{\cdot}(CH_3){\cdot}NH(COCH_3)$	.....	267.32
125	benzoic acid (*o*)	*N*-acetyl-anthranilic acid	$CH_3CO{\cdot}NH{\cdot}C_6H_4{\cdot}CO_2H$	XIV-337	179.17
126	benzoic acid (*m*)	.....	$CH_3CO{\cdot}NH{\cdot}C_6H_4{\cdot}CO_2H$	XIV-396	179.17
127	benzoic acid (*p*)	acetaminobenzoic acid	$CH_3CO{\cdot}NH{\cdot}C_6H_4{\cdot}CO_2H$	XIV-432	179.17
128	hydroxyphenylarsonic acid (3;4,1)	stovarsol; spirocid	$CH_3CONH{\cdot}C_6H_3(OH){\cdot}AsO_3H_2$	.....	275.08
129	phenylglycine (*p*)	.....	$CH_3CONH{\cdot}C_6H_4{\cdot}CH_2CO_2H$	.....	193.20
130	**Acetylene**	ethyne; ethine	$CH{:}CH$	I-228	26.04
131	dibromide (1,1)	α,α-dibromoethylene	$CH_2{:}CBr_2$	I-190	185.87
132	dibromide (*cis*)	1,2-dibromoethene	$CHBr{:}CHBr$	I-190	185.87
133	dibromide (*trans*)	1,2-dibromoethene	$CHBr{:}CHBr$	I-190	185.87
134	dicarboxylic acid	butynedioic acid	$(C{\cdot}CO_2H)_2$	II-801	114.06
135	dichloride (*cis*)	1,2-dichloroethene	$CHCl{:}CHCl$	I-187	96.95
136	dichloride (*trans*)	dioform	$CHCl{:}CHCl$	I-187	96.95
137	diiodide (*cis*)	1,2-diiodoethene	$CHI{:}CHI$	I-194	279.88
138	diiodide (*trans*)	1,2-diiodoethene	$CHI{:}CHI$	I-194	279.88
139	**urea**	glycoluril	$C_2H_2(CON_2H_2)_2$	XXVI-441	142.12

† Also cr. + $3H_2O$, and + $4H_2O$.

Acetyl-propiophenone 52
Acetyl-propylaniline 5364
Acetyl-resorcinol 5550
Acetyl-thymol 5945

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
108	pl./bz.	.....	softens >70	d. >87	s.; s. act.	s.; sl. s. bz.	s.; i. lg.
109	pl./al.	.....	280±	.....	s.; i. bz.	sl. s.	i.; i. lg.
110	lf./aq.	.....	172-3	.....	v. sl. s.	s.; s. ac.	v. sl. s.
111	pr.	.....	129	.....	s. h.	s.	sl. s.
112	lq.	1.011^{99}	.....	226-7	∞	s.	.....
113	lq.	.....	.....	181-2	i.	.....	d. HCl
114	yel. oil	.....	.....	283 d.	i.; s. alk.	∞; ∞ bz.	∞ chl.
115	col. nd./aq.	.....	135-6	.....	$1^{37°}$	v. sl. s. bz.	$5^{20°}$
116	cr./aq. al.	.....	.....	.....	16	1.4	i.
117	wh. hyg. pd.	.....	.....	.....	100	25	i.
118	wh. pd.	.....	.....	.....	s.	sl. s.	i.
119	cr./act.-et.	.....	218 sl. d.	.....	v. s.	v. s.	sl. s. act.
120	col. cr./ abs. al.	.....	97-8	198^{11mm}	i.	s.	s.
121	cr./al.	.....	175-6	.....	i.	sl. s.	i.
122	pr./aq.	.....	165-6	.....	s. h.	s.	sl. s.
123	nd./al.	.....	218	.....	$2^{15°}$; v. s. h.	10 h.	.....
124	r. nd./al.	.....	185-6	.....	i.	s. chl.	s.; s. oils
125	rhb./ac.	.....	184-6	.....	s. h.	s.	s.; s. bz.
126	nd./al.	.....	248-50	subl.	v. sl. s. h.	s. h.	v. sl. s.
127	nd.	.....	256.5 d.	.....	sl. s.	s.	.....
128	wh. pd.	.....	.....	.....	sl. s.	s. alk.	.....
129	col. fl.	.....	241-2	.....	i.	sl. s.	sl. s.
130	col. gas	lq. $0.613^{-80°}$ s. $0.730^{-85°}$ (A) 0.906	-81.5^{891mm}	-84^{760mm}	100 $cc^{18°}$ cf. special table	600 $cc^{18°}$	2500 $cc^{15°}$ act.; 30,000 cc act. 12 atm.
131	col. lq.	$2.178^{\frac{2}{4}1°}$	.....	$91\text{-}2^{754mm}$	i.	v. s.	v. s.
132	col. lq.	$2.285^{\frac{1}{4}\frac{7}{4}\cdot5°}$	−53	110^{754mm}	i.	v. s.	v. s.
133	col. lq.	$2.267^{\frac{1}{4}\frac{7}{4}\cdot5°}$	−6.5	108	i.	v. s.	v. s.
134	pl./et.	.....	179-80	.....	v. s.	v. s.	v. s.
135	col. lq.	$1.291^{\frac{1}{4}\frac{5}{4}°}$	−80.5	60.3	i.	∞	∞
136	col. lq.	$1.265^{\frac{1}{4}\frac{5}{4}°}$	−50	48.4	i.	∞	∞
137	col. lq.	$3.063^{20°}$	−13.8	188 d.	i.	s.	s.
138	mn. pr.	$3.303^{21°}$	73	192	i.	s.	s.
139	nd./aq.	.....	d. 300±	.....	$0.1^{17°}$; $1.5^{100°}$	i.; s. conc. HCl	>1, h. NH_4OH

Acetyl-toluidine 26-8
Acetylamino-phenol 33-5
Acetylene-tetrabromide 5719
Acetylene-tetrachloride 5739
Acetylidene-o-aminophenol 2908

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
140	**Aconic acid**	.....	$CH_2{\cdot}CO{\cdot}O{\cdot}CH{:}C(CO_2H){\cdot}$	XVIII-395	128.08
141	**Aconitic acid**	equisetic acid; citridic acid	$C_3H_3(CO_2H)_3$	II-849	174.11
142	**Acridine**	.....	$C_6H_4{\cdot}CH{\cdot}C_6H_4N$	XX-459	179.21
143	orange (3,6)	.....	$NC_{13}H_7[N(CH_3)_2]_2$	XXII-487	265.35
144	red (2,7)	.....	$CH_3NH{\cdot}C_{13}H_7O{:}N(Cl)CH_3$	.....	273.74
145	**Acridone**	dihydroketo-acridine	$C_6H_4{\cdot}CO{\cdot}C_6H_4{\cdot}NH$	XXI-335	195.21
146	**Acrolein**	acrylic aldehyde	$CH_2{:}CH{\cdot}CHO$	I-725	56.06
147	**Acrolein** (*meta*)	metacrolein	$(C_3H_4O)_3$	I-727	168.19
148	**Acrylamide**	acrylic amide	$CH_2{:}CH{\cdot}CONH_2$	II-400	71.08
149	**Acrylic** acid	propenoic acid	$CH_2{:}CH{\cdot}CO_2H$	II-397	72.06
150	anhydride	.....	$(CH_2{:}CH{\cdot}CO)_2O$	II-400	126.11
151	nitrile	vinyl cyanide	$CH_2{:}CH{\cdot}CN$	II-400	53.06
152	**Adipamide**	adipic diamide	$(\cdot CH_2CH_2CONH_2)_2$	II-653	144.17
153	**Adipic** acid	hexandioic acid	$(\cdot CH_2CH_2CO_2H)_2$	II-649	146.14
154	**Adipyl** chloride	.....	$(\cdot CH_2CH_2CO{\cdot}Cl)_2$	II-653	183.04
155	dinitrile	tetramethylene dicyanide	$(\cdot CH_2CH_2CN)_2$	II-653	108.14
156	**Adonitol**	adonite	$HOCH_2(CHOH)_3{\cdot}CH_2OH$	I-530	152.15
157	**Adrenaline** (*l*)(3,4,1)	*l*-suprarenine	$C_6H_3(OH)_2(CHOH{\cdot}CH_2NHCH_3)$	XIII-830	183.20
158	**Alanine** (α) (l +)	α-aminopropionic acid	$H_2N{\cdot}CH(CH_3){\cdot}CO_2H$	IV-387	89.09
159	**Alanine** (α) (*dl*)	.....	$H_2N{\cdot}CH(CH_3){\cdot}CO_2H$	IV-387	89.09
160	**Alanine** (β)	β-aminopropionic acid	$H_2N{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2H$	IV-401	89.09
161	**Aldehydin** (2,5)	2-Me-5-Et-pyridine	$(CH_3)C_5H_3N(C_2H_5)$	XX-248	121.18
162	**Aldehydo**-benzoic acid (o)	phthalic aldehyde	$HO_2C{\cdot}C_6H_4{\cdot}CHO$	X-666	150.13
163	benzoic acid (m)	isophthalic aldehyde	$HO_2C{\cdot}C_6H_4{\cdot}CHO$	X-671	150.13
164	benzoic acid (p)	terephthalic aldehyde	$HO_2C{\cdot}C_6H_4{\cdot}CHO$	X-671	150.13
165	o-hydroxybenzoic acid	(2;5,1)	$HO{\cdot}C_6H_3(CHO){\cdot}CO_2H$	X-953	166.13
166	o-hydroxybenzoic acid	(2;3,1)	$HO{\cdot}C_6H_3(CHO){\cdot}CO_2H{\cdot}1H_2O$	X-952	184.14
167	m-hydroxybenzoic acid	(3;4,1)	$HO{\cdot}C_6H_3(CHO){\cdot}CO_2H$	X-954	166.13
168	p-hydroxybenzoic acid	(4;3,1) formyl salicylic acid (5)	$HO{\cdot}C_6H_3(CHO){\cdot}CO_2H$	X-953	166.13
169	**Aldol**	2-hydroxybutyraldehyde	$CH_3{\cdot}CHOH{\cdot}CH_2{\cdot}CHO$	I-824	88.10
170	**Aldol** par-	paraldol	$(C_4H_8O_2)_2$	I-825	176.21
171	**Aleudrin**	α,α'-diCl-*iso*Pr-carbamate	$H_2N{\cdot}CO_2{\cdot}CH(CH_2{\cdot}Cl)_2$	III-29	172.02

Achilleic acid 141
Acid Cβ 4534
Acid F 4510
Acid G 4495-6
Acid H 342
Acid I 337
Acid J 337
Acid L 4503
Acid NW 4502
Acid R 4491
Acid S 339 or 344
Acid Sα 4533
Acid α S 4533
Acid β 559
Acid βC 4534
Acid $\beta\gamma$ 4537
Acid γ 338
Acid δ 4533 or 4553
Acid λ 4544
Acid ρ 553
Acid χ 554
Acid 1:2:4 340
Acid of sugar 5006-7
Acid amido G 4537
Acid amino H 4555
Acid yellow D 4996
Acid yellow S 3241
Acidogen nitrate 6389
Acidol 847; also cf. alkd.
Acidulin 3373
Acocantherin, cf. glcds.
Acoin 1760

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
140	rhb./aq.	.....	164	.....	$18^{15°}$	.....	s.
141	lf. or nd./aq.	.....	192 d.	.....	$33^{15°}$	$50^{12°}$, 88% al.	v. sl. s.
142	rhb./aq. al.	.....	110-1	346	sl. s. h.	s.	s.; s. CS_2
143	yel. nd./aq. al.	.....	181	.....	s.; s. dil. a.	s.; s. act.	v. sl. s. pet.
144	bronze pd.	.....	.....	.....	sl. s.	s.	i.
145	yel. nd./al.	.....	354	.....	i. aq. KOH; s. h. HCl	s. h.; s. h. ac.	i.; i. bz.; i. chl.
146	col. lq.	$0.841^{20°}_{4°}$	-87.7	52.5	40	s.	s.
147	nd.	.....	45-50	sl. diss.	v. sl. s. h.	s.	s.
148	lf./bz.	.....	84-5	.....	v. s.	v. s.	v. s.
149	col. lq.	$1.062^{\frac{16}{4}°}$	12.3-13	141-2	∞	∞	.....
150	col. lq.	$1.094^{0°}$	.....	97^{35mm}	.....	.....	.....
151	col. lq.	.....	-82	78-9	s.	.....	.....
152	cr. pd.	.....	226-7	.....	$0.4^{12°}$	.....	.....
153	mn. pr.	.....	151-3	265^{10mm}	$1.4^{15°}$	v. s.	$0.6^{15°}$
154	col. lq.	.....	.....	$125\text{-}8^{11mm}$	d. h.	d. h.	.....
155	col. oil	$0.951^{\frac{18}{15}°}$	1	295	v. sl. s.	s.	v. sl. s.
156	pr./aq.	.....	102	.....	v. s.	s. h.	i.; i. lg.
157	col. cr. pd.	.....	d. 207-11	.....	$0.027^{20°}$; s. alk.	v. sl. s.; s. a.	i.; i. chl.
158	col. rhb./aq.	.....	297 d.	.....	$20.5^{45°}$	v. sl. s. abs.	i.
159	col. nd./aq.	.....	295 d.	subl. >200	$21.7^{17°}$; $32^{75°}$	0.2, 80% c. al.	i.; i. act.
160	col. rhb.	.....	196 d.	.....	v. s.	v. sl. s. abs.	i.
161	lq.	$0.918^{23°}$	.....	173-4	i.; s. aq. a.	s.	s.; s. H_2SO_4
162	mn.	1.404	97-8	.....	v. s.	v. s.	v. s.
163	nd.	.....	164-6	.....	.....	.....	.....
164	nd./aq.	.....	285	.....	sl. s. h.	s. chl.	s.
165	nd.	.....	248-9	.....	$0.04^{25°}$; $0.7^{100°}$	s. h.; s. alk.	s.; i. chl.
166	nd./aq.	.....	$-H_2O$, 100; m. anh. 179	.....	$0.06^{25°}$; $6^{100°}$	s.	s. alk.
167	nd.	.....	234	.....	sl. s. h.	s.	s.
168	pr./aq.	.....	243-4	subl.	sl. s.	s.	s.
169	col. lq.	$1.103^{20°}_{4°}$	.....	83^{20mm}; d. 85	∞	∞	s.
170	tri.	.....	82	in vac. 90-100 (diss.)	v. s.	$25^{25°}$, 99% al.	$5^{23°}$
171	col. cr. pd.	.....	80-2	.....	sl.s.; s.bz.	s.; s. chl.	s.; s. oil

Aconine, cf. alkd.
Aconitine, cf. alkd.
Acopyrin 566
Acorn sugar 1608
Acraconitine, cf. alkd.
Acrol 1724
Acrylic aldehyde 146
Acrylic amide 148
Adamon 865
Adenine, cf. alkd.
Adermin 5510
Adipic diamide 152
Adonite 156
Adurol-Hauff 1386
Adurol-Schering 944
Aesculin, cf. glcde.
Aethon 3049
Afenil 6387
Agmatine, cf. alkd.
Agotan 5234
Alanine ethyl ester 2945
Alant starch 3872
Alantin 3872
Alantolactone 3497
Alanyl histidine 1251
Alcohol 2946
Aldehyde ammonia 6

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
172	**Alizarin** amide (β) (1,2)	.....	$C_6H_4(CO)_2C_6H_2(OH)NH_2$	XIV-267	239.22
173	amide (α) (2,1)	.....	$C_6H_4(CO)_2C_6H_2(OH)NH_2$	XIV-275	239.22
174	blue	diOH-anthraquinone-quinoline	$C_6H_4(CO)_2C_9H_3N(OH)_2$	XXI-632	291.25
175	blue S	.....	$C_{17}H_9O_4N{\cdot}2NaHSO_3$	XXI-633	499.38
176	carboxylic acid (β)	.....	$(HO)_2C_6H_2(CO)_2{:}C_6H_3{\cdot}CO_2H$	X-1035	284.21
177	3-sulfonic acid (1,2;3)	.....	$(HO)_2C_{14}H_5O_2{\cdot}SO_3H$	XI-355	320.26
178	3-sulfonic acid (Na)	alizarin S; alizarin carmine	$(HO)_2C_{14}H_5O_2{\cdot}SO_3Na{\cdot}H_2O$	XI-355	360.27
179	**Aljodan**	iodoethyl allophanate	$IC_2H_4{\cdot}CO_2NHCONH_2$	.....	258.03
180	**Alkannin**	.....	$C_{15}H_{14}O_4$	.....	258.26
181	**Allantoin** †	glyoxyldiureide	$C_4H_6O_3N_4$	XXV-474	158.12
182	**Allanturic acid**	lantanuric acid	$NH_2{\cdot}CO{\cdot}N{:}CH{\cdot}CO_2H$	XXV-475	116.08
183	**Allene**	propadiene	$CH_2{:}C{:}CH_2$	I-248	40.06
184	**Alloxan**	mesoxalylurea	$HN{\cdot}(CO)_3{\cdot}NH{\cdot}CO{\cdot}4H_2O$	XXIV-500	214.14
185	**Alloxan**	.....	$HN{\cdot}(CO)_3{\cdot}NH{\cdot}CO$	XXIV-500	142.07
186	**Alloxan** (monohydrate)	.....	$CO{\cdot}NHCONHCO{\cdot}C(OH)_2$	XXIV-500	160.09
187	**Alloxanic acid**	.....	$C_4H_4O_5N_2$	III-772	160.09
188	**Alloxantin**	uroxin	$C_8H_6O_8N_4{\cdot}2H_2O$	XXVI-556	286.16
189	**Allyl** acetate	.....	$CH_3CO_2{\cdot}C_3H_5$	II-136	100.11
190	acetic acid	pentenoic acid	$CH_2{:}CH{\cdot}C_2H_4{\cdot}CO_2H$	II-425	100.11
191	acetone	.....	$C_3H_5{\cdot}CH_2{\cdot}CO{\cdot}CH_3$	I-734	98.14
192	acetonitrile	.....	$C_3H_5{\cdot}CH_2CN$	II-426	81.11
193	alcohol	propen-1-ol-3	$CH_2{:}CH{\cdot}CH_2OH$	I-436	58.08
194	amine	.....	$CH_2{:}CH{\cdot}CH_2{\cdot}NH_2$	IV-205	57.09
195	*iso*-amyl ether	.....	$C_3H_5{\cdot}O{\cdot}C_5H_{11}$	I-438	128.21
196	aniline	.....	$C_3H_5{\cdot}NH{\cdot}C_6H_5$	XII-170	133.19
197	arsonic acid	.....	$CH_2{:}CH{\cdot}CH_2{\cdot}AsO(OH)_2$	.....	166.00
198	benzoate	.....	$C_6H_5{\cdot}CO_2{\cdot}C_3H_5$	IX-114	162.18
199	bromide	3-bromo-propene-1	$CH_2{:}CH{\cdot}CH_2Br$	I-201	120.99
200	butyrate	.....	$CH_3(CH_2)_2CO_2{\cdot}C_3H_5$	II-272	128.17
201	caproate (*n*)	.....	$CH_3(CH_2)_4CO_2{\cdot}C_3H_5$	.....	156.22
202	chloride	3-chloro-propene-1	$CH_2{:}CH{\cdot}CH_2Cl$	I-198	76.53
203	cinnamate	.....	$C_6H_5{\cdot}(CH)_2CO_2{\cdot}C_3H_5$	.....	188.22
204	cyanide	vinyl-acetonitrile	$CH_2{:}CH{\cdot}CH_2{\cdot}CN$	II-408	67.09
205	*iso*-cyanide	allyl carbylamine	$CH_2{:}CH{\cdot}CH_2{\cdot}NC$	IV-208	67.09
206	ether	diallyl ether	$(CH_2{:}CH{\cdot}CH_2)_2O$	I-438	98.14
207	formate	.....	$HCO_2{\cdot}CH_2{\cdot}CH{:}CH_2$	II-23	86.09
208	iodide	3-iodo-propene-1	$CH_2{:}CH{\cdot}CH_2I$	I-202	167.99
209	malonic acid	.....	$C_3H_5{\cdot}CH(CO_2H)_2$	II-776	144.12
210	mercaptan	.....	$CH_2{:}CH{\cdot}CH_2{\cdot}SH$	I-440	74.14
211	phenol (*p*)	chavicol	$CH_2{:}CH{\cdot}CH_2{\cdot}C_6H_4{\cdot}OH$	VI-571	134.17

† Cf. also Alkaloids table.

Alival 3402
Alizarin 2297
Alizarin (leuco) 2295
Alizarin S 177
Alizarin bordeaux 5801
Alizarin carmine 177
Alizarin orange 4599
Alizarin β-quinoline 174
Alizarin red R 178
Alizarin yellow A 6224
Alizarin yellow C 6211
Alizarin yellow R 4653

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
172	br. nd./al.	.....	.....	.....	i.	s.	s.; sl. s. NH_4OH
173	br. nd./al.	.....	250	.....	s. alk.	s.	s.; s. alk. carb.
174	b. met. nd./bz.	.....	270 ±	subl.	i.; s. h. bz.	sl. s.; s. ac.	sl. s.
175	r. br. cr.	.....	.....	.....	v. s.; d. h.	sl. s.	i.
176	or. nd./ $PhNO_2$	.....	305	subl.	s. aq. NaOAc	sl. s.	v. sl. s.
177	or. yel. cr.	.....	.....	.....	s.	s.	i.
178	or. yel. pd.	.....	.....	.....	s.	s.	.....
179	col. pd.	.....	192 ± d.	.....	sl. s.	s.	.....
180	br. met.	.....	<100	.....	s. alk.	v. sl. s.	v. sl. s.
181	nd./h. aq.	.....	235-6	.....	$0.76^{22°}$; 3.3 h.	sl. s.; s. NaOH	i.
182	hyg. pd.	.....	.....	.....	delq.	i.	d. h. alk.
183	gas	.....	−146	−32	.....	.....	.....
184	rhb. pr. /aq.; eff. $-3H_2O$	.....	$-4H_2O$, 150	d. 170	s.	s.	.....
185	rhb. yel. hyg.	.....	d. 170	.....	v. s.; s. ac.	v. s.; sl. s. pet.	i.; sl. s. chl.
186	tri./aq.	.....	d. 170	.....	v. s.	v. s.	i.
187	tri.	.....	d.	.....	v. s.	16	s.
188	rhb.	.....	$-2H_2O$, 120	d. 253-5	$0.3^{25°}$; 6h.	v. sl. s.	v. sl. s.
189	col. lq.	$0.928^{20°}_{4°}$	.....	104^{762mm}	i.	∞	∞
190	col. lq.	$0.984^{18°}_{4°}$	<−18	187-9	sl. s.	s.	s.
191	col. lq.	$0.847^{16°}_{4°}$	.....	129^{748mm}	i.	.....	.....
192	lq.	$1.180^{13°}$	.....	140	i.	.....	.....
193	lq.	$0.854^{20°}_{4°}$	−129	96.6	∞	∞	∞
194	col. lq.	$0.761^{22°}_{4°}$	.....	56.5^{756mm}	∞	∞	∞
195	col. lq.	.....	.....	120	i.	∞	∞
196	yel. oil	$0.982^{25°}$	.....	$217-9^{736mm}$	i.	s.	s.
197	col. cr./aq.	.....	129-30	.....	s.	s.	.....
198	yel. lq.	$1.058^{15°}_{15°}$	.....	230	i.	s.	s.
199	lq.	$1.398^{20°}_{4°}$	−119.4	$70-175^{3mm}$	i.	∞	∞
200	col. lq.	.....	.....	143^{772mm}	i.	s.	s.
201	pa. yel. lq.	.....	.....	185-7	i.	s.	s.
202	col. lq.	$0.938^{20°}_{4°}$	−136.4	44.6	<0.1	∞	∞
203	col. cr.	$1.052^{25°}_{25°}$	.....	286 d.	i.	s.	v. s.
204	col. lq.	$0.837^{16°}$	.....	118-9	.....	s.	.....
205	lq.	$0.797^{17°}$	.....	106	sl. s.	s.	∞
206	lq.	$0.808^{20°}_{4°}$	.....	94.3	0.3	∞	∞
207	lq.	$0.948^{18°}$	.....	83.6^{768mm}	i.	s.	.....
208	yel. lq.	$1.848^{12°}_{4°}$	−99.3	102^{734mm}	i.	∞	∞
209	cr./et.	.....	102-5	d.−CO_2, 180	s.	s.	s.; s. h. bz.
210	lq.	.....	.....	90	.....	∞	∞
211	lq.	$1.023^{19.4°}_{4°}$	<−25	237	∞ pet.	∞ ; ∞ chl.	∞

"Alkazene 6" 3575
"Alkazene 12" 2778
"Alkazene 20" 1379
"Alkazene 32" 5055

Allantoin, cf. alkd.
Allocinnamic acid 1497
Allophanamide 859
Allothreonine 5934

Alloxan-oxime 6445
Allyl-benzene 5223-5
Allyl-carbinol 6437
Allyl-carbylamine 205

Allyl ethyl ether 2949
Allyl guaiacol 3218
Allyl iodourotropine 3600

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Allyl				
212	phenylcinchonate	atoquinol (2,4)	$C_9H_5N(C_6H_5)CO_2 \cdot C_3H_5$	.....	289.32
213	phenylcinchonate HCl	.....	$C_{19}H_{15}O_2N \cdot HCl$	.....	325.78
214	phenyl ether	.....	$C_3H_5 \cdot O \cdot C_6H_5$	VI-144	134.17
215	phenyl urea (*N*,*N'*)	.....	$C_3H_5NH \cdot CO \cdot NHC_6H_5$	XII-350	176.21
216	propionate	.....	$C_2H_5 \cdot CO_2 \cdot C_3H_5$	II-241	114.14
217	*iso*-propylacetyl-carbamide	sedormid	$(C_3H_7)(C_3H_5):CH \cdot CO \cdot NHCONH_2$	.....	184.23
218	pyridine (2)	.....	$C_3H_5 \cdot C_5H_4N$	.....	119.16
219	thiocyanate	.....	$C_3H_5 \cdot SCN$	III-177	99.15
220	*iso*-thiocyanate	mustard oil	$C_3H_5 \cdot N:C:S$	IV-214	99.15
221	thiourea	thiosinamine	$C_3H_5 \cdot NH \cdot CS \cdot NH_2$	IV-211	116.18
222	trisulfide	.....	$(C_3H_5)_2S_3$	I-441	178.32
223	urea	.....	$C_3H_5 \cdot NH \cdot CO \cdot NH_2$	IV-209	100.12
224	*iso*-valerate	.....	$(CH_3)_2CH \cdot CH_2 \cdot CO_2C_3H_5$	II-313	142.19
225	**Allylene**	propyne; propine	$CH_3 \cdot C:CH$	I-246	40.06
226	oxide	.....	$CH_3 \cdot C:CH \cdot O$	XVII-20	56.06
227	**Aloin**	.....	$C_{21}H_{20}O_9$	.....	416.37
228	**Alstonine**	.....	$C_{21}H_{20}O_4N_2 \cdot 3\frac{1}{2}H_2O$	.....	427.44
229	**Aluminum** ethoxide	.....	$Al(OC_2H_5)_3$	I-313	164.15
230	triethyl	.....	$Al(C_2H_5)_3$	IV-643	114.15
231	trimethyl	.....	$Al(CH_3)_3$	IV-643	72.07
232	**Amalinic acid**	tetraMe-alloxantin	$(CH_3)_4C_8H_2O_8N_4$	XXVI-559	342.26
233	**Amarine**	triphenyl-imina-zoline	$C_6H_5CHCH(C_6H_5) \cdot N:C(C_6H_5) \cdot NH \cdot \frac{1}{2}H_2O$	XXIII-304	307.38
234	**Amaron**	tetraphenylpyrazine	$C_{28}H_{20}N_2$	XXIII-343	384.46
235	**Amino**-acetone	acetonyl-amine	$NH_2 \cdot CH_2 \cdot CO \cdot CH_3$	IV-314	73.09
236	acetophenone (*o*)	.....	$NH_2 \cdot C_6H_4 \cdot CO \cdot CH_3$	XIV-41	135.16
237	acetophenone (*m*)	.....	$NH_2 \cdot C_6H_4 \cdot CO \cdot CH_3$	XIV-45	135.16
238	acetophenone (*p*)	.....	$NH_2 \cdot C_6H_4 \cdot CO \cdot CH_3$	XIV-46	135.16
239	acetophenone (ω)	phenacylamine	$C_6H_5 \cdot CO \cdot CH_2 \cdot NH_2$	XIV-49	135.16
240	acetophenone HCl (ω)	.....	$C_8H_7O \cdot NH_2 \cdot HCl$	XIV-49	171.63
241	alizarin (3)	β-aminoalizarin	$C_6H_4(CO)_2C_6H \cdot (OH)_2NH_2$	XIV-285	255.22
242	alizarin (4)	α-aminoalizarin	$C_{14}H_5O_2(OH)_2NH_2$	XIV-286	255.22
243	amylene glycol	2-NH_2-2-Et-1,3-propandiol	$C_2H_5 \cdot C(NH_2):(CH_2OH)_2$	.....	119.16
244	anthraquinone (1)	.....	$C_6H_4(CO)_2C_6H_3NH_2$	XIV-177	223.22
245	anthraquinone (2)	.....	$C_6H_4(CO)_2C_6H_3NH_2$	XIV-191	223.22
246	2-azo-5-anisole	benzene-azo-*o*-anisidine (5;2,1)	$C_6H_5 \cdot N:N \cdot C_6H_3(NH_2) \cdot OCH_3$	XVI-396	227.26
247	azobenzene (*o*)	.....	$NH_2 \cdot C_6H_4 \cdot N_2 \cdot C_6H_5$	XVI-303	197.23
248	azobenzene (*m*)	.....	$NH_2 \cdot C_6H_4 \cdot N_2 \cdot C_6H_5$	XVI-304	197.23

Allyl sulfide 1684
Allylen dichloride 2059
Almond oil 642
Alpha S acid 4533
Alphogen 5662
Alphol 4568
Alphozone 5662
Alurate 5370
Alypin 736-7
Amatol, a mixt. of 6316 and ammonium nitrate.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
212	yel. nd./al.	.....	36	260^{15mm}	i.; s. oil	8; s. bz.	v. s.
213	yel. nd./al.	.....	145-7	.....	d.	s. h.	i.
214	col. oil	$0.986^{\frac{15}{15}°}$	.....	191.7	i.	.....	.....
215	nd./bz.	.....	114.5-5.5	.....	s. bz.	.....	.....
216	col. lq.	.....	.....	124.5^{774mm}	.....	.....	.....
217	col. pd.	.....	194	.....	0.03c., 0.5 h.	10	1.3
218	lq.	$0.959^{0°}$	.....	189-90	.....	.....	.....
219	oil	$1.056^{15°}$	.....	161	v. sl. s.	v. s.	v. s.
220	col. oil	$1.013^{\frac{20}{4}°}$	-80	150-1	0.2	∞	∞
221	col. pr.	$1.219^{\frac{20}{20}°}$	77-8	.....	3°°; s. h.	s.; i. bz.	v. sl. s.
222	lq.	$1.085^{15°}$	.....	$112\text{-}22^{16mm}$	.....	.....	.....
223	nd./al.	.....	85	.....	v. s.	v. s.	v. sl. s.
224	lq.	.....	.....	155	.....	∞	∞
225	gas	$0.660^{-1.1°}$	-104.7	-23.1	v. sl. s.	v. s.	3000cc.$^{16°}$
226	lq.	.....	.....	62-3	sl. s.	.....	i. aq. K_2CO_3
227	yel. pr./al.	.....	147.9	.....	sl. s. h.	sl. s. h.	v. s. alk.
228	br. amor.	.....	<100; 195 ± (anh.)	.....	sl. s.	s.	v. sl. s.
229	pd.	$1.142^{\frac{20}{0}°}$	150-60	$200\text{-}5^{10mm}$	d.	i.; sl. s. bz.	v. sl. s.
230	col. lq.	.....	<-18	194	.....	.....	.....
231	col. lq.	.....	0	129-30	.....	.....	.....
232	cr./aq.	.....	221 d.	.....	sl. s. h.	v. sl. s.	s. alk.
233	cr./al.	.....	106; 131-3 (anh.)	d. 198 (anh.)	i.	s.	s.
234	red nd./ac.	.....	245-6	subl.	i.; v. s. h. bz.	sl. s. h.; s. chl.	sl. s. h.
235	only salts are known	.....	.....	.....	.....	.....	.....
236	yel. oil	.....	.....	250 (sl. d.)	i.	s.	s.
237	lf./aq.	.....	99.5	289-90	.....	.....	.....
238	cr./aq.	.....	106	293-5	s. h.	s.	s.
239	unstable	.....	.....	.....	.....	.....	.....
240	cr.	.....	184-8	.....	s.	.....	i.
241	red pr./ac.	.....	>300	subl. d.	s. KOH	sl. s.	sl. s. HCl
242	bl. nd./al.	.....	.....	.....	s. alk.	s.	.....
243	col. cr.	$1.099^{\frac{20}{20}°}$	37.5-8.5	$152\text{-}3^{10mm}$	∞	∞	v. sl. s.
244	red nd.	.....	256	subl.	i.; s. HCl	s.; s. bz.	s.; s. chl.
245	red nd./al.	.....	302	subl.	i.	s.	i.; s. bz.
246	red br. pl./ PhMe	.....	110.5-1.5	.....	s. ac.	s.; s. bz.	s.
247	red pr./al.	.....	59	.....	i.	v. s.	v. s.
248	or. nd./lg.	.....	56-7	.....	s. bz.	s.	s.; s. chl.

Amber salt 5653
Amidol 1724
Amidopyrine 363
Amino-acetic acid 3437
Amino-acetanilide 107-8
Amino-acetylphenetidine 5115
Amino-anilinoacetic acid 358
Amino-anisole 534-6
Amino-anthracene 542-3

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Amino				
249	azobenzene (*p*)	aniline yellow	$NH_2{\cdot}C_6H_4{\cdot}N_2{\cdot}C_6H_5$	XVI-307	197.23
250	azobenzene HCl (*p*)	.....	$C_{12}H_9N_2(NH_2){\cdot}HCl$	XVI-310	233.70
251	α-azonaphthalene	azodinaphthylamine	$NH_2{\cdot}C_{10}H_6{\cdot}N_2{\cdot}C_{10}H_7$	XVI-365	297.34
252	azophenylene	benzotriazole	$C_6H_4NH{\cdot}N{:}N$ (ring)	XXVI-38	119.12
253	azoxylene HCl	.....	$(CH_3)_4C_{12}H_5(NH_2)N_2{\cdot}$ HCl	.....	289.80
254	benzaldehyde (*o*)	.....	$NH_2{\cdot}C_6H_4{\cdot}CHO$	XIV-21	121.13
255	benzaldehyde (*m*)	.....	$NH_2{\cdot}C_6H_4{\cdot}CHO$	XIV-28	121.13
256	benzaldehyde (*p*)	.....	$NH_2{\cdot}C_6H_4{\cdot}CHO$	XIV-29	121.13
257	benzaldoxime (*o*)	.....	$NH_2{\cdot}C_6H_4{\cdot}CH{:}NOH$	XIV-24	136.15
258	benzaldoxime (*m*)	.....	$NH_2{\cdot}C_6H_4{\cdot}CH{:}NOH$	XIV-28	136.15
259	benzamide (*o*)	anthranilamide	$NH_2{\cdot}C_6H_4{\cdot}CO{\cdot}NH_2$	XIV-320	135.15
260	benzamide (*m*)	.....	$NH_2{\cdot}C_6H_4{\cdot}CO{\cdot}NH_2{\cdot}$ H_2O	XIV-390	154.17
261	benzamide (*p*)	.....	$C_7H_8ON_2{\cdot}\frac{1}{2}H_2O$	XIV-425	140.66
262	benzidine (2,4;4')	triamino-diphenyl	$(NH_2)_2C_6H_3C_6H_4{\cdot}$ NH_2	XIII-306	199.25
263	benzimidazole (2)	*o*-phenylene-guanidine	$C_6H_4{\cdot}NH{\cdot}C(NH_2){:}N$ (ring)	XXIV-116	133.15
264	benzoic acid (*o*)	anthranilic acid	$NH_2{\cdot}C_6H_4{\cdot}CO_2H$	XIV-310	137.13
265	benzoic acid (*m*)	.....	$NH_2{\cdot}C_6H_4{\cdot}CO_2H$	XIV-383	137.13
266	benzoic acid (*p*)	aminodracylic acid	$NH_2{\cdot}C_6H_4{\cdot}CO_2H$	XIV-418	137.13
267	benzonitrile (*o*)	anthranilic nitrile	$NH_2{\cdot}C_6H_4{\cdot}CN$	XIV-322	118.13
268	benzonitrile (*m*)	.....	$NH_2{\cdot}C_6H_4{\cdot}CN$	XIV-391	118.13
269	benzonitrile (*p*)	.....	$NH_2{\cdot}C_6H_4{\cdot}CN$	XIV-425	118.13
270	benzophenone (*o*)	.....	$C_6H_5{\cdot}CO{\cdot}C_6H_4{\cdot}NH_2$	XIV-76	197.23
271	benzophenone (*m*)	.....	$C_6H_5{\cdot}CO{\cdot}C_6H_4{\cdot}NH_2$	XIV-81	197.23
272	benzophenone (*p*)	.....	$C_6H_5{\cdot}CO{\cdot}C_6H_4{\cdot}NH_2$	XIV-81	197.23
273	benzothiazole (2)	.....	$C_6H_4{\cdot}N{:}C(NH_2){\cdot}S$ (ring)	XXVII-182	150.19
274	benzyl-cyanide (*p*)	aminophenyl-aceto-nitrile	$H_2N{\cdot}C_6H_4{\cdot}CH_2{\cdot}CN$	XIV-457	132.16
275	benzyl-cyanide HCl (*p*)	.....	$H_2N{\cdot}C_6H_4{\cdot}CH_2{\cdot}CN{\cdot}$ HCl	XIV-457	168.62
276	benzoyl-2,2-di-methyl-3-di-ethylaminopro-panol HCl (*p*)	larocaine	$H_2N{\cdot}C_6H_4{\cdot}CO_2{\cdot}CH_2{\cdot}$ $C(CH_3)_2{\cdot}CH_2{\cdot}$ $N(C_2H_5)_2{\cdot}HCl$	.....	314.85
277	butyric acid (α) (*dl*)	.....	$C_2H_5{\cdot}CHNH_2{\cdot}CO_2H$	IV-408	103.12
278	butyric acid (β) (*dl*)	.....	$CH_3{\cdot}CHNH_2{\cdot}CH_2{\cdot}$ CO_2H	IV-412	103.12
279	butyric acid (γ)	piperidinic acid	$NH_2{\cdot}(CH_2)_3{\cdot}CO_2H$	IV-413	103.12
280	*iso*-butyric acid (α)	.....	$(CH_3)_2CNH_2{\cdot}CO_2H$	IV-414	103.12
281	camphor (3) (α)	.....	$C_{10}H_{15}O{\cdot}NH_2$	XIV-10	167.24
282	*n*-caproic acid (α) (*dl*)	.....	$CH_3(CH_2)_3CHNH_2{\cdot}$ CO_2H	IV-433	131.17
283	*n*-caproic acid (α)	norleucine (*l* +)	$CH_3(CH_2)_3CHNH_2{\cdot}$ CO_2H	IV-432	131.17
284	*n*-caproic acid (ϵ)	.....	$H_2N(CH_2)_5CO_2H$	IV-434	131.17

Amino-azotoluene 309-12
Amino-barbituric acid 6384
Amino-benzene 513
Amino-benzene sulfonic acid 523-5
Amino-butyl-guanidine, cf. alkd.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
249	yel. mn.	.....	126-7	225^{120mm}	sl. s. h.	s. h.	s.
250	steel b.*	.....	.....	.....	s.	.....	.....
251	br. nd.	.....	175	.....	sl. s. bz.	sl. s.	sl. s.
252	col. nd./bz.	.....	98.5	.....	i.	s.	s. bz.
253	br. pd.	.....	.....	.....	i.	s.	sl. s.
254	lf.	.....	39-40	d.	v. sl. s.	v. s.	v. s.
255	unstable	.....	.....	.....	.....	.....	.....
256	lf./aq.	.....	71.5	.....	s.	.....	.....
257	nd./bz.	.....	135-6	subl.	v. sl. s.	s.	s.
258	nd./bz.	.....	88	.....	v. sl. s. lg.	s.	s.
259	lf./chl.	.....	108	300 ± (sl.d.)	v. s. h.	v. s.	sl. s.; i. bz.
260	mn./aq.	.....	78-9	$-H_2O > 100$	s.	s.	s.
261	pa. yel. cr.	.....	182.9 (anh.)	$-\frac{1}{4}H_2O$, 170	sl. s.	.....	.....
262	nd.	.....	134	.....	.....	.....	.....
263	lf./aq.	.....	222-4	.....	s.; s. alk.; s. dil. a.	s.; s. act.; v. sl. s. bz.	v. sl. s.
264	col. rhb.	.....	144-5	subl.	$0.35^{14°}$	$^{**}10.7^{100°}$	$16^{7°}$
265	nd./aq.	$1.511^{4°}$	173-4	.....	$^{**}0.6^{15°}$	$^{**}2.2^{100°}$	$1.8^{6°}$
266	mn./pr.	.....	187-8	.....	$0.3^{13°}$	$^{**}11.3^{100°}$	$8.2^{6°}$
267	nd./CS_2	.....	51	$267\text{-}8^{777mm}$	v. sl. s.	s.	s.
268	nd./aq. al.	.....	53	288-90	s. h.	v. s.	v. s.
269	mn. pr.	.....	86	d.	v. s. h.	v. s.	v. s.; i. HCl
270	yel. lf./al.	.....	106-10	.....	.....	s.	s.
271	yel. lf./aq.	.....	86-7	.....	sl. s.	s.	s.
272	lf./aq. al.	.....	124	.....	v. sl. s. c.	v. s.	$2^{25°}$
273	lf./aq.	.....	130-2	d.	v. sl. s.; s. conc. a.	s.; s. chl.	s.
274	lf./aq.	.....	46	312	sl. s. h.	s.	s.
275	cr.	.....	217-20	.....	.....	v. sl. s. c.	.....
276	col. cr.	.....	196-7	.....	33.3	10	sl. s. c.
277	lf.	.....	285 d.	subl. >300	33 c.	0.2 h.	i.
278	cr.	.....	193-4	.....	100	i. abs. al.	i. abs. et.
279	lf. or nd.	.....	203 d.	.....	v. s.	i.	i.
280	pl. or pr./aq.	.....	203 d.	subl. 280	v. s.	sl. s.	i.
281	waxy cr.	.....	70-110	245-6	l.	s.	s.
282	col. lf./aq.	.....	300 ± †	.....	1.25	.....	.....
283	pl. or lf./aq.	.....	301	subl. >275	$1.74^{23°}$	v. sl. s.	.....
284	lf./MeOH-et.	.....	202-3	softens > 190	v. s.	i.	sl. s. MeOH

* Also a red-black crystalline form.
** In 90% alcohol.
† Sealed tube.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
285	**Amino** ***iso*****-caproic** (α)	leucine (*l* −)	$(CH_3)_2CHCH_2 \cdot CH(NH_2) \cdot CO_2H$	IV-437	131.17
286	caproic acid (α)	isoleucine (*l* +)	$(C_2H_5)(CH_3)CH \cdot CHNH_2CO_2H$	IV-454	131.17
287	caproic acid (α)	allo-isoleucine (*d* −)	$(C_2H_5)(CH_3)CH \cdot CHNH_2CO_2H$	IV-457	131.17
288	caprylic acid (α) (*dl*)	.....	$CH_3(CH_2)_5CHNH_2 \cdot CO_2H$	IV-461	159.22
289	cinnamic acid (*o*)	.....	$H_2N \cdot C_8H_6 \cdot CO_2H$	XIV-517	163.17
290	cinnamic acid (*m*)	.....	$H_2N \cdot C_8H_6 \cdot CO_2H$	XIV-520	163.17
291	cinnamic acid (*p*)	.....	$H_2N \cdot C_8H_6 \cdot CO_2H$	XIV-521	163.17
292	*o*-cresol (4;1,2)	amino-hydroxy-toluene	$NH_2 \cdot C_6H_3 \cdot CH_3(OH)$	XIII-574	123.15
293	*o*-cresol (5;1,2)	.....	$NH_2 \cdot C_6H_3CH_3 \cdot (OH)$	XIII-576	123.15
294	*o*-cresol H_2SO_4	(5;1,2)	$(C_7H_9ON)_2 \cdot H_2SO_4$	XIII-576	344.38
295	*m*-cresol (2;1,3)	.....	$NH_2 \cdot C_6H_3 \cdot CH_3(OH)$	XIII-589	123.15
296	*m*-cresol (4;1,3)	.....	$NH_2 \cdot C_6H_3 \cdot CH_3(OH)$	XIII-590	123.15
297	*m*-cresol (6;1,3)	.....	$NH_2 \cdot C_6H_3 \cdot CH_3(OH)$	XIII-593	123.15
298	*p*-cresol (2;1,4)	.....	$NH_2 \cdot C_6H_3 \cdot CH_3(OH)$	XIII-598	123.15
299	*p*-cresol (3;1,4)	.....	$NH_2 \cdot C_6H_3 \cdot CH_3(OH)$	XIII-601	123.15
300	dibutylaniline (*p*)	.....	$(C_4H_9)_2N \cdot C_6H_4 \cdot NH_2$	*XIII-23	220.35
301	dibutylaniline (*p*)	HCl	$C_{14}H_{24}N_2 \cdot 2HCl$	*XIII-23	293.28
302	diethylamino-toluene (mono) HCl	(5;1,2)	$(C_2H_5)_2N \cdot C_6H_3 \cdot (CH_3)NH_2 \cdot HCl$	.....	214.74
303	diethylaniline (*p*)	diEt-phenylene-diNH_2	$(C_2H_5)_2N \cdot C_6H_4 \cdot NH_2$	XIII-75	164.24
304	diethylaniline (*p*)	(mono-HCl)	$C_{10}H_{16}N_2 \cdot HCl$	.....	200.71
305	dimethylaniline (*o*)	diMe-*o*-phenylene-diamine (*N*,*N*)	$(CH_3)_2N \cdot C_6H_4 \cdot NH_2$	XIII-15	136.19
306	dimethylaniline (*m*)	.....	$(CH_3)_2N \cdot C_6H_4 \cdot NH_2$	XIII-38	136.19
307	dimethylaniline (*p*)	.....	$(CH_3)_2N \cdot C_6H_4 \cdot NH_2$	XIII-72	136.19
308	dimethylaniline (*p*)	H_2SO_4	$C_8H_{12}N_2 \cdot H_2SO_4$	XIII-73	234.27
309	2,3′-dimethyl-azobenzene (4)	amino-azo-toluene (3′;1,2,4)	$CH_3 \cdot C_6H_4 \cdot N_2 \cdot C_6H_3 \cdot (CH_3)NH_2$	XVI-348	225.28
310	2,3′-dimethyl-azobenzene (4′)	(2;1,3′,4′)	$CH_3 \cdot C_6H_4 \cdot N_2 \cdot C_6H_3 \cdot (CH_3)NH_2$	XVI-344	225.28
311	2,4′-dimethyl-azobenzene (4)	(4′;1,2,4)	$CH_3 \cdot C_6H_4 \cdot N_2 \cdot C_6H_3 \cdot (CH_3)NH_2$	XVI-348	225.28
312	3,4′-dimethyl-azobenzene (4)	(4′;1,3,4)	$CH_3 \cdot C_6H_4 \cdot N_2 \cdot C_6H_3 \cdot (CH_3)NH_2$	XVI-345	225.28
313	diphenylamine (*o*)	*N*-phenyl-*o*-phenylenediamine	$NH_2 \cdot C_6H_4 \cdot NH \cdot C_6H_5$	XIII-16	184.23
314	diphenylamine (*p*)	.....	$NH_2 \cdot C_6H_4 \cdot NH \cdot C_6H_5$	XIII-76	184.23
315	diphenylamine (*p*)	HCl	$C_{12}H_{10}N \cdot NH_2 \cdot HCl$	*XIII-23	220.70
316	diphenylamine (*p*)	H_2SO_4	$(C_{12}H_{10}N \cdot NH_2)_2 \cdot H_2SO_4$	XIII-78	466.54
317	4-(*p*-diphenyl)-thiazole (2)	.....	$C_6H_5 \cdot C_6H_4 \cdot C{:}CH \cdot$ $S \cdot C(NH_2){:}N$	.....	252.32
318	ethylacetanilide (*p*)	.....	$NH_2C_6H_4N(C_2H_5) \cdot COCH_3$	.....	178.23

Amino-cyclohexane 326
Amino-cymene 1256
Amino-dihydro-phthalazinedione 359
Amino-diiodobenzoic acid 2383
Amino-dimethylbenzene 6471-5, 6477
Amino-diphenyl 5153-5

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
285	lf./aq. al.	$1.293^{\frac{1}{4}8^\circ}$	293-5 d.*	subl.	2^{17°; 6.6 h.	0.07^{17° abs.	i.; 10.9 ac.
286	rhb./80% al.	.....	280 d.*	subl. >280	$3.9^{15.5^\circ}$; 6.1^{75°	sl. s. h.; s. h. ac.	i.; s. h. gly.
287	lf. or rods	.....	280 d.*	.....	2.6^{20°	i. c.	s. h. ac.
288	lf./aq.	.....	subl.	.....	sl. s. c.; 0.6 h.	v. sl. s.	v. sl. s.
289	yel. nd.	.....	158-9 d.	.....	s. h.	s.	s.
290	pa. yel. nd./al.	.....	181-2	.....	sl. s. h.	s.	s.
291	yel. nd.	.....	175-6 d.	.....	s. h.	s.	s.
292	col. lf./aq.	.....	159-61	subl.	s. h.	v. s.	v. s.
293	lf./bz.	.....	174-5	subl.	v. sl. s.	s.	s.; sl. s. bz.
294	.....	.....	178-9	.....	s.	i.	i.
295	lf.	.....	148-50	subl.	.....	.....	.....
296	lf.	.....	.....	.....	.....	.....	.....
297	cr./bz.	.....	174 d.	.....	.....	.....	.....
298	cr./aq.	.....	144.5	subl.	sl. s. c.	.....	.....
299	rhb./bz.	.....	135	subl.	i. c.	s.; sl. s. bz.	s.; s. chl.
300	lq.	.....	.....	.....	.....	.....	.....
301	nd./al.	.....	.....	.....	s.	s.	i.
302	col. nd.	.....	.....	.....	s.	sl. s.	i.
303	lq.	.....	.....	260-2	i.	s.	s.
304	col. nd.	.....	.....	.....	s.	s.	i.
305	oil	.....	.....	$217.5^{751.5mm}$	sl. s.	s.	s.
306	oil	0.995^{25°	<-20	$268\text{-}70^{740mm}$	sl. s.	s.	s.
307	col. nd.	$1.041^{\frac{15}{15}^\circ}$	41	262.3	s. c.	v. s.	s.; s. chl.
308	lf.	.....	.....	.....	v. s.	.....	.....
309	yel. nd.	.....	80	.....	i.	s.	.....
310	yel. mn./al.	.....	100	.....	i.	s.	s.; s. chl.
311	yel. lf./al.	.....	127	.....	i.	s.	sl. s. lg.
312	yel. nd./lg.	.....	127-8	.....	i.	s.	sl. s. lg.
313	nd./aq.	.....	79-80	.....	s. chl.	s. act.	s. bz.; sl. s. lg.
314	nd./aq. al.	.....	66-7**	354 (in H_2)	sl. s.	s. abs. al.	s.
315	grn. pd.	.....	.....	.....	s. h.	s. h.	i.
316	gr. pd.	.....	.....	.....	v. sl. s.	sl. s.	i.
317	col. pd.	.....	206-8	.....	i.	s. h.	i.
318	col. fl.	.....	98-9	.....	i.	v. s.	i.

* Sealed tube.
** Cryst./pet. m.p. 75°.
Amino-dracylic acid 266
Amino-ethane 2950
Amino-ethyl alcohol 8, 2907

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
319	**Amino** ethylbenzene (*o*)	*o*-Et-aniline	$NH_2 \cdot C_6H_4 \cdot C_2H_5$	XII-1089	121.18
320	ethylbenzene (*m*)	.....	$NH_2 \cdot C_6H_4 \cdot C_2H_5$	XII-1090	121.18
321	ethylbenzene (*p*)	.....	$NH_2 \cdot C_6H_4 \cdot C_2H_5$	XII-1090	121.18
322	guanidine	guanyl hydrazine	$H_2N \cdot C(NH) \cdot NH \cdot NH_2$	III-117	74.09
323	guanidine H_2CO_3	(bicarbonate)	$CH_6N_4 \cdot H_2CO_3$	III-118	136.12
324	guanidine H_2SO_4	(acid sulfate)	$CH_6N_4 \cdot H_2SO_4$	III-118	172.17
325	guanidine H_2SO_4	.....	$(CH_6N_4)_2 \cdot H_2SO_4 \cdot H_2O$	.....	264.27
326	hexahydrobenzene	cyclohexylamine	$H_6C_6H_5 \cdot NH_2$	XII-5	99.17
327	1-hydroxyanthraquinone (4)	quinizarinamide	$C_6H_4(CO)_2C_6H_2 \cdot (OH)NH_2$	XIV-268	239.22
328	malonic acid	.....	$NH_2 \cdot CH(CO_2H)_2$	IV-469	119.08
329	4-methylthiazole (2)	.....	$CH_3 \cdot C{:}CH \cdot S \cdot C(NH_2){:}N$	XXVII-159	114.16
330	methylacetanilide (*p*)	.....	$NH_2 \cdot C_6H_4 \cdot N(CH_3) \cdot COCH_3$	.....	164.20
331	naphthalene-4-azobenzene-*p*-sulfonic acid (1)	(1,4;4')	$NH_2 \cdot C_{10}H_5 \cdot N{:}N \cdot C_6H_4 \cdot SO_3H$	.....	327.36
332	α-naphthol (4,1)	4-amino-naphthol-1	$NH_2 \cdot C_{10}H_6 \cdot OH$	XIII-667	159.18
333	α-naphthol (8,1)	8-amino-naphthol-1	$NH_2 \cdot C_{10}H_6 \cdot OH$	XIII-672	159.18
334	β-naphthol (1,2)	1-amino-naphthol-2	$NH_2 \cdot C_{10}H_6 \cdot OH$	XIII-676	159.18
335	β-naphthol (1,2)	HCl	$NH_2 \cdot C_{10}H_6 \cdot OH \cdot HCl$	XIII-677	195.65
336	β-naphthol (7,2)	7-amino-naphthol-2	$NH_2 \cdot C_{10}H_6 \cdot OH$	XIII-684	159.18
337	1-naphthol-3-sulfonic acid (6) (6;1,3)	J acid	$NH_2 \cdot C_{10}H_5(OH) \cdot SO_3H$	XIV-823	239.24
338	1-naphthol-3-sulfonic acid (7) (7;1,3)	gamma acid	$NH_2 \cdot C_{10}H_5(OH) \cdot SO_3H$	XIV-828	239.24
339	1-naphthol-5-sulfonic acid (8) (8;1,5)	S acid	$NH_2 \cdot C_{10}H_5(OH) \cdot SO_3H$	XIV-835	239.24
340	2-naphthol-4-sulfonic acid (1) (1;2,4)	1:2:4-acid	$NH_2 \cdot C_{10}H_5(OH) \cdot SO_3H \cdot \frac{1}{2}H_2O$	XIV-846	248.25
341	2-naphthol-6-sulfonic acid (1) Na	eikonogen (1;2,6)	$NH_2 \cdot C_{10}H_5(OH) \cdot SO_3Na \cdot 2\frac{1}{2}H_2O$	XIV-848	306.27
342	1-naphthol-3,6-disulfonic acid (8;1,3,6)	H acid	$NH_2 \cdot C_{10}H_4(OH){:}(SO_3H)_2$	XIV-840	319.30
343	naphthol-disulfonic acid Na	H acid Na salt	$C_{10}H_7O_7NS_2Na_2 \cdot 1\frac{1}{2}H_2O$	XIV-840	390.30
344	1-naphthol-5,7-disulfonic acid (8;1,5,7)	2S acid	$NH_2 \cdot C_{10}H_4(OH){:}(SO_3H)_2$	XIV-845	319.30
345	phenol (*o*)	2-aminophenol	$NH_2 \cdot C_6H_4 \cdot OH$	XIII-354	109.12
346	phenol (*o*) HCl	.....	$HO \cdot C_6H_4 \cdot NH_2 \cdot HCl$	XIII-358	145.59
347	phenol (*m*)	3-aminophenol	$NH_2 \cdot C_6H_4 \cdot OH$	XIII-401	109.12
348	phenol (*m*) HCl	.....	$HO \cdot C_6H_4 \cdot NH_2 \cdot HCl$	XIII-403	145.59
349	phenol (*p*)	*p*-hydroxyaniline	$NH_2 \cdot C_6H_4 \cdot OH$	XIII-427	109.12
350	phenol (*p*) HCl	.....	$HO \cdot C_6H_4 \cdot NH_2 \cdot HCl$	XIII-434	145.59

Amino-ethyl-indole 6363
Amino-ethyl propandiol 243
Amino-form 3599
Amino G acid 4537
Amino-glutaric acid 3371-2
Amino H acid 4555
Amino-hydrocinnamic acid 5149-50
Amino-hydroxybenzoic acid 374-6
Amino-hydroxybutyric acid 5932-4
Amino-hydroxypurine, cf. alkd.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
319	lq.	$0.983^{22°}$	−45	214.3	i.	∞	∞
320	lq.	$0.990^{0°}$	.....	214-5^{764mm}	.....	.....	.....
321	col. oil	$0.976^{22°}$	−5	217.4	i.	∞	∞
322	cr.	.....	d.	.....	s.	s.	i.
323	cr.	.....	172 d.	.....	i. c.; d. h.	.....	.....
324	large pl.	.....	161	.....	s.	.....	.....
325	.....	.....	207 ±	.....	s.	.....	.....
326	col. lq.	$0.865^{20°}_{0}$	.....	134	i.	s.	.....
327	red-violet pd.	.....	207-8	.....	s. conc. HCl	s.	s. bz.
328	cr.	.....	109 d.	.....	s. c.	sl. s.	.....
329	hyg. cr.	.....	42*	231-2 (sl.d.)	v. s.	v. s.	v. s.
330	nd./pet.	.....	63	.....	.....	.....	.....
331	vl. nd.	.....	.....	.....	i.	v. sl. s.	.....
332	nd.	.....	.....	.....	sl. s.	s.	s.
333	cr./bz.-lg.	.....	95-7 d.	.....	s. h.	s. alk.	s. HCl
334	lf./et.	.....	.....	.....	v. sl. s. h.	.....	sl. s.
335	nd.	.....	255 d.	.....	.....	6.6 h.	.....
336	nd./al.	.....	201 (163)	.....	sl. s.	s.	s.
337	.....	.....	.....	.....	sl. s.	.....	.....
338	nd.	.....	.....	.....	0.4 h.	.....	.....
339	nd.	.....	.....	.....	sl. s.	i.	s. alk.
340	nd.	.....	.....	.....	v. sl. s.	i.	i.; i. bz.
341	col. pd.	.....	.....	.....	s.	i.	i.
342	col. cr.	.....	.....	.....	sl. s.	sl. s.	s. alk.
343	col. cr.	.....	.....	.....	$0.2^{20°}$; $2.4^{60°}$	.....	.....
344	cr.	.....	.....	.....	s.	.....	s. alk.
345	col. nd.	.....	173	subl.	$1.7^{0°}$	$4.3^{0°}$	v. s.
346	col. cr.	.....	.....	.....	$80^{0°}$	$40^{0°}$	.....
347	pr./toluene	.....	122-3	.....	$2.6^{0°}$	s.	sl. s.
348	pr./aq.	.....	229	.....	.....	.....	.....
349	lf.	.....	184-6 d.	subl. sl. d.	$1.1^{0°}$	$4.6^{0°}$, abs.	i. bz.
350	col. pr.	.....	306 d.	.....	$71^{0°}$	$10^{0°}$, abs.	.....

* Cryst. + 1 HCl, m. 100-2°.

Amino-hydroxytoluene 292-9
Amino-menthane 4029
Amino-methane 4105
Amino-methylaniline 4336
Amino-methylanisole 1544
Amino-naphthalene 4529-30
Amino-nitrophenol 4610-6
Amino-nonane 4926
Amino-octane 4970-2
Amino-oxamide 5017
Amino-pentane, cf. amylamine.
Amino-phenetole 5105

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
351	**Amino** phenol (*p*) $H_2C_2O_4$	acid oxalate	$HO{\cdot}C_6H_4{\cdot}NH_2{\cdot}H_2C_2O_4$	*XIII-144	199.16
352	phenol (*p*) $H_2C_2O_4$	oxalate	$(HOC_6H_4NH_2)_2{\cdot}H_2C_2O_4$	*XIII-144	308.28
353	phenol sulfonic acid	(1,2,4)	$C_6H_3(OH)(NH_2)SO_3H{\cdot}\frac{1}{2}H_2O$	XIV-814	198.19
354	phenol sulfonic acid	(1,4,2)	$C_6H_3(OH)(NH_2)SO_3H$	XIV-806	189.18
355	phenol sulfonic acid	(1,4,3)	$C_6H_3(OH)(NH_2)SO_3H$	XIV-812	189.18
356	phenylacetic acid (*α*) (*dl*)	.....	$C_6H_5{\cdot}CH(NH_2){\cdot}CO_2H$	XIV-460	151.16
357	phenylacetic acid (*p*)	*p*-amino-toluic acid	$H_2N{\cdot}C_6H_4{\cdot}CH_2CO_2H$	XIV-456	151.16
358	phenylglycine (*p*)	*N*-(4-aminophenyl)-glycine	$H_2N{\cdot}C_6H_4{\cdot}NH{\cdot}CH_2{\cdot}CO_2H$	XIII-105	166.18
359	phthalhydrazide (3)	luminol	$H_2N{\cdot}C_6H_3{\cdot}CO{\cdot}NH{\cdot}NH{\cdot}CO$	*XXV-698	177.16
360	pyridine (2) (*α*)	.....	$N{\cdot}CH(CH)_3{\cdot}C{\cdot}NH_2$	XXII-428	94.11
361	pyridine (3) (*β*)	.....	$NH_2{\cdot}C_5H_4N$	XXII-431	94.11
362	pyridine (4) (*γ*)	.....	$NH_2{\cdot}C_5H_4N$	XXII-433	94.11
363	pyrine	3-keto-1,5-diMe-4-dimethylamino-2-Ph-2,3-dihy-dropyrazole	$(CH_3)_2N{\cdot}C{:}C(CH_3){\cdot}N(CH_3){\cdot}N(C_6H_5){\cdot}CO$	.....	231.29
364	pyrine-butyl-chloral-hydrate	trigemin	$C_{13}H_{17}ON_3{\cdot}C_4H_7O_2Cl_3$	.....	424.76
365	quinoline (2) (*α*)	.....	$NH_2{\cdot}C_9H_6N$	XXII-443	144.17
366	quinoline (3) (*β*)	.....	$NH_2{\cdot}C_9H_6N$	*XXII-638	144.17
367	quinoline (4) (*γ*)	.....	$NH_2{\cdot}C_9H_6N{\cdot}H_2O$	XXII-444	162.19
368	quinoline (5)	.....	$NH_2{\cdot}C_6H_3{\cdot}CH{:}CH{\cdot}CH{:}N$	XXII-445	144.17
369	quinoline (6)	.....	$NH_2{\cdot}C_9H_6N{\cdot}2H_2O$	XXII-447	180.20
370	quinoline (7)	.....	$NH_2{\cdot}C_9H_6N$ + aq.	XXII-450	144.17
371	quinoline (8)	.....	$NH_2{\cdot}C_9H_6N$	XXII-450	144.17
372	resorcinol (2)	base unknown	.....	.....	.....
373	resorcinol (2) HCl	(2;1,3)	$NH_2{\cdot}C_6H_3(OH)_2{\cdot}HCl$	XIII-782	161.59
374	salicylic acid (3)	3-NH_2-2-OH-benzoic acid	$C_6H_3(CO_2H)(OH){\cdot}NH_2$	XIV-577	153.13
375	salicylic acid (4)	.....	$C_7H_4O_2(OH)NH_2$	XIV-579	153.13
376	salicylic acid (5)	.....	$C_7H_4O_2(OH)NH_2$	XIV-579	153.13
377	thiazol (2)	.....	$NH_2{\cdot}C{:}N{\cdot}CH{:}CH{\cdot}S$	XXVII-155	100.14
378	thiophene (*α*)	thiophenine	$NH_2C_4H_3S$	XVII-248	99.15
379	toluene sulfonic acid (1,2,3)	toluidine sulfonic acid	$C_6H_3(CH_3)(NH_2){\cdot}SO_3H$	XIV-723	187.21

Amino-phenyl-acetonitrile 274
Amino-phenyl-lepidine 3242
Amino-phenyl-propionic acid 5148
Amino-propandiol 3385
Amino-propane 5371-2
Amino-propionic acid 158-60
Amino-*iso*-propyl alcohol 5339
Amino-propylene-glycol 3385

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
351	vl. cr./aq.	.....	220 d.	.....	sl. s.	.....	.....
352	col. fl.	.....	290 d.	.....	i.	sl. s. alc.	i.
353	col. cr.	.....	.....	.....	$1^{14°}$	.....	.....
354	nd. +aq.	.....	d. >300	.....	$0.07^{14°}$	i.	i.
355	nd. +aq.	.....	d. >270-85	.....	$2^{14°}$	i.	i.; s. alk.
356	pr./aq. al.	.....	256	subl.256-65	v. sl. s.	v. sl. s.	v. sl. s.; s. alk.
357	col. lf./aq.	.....	199-200 d.	.....	s. h.	s.	s. alk.
358	lf./aq.	.....	222-3 d.	.....	sl. s.	.....	.....
359	yel. nd.	.....	280-300	.....	i.; s. h. ac.	sl. s.	sl. s.
360	lf./lg.	.....	56	204	s.	v. s.	s.; sl. s. lg.
361	lf./bz. lg.	.....	64	250-2	v. s.	v. s.	v. s.; i. lg.
362	nd./bz.	.....	158	.....	s.; s. alk.	s.; sl. s. bz.	sl. s.
363	col. cr.	.....	107-9	.....	5.5	75	10; 10 bz.
364	col. pd.	.....	82-4	.....	1.5	50	10; s. bz.
365	lf./aq.	.....	129	.....	v. s. h.	s.; sl. s. bz.	s.; sl. s. lg.
366	cr.	.....	94(84)	.....	s.	s.	.....
367	nd./aq.	.....	69-70*	$-H_2O$, 100	s. h.	s.; s. chl.	v. sl. s. CS_2
368	nd./al.	.....	109-10	310	sl. s.	s.	s.; i. lg.
369	cr./aq.	.....	73.5**	subl.	sl. s.	s.	s.; s. NH_4OH
370	yel. nd./aq.	.....	74-5	.....	.....	.....	.....
371	yel. nd./al.	.....	70	.....	s. h.	.....	.....
372	.....	.....	.....	.....	.....	.....	.....
373	gr. pd.	.....	.....	.....	v. s.	s.	i.
374	cr.	.....	235 d.	.....	.....	v. sl. s.	.....
375	cr. pd.	.....	220 d.	.....	v. s.	v. s.	sl. s.
376	nd.	.....	d. 260-80	.....	sl. s. h.	i.; s. HCl	s. CS_2
377	yel. pl./al.	.....	90	d.	sl. s.	sl. s.; s. h.	sl. s.
378	oil	.....	.....	$77\text{-}91^{1mm}$	v. s.	v. s.	i.
379	nd.	.....	.....	.....	$0.97^{11°}$; v. s. h.	.....	.....

* Anh. m.p. 154°.
** Anh. m.p. 93-4°.
Amino-purine, cf. alkd.
Amino Schaeffer's acid 4552
Amino-succinic acid 589-90
Amino-thiophenylimine 5922
Amino-toluene (ω) 783

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
380	**Amino** toluene sulfonic acid	(1,2,4)	$C_6H_3(CH_3)(NH_2)\cdot SO_3H\cdot H_2O$	XIV-728	205.23
381	toluene sulfonic acid	(1,4,2)	$C_6H_3(CH_3)(NH_2)\cdot SO_3H\cdot H_2O$	XIV-720	205.23
382	toluene sulfonic acid	(1,4,3)	$C_6H_3(CH_3)(NH_2)\cdot SO_3H\cdot \frac{1}{2}H_2O$	XIV-723	196.22
383	toluene sulfonic acid	(1,2,5)	$C_6H_3(CH_3)(NH_2)\cdot SO_3H\cdot H_2O$	XIV-726	205.23
384	triphenylmethane (*m*)	benzhydryl aniline	$(C_6H_5)_2CH\cdot C_6H_4NH_2$	XII-1342	259.33
385	triphenylmethane	(*p*)	$(C_6H_5)_2CH\cdot C_6H_4NH_2$	XII-1342	259.33
386	uracil (5)	.....	$H_2N\cdot C{:}CH\cdot NH\cdot CO\cdot$ $\vert\_\_\_\_\_$ $NH\cdot CO$ $\_\_\_\_\vert$	XXIV-463	127.10
387	valeric acid (α)	.....	$C_2H_5\cdot CH_2\cdot CHNH_2\cdot CO_2H$	IV-416	117.15
388	valeric acid (γ) (*dl*)	.....	$CH_3\cdot CHNH_2\cdot (CH_2)_2\cdot CO_2H$	IV-418	117.15
389	valeric acid (δ)	.....	$NH_2\cdot (CH_2)_4\cdot CO_2H$	IV-418	117.15
390	valeric acid HCl (δ)	.....	$NH_2(CH_2)_4CO_2H\cdot HCl$	IV-419	153.61
391	*iso*-valeric acid (α) (*dl*)	α-valine	$(CH_3)_2CH\cdot CHNH_2\cdot CO_2H$	IV-430	117.15
392	*iso*-valeric acid (α) (*l*+)	valine	$(CH_3)_2CH\cdot CHNH_2\cdot CO_2H$	IV-427	117.15
393	*iso*-valeric acid (β)	β-valine	$(CH_3)_2CNH_2\cdot CH_2\cdot CO_2H$	IV-426	117.15
394	valeric acid (α)	*dl-iso*-valine	$C_2H_5\cdot C(CH_3)(NH_2)\cdot CO_2H$	IV-425	117.15
395	valeric acid (α)	*iso*-valine (*l*+)	$C_2H_5\cdot C(CH_3)(NH_2)\cdot CO_2H\cdot H_2O$	*IV-513	117.15
396	**Ammelin**	triuretdiamidine	$(CN)_3(NH_2)_2OH$	XXVI-244	127.11
397	**Amyl** acetate (*n*)	.....	$CH_3\cdot CO_2\cdot C_5H_{11}$	II-131	130.18
398	acetate (*iso*)	common amyl acetate	$CH_3CO_2\cdot CH_2CH_2CH{:}(CH_3)_2$	II-132	130.18
399	acetate	β-Me-Bu-acetate	$CH_3CO_2\cdot CH_2\cdot CH\cdot (CH_3)\cdot C_2H_5$	II-132	130.18
400	acetate (*sec*)	α-Me-Bu-acetate	$CH_3CO_2\cdot CH(CH_3)\cdot CH_2\cdot C_2H_5$	II-131	130.18
401	acetate (*sec*)	diEt-carbinol acetate	$CH_3CO_2\cdot CH(C_2H_5)_2$	II-131	130.18
402	acetate (*tert*)	.....	$CH_3CO_2\cdot C(CH_3)_2\cdot C_2H_5$	II-132	130.18
403	acetic acid (*iso*)	.....	$(CH_3)_2{:}C_4H_7\cdot CO_2H$	II-342	130.18
404	alcohol (*n*)	pentanol-1	$CH_3\cdot (CH_2)_3\cdot CH_2OH$	I-383	88.15
405	alcohol (*sec. n*)	pentanol-2	$C_2H_5\cdot CH_2\cdot CHOH\cdot CH_3$	I-384	88.15
406	alcohol (*prim. iso*)	2-methyl-butanol-4	$(CH_3)_2CH\cdot CH_2\cdot CH_2OH$	I-392	88.15
407	alcohol (*sec. iso*)	2-methyl-butanol-3	$(CH_3)_2CH\cdot CHOH\cdot CH_3$	I-391	88.15
408	alcohol	pentanol-3	$(C_2H_5)_2{:}CHOH$	I-385	88.15
409	alcohol (*tert*)	2-methyl-butanol-2	$(CH_3)_2COH\cdot C_2H_5$	I-388	88.15
410	alcohol	2,2-diMe-propanol-1	$(CH_3)_3C\cdot CH_2OH$	I-406	88.15
411	alcohol (*d*)	active amyl alcohol	$C_2H_5\cdot CH(CH_3)\cdot CH_2OH$	I-385	88.15

Amino-toluic acid 357
Amphotropin 3601
Amygdalin, cf. glcde.
Amyl, cf. also diamyl.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
380	nd.	.....	.....	.....	$0.9^{11°}$	i.	.....
381	mn.	.....	d.	.....	$0.5^{20°}$	i.	.....
382	nd.	.....	.....	.....	0.47	.....	.....
383	tri./aq.	.....	$-H_2O$, 120	.....	$2.7^{11°}$ (anh.)	i.	.....
384	nd./et.	.....	120	.....	.....	.....	.....
385	pr./et.	.....	83-4	248^{12mm} ±	i.	s. bz.	.....
386	nd./aq.	.....	d.	subl. d.	0.05 c.; 1.6 h.	s. a.; s. alk.	s. NH_4OH
387	nd./aq.	.....	291.5	subl.	$10^{15°}$; v. s. h.	sl. s.	i.
388	cr.	.....	193-214 d.	.....	v. s.	v. sl. s.	i.; i. bz.
389	lf.	.....	157-8 d.	.....	v. s.	v. sl. s. abs.	i.
390	pl. or pr.	.....	90-2	.....	s.	s.	i.
391	lf./al.	.....	298 d.	subl.	$7^{25°}$	v. sl. s.	v. sl. s.
392	lf./aq. al.	.....	315*	subl. d.	$9.1^{16.5°}$	v. sl. s.	v. sl. s.
393	cr./al.+et.	.....	217	subl. >180	v. s.	v. sl. s.	i.
394	rhb.+aq./ aq. al.	.....	307.5**	subl. 300 ±	$36^{20°}$	$0.6^{15°}$	6 h.
395	nd./aq. al.	.....	315	subl.	s.	sl. s.	.....
396	nd./aq.	.....	.....	.....	$0.008^{23°}$	i.	i.; s. HCl
397	col. lq.	$0.879^{20°}_{20°}$	.....	148.4^{737mm}	v. sl. s.	∞	∞
398	col. lq.	$0.876^{15°}_{4°}$	.....	142^{757mm}	$0.25^{15°}$	∞	∞
399	col. lq.	$0.880^{12.5°}$	.....	141-2	v. sl. s.	∞	∞
400	col. lq.	$0.922^{0°}$	.....	133.5	sl. s.	∞	∞
401	col. lq.	$0.871^{20°}_{4°}$	.....	131	sl. s.	∞	∞
402	col. lq.	$0.874^{19°}$	.....	124.5^{749mm}	v. sl. s.	∞	∞
403	col. oil	$0.912^{18°}_{18°}$	.....	216^{762mm}	sl. s. h.	∞	∞
404	col. lq.	$0.817^{20°}_{20°}$	.....	137.8-7.9	$2.7^{22°}$	∞	∞
405	col. lq.	$0.810^{20°}_{20°}$	.....	118.5-9.5	16.6	∞	∞
406	col. lq.	$0.813^{15°}_{4°}$	-117.2	132.0	$21^{4°}$	∞	∞
407	col. lq.	$0.819^{19°}$	.....	113-4	$2.8^{30°}$	∞	∞
408	col. lq.	$0.815^{25°}_{4°}$	.....	115.6	$5.5^{30°}$	∞	∞
409	col. lq.	$0.809^{20°}_{4°}$	-11.9	102	sl. s.	s.	s.
410	cr.	.....	52-3	113-4	sl. s.	∞	∞
411	col. lq.	$0.816^{20°}_{4°}$	.....	128	$3.6^{30°}$	∞	∞

* Sealed tube.
** Sealed tube; loses aq. at 100°.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
412	**Amyl** amine (*n*)	.....	$CH_3(CH_2)_4NH_2$	IV-175	87.16
413	amine (*sec. n*)	.....	$(C_3H_7)(CH_3):CHNH_2$	IV-177	87.16
414	amine (*iso*)	.....	$(CH_3)_2CH(CH_2)_2NH_2$	IV-180	87.16
415	amine (*tert*)	.....	$(C_2H_5)(CH_3)_2C{\cdot}NH_2$	IV-179	87.16
416	amine	1-NH_2-2-Me-butane	$C_2H_5CH(CH_3){\cdot}CH_2NH_2$	IV-178	87.16
417	amine	3-aminopentane	$(C_2H_5)_2:CH{\cdot}NH_2$	IV-178	87.16
418	amine	3-NH_2-2-Me-butane	$(CH_3)_2CH{\cdot}CH{\cdot}(CH_3)NH_2$	IV-179	87.16
419	aniline (*iso*)	.....	$C_6H_5{\cdot}NH{\cdot}C_5H_{11}$	XII-169	163.25
420	aniline (*p*) (*tert*)	.....	$(C_2H_5)(CH_3)_2C{\cdot}C_6H_4{\cdot}NH_2$	XII-1179	163.25
421	benzene (*n*)	1-phenylpentane	$C_5H_{11}{\cdot}C_6H_5$	V-434	148.24
422	benzene (*iso*)	.....	$C_5H_{11}{\cdot}C_6H_5$	V-434	148.24
423	benzene (*tert*)	diMe-Et-Ph-methane	$C_5H_{11}{\cdot}C_6H_5$	V-436	148.24
424	benzene (*sec*)	diEt-Ph-methane	$(C_2H_5)_2CH{\cdot}C_6H_5$	V-436	148.24
425	benzoate (*iso*)	.....	$C_6H_5{\cdot}CO_2{\cdot}C_5H_{11}$	IX-113	192.25
426	benzyl ether (*iso*)	.....	$C_6H_5{\cdot}CH_2{\cdot}O{\cdot}C_5H_{11}$	.....	178.26
427	bromide (*n*)	1-bromopentane	$CH_3{\cdot}(CH_2)_3{\cdot}CH_2Br$	I-131	151.05
428	bromide (*iso*)	4-Br-2-Me-butane	$(CH_3)_2CH(CH_2)_2Br$	I-136	151.05
429	bromide (*tert*)	2-Br-2-Me-butane	$(CH_3)_2C(Br){\cdot}C_2H_5$	I-136	151.05
430	bromide	1-Br-2, 2-diMe-propane	$(CH_3)_3C{\cdot}CH_2Br$	I-141	151.05
431	bromide	1-Br-2-Me-butane	$C_2H_5{\cdot}CH(CH_3){\cdot}CH_2Br$	I-136	151.05
432	*n*-butyrate (*n*)	.....	$C_2H_5CH_2CO_2(CH_2)_4{\cdot}CH_3$	II-271	158.23
433	*n*-butyrate (*iso*)	.....	$C_2H_5CH_2CO_2{\cdot}C_5H_{11}$	II-271	158.23
434	*n*-butyrate (*tert*)	.....	$C_3H_7CO_2{\cdot}C(CH_3)_2{\cdot}C_2H_5$	II-271	158.23
435	*iso*-butyrate (*iso*)	.....	$(CH_3)_2CHCO_2{\cdot}C_5H_{11}$	II-291	158.23
436	*n*-caproate (*n*)	.....	$C_5H_{11}CO_2{\cdot}C_5H_{11}$	II-323	186.29
437	*n*-caproate (*iso*)	.....	$C_5H_{11}CO_2{\cdot}(CH_2)_2{\cdot}CH:(CH_3)_2$	.....	186.29
438	*n*-caprylate (*iso*)	.....	$C_7H_{15}CO_2{\cdot}(CH_2)_2{\cdot}CH:(CH_3)_2$	.....	214.34
439	carbamate (*n*)	.....	$H_2N{\cdot}CO_2{\cdot}C_5H_{11}$	.....	131.17
440	carbamate (*iso*)	.....	$NH_2{\cdot}CO_2{\cdot}C_5H_{11}$	III-30	131.17
441	carbamate (*tert*)	aponal	$H_2N{\cdot}CO_2{\cdot}C(CH_3)_2{\cdot}C_2H_5$	*III-14	131.17
442	chloride (*n*)	1-chloropentane	$CH_3{\cdot}(CH_2)_3{\cdot}CH_2Cl$	I-130	106.60
443	chloride (*sec*)	2-chloropentane	$C_3H_7{\cdot}CHCl{\cdot}CH_3$	I-131	106.60
444	chloride (*sec*)	3-chloropentane	$(C_2H_5)_2CHCl$	I-131	106.60
445	chloride (*iso*)	4-Cl-2-Me-butane	$(CH_3)_2CH(CH_2)_2Cl$	I-135	106.60
446	chloride (*sec. iso*)	3-Cl-2-Me-butane	$(CH_3)_2CH{\cdot}CHCl{\cdot}CH_3$	I-135	106.60
447	chloride (*tert*)	2-Cl-2-Me-butane	$(CH_3)_2CCl{\cdot}C_2H_5$	I-134	106.60
448	chloride	1-Cl-2-Me-butane	$(CH_3)(C_2H_5)CH{\cdot}CH_2Cl$	I-134	106.60
449	chloroformate (*n*)	*n*-amyl chlorocarbonate	$C_2H_5(CH_2)_3O{\cdot}COCl$	.....	150.61
450	chloroformate (*iso*)	*iso*-amyl chlorocarbonate	$(CH_3)_2CH(CH_2)_2{\cdot}O{\cdot}COCl$	III-12	150.61

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
412	col. lq.	$0.766^{19°}$	−55	103-4	s.	s.	s.
413	col. lq.	$0.749^{20°}_{4°}$	.....	91-2	∞	∞	∞
414	col. lq.	$0.751^{18°}_{4°}$	.....	95	∞	∞	∞
415	col. lq.	$0.731^{25°}_{4°}$	−105	77-8	∞	∞ ; ∞ chl.	∞
416	col. lq.	$0.755^{18°}$	.....	95-6	∞	∞	∞
417	col. lq.	$0.749^{20°}_{4°}$	.....	90-1	∞	∞	∞
418	col. lq.	$0.757^{18.5°}$	.....	83-4	∞	∞	∞
419	lq.	$0.928^{15°}_{4°}$	.....	254.5	.....	.....	.....
420	col. lq.	.....	.....	259-62	i.	s.	s.
421	lq.	$0.858^{20°}_{4°}$	−78.3	205.3	i.	∞	∞
422	lq.	$0.859^{20°}_{4°}$	.....	198-9	i.	∞	∞
423	lq.	$0.867^{20°}_{4°}$	.....	189-90	i.	∞	∞
424	col. lq.	$0.876^{15°}_{4°}$	.....	187^{753mm}	i.	s.	s.
425	col. lq.	$0.992^{14°}_{14°}$	.....	260.7^{746mm}	i.	∞	∞
426	col. lq.	.....	.....	237^{748mm}	i.	s.	s.
427	col. lq.	$1.218^{20°}_{4°}$	.....	128.7^{739mm}	i.	s.	.....
428	col. lq.	$1.220^{17°}_{15°}$	.....	120.4^{745mm}	i.	s.	s.
429	lq.	$1.216^{19°}_{0°}$	.....	108^{765mm}	i.	s.	s.
430	col. lq.	$1.260^{20°.4°}_{4°}$	.....	$89-91^{749mm}$	i.	s.	s.
431	lq.	$1.221^{20°}_{4°}$	.....	121^{755mm}	i.	s.	s.
432	col. lq.	$0.871^{15°}_{4°}$	−73.2	185	$0.05^{50°}$	∞	∞
433	col. lq.	$0.866^{18°}_{15°}$	.....	178.6	i.	∞	∞
434	col. lq.	$0.865^{14.5°}_{0°}$	.....	164	sl. s.	∞	∞
435	lq.	$0.876^{0°}_{4°}$	.....	168.8	i.	s.	s.
436	col. lq.	.....	.....	222-7	.....	.....	.....
437	col. lq.	.....	.....	$94-6^{10mm}$	i.	s.	.....
438	col. lq.	.....	.....	136^{10mm}	i.	s.	.....
439	col. pl.	.....	56-7.5	.....	i.	s.	s.
440	nd./aq.	$0.944^{7.6°}_{4°}$	64	220	s. h.	s.	s.
441	nd./aq. al.	.....	86	.....	sl. s.	s.	s.; sl. s. pet.
442	col. lq.	$0.878^{20°}_{4°}$	.....	108.4	i.	s.	s.
443	lq.	$0.870^{20°}_{4°}$	.....	96.7	i.	s.	s.
444	col. lq.	$0.895^{21°}$	.....	97.3	i.	∞	∞
445	col. lq.	$0.893^{20°}_{4°}$	.....	99.7^{758mm}	i.	s.	∞
446	lq.	$0.883^{0°}$	.....	91^{753mm}	i.	s.	s.
447	lq.	$0.871^{20°}_{4°}$	−72.9	85.7	i.	s.	s.
448	lq.	$0.881^{17.5°}$	.....	98-9	i.	s.	s.
449	col. lq.	.....	.....	$43-5^{7mm}$	.....	.....	.....
450	lq.	$1.028^{18.5°}_{15°}$	.....	155-6	i.	∞	∞

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
451	**Amyl** cinnamaldehyde (*n*) (*α*)	.....	$C_6H_5{\cdot}CH{:}C(C_5H_{11}){\cdot}CHO$	.....	202.28
452	*m*-cresol (*n*)	.....	$C_5H_{11}{\cdot}C_6H_3(OH)CH_3$	.....	178.26
453	*iso*-cyanide (*iso*)	*iso*-caproic *iso*-nitrile	$(CH_3)_2CH(CH_2)_2{\cdot}NC$	IV-184	97.16
454	formate (*n*)	.....	$HCO_2{\cdot}C_5H_{11}$	II-22	116.16
455	formate (*iso*)	.....	$HCO_2{\cdot}C_5H_{11}$	II-22	116.16
456	formate, ortho (*n*)	.....	$HC(OC_5H_{11})_3$	II-22	274.43
457	furoate (*iso*)	*iso*-Am pyromucate	$C_4H_3O{\cdot}CO_2{\cdot}C_5H_{11}$	.....	182.21
458	*β*-furylacrylate (*n*)	.....	$C_4H_3O{\cdot}CH{:}CH{\cdot}CO_2C_5H_{11}$	.....	208.25
459	iodide (*n*)	1-iodopentane	$CH_3{\cdot}(CH_2)_3{\cdot}CH_2I$	I-133	198.06
460	iodide (*iso*)	4-I-2-Me-butane	$(CH_3)_2CH{\cdot}CH_2{\cdot}CH_2I$	I-138	198.06
461	iodide (*sec n*)	2-iodopentane	$C_3H_7{\cdot}CHI{\cdot}CH_3$	I-133	198.06
462	iodide (*tert*)	2-I-2-Me-butane	$(CH_3)_2CI{\cdot}C_2H_5$	I-138	198.06
463	iodide	1-I-2-Me-butane	$C_2H_5{\cdot}CH(CH_3){\cdot}CH_2I$	I-138	198.06
464	*d*-lactate (*dl*) (−)	.....	$C_2H_5OCO_2{\cdot}CH_2{\cdot}CH(CH_3)C_2H_5$	III-265	160.21
465	malonic acid (*n*)	.....	$C_5H_{11}CH(CO_2H)_2$	II-695	174.19
466	malonic acid (*iso*)	.....	$C_5H_{11}CH(CO_2H)_2$	II-700	174.19
467	mercaptan (*n*)	pentanthiol-1	$CH_3{\cdot}(CH_2)_3{\cdot}CH_2{\cdot}SH$	I-384	104.21
468	mercaptan (*n*)	pentanthiol-3	$(C_2H_5)_2CH{\cdot}SH$	*I-194	104.21
469	mercaptan (*iso*)	2-Me-butanthiol-4	$(CH_3)_2CH(CH_2)_2SH$	I-405	104.21
470	naphthalene (*iso*) (*β*)	.....	$C_5H_{11}{\cdot}C_{10}H_7$	V-574	198.29
471	*β*-naphthyl ether (*iso*)	.....	$C_5H_{11}{\cdot}O{\cdot}C_{10}H_7$	VI-642	214.29
472	nitrate (*iso*)	.....	$(CH_3)_2CH{\cdot}CH_2{\cdot}CH_2{\cdot}O{\cdot}NO_2$	I-403	133.15
473	nitrite (*n*)	.....	$C_5H_{11}{\cdot}O{\cdot}NO$	I-384	117.15
474	nitrite (*iso*)	.....	$(CH_3)_2CH{\cdot}CH_2{\cdot}CH_2{\cdot}O{\cdot}NO$	I-402	117.15
475	oleate (*iso*)	.....	$C_8H_{17}CH{:}CHC_7H_{14}{\cdot}CO_2{\cdot}C_5H_{11}$	II-467	352.58
476	phenol (*tert*) (*p*)	pentaphen	$C_5H_{11}{\cdot}C_6H_4{\cdot}OH$	VI-548	164.24
477	phenol methyl ether (*tert*) (*p*)	.....	$(C_2H_5)(CH_3)_2C{\cdot}C_6H_4{\cdot}O{\cdot}CH_3$	VI-549	178.26
478	phenyl ether (*n*)	.....	$CH_3(CH_2)_4{\cdot}O{\cdot}C_6H_5$	*VI-82	164.24
479	phenyl ether (*iso*)	.....	$C_5H_{11}{\cdot}O{\cdot}C_6H_5$	VI-143	164.24
480	*α*-phenylhydrazine	(*iso*) (*α*)	$C_6H_5{\cdot}N(NH_2)C_5H_{11}$	XV-121	178.27
481	phenyl ketone (*n*)	caprophenone	$C_5H_{11}{\cdot}CO{\cdot}C_6H_5$	VII-333	176.25
482	phenyl ketone (*iso*)	*iso*-caprophenone	$C_5H_{11}{\cdot}CO{\cdot}C_6H_5$	VII-334	176.25
483	propionate (*n*)	.....	$C_2H_5{\cdot}CO_2{\cdot}C_5H_{11}$	.....	144.21
484	propionate (*iso*)	.....	$C_2H_5{\cdot}CO_2{\cdot}C_5H_{11}$	II-241	144.21
485	propionate (*act*)	.....	$C_2H_5{\cdot}CO_2{\cdot}C_5H_{11}$	II-241	144.21
486	salicylate (*n*)	.....	$HO{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_5H_{11}$	.....	208.25
487	salicylate (*iso*)	.....	$HO{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_5H_{11}$	X-76	208.25
488	stearate (*iso*)	.....	$CH_3(CH_2)_{16}CO_2{\cdot}C_5H_{11}$	II-380	354.60
489	stearate	.....	$C_{17}H_{35}CO_2{\cdot}CH_2{\cdot}CH{:}(CH_3)C_2H_5$	II-380	354.60
490	thiocyanate (*iso*)	.....	$(CH_3)_2CH(CH_2)_2{\cdot}S{\cdot}CN$	III-177	129.22
491	*iso*-thiocyanate (*n*)	amyl mustard oil	$CH_3(CH_2)_4{\cdot}N{:}C{:}S$	IV-176	129.22

Amyl cyanide 1217-8, 2104
Amyl disulfide 1753-4
Amyl ether 1740-1
Amyl-ethyl-barbituric acid 505
Amyl mustard oil 491-3
Amyl oxalate 1745
Amyl phthalate 1746-7

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
451	yel. lq.	.....	.....	163-8^{15mm}	.....	.....	.....
452	col.	.....	24-5	137-9^{15mm}	i.	s.	s.
453	lq.	.....	.....	137-9	i.	s.	s.
454	lq.	$0.902^{20°}$	.....	130.4	v. sl. s.	∞	∞
455	lq.	$0.871^{\frac{20}{4}°}$	.....	123.5	$0.3^{22°}$	∞	∞
456	lq.	$0.864^{23°}$	.....	265-7 dec.	.....	.....	.....
457	col. lq.	.....	.....	135-7^{25mm}	i.	∞	.....
458	col. lq.	$1.032^{\frac{20}{4}°}$	.....	119^{4mm}	i.	.....	.....
459	lq.	$1.510^{\frac{20}{4}°}$	.....	155.4^{739mm}	i.	s.	∞
460	lq.	$1.515^{\frac{18}{4}°}$	.....	147^{765mm}	i.	∞	∞
461	lq.	$1.507^{\frac{17}{4}°}$	.....	144-5	i.	∞	∞
462	lq.	$1.471^{\frac{15}{15}°}$	.....	127^{765mm}	i.	∞	∞
463	lq.	$1.524^{\frac{20}{4}°}$	.....	148^{760mm}	i.	∞	∞
464	col. lq.	$0.971^{\frac{20}{4}°}$	.....	114-5^{36mm}	v. sl. s.	s.	s.
465	col. pr.	.....	82	d. 140	v. s.	v. s.	v. s.
466	nd./aq.	.....	93	d.	v. s.	v. s.	v. s.
467	lq.	$0.857^{20°}$	.....	126^{767mm}	i.	∞	∞
468	col. lq.	.....	.....	105	i.	∞	∞
469	lq.	$0.835^{\frac{20}{4}°}$	.....	129.5	i.	∞	∞
470	col. lq.	$0.973^{0°}$	<-21	288-92	i.	s.	s.
471	col. lf.	$1.016^{\frac{2}{4}°}$	26.5	323-6	i.	s.	s.
472	lq.	$0.996^{21.7°}$	.....	147-8	v. sl. s.	i.	i.
473	pa. yel. lq.	$0.853^{20°}$	.....	104^{761mm}	sl. s.	∞	∞
474	lq.	$0.872^{\frac{20}{4}°}$	.....	99	sl. s.	∞	∞
475	col. lq.	$0.897^{15°}$	.....	223-4^{10mm}	i.	s.	v. s.
476	cr.	.....	93	265-7	sl. s.	s.	s.
477	col. lq.	.....	.....	216-7	i.	s.	s.
478	col. lq.	.....	.....	111^{17mm}	i.	s.	s.
479	col. oil	$0.920^{\frac{25}{4}°}$	.....	224-5	i.	s.	s.
480	lq.	$0.968^{15°}$	.....	260-2	.....	.....	.....
481	lf.	$0.958^{\frac{25}{4}°}$	24.7	265.2	.....	.....	.....
482	lq.	$0.962^{\frac{15}{4}°}$	-2	240-2^{720mm}	i.	v. s.	v. s.
483	lq.	$0.876^{\frac{15}{4}°}$	-73.1	168.7	i.	∞	∞
484	col. lq.	$0.870^{\frac{20}{4}°}$	.....	160.2	$0.1^{25°}$	∞	∞
485	col. lq.	$0.866^{\frac{20}{4}°}$	.....	58^{16mm}	v. sl. s.	∞	∞
486	lq.	$1.065^{15°}$	.....	265	i.	∞	∞
487	lq.	$1.045^{\frac{25}{25}°}$	.....	276-7^{743mm}	$0.004^{22°}$	∞	∞ ; ∞ chl.
488	col. pl.	$0.855^{\frac{20}{4}°}$	23	185-90^{1mm}	i.	sl. s.	s.
489	col. lq.	$0.855^{\frac{20}{4}°}$	21-2	.....	i.	s.	s.
490	pa. yel. oil	0.905	.....	197	i.	s.	s.
491	lq.	.....	.....	193.4	v. sl. s.	v. s.	v. s.

Amyl pyromucate 457
Amyl succinate 1748-50
Amyl sulfide (*iso*) 1751-2
Amyl sulfite 1755
Amyl sulfone 1756
Amyl tartrate 1757

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
492	**Amyl *iso*-thiocyanate (*iso*)**	amyl mustard oil	$(CH_3)_2CH(CH_2)_2 \cdot N:C:S$	IV-186	129.22
493	***iso*-thiocyanate (*tert*)**	amyl mustard oil	$C_5H_{11}N:C:S$	IV-179	129.22
494	urea (*iso*)	.....	$C_5H_{11} \cdot NH \cdot CO \cdot NH_2$	IV-185	130.19
495	urea (*tert*)	.....	$C_5H_{11} \cdot NH \cdot CO \cdot NH_2$	IV-179	130.19
496	*iso*-valerate (*iso*)	.....	$C_4H_9 \cdot CO_2 \cdot C_5H_{11}$	II-312	172.26
497	*iso*-valerate (*tert*)	valamin	$C_4H_9 \cdot CO_2 \cdot C_5H_{11}$	II-312	172.26
498	**Amylene (*n*)**	pentene-1	$C_2H_5 \cdot CH_2 \cdot CH:CH_2$	I-210	70.13
499	**Amylene (*iso*)**	2-methyl-butene-3	$(CH_3)_2CH \cdot CH:CH_2$	I-213	70.13
500	**Amylene (α)**	2-methyl-butene-1	$(C_2H_5)(CH_3)C:CH_2$	I-211	70.13
501	**Amylene (β)**	pentene-2	$C_2H_5 \cdot CH:CH \cdot CH_3$	I-210	70.13
502	**Amylene (β) (*iso*)**	2-methyl-butene-2	$(CH_3)_2:C:CH \cdot CH_3$	I-211	70.13
503	glycol (1,4)	γ-pentylene glycol	$C_5H_{10}(OH)_2$	I-480	104.15
504	glycol (2,4)	*iso*-amylene alcohol	$C_5H_{10}(OH)_2$	I-483	104.15
505	**Amytal**	*iso*-Am-Et-barbituric acid	$(C_2H_5)(C_5H_{11}):C \cdot CO \cdot NH \cdot CO \cdot NH \cdot CO$	.....	226.27
506	sodium	.....	$C_{11}H_{17}O_3N_2Na$	.....	248.26
507	**Anacardic acid**	.....	$HO \cdot C_{21}H_{30} \cdot CO_2H$	X-327	344.48
508	**Analgen**	8-EtO-5-benzoyl-amino-quinoline	$C_7H_5ONH \cdot C_6H_2 \cdot (OC_2H_5):C_3H_3N$	XXII-503	292.32
509	**Androsterone**	3-*trans*-hydroxy-17-keto-androstane	$C_{19}H_{30}O_2$	.....	290.43
510	**Anemonin**	pulsatilla camphor	$C_{10}H_8O_4$	.....	192.16
511	**Anethole**	*p*-propenyl anisole	$CH_3 \cdot CH:CH \cdot C_6H_4 \cdot OCH_3$	VI-566	148.20
512	**Anhydroformaldaniline**	methylene aniline	$(CH_2NC_6H_5)_3$	XXVI-3	315.40
513	**Aniline**	aminobenzene	$C_6H_5 \cdot NH_2$	XII-59	93.12
514	acetate	.....	$C_6H_5NH_2 \cdot C_2H_4O_2$	XII-118	153.18
515	arsonic acid (*p*)	arsanilic acid	$H_2N \cdot C_6H_4 \cdot AsO_3H_2$	XVI-878	217.04
516	blue	spirit blue	$C_{38}H_{32}N_3 \cdot Cl$	XIII-768	566.12
517	disulfonic acid	(2,5)	$NH_2 \cdot C_6H_3:(SO_3H)_2 \cdot 4H_2O$	XIV-780	325.31
518	disulfonic acid	(2,4)	$NH_2 \cdot C_6H_3:(SO_3H)_2 \cdot 2H_2O$	XIV-778	289.28
519	hydrobromide	.....	$C_6H_5NH_2 \cdot HBr$	XII-116	174.05
520	hydrochloride	.....	$C_6H_5NH_2 \cdot HCl$	XII-116	129.59
521	nitrate	.....	$C_6H_5NH_2 \cdot HNO_3$	XII-116	156.14
522	sulfate	.....	$(C_6H_5NH_2)_2 \cdot H_2SO_4$	XII-117	284.32
523	*o*-sulfonic acid	orthanilic acid	$NH_2 \cdot C_6H_4 \cdot SO_3H$†	XIV-681	173.18
524	*m*-sulfonic acid	metanilic acid	$NH_2 \cdot C_6H_4 \cdot SO_3H$‡	XIV-688	173.18
525	*p*-sulfonic acid	sulfanilic acid	$NH_2 \cdot C_6H_4 \cdot SO_3H$§	XIV-695	173.18
526	*p*-sulfonic Na	.....	$NH_2 \cdot C_6H_4 \cdot SO_3Na \cdot 2H_2O$	XIV-698	231.21
527	*p*-sulfonic amide	sulfanilamide	$NH_2 \cdot C_6H_4 \cdot SO_2 \cdot NH_2$	XIV-698	172.20

† Also crysts. $+ \frac{1}{2}H_2O$.
‡ Also crysts. $+ 1\frac{1}{2}H_2O$.
§ Also crysts. $+ 1H_2O$.
Amyl toluene 4119
Amylene alcohol 504, 4103
Amylene chloride 2034
Amylocaine 5644
Anabasine, cf. alkd.
Analgesine 565
Andirine 4405
Anemone camphor 510
Anesthesine 2955
Angelic acid 2425
Angeline 4405
Anhaline, cf. alkd.
Anhalonine, cf. alkd.
Aniline salt 520
Aniline violet 3593
Aniline yellow 249
Anilino-acetic acid 5194

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
492	yel. lq.	$0.942^{17°}$	.....	183-4	v. sl. s.	v. s.	v. s.
493	lq.	.....	<−10	166^{770mm}	v. sl. s.	v. s.	v. s.
494	cr.	.....	92-3	.....	v. sl. s.	.....	.....
495	mn./aq.	.....	152-8	.....	$1.3^{27°}$	.....	.....
496	col. lq.	$0.858^{20°}_{15°}$	.....	194	v. sl. s.	∞	∞
497	col. lq.	$0.861^{14°}_{0°}$	.....	173-4	sl. s.	s.	∞ oils
498	lq.	.....	.....	39-40	i.	∞	∞
499	col. lq.	$0.632^{15°}$	−135	20.5^{771mm}	*	∞	∞
500	col. lq.	$0.667^{0°}_{0°}$	.....	$31-2^{758mm}$	**	∞	∞
501	col. lq.	$0.650^{20°}_{4°}$	−139	36.4	v. sl. s.	∞	∞
502	col. lq.	$0.663^{18°}_{4°}$	−124	37-8	**	s.	∞
503	oil	$0.996^{17°}_{4°}$	.....	$219-20^{13mm}$	∞	∞	∞ chl.; i. lg.
504	syrup	$0.989^{20°}$	.....	202-3	.....	.....	.....
505	col. cr.	.....	154-6	.....	sl. s.	s.	s.; s. alk.
506	hyg. pd.	.....	150-5	.....	v. s.	100	i.
507	cr.	.....	26	.....	i.	s.	s.
508	yel. nd./al.	.....	210	.....	i.	v. sl. s. c.	s. a.
509	col. nd./ 65% al.	.....	184-5	.....	i.; s. MeOH	s.; s. CCl_4	s.; s. bz.
510	yel.-wh. cr.	.....	157-8	.....	sl. s. h.	s. h.	i.
511	lf./al.	$0.991^{20°}_{20°}$	22.5	235.3	v. sl. s.	∞ abs. al.	∞
512	pr./al.	.....	143	185	i.	sl. s.	s.; s. bz.
513	col. oil	$1.022^{20°}_{4°}$	-6.2	184.4	$3.6^{18°}$	∞	∞
514	col. lq.	1.07	.....	d., $-H_2O$	∞	∞	.....
515	nd./aq.	.....	232	d. $-H_2O$, 150	v. s. h.	v. s. h.	i.; i. bz.
516	bl.-brn. cr.	.....	.....	.....	i.	sl. s.	i.
517	cr./aq.	.....	.....	.....	v. s.	v. s.	.....
518	nd./aq.	.....	d. >120	.....	v. s.	v. s.	i.; s. alk.
519	cr. pd.	.....	286	.....	s.	s.	.....
520	lf. or nd.	$1.222^{4°}$	198	245	$18^{15°}$; $107^{25°}$	s.	i.
521	rhb.	$1.356^{4°}$	d. 190	.....	s.	s.	sl. s.
522	lf./al.	$1.377^{4°}$	d.	.....	$5^{14°}$	sl. s.	i.
523	col. cr.	.....	d.	.....	$1.5^{15°}$	v. sl. s.	v. sl. s.
524	col. nd.	.....	d.	.....	$2^{15°}$	v. sl. s.	v. sl. s.
525	col. cr.	.....	d. 280-300	.....	$0.8^{100°}$; $6.6^{100°}$	v. sl. s.	v. vl. s.
526	rhb.	.....	.....	.....	v. s.	s. h.	i.
527	col. lf./ aq. al.	.....	165-6	.....	0.8 c.; v. s. h.	3 c.	s.; 20 act.

* Insoluble in a mixt. of $2H_2SO_4 + 1H_2O$.
** Very soluble in mixt. of $2H_2SO_4 + 1H_2O$.
Anilino-azobenzene 659
Anilino-benzoic acid 5157
Anilino-ethyl alcohol 2930
Anilino-glyoxylic acid 3921
Anilino-phenol 3767-9
Aniluvitonic acid 5529
Animal starch 3443
Anisal-benzylamine 812
Anise camphor 511
Anise oil 1261
Anisic acid 4069
Anisoyl-anisole 2409
Anisoyl chloride 4071

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
528	**Anis**-alacetone (*p*)	MeO-benzalacetone	$CH_3O{\cdot}C_6H_4{\cdot}CH{:}CH{\cdot}CO{\cdot}CH_3$	VIII-131	176.22
529	alcinnamalacetone	(α,α')	$C_6H_5{\cdot}(CH{:}CH)_2{\cdot}CO{\cdot}CH{:}CH{\cdot}C_6H_4{\cdot}OCH_3$	VIII-208	290.34
530	alcohol	*p*-MeO-benzyl alcohol	$CH_3O{\cdot}C_6H_4{\cdot}CH_2OH$	VI-897	138.16
531	aldehyde (*o*)	MeO-benzaldehyde	$CH_3O{\cdot}C_6H_4{\cdot}CHO$	VIII-43	136.14
532	aldehyde (*p*)	.....	$CH_3O{\cdot}C_6H_4{\cdot}CHO$	VIII-67	136.14
533	aldehyde phenylhydrazone (*p*)	.....	$C_6H_5NH{\cdot}N{:}CH{\cdot}C_6H_4{\cdot}OCH_3$	XV-192	226.27
534	**Anisidine** (*o*)	2-amino-anisole	$NH_2{\cdot}C_6H_4{\cdot}OCH_3$	XIII-358	123.15
535	**Anisidine** (*m*)	MeO-aniline (*m*)	$NH_2{\cdot}C_6H_4{\cdot}OCH_3$	XIII-404	123.15
536	**Anisidine** (*p*)	4-amino-anisole	$NH_2{\cdot}C_6H_4{\cdot}OCH_3$	XIII-435	123.15
537	**Anisole**	methyl-phenyl ether	$CH_3{\cdot}O{\cdot}C_6H_5$	VI-138	108.13
538	**Anthracene**	.....	$(C_6H_4CH)_2$	V-657	178.22
539	carboxylic acid (1) (β)	.....	$C_6H_4{:}C_2H(CO_2H){:}C_6H_4$	IX-704	222.23
540	carboxylic acid (2) (γ)	.....	$C_6H_4{:}(CH)_2{:}C_6H_3{\cdot}CO_2H$	IX-705	222.23
541	carboxylic acid (9) (α)	.....	$C_6H_4{:}(CH)_2{:}C_6H_3{\cdot}CO_2H$	IX-705	222.23
542	**Anthramine** (α)	α-amino-anthracene	$C_{14}H_9{\cdot}NH_2$	XII-1335	193.24
543	**Anthramine** (β)	β-amino-anthracene	$C_{14}H_9{\cdot}NH_2$	XII-1335	193.24
544	**Anthranil**	.....	$O{\cdot}N{:}C_6H_4{:}CH$	XXVII-39	119.12
545	**Anthranol**	γ-hydroxy anthracene	$C_6H_4{\cdot}CO{\cdot}C_6H_4{\cdot}CH_2$	VII-473	194.22
546	**Anthranoyl anthranilic acid**	.....	$NH_2{\cdot}C_6H_4{\cdot}CO{\cdot}NHC_6H_4{\cdot}CO_2H$	XIV-358	256.25
547	**Anthraquinoline** (β)	.....	$C_{17}H_{11}N$	XX-506	229.27
548	**Anthraquinone** (1,2)	.....	$C_{10}H_6(CO)_2CH{:}CH$	VII-780	208.20
549	**Anthraquinone** (1,4)	.....	$C_{10}H_6(COCH)_2$	VII-781	208.20
550	**Anthraquinone** (9,10)	anthraquinone	$(C_6H_4)_2(CO)_2$	VII-781	208.20
551	carboxylic acid (α)	.....	$C_6H_4(CO)_2C_6H_3{\cdot}CO_2H$	X-834	252.21
552	carboxylic acid (β)	.....	$C_6H_4(CO)_2C_6H_3{\cdot}CO_2H$	X-835	252.21
553	disulfonate Na_2 (1,5)	*p*-anthraquinone disulfonate	$C_{14}H_6O_2(SO_3Na)_2{\cdot}5H_2O$	XI-340	502.38
554	disulfonate Na_2 (1,8)	χ-anthraquinone disulfonate	$C_{14}H_6O_2(SO_3Na)_2{\cdot}4H_2O$	XI-341	484.37
555	disulfonate Na_2 (2,6)	.....	$C_{14}H_6O_2(SO_3Na)_2{\cdot}7H_2O$	*XI-84	538.41
556	disulfonic acid (2,7)	.....	$C_{14}H_6O_2(SO_3H)_2$	*XI-84	368.32
557	disulfonate Na_2 (2,7)	.....	$C_{14}H_6O_2(SO_3Na)_2{\cdot}4H_2O$	*XI-84	484.37
558	sulfonate Na (1)	.....	$C_{14}H_7O_2{\cdot}SO_3Na$	XI-336	310.25
559	sulfonic acid (2)	β-sulfoanthraquinone	$C_{14}H_7O_2{\cdot}SO_3H{\cdot}3H_2O$	XI-337	342.31

Anisyl chloride 4071
Anisyl methyl ketone 4065
Anisylidene, cf. anisal.
Annidalin 5940
Anol 1605
Anon 1606
Anthracene-hexahydride 3576
Anthrachryson 5800
Anthraflavic acid 2303-4
Anthragallol 6212
Anthrahydroquinone 5019
Anthrahydroquinone diacetate 5020
Anthralin 2296
Anthranilamide 259
Anthranilic acid 264
Anthranilic nitrile 267
Anthrapurpurin 6215
Anthrarobin 2295

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
528	lf./et.	.....	73-4	.....	i.; s. bz.	v. s.	v. s.; s. ac.
529	yel. lf./al. or CS_2	.....	138-9	.....	i.; s. chl.	sl. s.; s. bz.	sl. s.; sl. s. CCl_4
530	nd.	$1.113_{15}^{15°}$	25	258.8	i.	s.	s.
531	col. pr.	$1.135_{15}^{15°}$	35-8 (3)	243-4	i.; sl. s. bz.	sl. s.	v. s.
532	col. oil	$1.123_{4}^{20°}$	2.5	247-8	v. sl. s.	∞	∞
533	col. nd.	.....	120-1	.....	s. h. bz.	s. h.	s.
534	col. lq.	$1.098_{15}^{15°}$	5.2	225	v. sl. s.	∞	∞
535	oil	$1.096_{4}^{20°}$	<-12	251	v. sl. s.	s.	s.; s. a.
536	pl./aq.	$1.089_{55}^{55°}$	57.2	243	s. h.	s.	s.
537	col. lq.	$0.990_{4}^{22°}$	-37.3	154-5	i.	s.	s.
538	col. mn.	$1.252_{4}^{7°}$	217-8	340-2	i.	$1.9^{20°}$, abs. al.	$12.2^{100°}$, toluene
539	yel. pr./al.	.....	245 (260)	subl.	i.	s.	s.; sl. s. bz.
540	yel. lf./al.	.....	280 ±	subl.	i.	sl. s.	i. bz.; i. CS_2
541	lt. yel./al.	.....	206 ($-CO_2$)	.....	v. sl. s. h.	s.	.....
542	yel. nd./al.	.....	130 ±	.....	i. HCl	s.	.....
543	yel. lf./al.	.....	238	subl. 93^{9mm}	i.	sl. s.	sl. s.
544	col. oil	$1.187_{4}^{15°}$	<-18	d. >215	sl. s. h.	s.	s.; s. c. HCl
545	col. rhb.	.....	160-70 d.	.....	i.	v. s. h. bz.	s. h. alk.
546	nd./aq. al.	.....	202-4	d.	v. sl. s. c.	3, in 50% h. al.	0.3, h. bz.
547	col. lf.	.....	170	446	i.	s.	s.
548	or. nd./al.	.....	185-90 d.	.....	v. sl. s.	3	s. h. chl.
549	yel. nd./al.	.....	206-18 d.	.....	.....	.....	.....
550	yel. rhb.	$1.438_{4}^{20°}$	286	379-81	i.	$0.05^{18°}$; 2.25 h.	v. sl. s.
551	yel. nd./aq.	.....	293.4	.....	sl. s. h.	.....	.....
552	yel. nd./al.	.....	290	.....	s. act.	v. sl. s. abs. al.	i.
553	yel. lf.	.....	.....	.....	v. s.	i.	i.
554	yel. pr.	.....	.....	.....	sl. s.	.....	.....
555	col.cr.darken in light	.....	.....	.....	$3.9^{20°}$; $18^{100°}$	.....	.....
556	yel. cr.	.....	.....	.....	v. s.	s.	i.; i. bz.
557	cr.	.....	.....	.....	$30.5^{20°}$; $13^{100°}$	v. sl. s.	i.; i. bz.
558	yel. lf.	.....	.....	.....	0.5 c.; s. h.	i.; v. sl. s. act.	i.
559	col. lf.	.....	.....	.....	v. s. c.	v. s.	i.

Anthrarufin 2300
Antiarin, cf. glcde.
Antifebrin 17
Antimony triethyl 6198
Antimony trimethyl 6274
Antipyrene salicylate 5590
Antisepsin 882
Antodin 3410
Antodyne 3410
Aphrodine, cf. alkd.
Apiin, cf. glcde.
Apocupreine, cf. alkd.
Apocynin 3776
Apomorphine, cf. alkd.
Aponal 1738
Apoquinine, cf. alkd.
Aposafranone 670
Apothesine 2119
Apple oil 496
Apyron 118

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
560	**Anthraquinone** sulfonate Na (2)	"silver salt"	$C_{14}H_7O_2 \cdot SO_3Na$	XI-337	310.25
561	**Anthrol** (α)	1-hydroxy-anthracene	$C_6H_4(CH)_2C_6H_3OH$	VI-702	194.22
562	**Anthrol** (β)	2-anthrol	$C_6H_4(CH)_2C_6H_3OH$	VI-702	194.22
563	**Antimony triphenyl**	triphenyl stibine	$Sb(C_6H_5)_3$	XVI-891	353.06
564	dichloride	tri-Ph-stibine-di-Cl	$(C_6H_5)_3SbCl_2$	XVI-893	423.97
565	**Antipyrene**	1-Ph-2, 3-di Me-pyrazolone-5	$C_{11}H_{12}ON_2$	XXIV-27	188.22
566	acetylsalicylate	pyrosal	$C_{20}H_{20}O_5N_2$	XXIV-32	368.38
567	chloralhydrate	hypnal; chloral-antipyrene	$Cl_3C \cdot CH(OH)_2 \cdot C_{11}H_{12}ON_2$	XXIV-31	353.64
568	mandelate	tussol	$C_{11}H_{12}ON_2 \cdot C_8H_8O_3$	.....	340.37
569	**Apiole**	1-allyl-2, 5-di MeO-3, 4-methylenedi-oxybenzene	$C_{12}H_{14}O_4$	XIX-87	222.23
570	**Arabinose** (α) (*d* or *l*)	.....	$C_4H_9O_4 \cdot CHO$	I-859	150.13
571	phenylhydrazone (*l*)	.....	$C_6H_5NH \cdot N:C_5H_{10}O_4$	XV-215	240.25
572	**Arabitol** (*d*)	pentanpentol	$C_5H_7(OH)_5$	I-531	152.15
573	**Arabonic acid**	.....	$HO \cdot CH_2(CHOH)_3 \cdot CO_2H$	III-473	166.13
574	**Arachidic acid**	eicosanoic acid	$CH_3(CH_2)_{18} \cdot CO_2H$	II-389	312.52
575	**Arginine** (*l*+)	guanidine-amino-valeric acid	$H_2N \cdot C(:NH) \cdot NH \cdot (CH_2)_3 \cdot CH(NH_2) \cdot CO_2H$	IV-420	174.20
576	hydrochloride (*d*)	.....	$C_6H_{14}O_2N_4 \cdot HCl$	IV-423	210.67
577	**Arsacetin** (*p*)	acetyl arsanilic acid	$CH_3CO \cdot NH \cdot C_6H_4 \cdot AsO(OH)_2$	XVI-880	259.08
578	Na salt	.....	$C_8H_9O_4NAsNa \cdot 4H_2O$	XVI-880	353.13
579	**Arsenic** diethyl	ethyl cacodyl	$[(C_2H_5)_2As]_2$	IV-616	266.06
580	triphenyl	triphenylarsine	$As(C_6H_5)_3$	XVI-828	306.21
581	**Arseno-phenyl-glycine** Na	.....	$(As \cdot C_6H_4 \cdot NH \cdot CH_2 \cdot CO_2Na)_2$	.....	494.10
582	**Arsono-phenyl-glycinamide** (4)	.....	$H_2N \cdot CO \cdot CH_2 \cdot NH \cdot C_6H_4 \cdot AsO(OH)_2$	*XVI-470	274.09
583	Na salt	tryparsamide	$C_2H_5ON_2 \cdot C_6H_4 \cdot AsO(ONa)_2 \cdot 3H_2O$	*XVI-470	372.12
584	**Asarone**	propenyl-2,4,5-tri-MeO-benzene	$CH_3CH:CH \cdot C_6H_2(OCH_3)_3$	VI-1129	208.25
585	**Ascaridole**	.....	$CH_3 \cdot C_6H_6O_2 \cdot CH:(CH_3)_2$	XIX-17	168.25
586	**Ascorbid acid** (*l*+)	vitamin C; redoxon; cevitamic acid	$O \cdot CO \cdot C(OH):C(OH) \cdot CH \cdot CHOH \cdot CH_2OH$	.....	176.12
587	***iso*-Ascorbic acid** (*d*)	.....	$C_6H_8O_6$	.....	176.12
588	**Asparagin** (*l*)	.....	$HO_2C \cdot CH(NH_2) \cdot CH_2 \cdot CONH_2$	IV-476	132.12
589	**Aspartic acid** (*l*−)	amino-succinic acid	$HO_2C \cdot CH(NH_2) \cdot CH_2 \cdot CO_2H$	IV-472	133.10
590	**Aspartic acid** (*dl*)	amino-succinic acid	$C_4H_7O_4N$	IV-483	133.10
591	**Atropic acid**	α-phenyl acrylic acid	$C_6H_5C(:CH_2) \cdot CO_2H$	IX-610	148.15

Arbutin, cf. glcde.
Arecoline, cf. alkd.
Aresol 3400
Arheol 5595
Aristol 5940
Armstrong's δ acid 4461
Armstrong and Wynne's acid II 4535
Arsanilic acid 515
Arsenic triethyl 6183
Arsenic trimethyl 6252
Arsphenamine 5592
Arsphenamine S 5593
Artamin 5234
Arthanitin, cf. glcde.
Arthriticin 2226

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
560	silver lf.	.....	.....	.....	0.8 c.; 21 h.	i.	i.
561	nd./al.	.....	150-3	.....	i.	v. s.	v. s.
562	nd./aq.	.....	d. 200	.....	i.	v. s.	v. s.
563	tri. pr./pet.	$1.5^{12°}$	50-3	>360 d.	i.; v. s. bz.	sl. s.	v. s.
564	col. nd.	.....	143	.....	v. sl. s.	i. c.	i.; s. bz.
565	mn./aq.	$1.088^{11\frac{1}{4}°}$	113 (109)	319^{174mm}	100	100	sl. s.
566	col. pd.	.....	64-5	.....	$1^{25°}$; $4^{80°}$	$12^{625°}$	$13^{25°}$; s. bz.
567	col. rhb.	.....	67-8	.....	7.9^{14}	33	sl. s.
568	col. cr.	.....	52-5	.....	6.6	30	5
569	col. nd.	$1.022^{20°}_{4}$	30*	294	i.; s. bz.	s.; s. act.	s.; s. oil
570	rhb. pr.	$1.585^{20°}_{4}$	158.5-9.5	.....	$46^{0°}$	$0.5^{9°}$, 90% al.	i.
571	col. nd.	.....	151-3	.....	$1.2^{15°}$	$1.3^{15°}$, abs.	v. sl. s.
572	pr. or warts	.....	102-3	.....	v. s.	$2^{12°}$, 90% al.	.....
573	cr.	.....	89	d., $-H_2O$	s.	.....	.....
574	col. lf.	.....	77	328 sl. d.	i.	v. s. h. abs.	v. s.
575	pr./aq.	.....	238 d.	.....	$15^{21°}$	sl. s.	i.
576	col. pl.	.....	222-35 d.	softens 218	v. s.	.....	.....
577	lf.	.....	>200	.....	s. Na_2CO_3;	v. sl. s. dil. HCl	.....
578	wh. cr. pd.	.....	.....	.....	$10^{20°}$	$33^{50°}$	.....
579	lq.	>1	ign. in air	185-90	i.	v. s.	v. s.
580	pl./bz.	1.306	59-60	>360(CO_2)	i.; i. HCl	s.; v. s. bz.	v. s.
581	yel. pd.	.....	d. in air	.....	s.	.....	.....
582	pl./aq.	.....	darkens 280	.....	v. s. h.; s. h. ac.	v. sl. s. h.; i. c. chl.	i. c. act.
583	wh. pd.	.....	.....	.....	50	sl. s.	i.; i. chl.
584	mn. nd./aq.	$1.165^{18°}$	67	296	sl. s. h.; s. ac.	$7^{18°}$, $16^{55°}$, 60% al.	s.; s. chl.
585	col. lq.	$0.999^{20°}_{20°}$	expl. 250	115^{15mm}	i.	s.	expl. with a.
586	col. mn.	.....	192	.....	33; 1 gly.	4; i. pet.; i. fat	i.; i. bz.
587	col. cr.	.....	168-71	.....	v. s.	s.; i. act.	v. sl. s.
588	rhb.	$1.543^{18°}_{4}$	227-35**	235 d.	$3.1^{28°}$	i. c. abs. al.	s. NH^3
589	rhb.	.....	251-83 d.	.....	$0.5^{16°}$	i.	i.
590	mn. pr.	$1.663^{13°}_{18}$	271**	d. 290	$2.71^{75°}$	i.	i.
591	mn. nd./aq.	.....	106-7	267 d.	0.13 c.	s.; s. chl.	s.; s. CS_2

* Also modifications, m.p. 27.5 and 18-9. ** Sealed tube.

Artificial camphor 5319
Asaprol 4506
Asarin 584
Asaronic acid 6241
Asebogenol 5264
Asebotin, cf. glcde.
Asepsin 882
Aspidospermine, cf. alkd.
Aspirin 115
Athenon 3800
Aticine, cf. alkd.
Atisine, cf. alkd.
Atophan 5234
Atoquinol 212
Atoxylic acid 515
Atropine, cf. alkd.
Atroscine, cf. alkd.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
592	**Auramine**	4,4′-dimethylamino-benzophenonimide	$[(CH_3)_2NC_6H_4]_2C{:}NH$	XIV-91	267.36
593	**Aurin**	4′,4″-diOH-fuchsone	$(HOC_6H_4)_2C{:}C_6H_4{:}O$	VIII-361	290.30
594	**Azafrin**	.....	$C_{27}H_{38}O_4$	XXX-115	426.57
595	**Azafrinone**	.....	$C_{27}H_{36}O_4$	XXX-116	424.56
596	**Azelaic** acid	nonandioic acid	$(CH_2)_7(CO_2H)_2$	II-707	188.22
597	nitrile	.....	$(CH_2)_7(CN)_2$	II-709	150.22
598	**Azo**-anisole (2,2′)	diMeO-azobenzene	$(CH_3O{\cdot}C_6H_4N{:})_2$	XVI-92	242.27
599	benzene	diphenyldiimide	$C_6H_5{\cdot}N{:}N{\cdot}C_6H_5$	XVI-8	182.22
600	benzoic acid (2,2′)	.....	$(HO_2C{\cdot}C_6H_4{\cdot}N{:})_2$	XVI-228	270.24
601	benzoic acid (3,3′)	.....	$(HO_2C{\cdot}C_6H_4{\cdot}N{:})_2{\cdot}\frac{1}{2}H_2O$	XVI-233	279.24
602	benzoic acid (4,4′)	.....	$(HO_2C{\cdot}C_6H_4{\cdot}N{:})_2$	XVI-236	270.24
603	dicarbonamide	.....	$(NH_2{\cdot}CO{\cdot}N{:})_2$	III-123	116.08
604	naphthalene (α,α′)	.....	$C_{10}H_7{\cdot}N{:}N{\cdot}C_{10}H_7$	XVI-79	282.33
605	naphthalene (β,β′)	.....	$C_{10}H_7{\cdot}N{:}N{\cdot}C_{10}H_7$	XVI-80	282.33
606	phenetole (2,2′)	.....	$(C_2H_5O{\cdot}C_6H_4{\cdot}N{:})_2$	XVI-92	270.32
607	phenetole (3,3′)	.....	$(C_2H_5O{\cdot}C_6H_4{\cdot}N{:})_2$	XVI-95	270.32
608	phenetole (4,4′)	.....	$(C_2H_5O{\cdot}C_6H_4{\cdot}N{:})_2$	XVI-113	270.32
609	phenol (2,2′)	dihydroxy-azobenzene	$(HO{\cdot}C_6H_4{\cdot}N{:})_2$	XVI-91	214.22
610	phenol (3,3′)	.....	$(HO{\cdot}C_6H_4{\cdot}N{:})_2$	XVI-95	214.22
611	phenol (4,4′)	.....	$(HO{\cdot}C_6H_4{\cdot}N{:})_2$	XVI-110	214.22
612	toluene (2,2′)	dimethylazobenzene	$(CH_3{\cdot}C_6H_4{\cdot}N{:})_2$	XVI-61	210.27
613	toluene (3,3′)	.....	$(CH_3{\cdot}C_6H_4{\cdot}N{:})_2$	XVI-64	210.27
614	toluene (4,4′)	.....	$(CH_3{\cdot}C_6H_4{\cdot}N{:})_2$	XVI-67	210.27
615	**Azoxy**-benzene	.....	$C_6H_5{\cdot}N(:O){:}N{\cdot}C_6H_5$	XVI-622	198.22
616	benzoic acid (2,2′)	.....	$(HO_2C{\cdot}C_6H_4)_2{:}N_2O$	XVI-644	286.24
617	benzoic acid (3,3′)	.....	$(HO_2C{\cdot}C_6H_4)_2{:}N_2O$	XVI-646	286.24
618	benzoic acid (4,4′)	.....	$(HO_2C{\cdot}C_6H_4)_2{:}N_2O$	XVI-647	286.24
619	naphthalene (α,α′)	.....	$(C_{10}H_7N)_2O$	XVI-633	298.33
620	naphthalene (β,β′)	.....	$(C_{10}H_7N)_2O$	XVI-633	298.33
621	**Barbituric acid**	malonyl urea	$CH_2CONHCONHCO{\cdot}$ (2H₂O)	XXIV-467	128.09
622	**Bassorine**	.....	$C_6H_{10}O_5$	.....	162.14
623	**Behenic acid**	docosanoic acid	$CH_3{\cdot}(CH_2)_{20}{\cdot}CO_2H$	II-391	340.57
624	**Behenolic acid**	docosinoic acid	$C_8H_{17}C{:}C(CH_2)_{11}{\cdot}CO_2H$	II-497	336.54
625	**Benzal** acetoacetic ester	.....	$C_2H_3O{\cdot}C(C_7H_6){\cdot}CO_2C_2H_5$	X-731	218.24
626	acetone	Me-cinnamyl ketone	$C_6H_5{\cdot}C_2H_2{\cdot}CO{\cdot}CH_3$	VII-364	146.18
627	acetophenone	chalcone	$C_6H_5{\cdot}C_2H_2{\cdot}CO{\cdot}C_6H_5$	VII-479	208.25
628	acetophenone dibromide	.....	$C_6H_5{\cdot}(CHBr)_2{\cdot}COC_6H_5$	VII-445	368.08
629	acetophenone dibromide	high m. p. form	$C_6H_5{\cdot}(CHBr)_2{\cdot}CO{\cdot}C_6H_5$	VII-445	368.08
630	amino-2-cresol (5)	(5; 1, 2)	$C_6H_5CH{:}N{\cdot}C_6H_3(CH_3){\cdot}OH)$	.....	211.25
631	aminophenol (*p*)	.....	$C_6H_5CH{:}N{\cdot}C_6H_4{\cdot}OH$	XIII-453	197.23
632	aniline	benzaldehyde anil	$C_6H_5CH{:}N{\cdot}C_6H_5$	XII-195	181.23

Aurantiin, cf. glcde.
Aurin 5573
Avenein, cf. glcde.
Avertin 6104
Avornin, cf. glcde.

Azamin-4B 733
Azo-aniline 1697
Azo-benzil 698
Azo-chloramide 1949
Azodermin 124

Azo-dinaphthylamine 251
Azo-phenylene 5104
Azo-resorcin 5551
Azo-resorufin 5554

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
592	col./al.	.....	136	.....	i.	$7^{20°}$	$2.3^{20°}$
593	rhb. red	.....	308-10 d.	.....	i.; i. bz.	s.	s.; s. alk.
594	or. nd./bz.	.....	212-4	.....	i.; s. alk.	sl. s.	i.; sl. s. bz.
595	or. cr./act.	.....	191	.....	.....	.....	.....
596	lf. or nd.	$1.029^{\frac{30°}{4°}}$	106.5	286.5^{100mm}	0.2 c.; ∞ h.	v. s.	$2.7^{15°}$
597	oil	$0.941^{0°}$	.....	$195\text{-}6^{19mm}$	i.	v. s.	v. s.
598	or. pr./ MeOH	.....	153 (141)	.....	i.; s. act.	s.; s. chl.	s.; s. bz.
599	or. mn.	$1.203^{\frac{20°}{4°}}$	68	297	i.	$4.2^{20°}$	$12^{20°}$ lg.
600	yel. nd./al.	.....	237 d.	.....	sl. s. h.	v. s. h.	i. bz.
601	yel. nd./ac.	.....	340 ±	d.	v. sl. s.	0.2 h.	sl. s.
602	red nd./ac.	.....	d. 330 ±	.....	v. sl. s.	v. sl. s.	v. sl. s.
603	or. red pd.	.....	d. 180-200	.....	v. sl. s. h.	i.	d. h. HCl
604	red nd./ac.	.....	190	subl. >190	i.; s. ac.	v. sl. s.	v. s. bz.
605	red pr./chl.	.....	204	subl. 210	i.	sl. s.	s. bz.
606	red pr./al.	.....	131	240 d.	i.; s. HCl	s.	s.
607	yel. pr./al.	.....	91	d.	i.; i. HCl	s.	s.
608	or. lf.	.....	159-60	d.	v. s. chl.	s. h.	v. s.
609	yel. lf.	.....	171-2	subl.	i.	0.3 c.	s.; s. KOH
610	brn./aq. al.	.....	205	.....	v. sl. s.	s. h.	s. Na_2CO_3
611	brn. tri.	.....	215 d.	.....	sl. s.	s.	s.; s. bz.
612	red mn./et.	.....	55	.....	i.; s. bz.	$6.03^{15°}$	$147.7^{17°}$
613	or. rhb.	.....	54-5	.....	i.	s.	s.
614	or. nd./lg.	.....	144-5	.....	i.	sl. s.	s.; s. lg.
615	yel. rhb.	$1.248^{\frac{20°}{20°}}$	36	d.	i.	$11.4^{15°}$	$43.5^{15°}$ lg.
616	brn./al.	.....	246-8 d.	.....	v. sl. s. h.	s. h.	s. h.
617	nd. or lf.	.....	320 d.	.....	i.	sl. s.	sl. s.
618	yel. armor.	.....	d. 240 ±	.....	i.	i.	s. C_5H_5N
619	yel.rhb./al.	.....	127	.....	i.	s.	.....
620	yel.rhb./al.	.....	167-8	.....	i.	.....	.....
621	col. pr./aq.	.....	d. 245 ±	.....	s. h.	sl. s.	s.; s. HCl
622	wh. amor.	.....	.....	.....	v. sl. s.	i.; d. h. a.	i. $(NH_4)_2S$
623	col. nd.	.....	84	306^{60mm}	i.	sl. s.	sl. s.
624	nd.	.....	57.5	.....	i.	v. s.	v. s.
625	rhb./al.	.....	59-60	295-7 sl. d.	v. s. chl.	sl. s. c.	sl. s. c.
626	pl.	$1.035^{\frac{20°}{20°}}$	41-2	260-2	s. H_2SO_4	s.; s. chl.	s.; s. bz.
627	lt. yel. rhb.	$1.071^{\frac{0°}{4°}}$	62	345-8 sl. d.	i.	sl. s.	v. s.
628	nd./al.	.....	108-9	.....	.....	$1^{30°}$; s. h.	.....
629	.....	.....	156-7	.....	.....	$0.16^{30°}$	.....
630	brn. fl.	.....	210-11	.....	i.	sl. s.	i.
631	lf./aq. al.	.....	183	.....	.....	v. s.	.....
632	yel. cr.	.....	56 (48)	300 ±	i.	s.	s.

Badische acid 4551
Banana oil 398
Banisterine, cf. alkd.
Baptisin, cf. glcde.
Baptitoxine, cf. alkd.
Barbital 2124
Barytine, cf. alkd.
Baum's acid 4498
Bayer acid 4512 or 4553
Bebeerine, cf. alkd.
Beet sugar 5663
Benzacetin 29

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
633	**Benzal** azine	dibenzal hydrazine	$(C_6H_5CH{:}N\cdot)_2$	VII-225	208.25
634	bromide	benzylidene bromide	$C_6H_5{\cdot}CH{:}Br_2$	V-308	249.95
635	chloride	benzylidene chloride	$C_6H_5{\cdot}CH{:}Cl_2$	V-297	161.03
636	diacetate	benzylidene diacetate	$C_6H_5CH{:}(O_2CCH_3)_2$	VII-210	208.21
637	lactic acid	phenyl-hydroxy-crotonic acid	$C_6H_5{\cdot}CH{:}CH{\cdot}CHOH{\cdot}CO_2H$	X-308	178.18
638	malonic acid	.....	$C_6H_5{\cdot}CH{:}C(CO_2H)_2$	IX-891	192.16
639	methylamine	.....	$C_6H_5{\cdot}CH{:}N{\cdot}CH_3$	VII-213	119.16
640	phthalide	benzylidene phthalide	$C_7H_6{:}C{\cdot}C_6H_4{\cdot}CO{\cdot}O$	XVII-376	222.23
641	2-thiohydantoin (5)	.....	$CO{\cdot}NH{\cdot}CS{\cdot}NH{\cdot}C{:}C_7H_6$	XXIV-400	204.24
642	**Benzaldehyde**	art. almond oil	$C_6H_5{\cdot}CH{:}O$	VII-174	106.12
643	oxime (α; *anti*)	.....	$C_6H_5CH{:}NOH$	VII-218	121.13
644	oxime (β, *syn*)	.....	$C_6H_5CH{:}NOH$	VII-221	121.13
645	oxime carboxylic anhydride (o)	benzoxazinone	$C_6H_4{\cdot}CH{:}N{\cdot}O{\cdot}CO$	XXVII-198	147.13
646	phenylhydrazone	.....	$C_6H_5NH{\cdot}N{:}CH{\cdot}C_6H_5$	XV-134	196.24
647	**Benzamaron**	.....	$C_6H_5CH[CH(C_6H_5){\cdot}COC_6H_5]_2$	VII-849	480.57
648	***iso*-Benzamaron**	.....	$C_{35}H_{28}O_2$	VII-849	480.57
649	**Benzamidine**	benzenylamidine	$C_6H_5C(:NH){\cdot}NH_2$	IX-280	120.15
650	**Benzanthracene** (1,2)	naphthanthracene	$C_{18}H_{12}$	V-718	228.28
651	**Benzarsonic acid** (p)	.....	$(HO)_2OAs{\cdot}C_6H_4{\cdot}CO_2H$	XVI-876	246.04
652	**Benzaurine**	.....	$C_6H_5C(:C_6H_4O){\cdot}C_6H_4OH$	VI-1145	274.30
653	**Benzazide**	benzoyl azide	$C_6H_5CO{\cdot}N_3$	IX-332	147.13
654	**Benzedrine**	*dl*-desoxy-nor-ephedrine	$C_6H_5CH_2CH(NH_2){\cdot}CH_3$	XII-1145	135.20
655	sulfate	.....	$(C_9H_{13}N)_2{\cdot}H_2SO_4$	.....	368.48
656	**Benzene**	benzol	C_6H_6	V-179	78.11
657	azo-o-cresol (5)	(1;4,3)	$C_6H_5{\cdot}N_2{\cdot}C_6H_3(OH){\cdot}CH_3$	XVI-130	212.24
658	azo-m-cresol (6)	(1;4,2)	$C_6H_5{\cdot}N_2{\cdot}C_6H_3(OH){\cdot}CH_3$	XVI-134	212.24
659	azodiphenylamine (p)	4-anilino-azobenzene	$C_6H_5{\cdot}N_2{\cdot}C_6H_4NHC_6H_5$	XVI-314	273.32
660	azo-α-naphthylamine (4)	.....	$C_6H_5{\cdot}N_2{\cdot}C_{10}H_6{\cdot}NH_2$	XVI-361	247.29
661	azo-β-naphthylamine (1)	Yellow AB	$C_6H_5{\cdot}N_2{\cdot}C_{10}H_6{\cdot}NH_2$	XVI-369	247.29
662	azoresorcinol	(1;2,4); Sudan G	$C_6H_5{\cdot}N_2{\cdot}C_6H_3(OH)_2$	XVI-180	214.22
663	disulfone chloride	(1,3)	$C_6H_4{:}(SO_2Cl)_2$	XI-200	275.13
664	disulfonic acid (m)	.....	$C_6H_4{\cdot}(SO_3H)_2{\cdot}2\frac{1}{2}H_2O$	XI-199	283.27
665	disulfonic Na (m)	.....	$C_6H_4(SO_3Na)_2{\cdot}4H_2O$	XI-199	354.27
666	hexabromide (α, *trans*)	hexabromo-cyclohexane	$C_6H_6Br_6$	V-25	557.60
667	hexacarboxylic acid	mellitic acid	$C_6(CO_2H)_6$	IX-1008	342.17
668	hexachloride (α, *trans*)	hexachloro-cyclohexane	$C_6H_6Cl_6$	V-23	290.85

Benzaldehyde-anil 632
Benzaldehyde-cyanohydrin 4010
Benz-amide 713
Benz-aminobenzoic acid 746-8
Benz-anilide 715
Benz-triazole 252
Benzene-azimide 252
Benzene azoanisidine 246
Benzene azodimethylaniline 2431

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
633	yel. pr.	.....	93	.....	i. c.	s. h.	s.
634	oil	$1.511^{5°}$	.....	140^{20mm}	i.	∞	∞
635	col. lq.	$1.295^{16°}$	−16.1	214	i.	∞	∞
636	pl./et.	.....	45-6	154^{20mm}	s. dil. alk.	v. s.	v. s.
637	nd./aq.	.....	137 ±	.....	s. h.	i. bz., CS_2	sl. s.; i. lg.
638	cr./et.-CS_2	.....	195-6 d.	.....	v. s. h.	s.	sl. s.
639	col. lq.	.....	.....	180 ±	.....	.....	.....
640	mn./al.	.....	98-9	.....	i. h.	v. s. h.	.....
641	yel. nd./al.	.....	258 sl. d.	.....	.....	.....	.....
642	col. lq.	$1.046^{\frac{20}{4}°}$	−26*	179	0.3	∞	∞
643	pr.	$1.111^{\frac{20}{4}°}$	35 (5)	117.5^{14mm}	sl. s.	v. s. bz.	v. s.
644	nd./et.	.....	128-30	.....	s. h.	v. sl. s. bz.	.....
645	cr./bz.	.....	d. 120	.....	.....	.....	.....
646	col.** mn.	.....	155-6	.....	s. bz.	s. h.	sl. s.
647	cr.	.....	218-9	.....	$1.6^{12°}$, bz.	.....	.....
648	cr.	.....	179-80	.....	$4.1^{12°}$, bz.	.....	.....
649	cr.	.....	80	.....	s.	v. s.	sl. s.
650	lf./al.-ac.	.....	159-60	subl.	.....	.....	.....
651	cr./aq.	.....	d.-H_2O, 210	.....	v. sl. s.	i.	i. ac.
652	r. pd.	.....	.....	.....	i.; s. alk.	s.	s.
653	col. pl./act.	.....	32	expl.	i.	sl. s.	s.
654	col. lq.	0.93	.....	203	sl. s.; s. a.	s.; s. EtOAc	s.; s. chl.
655	wh. pd.	.....	.....	.....	10	sl. s.	i.
656	col. lq.	$0.879^{\frac{20}{4}°}$	5.4-5.5	80.1	$0.07^{22°}$	∞ abs. al.	∞
657	yel. nd./al.	.....	129-30	.....	v. s. h.; s. alk.	s.; s. chl.	s.; s. bz.
658	yel. nd./lg.	.....	109†	.....	.....	s.; s. chl.	s.; s. bz.
659	yel. pr./et. al.	.....	82	.....	v. s. lig.	v. s.	v. s.
660	r. nd./al.	.....	123	.....	s. bz.	s.	s.
661	r. pl./al.	.....	102-4	.....	i.; s. oil	s.; s. CCl_4	s. ac.
662	r. nd./aq. al.	.....	170‡	.....	i.; s. alk.	v. s.	v. s.; v. s. bz.
663	mn./et.	.....	63	210.7^{20mm}	d. 130°	s. h. d.	s.
664	delq. cr.	.....	.....	.....	s.	.....	.....
665	col. nd.	.....	.....	.....	s.	.....	.....
666	mn. pr.	.....	212	.....	.....	sl. s.	sl. s.
667	nd./al.	.....	286-8§	d.	v. s.	v. s.	s. h. H_2SO_4
668	mn. pr.	.....	157-8	d. >158	$4.4^{15°}$, chl.	s.	$6.5^{18°}$, bz.

* Solidifies −56°.
** Pink on exposure to light.
† Crysts. $+1H_2O$, m. 90°.
‡ Cryst. $+\frac{1}{2}H_2O$, m. 161°.
§ Sealed tube.

Benzene azonitromethane 4739
Benzene azophenol 3727-9
Benzene diazoanilide 1762
Benzene diazonium, cf. diazobenzene.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
669	**Benzene** hexachloride (*β*, *cis*)	.....	$C_6H_6Cl_6$	V-23	290.85
670	indone	safranone	$C_{18}H_{12}ON_2$	XXIII-413	272.29
671	pentacarboxylic acid	.....	$C_6H(CO_2H)_5{\cdot}5H_2O$	IX-1006	388.24
672	sulfinic acid	.....	$C_6H_5{\cdot}SO_2H$	XI-2	142.17
673	sulfinic Na	.....	$C_6H_5{\cdot}SO_2Na{\cdot}2H_2O$	XI-6	200.19
674	sulfohydroxamic acid	Piloty's acid	$C_6H_5SO_2{\cdot}NHOH$	XI-51	173.18
675	sulfonic acid	.....	$C_6H_5{\cdot}SO_3H$	XI-26	158.17
676	sulfonic Na	.....	$C_6H_5SO_3Na{\cdot}H_2O$	XI-28	198.17
677	sulfonic amide	benzenesulfonamide	$C_6H_5{\cdot}SO_2{\cdot}NH_2$	XI-39	157.18
678	sulfonic chloride	benzenesulfonyl chloride	$C_6H_5{\cdot}SO_2{\cdot}Cl$	XI-34	176.62
679	1-sulfonic acid-(4-azo-5)-8-hydroxy-quinoline	sulfenazoxine	$HO_3S{\cdot}C_6H_4{\cdot}N_2{\cdot}C_9H_5N(OH)$	XXII-584	329.32
680	tetracarboxylic acid (1,2,3,4)	prehnitic acid	$C_6H_2(CO_2H)_4{\cdot}2H_2O$	IX-997	290.18
681	tetracarboxylic acid (1,2,3,5)	mellophanic acid	$C_6H_2(CO_2H)_4$	IX-997	254.15
682	tetracarboxylic acid (1,2,4,5)	pyromellitic acid	$C_6H_2(CO_2H)_4{\cdot}2H_2O$	IX-997	290.18
683	tricarboxylic acid (1,2,3)	hemimellitic acid	$C_6H_3(CO_2H)_3{\cdot}2H_2O$	IX-976	246.17
684	tricarboxylic acid (1,2,4)	trimellitic acid	$C_6H_3(CO_2H)_3$	IX-977	210.14
685	tricarboxylic acid (1,3,5)	trimesic acid	$C_6H_3(CO_2H)_3$	IX-978	210.14
686	trisulfonic acid	(1,3,5)	$C_6H_3(SO_3H)_3$ + aq.	XI-227	318.29
687	**Benzenyl**-aminothiophenol	*μ*-phenylbenzothiazole	$C_6H_4{\cdot}N{:}C(C_6H_5){\cdot}S$ (ring)	XXVII-74	211.27
688	aminoxime	.....	$C_6H_5C(NOH)NH_2$	IX-304	136.15
689	naphthylamidine	*α*-naphthyl-benzamidine	$C_6H_5C(:NH)NH{\cdot}C_{10}H_7$	XII-1233	246.30
690	phenylenediamine (1,2)	*α*-phenylbenzimidazole	$C_6H_5C{:}N{\cdot}C_6H_4{\cdot}NH$ (ring)	XXIII-230	194.23
691	**Benzhydrol**	diphenyl carbinol	$(C_6H_5)_2CHOH$	VI-678	184.23
692	ether	.....	$[(C_6H_5)_2CH]_2O$	VI-679	350.44
693	**Benzhydryl** amine	.....	$(C_6H_5)_2CH{\cdot}NH_2$	XII-1323	183.24
694	benzoic acid (*p*)	.....	$C_6H_5CH(OH){\cdot}C_6H_4CO_2H$	X-346	228.24
695	**Benzidine** disulfonic acid (*o*,*o'*)	.....	$[C_6H_3(NH_2){\cdot}SO_3H]_2$	XIV-794	344.35
696	monosulfonic acid	(4;4',3)	$H_2N{\cdot}C_6H_4{\cdot}C_6H_3(NH_2){\cdot}SO_3H$	XIV-770	264.29
697	**Benzil**	dibenzoyl	$(C_6H_5{\cdot}CO)_2$	VII-747	210.22
698	**Benzilam**	triphenyloxazole	$C_6H_5C{:}C(C_6H_5){\cdot}O{\cdot}C(C_6H_5){:}N$ (ring)	XXVII-88	297.34
699	**Benzilic acid**	diphenyl glycolic acid	$(C_6H_5)_2C(OH){\cdot}CO_2H$	X-342	228.24

Benzene hexahydride 1601
Benzene sulfonamide 677
Benzene sulfonyl chloride 678
Benzene tetrahydride 1609

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
669	col. cr.	$1.89^{19°}$	297 d.	.....	$0.13^{20°}$, chl.	$1^{22°}$, bz.	v. sl. s. ac.
670	brn. met.	.....	248-9	.....	sl. s.	v. s.	i. alk.
671	rhb.	.....	228-30; 238 (anh.)	.....	v. s. h.	s.	sl. s.; i. bz.
672	pr./aq.	.....	83-4	d. >100	v. s. h.; sl. s. c.	v. s.	v. s.
673	lf./aq.	.....	.....	.....	s.	.....	.....
674	rhb. pl./aq.	.....	126 ±	d. > m. p.	s. h.	s.; v. sl. s. bz.	s.; s. act.
675	col. nd.	.....	65-6*	d.	v. s.	v. s.	i.; sl. s. bz.
676	nd./aq. al.	.....	450 d.	.....	$60^{30°}$	sl. s. h.	.....
677	mn. nd./aq.	.....	156	.....	$0.43^{16°}$	v. s.	v. s.
678	cr.	$1.384^{\frac{15}{15}°}$	14.5	251.5	i.; d. h.	v. s.; d. h.	s.
679	or. nd./aq. al.	.....	.....	.....	.....	.....	.....
680	pr./aq.	.....	237-50 d.	.....	v. s.	.....	sl. s.
681	cr./aq.	.....	215-38 d.	.....	v. s.	.....	.....
682	tri./aq.	.....	269-71 d.	.....	(anh.) $1.4^{16°}$	v. s.	.....
683	pl./aq.	.....	190 d.	.....	$3.2^{19°}$; v. s. h.	.....	s.
684	nd./aq.	.....	216-8 d.	.....	sl. s.	.....	sl. s.
685	pr./aq.	.....	375-80	subl.	$2.8^{22.5°}$	v. s.	s.
686	hyg. nd.	.....	d. >100	.....	s.	.....	.....
687	nd./al.	.....	115	360 ± (sl. d.)	i.; s. HCl	sl. s.	s.; s. CS_2
688	mn./aq.	.....	79-80	.....	sl. s. c.	s.; s. bz.	s.; i. lg.
689	pl./aq.	.....	141	.....	i.	s.	s.
690	nd./aq.	.....	291	.....	sl. s.	s.	sl. s. chl., bz.
691	nd./lg.	.....	68-9	$297\text{-}8^{48mm}$	$0.05^{20°}$	v. s.	v. s.
692	mn./bz.	.....	109-10	267^{15mm}	.....	sl. s. h.	v. s. bz.
693	lq.	$1.064^{\frac{21}{0}°}$	.....	$301\text{-}2^{746mm}$	.....	.....	.....
694	nd./aq.	.....	164-5	d.	s. h.	s.	s.; sl. s. chl.
695	pr./aq. (+$3H_2O$)	.....	d. >175	.....	$0.08^{25°}$	i.	i.
696	lf.	.....	.....	.....	v. sl. s. h.	v. sl. s.	v. sl. s.
697	trig. pr.	$1.23^{15°}$	95	346-8 (sl. d.)	i.	v. s.	v. s.
698	pr./al. et.	.....	115	.....	v. sl. s.	sl. s. c.	v. s.; s. h. ac.
699	nd./aq.	.....	150	.....	s. h.	s.	s.; s. H_2SO_4

* Cryst. +1.5H_2O, m.p. 43-4.

Benzenyl-amidine 649
Benzhydryl-aniline 384-5
Benzidine 1713-4
Benzidine (β) 1711

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
700	**Benzil**-oxime, di-(*syn*)	α-benzildioxime	$(C_6H_5C{:}NOH)_2$	VII-760	240.25
701	oxime, di-(*anti*)	β-benzildioxime	$(C_6H_5C{:}NOH)_2$	VII-761	240.25
702	oxime, di- (*amphi*)	γ-benzildioxime	$(C_6H_5C{:}NOH)_2 \cdot C_2H_5OH$	VII-763	286.32
703	oxime, mono- (α)	.....	$C_6H_5CO{\cdot}C(:NOH){\cdot}C_6H_5$	VII-757	225.24
704	oxime, mono- (β)	.....	$C_{14}H_{11}O_2N \cdot \frac{1}{2}C_6H_6$	VII-758	264.29
705	oxime, mono- (β)	.....	$C_{14}H_{11}O_2N$	VII-758	225.24
706	osazone (α) (*syn*)	.....	$(C_6H_5C)_2 \cdot (N{\cdot}NHC_6H_5)_2$	XV-173	390.47
707	osazone (β) (*anti*)	.....	$(C_6H_5C)_2 \cdot (N{\cdot}NHC_6H_5)_2$	XV-174	390.47
708	**Benzimidazole** (*o*)	.....	$C_6H_4{\cdot}N{:}CH{\cdot}NH$ |_____|	XXIII-131	118.13
709	**Benzimidazolone** (*o*)	*o*-phenylene urea	$C_6H_4{\cdot}NH{\cdot}CO{\cdot}NH$ |_____|	XXIV-116	134.13
710	**Benzohydroxamic acid**	*N*-benzoyl hydroxylamine	$C_6H_5CO{\cdot}NHOH$	IX-301	137.13
711	**Benzoic** acid	.....	$C_6H_5{\cdot}CO_2H$	IX-92	122.12
712	Na salt	sodium benzoate	$C_6H_5{\cdot}CO_2Na{\cdot}H_2O$	IX-107	162.12
713	amide	benzamide	$C_6H_5CO{\cdot}NH_2$	IX-195	121.13
714	anhydride	.....	$(C_6H_5CO)_2O$	IX-164	226.22
715	anilide	benzanilide; *N*-Ph-benzamide	$C_6H_5NH{\cdot}COC_6H_5$	XII-262	197.23
716	nitrile	phenyl cyanide	$C_6H_5{\cdot}CN$	IX-275	103.12
717	**Benzoin** (*dl*)	.....	$C_6H_5{\cdot}CHOH{\cdot}CO{\cdot}C_6H_5$	VIII-166	212.24
718	acetate	acetyl benzoin	$C_6H_5CO{\cdot}CH(C_6H_5){\cdot}O_2C{\cdot}CH_3$	VIII-174	254.27
719	ethyl ether	.....	$C_6H_5CH(OC_2H_5){\cdot}CO{\cdot}C_6H_5$	VIII-174	240.29
720	oxime (α)	cupron	$C_{13}H_{12}O{:}C{:}NOH$	VIII-175	227.25
721	oxime (β)	.....	$C_{13}H_{12}O{:}C{:}NOH$	VIII-175	227.25
722	phenylhydrazone (α)	.....	$C_6H_5NHN{:}C(C_6H_5){\cdot}CHOHC_6H_5$	XV-200	302.36
723	phenylhydrazone (β)	.....	$C_6H_5NHN{:}C(C_6H_5){\cdot}CHOHC_6H_5$	XV-200	302.36
724	**Benzophenone**	diphenyl ketone	$(C_6H_5)_2CO$	VII-410	182.21
725	anil	.....	$(C_6H_5)_2C{:}N{\cdot}C_6H_5$	XII-201	257.32
726	chloride	diPh-diCl-methane	$(C_6H_5)_2CCl_2$	V-590	237.12
727	dicarboxylic acid	(2,2′)	$(HO_2C{\cdot}C_6H_4)_2{:}CO$	X-881	270.23
728	oxime	diphenyl ketoxime	$(C_6H_5)_2C{:}NOH$	VII-416	197.23
729	phenylhydrazone	.....	$C_6H_5NHN{:}C(C_6H_5)_2$	XV-148	272.33
730	**Benzo**-phosphinic acid (*p*)	.....	$HO_2C{\cdot}C_6H_4{\cdot}PO(OH)_2$	XVI-820	202.11

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
700	lf.	.....	235-7 d.	.....	i.; s. NaOH	$0.05^{17°}$	v. sl. s.
701	cr.	.....	206-7 d.	.....	sl. s. h.	$15.3^{17°}$	v. s.
702	nd./al.	.....	anh. 164-6	.....	i.	$>15.3^{17°}$	v. s.
703	lf./aq. al.	.....	137-8	d. 200	i.	s. c.	s.
704	nd./bz.	.....	70	.....	v. sl. s.	v. s.	v. s.
705	.....	.....	113-4	.....	.....	.....	.....
706	yel. nd.	.....	205-15	.....	$1.7^{19°}$ act.	sl. s. c.	s.
707	nd.	.....	225-35	.....	$2.4^{19°}$ act.	sl. s.	sl. s.
708	rhb./al.	.....	170	>360	sl. s.; s. a.	v. s.	sl. s.; s. alk.
709	lf./aq.	.....	310-2	subl. >270	sl. s. h.	s.; sl. s. bz.	i. aq. a.
710	rhb.	.....	131-2	expl.	$2.25^{6°}$	v. s.	sl. s.; i. bz.
711	mn. pr.	$1.266^{\frac{15}{4}°}$	121.7; subl. > 100	249.2	$0.21^{17.5°}$; $2.2^{75°}$	$46.6^{15°}$, abs. al.	$66^{15°}$
712	col. cr.	.....	$-H_2O$, 120	.....	$61^{25°}$; $77^{100°}$	$2.3^{25°}$; $8.3^{78°}$	.....
713	col. pr.	1.341	130	290	$1.35^{25°}$	$17.0^{25°}$, abs. al.	sl. s.
714	rhb./et.	$1.199^{\frac{15}{4}°}$	42	360	i.; s. act.	s.; s. bz.	s.; s. chl.
715	lf./al.	$1.31^{4°}$	163	$117\text{-}9^{10mm}$	i.	$4^{30°}$, abs. al.	sl. s.
716	col. lq.	$1.001^{\frac{25}{4}°}$	-12.9	190.7	$1^{100°}$	∞	∞
717	mn.	.....	133-7	$343\text{-}4^{768mm}$	v. sl. s. h.	s. h.; s. act.	sl. s.
718	pr./et. or al.	.....	83	.....	.....	v. s.	v. s.
719	nd./lg.	.....	62-3	.....	v. s. bz.	v. s.	v. s.
720	pr./bz.	.....	151-2	.....	sl. s.	s.	s. NH_4OH
721	pr.	.....	99	.....	.....	.....	s.
722	col. nd.	.....	155-8	.....	i.	$2.2^{20°}$	.....
723	col. nd.	.....	106	.....	.....	$8.8^{20°}$	s.
724	col. rhb.	(α) $1.083^{54°}$ (β) $1.108^{23°}$	(α) 48.5 (β) 26.5 (γ) 45.8 (δ) -51	305.4	i.	$6.5^{15°}$; s. chl.	$15^{13°}$
725	yel. rhb./et.	.....	117 (112)	356-8	s. bz., CS_2	sl. s.	sl. s.
726	col. lq.	$1.235^{19°}$	.....	305 d.	d.	d.	s. bz.
727	cr.	.....	150-5 d.	$-H_2O$ >160°	i.	s.	s.
728	cr./lg.	.....	143-4	.....	v. sl. s.	v. s. act.	v. s.
729	col. nd.	.....	137-8	.....	.. . ...	sl. s. h.	.....
730	nd./aq.	.....	>300	d. >300	s.	sl. s.	sl. s. HCl

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
731	**Benzo**-pinacoline (β)	phenyl-trityl ketone	$(C_6H_5)_3C{\cdot}CO{\cdot}C_6H_5$	VII-544	348.42
732	pinacone	.....	$[(C_6H_5)_2C{\cdot}OH]_2$	VI-1058	366.44
733	purpurin 4B	ditolyl-bis-(azo-naphthionic acid)	$[C_{10}H_5(NH_2)(SO_3Na){\cdot}N{:}N{\cdot}C_6H_3(CH_3){\cdot}]_2$	*XVI-342	724.71
734	thiazylhydrazine (2)	.....	$C_6H_4N{:}C(N_2H_3){\cdot}S{\cdot}$ (ring)	.....	165.21
735	trichloride	phenyl chloroform	$C_6H_5CCl_3$	V-300	195.48
736	**Benzoxyl-2-dimethyl-aminomethyl-1-dimethyl-aminobutane** (2) HCl	alypin hydrochloride	$[(CH_3)_2N{\cdot}CH_2]_2{:}C{:}(C_2H_5)(O_2C{\cdot}C_6H_5){\cdot}HCl$	IX-175	314.85
737	nitrate	alypin nitrate	$C_{16}H_{26}O_2N_2{\cdot}HNO_3$	*IX-92	341.40
738	**Benzoyl** acetic acid	.....	$C_6H_5{\cdot}CO{\cdot}CH_2{\cdot}CO_2H$	X-672	164.15
739	acetic ester	ethyl benzoyl-acetate	$C_6H_5{\cdot}CO{\cdot}CH_2{\cdot}CO_2{\cdot}C_2H_5$	X-674	192.21
740	acetoacetic ester	.....	$C_2H_3O{\cdot}CH(C_7H_5O){\cdot}CO_2C_2H_5$	X-817	234.24
741	acetone	.....	$C_6H_5CO{\cdot}CH_2{\cdot}CO{\cdot}CH_3$	VII-680	162.18
742	acetonitrile	ω-cyanoacetophenone	$C_6H_5{\cdot}CO{\cdot}CH_2{\cdot}CN$	X-680	145.15
743	acrylic acid (β)	.....	$C_7H_5O{\cdot}CH{:}CH{\cdot}CO_2H{\cdot}H_2O$	X-726	194.18
744	alanine (*dl*)	.....	$C_6H_5CO{\cdot}NH{\cdot}CH(CH_3){\cdot}CO_2H$	IX-248	193.20
745	alanine (*l*)	.....	$C_{10}H_{11}O_3N$	IX-248	193.20
746	aminobenzoic acid (*o*)	*N*-benzoyl-anthranilic acid	$C_7H_5O{\cdot}NH{\cdot}C_6H_4{\cdot}CO_2H$	XIV-340	241.24
747	aminobenzoic acid (*m*)	benzaminobenzoic acid	$C_7H_5O{\cdot}NH{\cdot}C_6H_4{\cdot}CO_2H$	XIV-397	241.24
748	aminobenzoic acid (*p*)	.....	$C_7H_5O{\cdot}NH{\cdot}C_6H_4{\cdot}CO_2H$	XIV-433	241.24
749	auramine	.....	$[(CH_3)_2N{\cdot}C_6H_4]_2C{:}N{\cdot}COC_6H_5$	XIV-95	371.46
750	benzoic acid (*o*)	.....	$C_6H_5CO{\cdot}C_6H_4{\cdot}CO_2H{\cdot}H_2O$	X-747	244.24
751	benzoic acid (*m*)	.....	$C_6H_5CO{\cdot}C_6H_4{\cdot}CO_2H$	X-752	226.22
752	benzoic acid (*p*)	.....	$C_6H_5CO{\cdot}C_6H_4{\cdot}CO_2H$	X-753	226.22
753	bromide	.....	$C_6H_5{\cdot}CO{\cdot}Br$	IX-195	185.03
754	carbinol	phenacyl alcohol	$C_6H_5CO{\cdot}CH_2OH$	VIII-90	136.14
755	chloride	.....	$C_6H_5{\cdot}CO{\cdot}Cl$	IX-182	140.57
756	cyanide	.....	$C_6H_5{\cdot}CO{\cdot}CN$	X-659	131.13
757	fluoride	.....	$C_6H_5{\cdot}CO{\cdot}F$	IX-181	124.11
758	formic acid	phenylglyoxylic acid	$C_6H_5{\cdot}CO{\cdot}CO_2H$	X-654	150.13
759	glycolic acid	.....	$C_7H_5O{\cdot}OCH_2{\cdot}CO_2H$	IX-167	180.15
760	hydrazine	.....	$C_6H_5CO{\cdot}NH{\cdot}NH_2$	IX-319	136.15
761	hydrogen peroxide	.....	$C_6H_5CO_2{\cdot}OH$	IX-178	138.12
762	iodide	.....	$C_6H_5{\cdot}CO{\cdot}I$	IX-195	232.03
763	lactic acid (*dl*)	.....	$CH_3{\cdot}CH(O_2C_7H_5){\cdot}CO_2H$	IX-167	194.18
764	γ-(2-methylpiperidino)-propanol HCl	neothesin	$C_{16}H_{23}O_2N{\cdot}HCl$	.....	297.82

Benzo-flavone 4479
Benzo-hydroquinone 2322
Benzo-γ-pyrone 1490
Benzo-pyrrole 3864
Benzo-quinoline 4518
Benzo-quinone 5541-2
Benzo-resorcin 2321
Benzo-salin 4143
Benzosol 3482
Benzo-thiophene 5912
Benzo-triazole 252
Benzozone 73
Benzol 656
Benzoxazinone 645
Benzoyl-acetophenone 1781.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
731	nd./al.	.....	179-81	.....	i.	v. sl. s. c.; 1.2 h.	s.
732	mn.	.....	185-6 d.	.....	.....	2.5 h.	v. s.
733	cr.	.....	.....	.....	s.	.....	.....
734	pa. yel. cr.	.....	197-8	.....	i.	s. h.	i.
735	col. lq.	$1.380^{14°}$	-21.2	220.7	i.; d.	s.; s. bz.	s.
736	cr./act.	.....	169 d.	.....	v. s.; s. act.	s.; s. chl.	i.
737	col. pd.	.....	163	.....	v. s.	v. s.	v. sl. s.
738	nd./bz.	.....	103-4 d.	.....	s. h.	s.	s.
739	col. lq.	$1.111^{25°}_{4}$	.....	165-7 ^{20mm}	v. sl. s.	∞	∞
740	oil	.....	.....	175-6 ^{12mm} (sl. d.)	.....	.....	.....
741	pr.	$1.090^{80°}_{00}$	60-1	260-2 (sl. d.)	s. h.	v. s.	v. s.
742	pr./aq.	.....	80.5	.....	sl. s. c.	s.	s.; v. s. bz.
743	cr.	.....	65; anh. 99	.....	sl. s. c.	s.	s.
744	lf./et.	.....	165-6	.....	0.4 c.	v. s.	v. sl. s.
745	pl./aq.	.....	150-1	.....	$1.1^{20°}$	v. s.	v. sl. s.
746	nd./al.	.....	181-2	.....	i.	s.	s.
747	pr./al.	.....	248	.....	sl. s.	s.	sl. s.
748	nd./al.	.....	278	.....	sl. s. h.	s.	s.; s. ac.
749	yel. nd./al.	.....	179	.....	.....	$0.16^{16°}$	$0.93^{16°}$ bz.
750	tri./aq.	.....	93-4; anh. 128	.....	sl. s.	.....	.....
751	lf./aq. al.	.....	161-2	subl.	sl. s. h.	s.	s.
752	mn.	.....	194	subl.	v. sl. s. c.	s.	s.
753	lq.	$1.570^{20°}_{4}$	0±	218-9	d.	d. h.	∞
754	hex. pl./al.	1.013	85-6	118-20 ^{11mm}	sl. s. h.	v. s.	v. s.
755	col. lq.	$1.212^{20°}_{4}$	-0.5	197.2	d.; s. bz.	d. h.	∞; s. CS_2
756	cr. pl.	.....	33-4	208-10	i.	.....	.....
757	lq.	>1	.....	161.5^{45mm}	sl. d. h.	d. h.	s.
758	pr.	.....	65-6	148^{6mm}	s.	i. CS_2	s.
759	pr.	.....	79	.....	sl. s. c.; d. h.	s.	s.
760	pl./aq.	.....	112.0-2.5	d.	s.	s.; sl. s. bz.	sl. s.
761	lf./lg.	.....	41-3	$97-100^{13mm}$	i.	s.	s.
762	nd.	.....	3	135^{25mm}	d. h.	d. h.	s.
763	pl.	.....	112	.....	0.25 c.; d. h.	v. s.	v. s.
764	wh. cr. pd.	.....	171-3	.....	100	s.; s. chl.	i.

Benzoyl-anisole 4070
Benzoyl-anthranilic acid (*N*) 746
Benzoyl-azide 653
Benzoyl-ecgonine, cf. alkd.
Benzoyl-eugenol 3220
Benzoyl-formaldoxime 4874
Benzoyl-glucose, cf. glcd.
Benzoyl-glycine 3664
Benzoyl-guaiacol 3482
Benzoyl-hydroquinone 2322
Benzoyl-hydroxylamine (*N*) 710
Benzoyl-naphthalene 5210-1

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Benzoyl				
765	α-naphthylamine	benznaphthalide	$C_6H_5CO{\cdot}NH{\cdot}C_{10}H_7$	XII-1233	247.28
766	peroxide	.....	$(C_6H_4CO)_2O_2$	IX-179	242.22
767	phenylhydrazine (α, α′)	.....	$C_6H_5N(COC_6H_5){\cdot}NH_2$	XV-250	212.24
768	phenylhydrazine	(α, β)	$C_6H_5NH{\cdot}NHCOC_6H_5$	XV-255	212.24
769	phthalic acid (1;2,3)	.....	$C_6H_5CO.C_6H_3.(CO_2H)_2{\cdot}H_2O$	X-880	288.25
770	piperidine (*N*)	.....	$C_7H_5O{\cdot}N{\cdot}CH_2(CH_2)_4$ | |	XX-46	189.25
771	propionic acid (β)	.....	$C_7H_5O{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2H$	X-696	178.18
772	terephthalic acid	(1;2,5)	$C_{13}H_8O(CO_2H)_2$	X-881	270.23
773	2-thiohydantoin (1)	.....	$CH_2{\cdot}CO{\cdot}NH{\cdot}CS{\cdot}N{\cdot}$ | | C_7H_5O	*XXIV-294	220.24
774	thiourea	.....	$C_7H_5O{\cdot}NH{\cdot}CS{\cdot}NH_2$	IX-219	180.22
775	toluidide (*o*)	*N*-tolylbenzamide (*o*)	$C_7H_5O{\cdot}NH{\cdot}C_6H_4{\cdot}CH_3$	XII-795	211.25
776	toluidide (*m*)	.....	$C_7H_5O{\cdot}NH{\cdot}C_6H_4{\cdot}CH_3$	XII-861	211.25
777	toluidide (*p*)	.....	$C_7H_5O{\cdot}NH{\cdot}C_6H_4{\cdot}CH_3$	XII-926	211.25
778	urea (*N*)	.....	$C_6H_5CO{\cdot}NHCONH_2$	IX-215	164.16
779	**Benzoylene urea**	2,4-diketotetrahydro-quinazoline	$C_6H_4{\cdot}NH{\cdot}CO{\cdot}NH{\cdot}CO$ | |	XXIV-373	162.14
780	**Benzyl** acetamide (*N*)	acetyl-benzylamine	$CH_3CO{\cdot}NH{\cdot}CH_2C_6H_5$	XII-1044	149.19
781	acetate	.....	$C_6H_5CH_2O{\cdot}COCH_3$	VI-435	150.17
782	alcohol	phenyl carbinol	$C_6H_5{\cdot}CH_2OH$	VI-428	108.13
783	amine	ω-aminotoluene	$C_6H_5CH_2{\cdot}NH_2$	XII-1013	107.15
784	aminophenol (*p*)	.....	$C_6H_5CH_2{\cdot}NH{\cdot}C_6H_4OH$	XIII-448	199.24
785	aminophenol HCl	(*p*)	$C_{13}H_{13}ON{\cdot}HCl{\cdot}H_2O$	XIII-448	253.72
786	aniline	phenyl-benzylamine	$C_6H_5CH_2{\cdot}NH{\cdot}C_6H_5$	XII-1023	183.24
787	arsonic acid	.....	$C_6H_5CH_2{\cdot}AsO(OH)_2$	XVI-872	216.05
788	azide	.....	$C_6H_5{\cdot}CH_2{\cdot}N_3$	V-350	133.15
789	benzoate	.....	$C_6H_5CO_2{\cdot}CH_2{\cdot}C_6H_5$	IX-121	212.24
790	benzoic acid (*o*)	.....	$C_6H_5{\cdot}CH_2{\cdot}C_6H_4{\cdot}CO_2H$	IX-676	212.24
791	benzoic acid (*m*)	.....	$C_6H_5{\cdot}CH_2{\cdot}C_6H_4{\cdot}CO_2H$	IX-676	212.24
792	benzoic acid (*p*)	.....	$C_6H_5{\cdot}CH_2{\cdot}C_6H_4{\cdot}CO_2H$	IX-677	212.24
793	bromide	ω-bromotoluene	$C_6H_5{\cdot}CH_2{\cdot}Br$	V-306	171.04
794	butyrate	.....	$C_2H_5CH_2CO_2CH_2{\cdot}C_6H_5$	VI-436	178.22
795	carbamate	.....	$NH_2{\cdot}CO_2{\cdot}CH_2C_6H_5$	VI-437	151.16
796	chloride	ω-chlorotoluene	$C_6H_5{\cdot}CH_2{\cdot}Cl$	V-292	126.58
797	chloroacetate	.....	$ClCH_2CO_2{\cdot}CH_2C_6H_5$	VI-435	184.62
798	cinnamate	cinnamein	$C_8H_7{\cdot}CO_2{\cdot}C_7H_7$	IX-584	238.27
799	cyanamide	.....	$C_6H_5{\cdot}CH_2{\cdot}NH{\cdot}CN$	XII-1051	132.16
800	cyanide	phenylacetonitrile	$C_6H_5{\cdot}CH_2{\cdot}CN$	IX-441	117.14
801	cyanurate (*iso*)	.....	$(C_6H_5CH_2N{\cdot}CO)_3$	XXVI-255	399.43
802	diphenyl (*o*)	.....	$C_6H_5CH_2{\cdot}C_6H_4{\cdot}C_6H_5$	V-708	244.32
803	diphenyl (*p*)	.....	$C_6H_5CH_2{\cdot}C_6H_4{\cdot}C_6H_5$	V-708	244.32
804	diphenylamine	diphenyl-benzylamine	$(C_6H_5)_2N{\cdot}CH_2C_6H_5$	XII-1033	259.33
805	disulfide	dibenzyl-disulfide	$(C_6H_5{\cdot}CH_2)_2S_2$	VI-465	246.37

Benzoyl-nitromethane 4594
Benzoyl-persulfide 1779
Benzoyl-pseudotropine, cf. alkd.
Benzoyl-pyrogallol 6224
Benzoyl-resorcin 2321
Benzoyl-salicin, cf. glcde.
Benzoyl-sulfimide 5579
Benzoyl-*pseudo*-tropine, cf. alkd.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
765	nd./aq. al.	.....	161-2	.....	s. ac.	v. sl. s. abs.	.....
766	rhb./et.	.....	108 d.	expl.	i.	sl. s. c.; s. h.	s.; s. bz.
767	nd./aq.	.....	70	.....	sl. s. c.	v. s.	v. s.
768	pr./al.	.....	168	.....	sl. s. h.	s. h.; s. chl.	sl. s.
769	nd./aq.	.....	$-H_2O$, 100	$-2H_2O > 100$	s. h.	s.	v. sl. s. bz.
770	col. tri.	.....	48	320-1	i.	s.	s.
771	nd./aq.	.....	116	sl. d.	s. h.	s.	s.; i. lg.
772	cr./al.	.....	>290	.....	i.	s.	s.
773	cr./al.	.....	165 d.	.....	.....	.....	.....
774	pr./aq. al.	.....	169-70	.....	sl. s. c.	s.	i.
775	rhb.	$1.205^{15°}$	145-6	.....	sl. s. h.	s.	.....
776	mn./aq. al.	$1.170^{15°}$	.....	.....	.....	$13^{15°}$ abs.	.....
777	rhb./al.	$1.202^{15°}$	157-8	232	i.	4.2^{180} abs.	.....
778	nd./al.	.....	214-5	.....	s. h.	1, c,; 4, h.	i.
779	col. nd.	.....	353-4	.....	$0.013^{23°}$	v. sl. s.	s. alk.
780	lf./et.	.....	60-1	>300	sl. s. pet.	v. s.	v. s.
781	col. lq.	$1.057^{17°}$	−51.5	213.5	i.	∞	∞
782	col. lq.	$1.043^{20°}_{4}$	−15.3	204.7	$4^{17°}$	∞; ∞ chl.	∞
783	lq.	$0.982^{20°}_{4}$	.....	184.5	∞	∞	∞
784	lf.	.....	89	.....	v. sl. s.	v. s.	v. s. bz.; s. NaOH
785	pr./aq.	.....	172 (anh.)	.....	s. h.	s.	i.
786	mn. pr.	$1.065^{25°}_{25°}$	37-8	306^{759mm}	i.	s. h. Me al.	s.; s. chl.
787	nd.	.....	167	d.	$0.34^{23°}$; $3.59^{97°}$	$0.87^{23°}$; 5.97^{00}	.....
788	oil	$1.066^{25°}$	.....	108^{23mm}	i.	∞	∞
789	nd. or lf.	1.122 (lq.)	21	323-4	i.; ∞ chl.	∞; s. oil	∞
790	nd./aq. al.	.....	114-7	subl.	sl. s.	s.; s. chl.	s.; s. bz.
791	lf./aq. al.	.....	107-8	subl.	sl. s.	s.; s. chl.	s.
792	lf./aq. al.	.....	155-7	subl.	sl. s.	s.; s. chl.	s.
793	col. lq.	$1.443^{17°}$	−4	198-9	i.	∞	∞
794	col. lq.	$1.016^{16°}_{16°}$	.....	238-40	i.	v. s.	v. s.
795	cr.	.....	86	d.	v. sl. s.	s.	s.
796	col. lq.	$1.100^{20°}_{20°}$	−39	179.4	i.	∞; ∞ chl.	∞
797	col. oil	$1.222^{0°}_{4}$	.....	147.5^{9mm}	.....	.....	.....
798	pr.	.....	39	244^{25mm}	i.	s.	s.
799	pl./et.	.....	43	.....	i.	v. s.	v. s.
800	col. lq.	$1.018^{20°}_{4}$	−23.8	233-4	i.	∞	∞
801	nd./al.	.....	157	>320	i. c.	s.	sl. s.
802	mm.	.....	54	$283\text{-}7^{110mm}$	v. s. bz.	s.	v. s.
803	lf.	.....	85	$285\text{-}6^{110mm}$	v. s. bz.	sl. s.	v. s.
804	nd.	.....	86-7	.....	v. sl. s.	s. h.	s.
805	lf./al.	.....	71-2	d. >270	v. sl. s.	s. h.	s.; s. bz.

Benzyl, cf. also dibenzyl.
Benzyl-acetic acid 3704
Benzyl-acetoacetic ester 2983
Benzyl-carbamide 844
Benzyl-carbinol 5187
Benzyl-cellosolve 3449
Benzyl citrate 6085

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
806	**Benzyl** ether	dibenzyl ether	$(C_6H_5{\cdot}CH_2)_2O$	VI-434	198.25
807	formate	.....	$HCO_2{\cdot}CH_2{\cdot}C_6H_5$	VI-435	136.14
808	hydrazine	.....	$C_6H_5{\cdot}CH_2{\cdot}NH{\cdot}NH_2$	XV-531	122.17
809	hydroxybenzoate (*p*)	.....	$HO{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_7H_7$	.....	228.24
810	hydroxylamine (*α*)	.....	$C_6H_5{\cdot}CH_2{\cdot}O{\cdot}NH_2$	VI-440	123.15
811	hydroxylamine (*β*)	.....	$C_6H_5{\cdot}CH_2{\cdot}NH{\cdot}OH$	XV-17	123.15
812	imino-(4-methoxy-phenyl) methane	anisalbenzylamine	$C_6H_5CH_2N{:}CH{\cdot}C_6H_4{\cdot}OCH_3$	XII-1043	225.28
813	iodide	*ω*-iodotoluene	$C_6H_5{\cdot}CH_2{\cdot}I$	V-314	218.05
814	lactate	.....	$CH_3CHOHCO_2{\cdot}C_7H_7$	.....	180.20
815	malonic acid	.....	$C_6H_5CH_2{\cdot}CH(CO_2H)_2$	IX-868	194.18
816	mercaptan	.....	$C_6H_5{\cdot}CH_2{\cdot}SH$	VI-453	124.19
817	naphthalene (*α*)	Ph-naphthylmethane	$C_6H_5{\cdot}CH_2{\cdot}C_{10}H_7$	V-689	218.28
818	naphthalene (*β*)	Ph-naphthylmethane	$C_6H_5{\cdot}CH_2{\cdot}C_{10}H_7$	V-690	218.28
819	*α*-naphthyl ether	.....	$C_6H_5{\cdot}CH_2{\cdot}O{\cdot}C_{10}H_7$	.....	234.28
820	*β*-naphthyl ether	.....	$C_6H_5{\cdot}CH_2{\cdot}O{\cdot}C_{10}H_7$	VI-642	234.28
821	*α*-naphthyl ketone	.....	$C_6H_5{\cdot}CH_2{\cdot}CO{\cdot}C_{10}H_7$	VII-512	246.29
822	phenanthracene (9)	.....	$C_7H_7{\cdot}C_6H_3{:}C_2H_2{:}C_6H_4$	*V-359	268.34
823	phenol (*o*)	HO-diPh-methane	$C_6H_5{\cdot}CH_2{\cdot}C_6H_4{\cdot}OH$	VI-675	184.23
824	phenol (*p*)	4-hydroxy-ditane	$C_6H_5{\cdot}CH_2{\cdot}C_6H_4{\cdot}OH$	VI-675	184.23
825	phenyl carbamate (*p*)	butolan	$C_7H_7{\cdot}C_6H_4O_2C{\cdot}NH_2$	*VI-325	227.25
826	phenylhydrazine (*α*,*α*)	.....	$(C_7H_7)(C_6H_5)N{\cdot}NH_2$	XV-532	198.26
827	phenylhydrazine HCl	(*α*,*α*)	$C_{13}H_{12}N{\cdot}NH_2{\cdot}HCl$	XV-533	234.72
828	phenylnitrosamine	nitroso-benzyl-aniline	$C_6H_5CH_2{\cdot}N(NO){\cdot}C_6H_5$	XII-1071	212.24
829	propionate	.....	$C_2H_5CO_2{\cdot}CH_2C_6H_5$	VI-436	164.20
830	pyridine (2)(*α*)	.....	$C_6H_5{\cdot}CH_2{\cdot}C_5H_4N$	XX-425	169.22
831	pyridine (3)(*β*)	.....	$C_6H_5{\cdot}CH_2{\cdot}C_5H_4N$	XX-426	169.22
832	pyrrole (*N*)	.....	$C_4H_4N{\cdot}CH_2{\cdot}C_6H_5$	XX-164	157.21
833	salicylate	.....	$HOC_6H_4CO_2{\cdot}CH_2C_6H_5$	X-80	228.24
834	succinate (mono)	.....	$C_7H_7O_2C(CH_2)_2{\cdot}CO_2H$	VI-436	208.22
835	sulfone	dibenzyl sulfone	$(C_6H_5{\cdot}CH_2)_2SO_2$	VI-456	246.31
836	sulfoxide	.....	$(C_6H_5{\cdot}CH_2)_2SO$	VI-456	230.31
837	tartronic acid	.....	$C_7H_7{\cdot}C(OH)(CO_2H)_2$	X-515	210.18
838	***iso***-thiocyanate	benzyl mustard oil	$C_6H_5{\cdot}CH_2{\cdot}N{:}CS$	XII-1059	149.20
839	thiourea	.....	$C_6H_5CH_2{\cdot}NH{\cdot}CS{\cdot}NH_2$	XII-1051	166.24
840	***iso***-thiourea	.....	$C_7H_7{\cdot}S{\cdot}C(:NH){\cdot}NH_2$	VI-461	166.24
841	***iso***-thiourea HCl	.....	$C_8H_{10}N_2S{\cdot}HCl$	VI-461	202.70
842	toluene (*m*)	phenyl-tolyl-methane	$C_7H_7{\cdot}C_6H_4{\cdot}CH_3$	V-607	182.25
843	toluene (*p*)	.....	$C_7H_7{\cdot}C_6H_4{\cdot}CH_3$	V-607	182.25
844	urea	benzyl carbamide	$C_6H_5CH_2{\cdot}NH{\cdot}CO{\cdot}NH_2$	XII-1050	150.18
845	**Beryllium** diethyl	.....	$(C_2H_5)_2Be$	IV-645	67.14
846	**Betaine**†	trimethyl glycine; oxyneurine	$(CH_3)_3N{\cdot}CH_2{\cdot}CO{\cdot}O$ (inner salt)	IV-346	117.15
847	hydrochloride	acidol; lycine	$C_5H_{11}O_2N{\cdot}HCl$	IV-348	153.61
848	**Betulin**	.....	$C_6H_6O_3$	.....	126.11

† See also alkaloids table.

Benzyl-ethyl-aniline 2984
Benzyl-ethyl ether 2986
Benzyl fumarate 1785
Benzyl maleate 1788
Benzyl-methyl ether 4145
Benzyl mustard oil 838
Benzyl phthalate 1789
Benzyl succinate 1790
Benzyl sulfide 1791

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
806	lq.	$1.036^{16°}$	.....	295-8	i.	s. h.	s.
807	col. lq.	$1.081^{23°}$	3.6	202-3 ^{747mm}	i.	s.	∞
808	col. oil	.....	26	135^{29mm}	∞	∞	∞
809	wh. pd.	.....	110-2	.....	i.	v. s.	s.
810	oil	.....	.....	$118-9^{30mm}$	.....	.....	.....
811	nd./pet.	.....	57-8	123^{50mm}	s.	.....	.....
812	col. cr./pet.	.....	89-91	.....	.....	.....	.....
813	cr.	$1.734^{25°}$	24.1	93^{10mm}	i.	s.	s.
814	col. lq.	.....	.....	$136-8^{10mm}$	.....	.....	.....
815	cr./et.	.....	121	d. 180	s.	s.	s.; s. h. bz.
816	col. lq.	$1.058^{20°}$	.....	194-5	.....	.....	.....
817	lf./al.	$1.165^{0°}$	58-9	350	s. chl., bz.	1.6 c., 3 h.	50 c.
818	mn. pr.	$1.176^{0°}$	35.5	350	.....	v. s. h.	v. s. bz.
819	col. cr.	.....	76-7	.....	i.	s. h.	s.
820	lf./al.	.....	98-9	.....	s. chl., bz.	s.	s.
821	pl./al.	.....	57	.....	i.	s.	s.
822	lf./al.	.....	91-2	.....	i.	.....	.....
823	col. oil	.....	52(21)	312	v. s. h.	s.	s.; s. alk.
824	nd./al.	.....	84	320-2	s. h.	s.	s.; s. alk.
825	wh. cr./al.	.....	144	.....	sl. s.	s. h.	s. bz.
826	col. oil	.....	.....	$216-8^{38mm}$	.....	.....	.....
827	nd./aq.	.....	167-70	.....	.....	.....	.....
828	yel. nd./al	.....	58	.....	s. chl., lg.	s.	s.
829	lq.	$1.036^{\frac{16}{17.5}°}$	.....	220-2	i.	.....	.....
830	lq.	$1.054^{\frac{20}{0}°}$	.....	276^{742mm}	i.	v. s.	v. s.
831	lq.	$1.061^{\frac{20}{0}°}$	34	287^{742mm}	i.	v. s.	v. s.
832	.....	.....	<37.5	246-7	i.	s.	s.
833	col. oil	$1.176^{\frac{18}{15}°}$	.....	208^{26mm}	v. sl. s.	∞	∞
834	cr.	.....	59	.....	i.	s.	s.
835	nd./al. + bz.	.....	150-1	290(sl. d.)	i.	sl. s.	s. bz.
836	lf./al.	.....	133-4	d. 210	s. h.	v. s.	v. s.
837	pr.	.....	147 d.	.....	s.	s.	s.
838	lq.	$1.125^{\frac{15}{4}°}$	.....	243	i.	.....	s.
839	pr./aq.	.....	162-4	.....	i. c.	1.5 c.	.....
840	nd./bz.	.....	103-4 d.	.....	s. chl., bz.	s.	s.
841	pl./HCl	.....	176(148)	.....	s.	s.	i.
842	lq.	$0.997^{17.5°}$	.....	275^{747mm}	.....	s.	s.
843	lq.	$0.994^{18°}$	-30	285-6	v. s. chl.	v. s.	v. s.
844	nd./al.	.....	147-8	d. 200	$1.74^{5°}$	$3.1^{23°}$, act.	$0.05^{22.5°}$
845	col. lq.	.....	.....	185-8	d.	d.	.....
846	pr./al.	.....	293 d.	.....	$157^{19°}$	$8.6^{18°}$	i.
847	col. mn./al.	.....	227-8 d.	.....	60	0.6	i.; i. chl.
848	nd./al.	.....	258	subl. sl. d.	i.; i. CS_2	0.7, c.; 4.27, h.	0.4, c.; 3, h.

Benzyl tartrate 1792
Benzylidene, cf. also benzal.
Berberine, cf. alkd.
Berberonic acid 5507
Bergamol 3975
Beta acid 559
Beta C acid 4534
Beta gamma acid 4537
Betaine, cf. alkd.
Betol 4569

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
849	**Betulinic acid**	.....	$C_{36}H_{54}O_6$	.....	582.79
850	**Bilifuscin**	bile pigment	$C_{16}H_{10}O_4N_2$	.....	294.26
851	**Bilirubin**	principal bile pigment	$(C_{16}H_{18}O_3N_2)_2$	.....	572.64
852	**Biliverdin**	bile pigment	$C_{32}H_{36}O_8N_4$	.....	604.64
853	**Biotin**	vitamin H	$C_{10}H_{16}O_3N_2S$	.....	244.30
854	methyl ester	.....	$C_{11}H_{18}O_3N_2S$	.....	258.33
855	**Bismuth** triethyl	triethyl bismuthine	$(C_2H_5)_3Bi$	IV-622	296.18
856	trimethyl	trimethyl bismuthine	$(CH_3)_3Bi$	IV-622	254.10
857	triphenyl	triphenyl bismuthine	$(C_6H_5)_3Bi$	XVI-898	440.30
858	triphenyl dichloride	triphenylbismuthine dichloride	$(C_6H_5)_3Bi:Cl_2$	XVI-899	511.21
859	**Biuret**	allophanamide	$NH(CONH_2)_2$†	III-70	103.08
860	**Borneol** (*d* or *l*)	.....	$C_{10}H_{17}OH$	VI-75	154.24
861	**Bornyl** acetate (*d*)	.....	$C_{10}H_{17}O{\cdot}CO{\cdot}CH_3$	VI-78	196.28
862	amine (*d*)	.....	$C_{10}H_{17}{\cdot}NH_2$	XII-45	153.26
863	*α*-bromo-*iso*-valerate (*d*)	brovalol; valisan; eubornyl	$(CH_3)_2CH{\cdot}CHBr{\cdot}CO_2C_{10}H_{17}$	VI-79	317.27
864	chloride‡	*iso*-bornyl chloride	$C_{10}H_{17}Cl$	V-97	172.69
865	dibromo-dihydrocinnamate	adamon	$C_6H_5(CHBr)_2CO_2{\cdot}C_{10}H_{17}$	*IX-202	444.21
866	salicylate (*d*)	salit	$HO{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_{10}H_{17}$	X-76	274.35
867	*iso*-valerate (*d*)	bornyval	$(CH_3)_2CHCH_2CO_2{\cdot}C_{10}H_{17}$	VI-79	238.36
868	*iso*-valeryl-glycollate	neobornyval	$(CH_3)_2CHCH_2CO_2{\cdot}CH_2{\cdot}CO_2{\cdot}C_{10}H_{17}$	.....	296.39
869	***iso*-Bornyl-*n*-valerate** (*d*)	gynoval	$CH_3(CH_2)_3CO_2{\cdot}C_{10}H_{17}$	VI-88	238.36
870	**Bornylene** (*l*)	.....	$C_{10}H_{16}$	V-155	136.23
871	**Boron** triethyl	.....	$(C_2H_5)_3B$	IV-641	98.00
872	trimethyl	.....	$(CH_3)_3B$	IV-641	55.92
873	**Brassidic acid**	.....	$C_{21}H_{41}{\cdot}CO_2H$	II-474	338.56
874	**Brazilein**	.....	$C_{16}H_{12}O_3{\cdot}H_2O$	XVIII-194	302.27
875	**Brazilin**	.....	$C_{16}H_{14}O_5$	XVII-194	286.27
876	**Bromal**	tribromo-acetaldehyde	$Br_3C{\cdot}CH{:}O$	I-626	280.78
877	hydrate	.....	$Br_3C{\cdot}CH(OH)_2$	I-626	298.79
878	**Bromo**-acenaphthene (3)	.....	$C_{12}H_9Br$	.....	233.11
879	acetamide (*N*)	acetbromamide	$CH_3{\cdot}CO{\cdot}NHBr{\cdot}H_2O$	II-181	155.99
880	acetanilide (*o*)	.....	$Br{\cdot}C_6H_4{\cdot}NH{\cdot}CO{\cdot}CH_3$	XII-632	214.07
881	acetanilide (*m*)	.....	$Br{\cdot}C_6H_4{\cdot}NH{\cdot}CO{\cdot}CH_3$	XII-634	214.07
882	acetanilide (*p*)	asepsin	$Br{\cdot}C_6H_4{\cdot}NH{\cdot}CO{\cdot}CH_3$	XII-642	214.07
883	acetic acid	.....	$Br{\cdot}CH_2{\cdot}CO_2H$	II-213	138.96
884	acetoacetanilide (*α*)	.....	$CH_3CO{\cdot}CHBr{\cdot}CO{\cdot}NH{\cdot}C_6H_5$	XII-519	256.10
885	aceto-*β*-naphthone (*ω*)	.....	$C_{10}H_7{\cdot}CO{\cdot}CH_2Br$	.....	249.11
886	acetone	.....	$Br{\cdot}CH_2{\cdot}CO{\cdot}CH_3$	I-657	136.99
887	acetophenone (*ω*)	phenacyl bromide	$C_6H_5CO{\cdot}CH_2{\cdot}Br$	VII-283	199.05

† Cryst. $+1H_2O$/aq.; $-H_2O$, 110°. ‡ See also pinene hydrochloride.

Bi-, cf. also di.
Bile acid 1479
Bile pigments 850-2
Bilineurine 1488
Biloptin 2384
Bindschedler's green 5833
Biohenin 1722
Biphenyl 2695
Bismark brown 6058
Bistriazo-ethane 1761
Biuret-amidine 2081
Biuret base 6209
Bixin 4933
Blue cross gas 2712
Bonoform 5739
Bordeaux DH 3732

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
849	wh. pd.	.....	195	.....	v. sl. s.	s.	.....
850	br. pd.	.....	183	.....	v. sl. s.	s.; v. s. alk.	v. sl. s.
851	or. pd.	.....	192	.....	i.; s. alk.; s. bz.	v. sl. s.; s. CS_2	v. sl. s.; s. chl.
852	gn. pd.	.....	.....	.....	i.; s. alk.	s.; s. bz.; s. CS_2	v. sl. s.; i. chl.
853	nd.	.....	230-2	.....	s. NaOH	.....	.....
854	cr./al. et.	.....	166-7	.....	i.	s.; s. Me al.	s.
855	col. oil	1.82	.....	*107 ^{79mm}	i.	v. s.	v. s.
856	col. oil	$2.30^{18°}$	.....	*110	i.	v. s.	v. s.
857	mn./al.	$1.952^{15°}_{4°}$	77-8	242^{14mm}	i.; v. s. chl.	v. sl. s.	s.; s. act.
858	pr./chl. al.	.....	141.5	.....	v. s. bz.	v. sl. s.	v. sl. s.
859	nd./al.	.....	192-3 d.	.....	$1.25^{0°}$; $45^{106°}$	s.	.....
860	col. cr.	$1.011^{20°}_{4°}$	208-9	212-3	v. sl. s.	v. s.; s. bz.	v. s.
861	rhb./pet.	$0.991^{15°}$	29	226-7	i.	s.	s.
862	col. cr.	.....	163	200	i.	v. s.	v. s.
863	col. oil	1.18	.....	163	i.	s.	s.; s. chl.
864	col. cr.	.....	161.5	.....	i.	v. sl. s. c.	v. s.
865	col. cr./al.	.....	75±	.....	i.; s. h. chl.	s. h.	s. h.
866	cr.	.....	44-5	$230-5^{50mm}$	i.; ∞ oil	∞; ∞ chl.	∞
867	col. lq.	$0.951^{20°}$	.....	255-60	i.	s.	s.
868	col. oil	1.03	.....	283-5 d.	i.; s. oil	v. s.; v. s. bz.	v. s.
869	col. lq.	$0.953^{18°}_{4°}$	.....	$143-5^{18mm}$	v. sl. s.; s. act.	s.; s. chl.	s.; s. bz.
870	col. cr.	.....	113	146^{740mm}	i.	s. Me al.	s. toluene
871	col. lq.	$0.696^{23°}$	.....	95	v. sl. s.	.....	.....
872	col. gas	.....	−160	−20	v. sl. s.	v. s.	v. s.
873	lf./al.	$0.859^{57°}$	61-2	282^{30mm}	$0.7^{25°}$	v. sl. s. c.	sl. s.
874	rhd. red	.....	softens 130-40	.....	sl. s. h.	s. alk.	s. d. H_2SO_4
875	cr./abs. al.	.....	250	.....	s.; s. alk.	s.	s.
876	yel. lq.	$2.665^{25°}_{4°}$	.....	174 d.	forms hydr.	s.	s.
877	cr.	$2.566^{40°}_{4°}$	53.5	.....	s.	s.; s. chl.	s.; s. glyc.
878	yel. cr.	.....	49-51	.....	i.	s.	v. s.
879	pl. + H_2O	.....	70-80	m. anh. 108	s.	s.	v. s.
880	nd./al.	.....	99	.....	i.	s.	s.
881	nd./aq. al.	.....	87.5	.....	.....	v. s.	v. s.
882	mn. pr.	1.717	166-7	.....	sl. s. h.	s.; s. bz.	s. chl.
883	pl. or rhb.	$1.934^{50°}_{50°}$	49-50	208	$\infty^{25°}$	$\infty^{25°}$	$\infty^{25°}$
884	col. lf./al.	.....	138 d.	.....	v. sl. s.; s. alk.	v. s.	sl. s.; sl. s. chl.
885	red fl.	.....	80-2	.....	i.	sl. s.	v. s.
886	lq.	$1.634^{23°}$	−54	136.5^{725mm}	v. sl. s.	v. s.	v. s.
887	rhb.	$1.647^{20°}_{4°}$	50	119	i.; s. bz.	v. s.	v. s.

* Explodes when heated in air.

Bordeaux S 3732 Brilliant green base 5762 Brom cresol purple 1832 Brom thymol blue 1879
Bornyval 867 Bromacetol 1866 Bromisoval 1009 Bromelia 3094
Bourbonal 3188 Bromanil 5726 Brom phenol blue 5724 Brometone 6102
Brilliant cotton blue 6345 Brom cresol green 5718 Brom-tetragnost 5723 Bromo-acetonitrile 954

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
888	**Bromo** acetophenone (*p*)	Me-*p*-Br-phenyl ketone	$Br{\cdot}C_6H_4{\cdot}CO{\cdot}CH_3$	VII-283	199.05
889	acettoluidide	3;1,4	$Br{\cdot}C_6H_3(CH_3){\cdot}NH{\cdot}CO{\cdot}CH_3$	XII-991	228.09
890	acetyl bromide	.....	$Br{\cdot}CH_2{\cdot}CO{\cdot}Br$	II-215	201.87
891	acetylene	bromo-ethyne	$CH{:}C{\cdot}Br$(or $C{:}CHBr$)	I-245	104.94
892	allyl alcohol (*β*)	.....	$CH_2{:}CBr{\cdot}CH_2OH$	I-439	136.99
893	aniline (*o*)	.....	$Br{\cdot}C_6H_4{\cdot}NH_2$	XII-631	172.03
894	aniline (*m*)	.....	$Br{\cdot}C_6H_4{\cdot}NH_2$	XII-633	172.03
895	aniline (*p*)	.....	$Br{\cdot}C_6H_4{\cdot}NH_2$	XII-636	172.03
896	aniline (*p*) HCl	.....	$Br{\cdot}C_6H_4{\cdot}NH_2{\cdot}HCl$	XII-637	208.50
897	anisole (*o*)	.....	$CH_3O{\cdot}C_6H_4{\cdot}Br$	VI-197	187.04
898	anisole (*p*)	.....	$CH_3O{\cdot}C_6H_4{\cdot}Br$	VI-199	187.04
899	anthraquinone (1)	.....	$C_6H_4{:}(CO)_2{:}C_6H_3Br$	VII-789	287.11
900	anthraquinone (2)	.....	$C_6H_4{:}(CO)_2{:}C_6H_3Br$	VII-789	287.11
901	antipyrine (*p*)	bromopyrine	$BrC_6H_4{\cdot}C_5H_7ON_2$	XXIV-33	267.13
902	benzene	phenyl bromide	C_6H_5Br	V-206	157.02
903	benzene sulfonic acid (*o*)	.....	$Br{\cdot}C_6H_4{\cdot}SO_3H$	XI-56	237.08
904	benzene sulfonic acid (*p*)	.....	$Br{\cdot}C_6H_4{\cdot}SO_3H$	XI-57	237.08
905	benzene sulfonyl chloride	.....	$Br{\cdot}C_6H_4{\cdot}SO_2Cl$	XI-57	255.53
906	benzoic acid (*o*)	.....	$Br{\cdot}C_6H_4{\cdot}CO_2H$	IX-347	201.03
907	benzoic acid (*m*)	.....	$Br{\cdot}C_6H_4{\cdot}CO_2H$	IX-349	201.03
908	benzoic acid (*p*)	.....	$Br{\cdot}C_6H_4{\cdot}CO_2H$	IX-351	201.03
909	benzonitrile (*p*)	*p*-Br-phenyl cyanide	$Br{\cdot}C_6H_4{\cdot}CN$	IX-354	182.03
910	benzoyl bromide (*m*)	.....	$Br{\cdot}C_6H_4{\cdot}CO{\cdot}Br$	.....	263.93
911	benzoyl chloride (*p*)	.....	$Br{\cdot}C_6H_4{\cdot}CO{\cdot}Cl$	IX-353	219.48
912	benzyl bromide (*p*)	.....	$Br{\cdot}C_6H_4{\cdot}CH_2Br$	V-308	249.95
913	benzyl chloride (*o*)	*ω*-Cl-2-Br-toluene	$Br{\cdot}C_6H_4{\cdot}CH_2Cl$	*V-155	205.49
914	benzyl chloride (*p*)	.....	$Br{\cdot}C_6H_4{\cdot}CH_2Cl$	V-307	205.49
915	*iso*-butyl benzene (*p*)	.....	$Br{\cdot}C_6H_4{\cdot}C_4H_9$	V-415	213.12
916	*tert*-butyl phenol	(4;2,1)	$(CH_3)_3C{\cdot}C_6H_3(Br)OH$	.....	229.12
917	butyric acid (*α*)(*dl*)	.....	$C_2H_5{\cdot}CHBr{\cdot}CO_2H$	II-281	167.01
918	*iso*-butyric acid (*α*)	.....	$(CH_3)_2CBr.CO_2H$	II-295	167.01
919	camphor (3)(*d*)	*α*-bromocamphor	$C_8H_{14}{\cdot}CO{\cdot}CHBr$ (|_____|)	VII-120	231.14
920	*n*-caproic acid (*α*)	.....	$CH_3(CH_2)_3{\cdot}CHBr{\cdot}CO_2H$	II-325	195.06
921	cinnamic acid (*α*) (*cis*)	bromo-allocinnamic acid	$C_6H_5{\cdot}CH{:}CBr{\cdot}CO_2H$	IX-600	227.06
922	cinnamic acid (*α*) (*trans*)	.....	$C_6H_5{\cdot}CH{:}CBr{\cdot}CO_2H$	IX-599	227.06
923	cinnamic acid (*β*) (*cis*)	bromo-allocinnamic acid	$C_6H_5{\cdot}CBr{:}CH{\cdot}CO_2H$	IX-598	227.06

Bromo-acetylamino-toluene 889
Bromo-allocinnamic acid 921, 923
Bromo-allyl bromide 1869
Bromo-allylene 5342

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
888	col. lf./al.	.....	50-1	255^{736mm}	i.; s. bz.	s.; s. CS_2	v. s.; s. ac.
889	nd./bz.	.....	116-7	.....	.....	.....	.....
890	lq.	$2.317^{21.5^\circ}_{21.5^\circ}$	.....	149-50	d.	d.	.....
891	poisonous gas	.....	.....	−2	5000-6000 cc.$^{15^\circ}$, CH_2CBr_2	s.	.....
892	lq.	1.61^{15°	.....	153-4	.....	.....	.....
893	cr.	.....	31-2	229	i.	v. s.	s.
894	cr.	$1.579^{20^\circ}_{4^\circ}$	18.5	251	i.	s.	s.
895	rhb.	1.80^{15-20°	63-4	.....	i. c.	v. s.	v. s.
896	mn. pr.	.....	.....	.....	s.	s.	i.
897	oil	.....	.....	218-21	.....	s.	.....
898	cr.	1.494^{9°	12-13	215	.....	s.	.....
899	yel. nd./bz.	.....	188	subl.	s. H_2SO_4	.....	.....
900	cr./am. al.	.....	204-5	.....	.....	.....	.....
901	col. mn./ aq.	.....	122	300^{9mm} ±	s. h.	s.; s. chl.	sl. s.
902	col. lq.	$1.495^{20^\circ}_{4^\circ}$	−30.6	156.2	i.	s.	∞; ∞ chl.
903	delq. nd.	.....	.....	.....	v. s.	v. s.	i.
904	delq. nd.	.....	102-3	155^{25mm}	s.	s.	i.
905	tri. pr./et.	.....	75-6	153^{15mm}	d. h.	d. h.	.....
906	nd./aq.	.....	148-50	subl.	0.18^{25°	s.	s.
907	nd.	.....	154-5	>280	0.04^{25°	s.	s.
908	mn. pr.	.....	251-3	.....	sl. s. h.	s.	s.
909	nd./aq. or al.	.....	112-3	.....	s. h.	s.	v. s.
910	col. lq.	.....	.....	$118-22^{8mm}$	.....	.....	.....
911	nd./pet.	.....	42	245-7 sl. d.	d.; v. s. bz.	v. s. lg.	s.
912	nd./al.	.....	61	.....	v. sl. s.	s. h.	s.
913	col. lq.	.....	.....	$124-6^{20mm}$	i.	v. s.	v. s.
914	nd./al.	.....	41	236	i.	v. s. h.	v. s.
915	lq.	.....	<−18	$232-3^{739mm}$	.....	.....	.....
916	lq.	$1.338^{25^\circ}_{25^\circ}$	<−20*	$109-29^{5mm}$	i.	∞; ∞ Me al.	∞ bz., act.
917	col. oil	$1.567^{20^\circ}_{20^\circ}$	−4	$127-8^{25mm}$	6.6	s.	s.
918	pl.	$1.523^{60^\circ}_{60^\circ}$	48	198-200	forms oil	s.	s.
919	cr.	$1.449^{20^\circ}_{4^\circ}$	77-8	274(sl. d.)	i.	20^{26°	v. s.
920	lq.	.....	.....	$128-31^{10mm}$	s.	s.	s.
921	rhb./aq.	.....	120-1	$110^{0.6mm}$	s. h.	s.	s. bz.
922	nd./aq.	.....	131-2	$121^{0.6mm}$	v. sl. s. h.	∞	∞
923	mn./al.	.....	160	$110^{0.6mm}$	sl. s. h.; sl. d.	sl. s. c.	s.; s. h. bz.

* Crysts. $+1H_2O$, m.p. 51-2°.

Bromo-aminotoluene 1002-3

Bromo-aspirin 76

Bromo-butane 1057-60

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
924	**Bromo** cinnamic acid (β) (*trans*)	.....	$C_6H_5 \cdot CBr:CH \cdot CO_2H$	IX-597	227.06
925	crotonic acid (β)	.....	$CH_3 \cdot C(Br):CH \cdot CO_2H$	II-419	165.00
926	bromocymene (2)	(4;2,1)	$(CH_3)_2CH \cdot C_6H_3(Br) \cdot CH_3$	V-423	213.12
927	diethylaniline (*p*)	.....	$Br \cdot C_6H_4 \cdot N(C_2H_5)_2$	XII-638	228.14
928	diiodo-methane	.....	$BrCHI_2$	I-72	346.77
929	dimethylaniline (*p*)	.....	$Br \cdot C_6H_4 \cdot N(CH_3)_2$	XII-637	200.08
930	dinitrobenzene	(4;1,2)	$Br \cdot C_6H_3(NO_2)_2$	V-266	247.02
931	dinitrobenzene	(4;1,3)	$Br \cdot C_6H_3(NO_2)_2$	V-266	247.02
932	dinitrobenzoic acid	(4;3,5,1)	$Br \cdot C_6H_2(NO_2)_2CO_2H$	IX-416	291.03
933	diphenyl (*o*)	.....	$Br \cdot C_6H_4 \cdot C_6H_5$	V-580	233.11
934	diphenyl (*p*)	.....	$Br \cdot C_6H_4 \cdot C_6H_5$	V-580	233.11
935	diphenyl ether (*p*)	.....	$Br \cdot C_6H_4 \cdot O \cdot C_6H_5$	*VI-105	249.11
936	ethyl acetate (β)	.....	$CH_3CO_2 \cdot CH_2 \cdot CH_2Br$	II-128	167.01
937	ethyl benzene (β)	Ph-Et-bromide	$C_6H_5 \cdot CH_2 \cdot CH_2Br$	V-356	185.07
938	ethyl benzene (α)	Ph-Et-bromide	$C_6H_5 \cdot CH(Br)CH_3$	V-355	185.07
939	ethyl ethyl ether	β-Br-diethyl ether	$BrCH_2CH_2 \cdot O \cdot C_2H_5$	I-338	153.03
940	ethyl phthalimide (β)(*N*)	phthalimino-Et-bromide	$C_6H_4(CO)_2N \cdot CH_2 \cdot CH_2Br$	XXI-461	254.09
941	fumaric acid	.....	$CH:CBr(CO_2H)_2$	II-745	194.98
942	furan (2)	.....	$Br \cdot C_4H_3O$	XVII-27	146.98
943	furoic acid (3)	.....	$Br \cdot C_4H_2O \cdot CO_2H$	XVIII-284	190.99
944	hydroquinone	.....	$Br \cdot C_6H_3(OH)_2$	VI-852	189.02
945	iodobenzene (*o*)	.....	$Br \cdot C_6H_4 \cdot I$	V-223	282.93
946	iodobenzene (*m*)	.....	$Br \cdot C_6H_4 \cdot I$	V-223	282.93
947	iodobenzene (*p*)	.....	$Br \cdot C_6H_4 \cdot I$	V-223	282.93
948	iodo-ethane (1,1)	.....	$CH_3 \cdot CHBrI$	I-98	234.89
949	iodo-ethane (1,2)	.....	$BrCH_2 \cdot CH_2I$	I-98	234.89
950	iodo-methane	.....	$BrCH_2I$	I-71	220.86
951	maleic acid	.....	$CH:CBr(CO_2H)_2$	II-754	194.98
952	malonic acid	.....	$BrCH(CO_2H)_2$	II-594	182.97
953	mesitylene	(2;1,3,5)	$Br \cdot C_6H_2(CH_3)_3$	V-408	199.09
954	methyl cyanide	bromo-acetonitrile	$BrCH_2 \cdot CN$	II-216	119.96
955	methyl acetate	.....	$CH_3 \cdot CO_2 \cdot CH_2Br$	II-152	152.99
956	naphthalene (α)	α-naphthyl bromide	$C_{10}H_7Br$	V-547	207.07
957	naphthalene (β)	β-naphthyl bromide	$C_{10}H_7Br$	V-548	207.07
958	α-naphthol (4,1)	.....	$Br \cdot C_{10}H_6 \cdot OH$	VI-613	223.07
959	β-naphthol (1,2)	.....	$Br \cdot C_{10}H_6 \cdot OH$	VI-650	223.07
960	nitrobenzene (*o*)	.....	$Br \cdot C_6H_4 \cdot NO_2$	V-247	202.02
961	nitrobenzene (*m*)	.....	$Br \cdot C_6H_4 \cdot NO_2$	V-248	202.02
962	nitrobenzene (*p*)	.....	$Br \cdot C_6H_4 \cdot NO_2$	V-248	202.02
963	3-nitrobenzene-1-sulfonic acid (4)	(4;3,1)	$Br \cdot C_6H_3(NO_2) \cdot SO_3H$	XI-74	282.08
964	3-nitrobenzoic acid (2)	(2;3,1)	$Br \cdot C_6H_3(NO_2) \cdot CO_2H$	IX-406	246.03
965	nitroethane (1,1)	.....	$CH_3 \cdot CHBr \cdot NO_2$	I-101	153.98
966	nitromethane	.....	$Br \cdot CH_2 \cdot NO_2$	I-77	139.95

Bromo-cumene 986
Bromo-cyanogen 1590
Bromo-cyclohexane 1612
Bromo-diethyl ether 939
Bromo-ethane 2989
Bromo-ethanol 3193
Bromo-ethylene 6434
Bromo-ethyl phenyl ether 969-71
Bromo-ethyne 891
Bromo-heptane 3545
Bromo-hexadecane 1276
Bromo-hexahydrobenzene 1612
Bromo-hexane 3641-3
Bromo-hydrin 3193, 6278
Bromo-hydroxydiphenyl 977

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
924	nd./aq.	.....	134-5	$122^{20.6mm}$	sl. s. h.	s.	s. h. bz.
925	nd./lg.	.....	95-7	.....	sl. s. c.	v. s.; v. s. bz.	v. s.; v. s. CS_2
926	lq.	1.253^{25}_{25}°	<-20	233-5	i.; $\infty^{25°}$ act.	$50^{25°}$ Me al.	∞; ∞ bz.
927	yel. red/ac.	.....	33	270	i.	v.s.	v.s.
928	yel. cr.	.....	60	110^{25mm}	sl. s. pet.	.....	soln. d. in light
929	lf./al.	.....	55	264	i.	v. s.	v. s.
930	mn. pr.	.....	59.4(34.8)	.....	i.	s. h.	s.
931	yel. cr.	.....	75.3	.....	.....	v. s. h.	.....
932	pr./aq. H_2SO_4	.....	181	.....	sl. s.	v. s.	v. s.
933	lq.	.....	<-20	296-8	i.	s.	v. s.
934	cr./al.	.....	90-1	310	i.; $100^{25°}$ bz.	s.; $3^{25°}$ Me al.	$34^{25°}$
935	lq.	$1.449^{13°}$	.....	305	.....	.....	.....
936	col. lq.	$1.514^{20°}_{4}$	-13.8	162-3	i.	∞	∞
937	lq.	.....	.....	$217\text{-}8^{734mm}$	.....	.....	.....
938	lq.	$1.311^{23°}$	.....	200-10 d.	i.	s.	s.
939	col. lq.	$1.357^{20°}_{4}$	.....	127-8	sl. s.	∞	∞
940	nd./al.	.....	82-3	d.	.....	.....	.....
941	lf./aq.	.....	185-6	d.	v. s.	.....	.....
942	lq.	1.650	.....	101-2	i.	s.	.....
943	nd./aq.	.....	128-9	.....	$1.3^{20°}$	s.; v. sl. s. CS_2	s.; v. sl. s. lg.
944	lf./pet.	.....	113	subl.	v. s.	v. s.	v. s.
945	col. lq.	$2.257^{25°}_{4}$	5.0(2.1)	257.4^{754mm}	i.	v. sl. s.	v. sl. s. ac.
946	col. lq.	.....	-9.3	252^{754mm}	i.	v. sl. s.	v. sl. s. ac.
947	pl./al. et.	.....	91-2	251.5^{754mm}	i.	v. sl. s. c.	sl. s.
948	lq.	$2.452^{16°}$	<-20	142-3	.....	.....	.....
949	long nd.	$2.516^{29°}$	28	163	.....	v. s. h.	.....
950	lq.	$2.926^{17°}$	.....	138-40	.....	.....	.....
951	nd. or pr.	.....	128*	d.	v. s.	v. s.	v. s.
952	nd./et.	.....	112-3 d.	.....	.....	v. s.	v. s.
953	lq.	$1.319^{10°}$	-1	225-30	.....	.....	.....
954	yel. oil	1.771	.....	148-50	.....	.....	s.
955	col. lq.	$1.195^{14°}$	.....	110-2	i.; sl. d.	s.	s.
956	col. oil	$1.482^{20°}_{4}$	5-6	281.1	i.; ∞ bz.	∞ abs. al.	∞
957	lf./al.	$1.605^{0°}$	59	281-2	i.; s. bz.	$6^{20°}$, 92% al.	v. s.; v. s. chl.
958	nd./aq. al.	.....	127-8	.....	.....	.....	.....
959	rhb. pr.	.....	83-4	d. 130	.....	.....	.....
960	yel. cr.	$1.623^{80°}_{4}$	43	261	i.	v. s.	s.
961	rhb.	$1.704^{20°}_{4}$	56.4	256-7	i.	s.	s.
962	tri.	1.948	126-7	255-6	i.	1.4 c.	s.
963	yel. nd.	.....	87-8	.....	s.	s.	i.
964	cr./aq. al.	.....	186-8	.....	.....	.....	.....
965	lq.	.....	.....	146-7	i.	.....	.....
966	lq.	.....	.....	152.5^{765mm}	i.	s. alk.	.....

* Heated slowly, m.p. 136-8°; rapidly, m.p. 140-1°.

Bromo-methane 4147
Bromo-methylacetophenone 4333
Bromo-methyl-*p*-tolyl ketone 4333
Bromo-nitrotoluene 4681
Bromo-nonane 4927
Bromo-octane 4973-4
Bromo-pentadecane 5063
Bromo-pentane 427-31

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
967	**Bromo** phenacyl bromide (*p*)	diBr-acetophenone	$Br{\cdot}C_6H_4{\cdot}CO{\cdot}CH_2Br$	VII-285	277.96
968	phenanthrene (9)	.....	$C_{14}H_9Br$	V-671	257.13
969	phenetole (*β*)	*β*-PhO-ethyl bromide	$Br{\cdot}CH_2CH_2{\cdot}O{\cdot}C_6H_5$	VI-142	201.07
970	phenetole (*o*)	.....	$Br{\cdot}C_6H_4{\cdot}O{\cdot}C_2H_5$	VI-197	201.07
971	phenetole (*p*)	.....	$Br{\cdot}C_6H_4{\cdot}O{\cdot}C_2H_5$	VI-199	201.07
972	phenol (*o*)	.....	$Br{\cdot}C_6H_4{\cdot}OH$	VI-197	173.02
973	phenol (*m*)	.....	$Br{\cdot}C_6H_4{\cdot}OH$	VI-198	173.02
974	phenol (*p*)	.....	$Br{\cdot}C_6H_4{\cdot}OH$	VI-198	173.02
975	phenylhydrazine (*p*)	.....	$Br{\cdot}C_6H_4{\cdot}NH{\cdot}NH_2$	XV-434	187.05
976	phenylhydrazine HCl	(*p*)	$Br{\cdot}C_6H_4{\cdot}N_2H_3{\cdot}HCl$	XV-435	223.51
977	phenylphenol	(1;3,4)	$C_6H_5{\cdot}C_6H_3(Br)OH$	.....	249.11
978	phthalic acid	(3;1,2)	$Br{\cdot}C_6H_3(CO_2H)_2$	IX-821	245.04
979	(tere)-phthalic acid	(2;1,4)	$Br{\cdot}C_6H_3(CO_2H)_2$	IX-848	245.04
980	propionic acid (*α*)	(*dl*)	$CH_3{\cdot}CHBr{\cdot}CO_2H$	II-254	152.99
981	propionic acid (*β*)	.....	$BrCH_2{\cdot}CH_2{\cdot}CO_2H$	II-256	152.99
982	propionyl bromide (*α*)	.....	$CH_3{\cdot}CHBr{\cdot}CO{\cdot}Br$	II-256	215.89
983	*n*-propyl acetate (*β*)	.....	$CH_3CO_2{\cdot}CH_2{\cdot}CHBr{\cdot}CH_3$	.....	181.04
984	*n*-propyl acetate (*γ*)	.....	$CH_3CO_2{\cdot}(CH_2)_3Br$	.....	181.04
985	*n*-propyl benzene (*p*)	.....	$Br{\cdot}C_6H_4{\cdot}(CH_2)_2CH_3$	V-391	199.09
986	*iso*-propyl benzene (*p*)	*p*-bromocumene	$Br{\cdot}C_6H_4{\cdot}CH(CH_3)_2$	V-395	199.09
987	*n*-propyl phenyl ether (*γ*)	.....	$C_6H_5{\cdot}O{\cdot}(CH_2)_3Br$	VI-142	215.09
988	propylene (1)(*α*)	1-bromo-propene-1	$CH_3{\cdot}CH{:}CHBr$	I-200	120.99
989	propylene (1)(*β*)	1-bromo-propene-1	$CH_3{\cdot}CH{:}CHBr$	I-200	120.99
990	propylene (2)	2-bromo-propene-1	$CH_3{\cdot}CBr{:}CH$	I-200	120.99
991	pyridine (2)	*α*-bromo-pyridine	$Br{\cdot}C_5H_4N$	XX-233	158.01
992	pyridine (3)	*β*-bromo-pyridine	$Br{\cdot}C_5H_4N$	XX-233	158.01
993	salicylic acid (5)	(5;2,1)	$Br{\cdot}C_6H_3(OH)CO_2H$	X-107	217.03
994	styrene (*α*)	.....	$C_6H_5{\cdot}CBr{:}CH_2$	V-477	183.05
995	styrene (*ω*)	***isomer No. 1***	$C_6H_5{\cdot}CH{:}CHBr$	V-477	183.05
996	styrene (*ω*)	***isomer No. 2***	$C_6H_5{\cdot}CH{:}CHBr$	V-477	183.05
997	succinic acid (*dl*)	.....	$(\cdot CH_2CHBr\cdot)(CO_2H)_2$	II-621	197.00
998	sulfalein	di-Na-phenol-tetra-bromo-phthalein-disulfonate	$Br_4C_6{\cdot}CO{\cdot}O{\cdot}C{:}$ |_____| $(C_6H_3OHSO_3Na)_2$	.....	838.04
999	toluene (*o*)	*o*-tolyl bromide	$Br{\cdot}C_6H_4{\cdot}CH_3$	V-304	171.04
1000	toluene (*m*)	.....	$Br{\cdot}C_6H_4{\cdot}CH_3$	V-305	171.04
1001	toluene (*p*)	.....	$Br{\cdot}C_6H_4{\cdot}CH_3$	V-305	171.04
1002	*o*-toluidine (5)	(5;2,1)	$Br{\cdot}C_6H_3(NH_2)CH_3$	XII-838	186.06
1003	*p*-toluidine (3)	(3;4,1)	$Br{\cdot}C_6H_3(NH_2)CH_3$	XII-991	186.06
1004	triiodomethane	.....	$BrCI_3$	I-74	472.69
1005	trinitromethane	.....	$BrC(NO_2)_3$	I-79	229.95

Bromo-phenylacetophenone 5214 Bromo-phenyl-ethyl ether 970-1 Bromo-propane 5388-9
Bromo-phenyl-cyanide 909 Bromo-picrin 4688 Bromo-propyl alcohol 5460, 6278

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
967	nd.	.....	109-10	.....	i.	s. h.	s.
968	pr./al.	$1.409^{\frac{1}{4}0^\circ}$	63	>360; subl.	v. s. ac.	.....	v. s. CS_2
969	cr.	.....	35	240-50 d.	i.	s.	s.
970	lq.	.....	.....	218-22	.....	s.	s.
971	lq.	.....	4	227-33	.....	.....	.....
972	col. lq.	1.553^{80°	5.6	194-5	s.; s. alk.	s.; ∞ chl.	∞
973	cr.	.....	32-3	236-7	s. alk.	s.	s.
974	tet. cr.	1.588^{80°	63.5	238	1.4^{15°	v. s.; 88^{25° act.	v. s.; 40^{25° bz.
975	nd./al.	.....	106-7	.....	s. bz.	s.	s.
976	cr./aq.	.....	.....	.....	s. h.	.....	.....
977	cr.	.....	94-6	.....	i.; 32^{25° bz.	125^{25°	v. s.
978	nd./aq.	.....	178.5 ($-H_2O$)	.....	s.	s.	s.; v. sl. s. chl.
979	nd./al.	.....	299	.....	0.18^{24°; s. h.	s.	i.; i. bz.
980	pr.	$1.700^{\frac{20}{4}^\circ}$	25.7(-3.9)	205.5 sl. d.	v. s.	v. s.	v. s.
981	pl.	.....	62.5	.....	v. s.	v. s.	v. s.
982	lq.	$2.061^{\frac{18}{4}^\circ}$	.....	152-4	.....	.....	.....
983	col. lq.	.....	.....	$51\text{-}3^{9mm}$	.....	.....	.....
984	col. lq.	.....	.....	$88\text{-}90^{22mm}$	.....	.....	.....
985	col. lq.	.....	.....	220	.....	.....	.....
986	lq.	$1.365^{\frac{22}{4}^\circ}$	<-20	216-8	.....	.....	.....
987	col. lq.	$1.365^{\frac{16}{16}^\circ}$	.....	$211\text{-}2^{200mm}$	.....	.....	.....
988	lq.	$1.434^{\frac{15.8}{4}^\circ}$	-113	59-60	.....	.....	.....
989	lq.	$1.417^{\frac{15.8}{4}^\circ}$	-76.5	63.3	.....	.....	.....
990	lq.	$1.397^{\frac{15.8}{4}^\circ}$	-125	48.4	.....	.....	.....
991	lq.	1.657^{15°	.....	193-4	sl. s.	.....	.....
992	col. lq.	1.632^{10°	.....	$173\text{-}4^{758mm}$	sl. s.	s.	s.
993	nd./aq. al.	.....	165-6	subl. >100	0.3^{80°	85^{25°	70^{25°
994	oil	$1.406^{\frac{20}{4}^\circ}$	-43.5	160^{75mm}	.....	.....	.....
995	lq.	$1.422^{\frac{20}{4}^\circ}$	7	221 sl. d.	i.	∞	∞
996	lq.	$1.427^{\frac{20}{4}^\circ}$	-7.5	108^{26mm}	i.	∞	∞
997	col.	2.073	160-1	.....	19^{15°	s.	.....
998	wh. pd.	.....	.....	.....	s.	i.	i. act.
999	col. lq.	$1.422^{\frac{20}{4}^\circ}$	-28	181.8	i.	s.; ∞ bz.	∞^{25°
1000	col. lq.	$1.410^{\frac{20}{4}^\circ}$	-39.8	183.7	i.	s.; ∞ bz.	s.
1001	cr./al.	$1.390^{\frac{20}{4}^\circ}$	28.5	184-5	i.	s.	∞^{25°
1002	rhb./al.	.....	58-9	240	v. sl. s.	s.	.....
1003	lf.	1.5^{20°	26	240	i.	s.	s.
1004	cr.	.....	113	.....	.....	.....	.....
1005	lq.	2.8	<12	d. 140	i.	.....	.....

Bromo-propylene 199
Bromo-propyne 5342
Bromo-pyrine 901
Bromo-toluene (ω) 793

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1006	**Bromo** *n*-valeric acid (α)	.....	$CH_3(CH_2)_2CHBr \cdot CO_2H$	II-302	181.04
1007	*iso*-valeric acid	(α)(*dl*)	$(CH_3)_2CHCHBr \cdot CO_2H$	II-317	181.04
1008	*iso*-valeryl-*p*-phenetidine (α) (*d*)	phenoval	$(CH_3)_2CHCHBr \cdot CO \cdot NH \cdot C_6H_4 \cdot O \cdot C_2H_5$	*XIII-163	300.20
1009	*iso*-valeryl urea (α)	bromural; bromisoval	$(CH_3)_2CHCHBr \cdot CO \cdot NH \cdot CO \cdot NH_2$	III-63	223.08
1010	xylene (3;1,2)	bromo-*o*-xylene (3)	$Br \cdot C_6H_3(CH_3)_2$	V-365	185.07
1011	xylene (4;1,2)	bromo-*o*-xylene (4)	$Br \cdot C_6H_3(CH_3)_2$	V-365	185.07
1012	xylene (2;1,3)	bromo-*m*-xylene (2)	$Br \cdot C_6H_3(CH_3)_2$	V-374	185.07
1013	xylene (4;1,3)	bromo-*m*-xylene (4)	$Br \cdot C_6H_3(CH_3)_2$	V-374	185.07
1014	xylene (5;1,3)	bromo-*m*-xylene (5)	$Br \cdot C_6H_3(CH_3)_2$	V-374	185.07
1015	xylene (2;1,4)	bromo-*p*-xylene (2)	$Br \cdot C_6H_3(CH_3)_2$	V-385	185.07
1016	**Bromoform**	tribromo-methane	$CHBr_3$	I-68	252.77
1017	**Bryonane**	laurane	$C_{20}H_{42}$	I-174	282.54
1018	**Butadiene** (1,2)	methyl-allene	$CH_3 \cdot CH:C:CH_2$	I-249	54.09
1019	**Butadiene** (1,3)	erythrene	$CH_2:CH \cdot CH:CH_2$	I-249	54.09
1020	**Butandiolamine**	2-NH_2-2-Me-propandiol-1,3	$CH_3 \cdot C(NH_2):(CH_2OH)_2$	IV-303	105.14
1021	**Butane** (*n*)	diethyl	$CH_3 \cdot CH_2 \cdot CH_2 \cdot CH_3$	I-118	58.12
1022	**Butane** (*iso*)	trimethyl-methane	$(CH_3)_3CH$	I-124	58.12
1023	**Butanolamine**	2-NH_2-butanol-1	$C_2H_5 \cdot CH(NH_2) \cdot CH_2OH$	IV-291	89.14
1024	*iso*-**Butanolamine**	2-NH_2-2-Me-propanol-1	$(CH_3)_2C(NH_2) \cdot CH_2OH$	.....	89.14
1025	**Butoxy**-cinchoninic acid diethylethylene-diamide HCl	nupercaine; percaine	$C_4H_9O \cdot C_9H_5N \cdot CO \cdot NH(CH_2)_2N:(C_2H_5)_2 \cdot HCl$	.....	379.92
1026	ethoxyethyl bromide (2)(β)	.....	$C_4H_9O \cdot (CH_2)_2 \cdot O \cdot (CH_2)_2Br$	.....	225.13
1027	ethyl phthalate	.....	$C_6H_4(CO_2CH_2CH_2 \cdot O \cdot C_4H_9)_2$	.....	366.44
1028	ethyl salicylate (β)(n)	.....	$HOC_6H_4CO_2 \cdot CH_2 \cdot CH_2 \cdot O \cdot C_4H_9$	.....	238.27
1029	**Butyl** acetate (*n*)	.....	$CH_3CO_2 \cdot CH_2CH_2 \cdot C_2H_5$	II-130	116.16
1030	acetate (*sec*)	.....	$CH_3CO_2 \cdot CH(CH_3) \cdot C_2H_5$	II-131	116.16
1031	acetate (*iso*)	.....	$CH_3CO_2 \cdot CH_2CH:(CH_3)_2$	II-131	116.16
1032	acetate (*tert*)	.....	$CH_3CO_2 \cdot C(CH_3)_3$	II-131	116.16
1033	acetoacetate (*n*)	.....	$CH_3COCH_2CO_2C_4H_9$	.....	158.19
1034	alcohol (*n*)	butanol-1	$C_2H_5 \cdot CH_2 \cdot CH_2OH$	I-367	74.12
1035	alcohol (*sec*)	butanol-2	$C_2H_5 \cdot CHOH \cdot CH_3$	I-371	74.12
1036	alcohol (*iso*)	2-methyl-propanol-1	$(CH_3)_2CH \cdot CH_2OH$	I-373	74.12
1037	alcohol (*tert*)	2-methyl-propanol-2	$(CH_3)_3COH$	I-379	74.12
1038	allylbarbituric acid (*iso*)	sandoptal	$C_4H_9(C_3H_5):C_4H_2O_3N_2$	.....	224.25
1039	amine (*n*)	.....	$C_2H_5 \cdot CH_2 \cdot CH_2 \cdot NH_2$	IV-156	73.14

Bromo-xylene 6485-7
Bromural 1009
Bronner's acid 4552
Brovalol 863
Brucine, *cf.* alkd.
Bryonin, *cf.* glcde.
Butadiyne 1679
Butanal 1160
Butandioic acid 5653
Butandiol 2329-32
Butandione 1667
Butanoic acid 1166
Butanol 1034-5
Butanone 4232
Butanoxime 4233
Butantetrol 2894
Butanthiol 1103
Butenal 1559
Butendioic acid 3314, 3995
Butene 1147-9

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1006	lq.	.....	.....	126-30^{27mm}	sl. s.	v. s.	s.
1007	col. pr./et.	.....	44	230 sl. d.	1.4 c.	v. s.	s.
1008	col. cr./aq. al	.....	151	.....	i.; sl. s. gly.	s. h.; v. sl. s. bz.	sl. s.; sl. s. chl.
1009	lf./toluene	.....	151	subl.	s. h.	s.	s.; s. alk.
1010	col. lq.	$1.365^{20°}_{4}$	.....	213-4	i.	.....	.....
1011	col. lq.	$1.369^{17.5°}_{15}$	−0.2	214.5	i.	.....	.....
1012	col. lq.	.....	<−10	206±	i.	.....	.....
1013	col. lq.	.....	.....	205-7	i.	.....	.....
1014	col. lq.	$1.362^{20°}$	<−20	204	.....	.....	.....
1015	lf. or pl.	$1.356^{20°}_{4}$	9-10	205.5^{755mm}	.....	.....	.....
1016	col. lq.	$2.890^{20°}_{4}$	8-9	150.5	sl. s.	∞; ∞ bz.	∞; ∞ chl.
1017	nd.	.....	69	400	v. s. pet.	v. s. h. abs.	v. s. bz.
1018	lq.	.....	.....	18-19	i.	∞	∞
1019	col. gas	$0.621^{20°}_{4}$	−108.9	−4.41	i.	∞	∞
1020	cr.	.....	109-11	151-2^{10mm}	$250^{20°}$	$25^{20°}$	0.1
1021	col. gas	$0.60^{0°}$ (lq.)	−135	−0.6	$15\frac{17}{772}$° cc.	$1883\frac{17}{775}$° cc.	$2980\frac{18}{773}$° cc.
1022	col. gas	$0.603^{0°}$ (lq.)	−145	−10^{760mm}	$13\frac{17}{772}$° cc.	$1320\frac{17}{775}$° cc.	$2790\frac{18}{773}$° cc.
1023	lq.	$0.944^{20°}_{20°}$	−2	174-8	∞	∞	∞
1024	col. cr.	$0.934^{20°}_{20°}$*	30-1	165	∞	∞	∞
1025	wh. cr.	.....	90*	.....	200; s. chl.	s.; sl. s. bz.	i.; s. act.
1026	col. lq.	.....	.....	107-9^{12mm}	.....	.....	.....
1027	col. lq.	.....	.....	189-91^{2mm}	.....	.....	.....
1028	col. lq.	$1.077^{25°}_{25°}$	<−20	186-93^{23mm}	i.; ∞ bz.	∞; ∞ chl.	∞
1029	col. lq.	$0.882^{20°}$	−76.3	125.1^{740mm}	0.7	∞	∞
1030	col. lq.	$0.865^{25°}_{4}$	.....	111.5-2.5^{744mm}	i.	∞	∞
1031	col. lq.	$0.871^{20°}_{4}$	−98.9	118	0.6$^{25°}$	∞	∞
1032	col. lq.	$0.896^{20°}$	.....	95-6^{750mm}	i.	∞	∞
1033	col. lq.	.....	.....	98-100^{16mm}	i.	s.	s.
1034	col. lq.	$0.810^{20°}_{4}$	−79.9	117	$9^{15°}$	∞	∞
1035	col. lq.	$0.808^{20°}_{4}$	−114.7	99.5	$12.5^{20°}$	∞	∞
1036	col. lq.	$0.805^{17.5°}$	−108	107-8	$10^{15°}$	∞	∞
1037	lq. or rhb.	$0.779^{26°}$	25.0-5.5	82.9	∞	∞	∞
1038	wh. cr. pd.	.....	138-9	.....	sl. s.	s.; s. chl.	s.; s. act.
1039	col. lq.	$0.739^{25°}_{4}$	−50	77.8	∞	∞	∞

* Free base, m. 97-8°; s. al., aq., bz.; i. et.

Butenoic acid 1557-8, 2943, 6427
Butenol 1565, 4422
Butenyl chloride (*iso*) 4060
Butesin 1043
Butine, cf. butyne
Butoben 1093
Butolan 825
Butoxy-benzene 1116
Butter yellow 2431 or 2438
Butyl, cf. also dibutyl.
Butyl adipate 1883

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1040	**Butyl** amine (*sec*)	.....	$(C_2H_5)(CH_3):CH\cdot NH_2$	IV-160	73.14
1041	amine (*iso*)	.....	$(CH_3)_2CH\cdot CH_2\cdot NH_2$	IV-163	73.14
1042	amine (*tert*)	.....	$(CH_3)_3C\cdot NH_2$	IV-173	73.14
1043	*p*-aminobenzoate (*n*)	butesin	$H_2N\cdot C_6H_4\cdot CO_2C_4H_9$	.....	193.24
1044	aminobenzoate picrate	butesin picrate	$(C_{11}H_{15}O_2N)_2\cdot C_6H_3O_7N_3$	.....	615.58
1045	*p*-aminobenzoate (*iso*)	cycloform	$H_2N\cdot C_6H_4\cdot CO_2C_4H_9$	*XIV-567	193.24
1046	aniline (*n*)	.....	$C_6H_5\cdot NH\cdot C_4H_9$	XII-168	149.23
1047	aniline (*iso*)	.....	$C_6H_5\cdot NH\cdot C_4H_9$	XII-168	149.23
1048	arsonic acid (*n*)	.....	$C_4H_9\cdot AsO(OH)_2$	.....	182.04
1049	benzene (*n*)	.....	$C_6H_5\cdot C_4H_9$	V-413	134.21
1050	benzene (*sec*)	.....	$C_6H_5\cdot C_4H_9$	V-414	134.21
1051	benzene (*iso*)	.....	$C_6H_5\cdot C_4H_9$	V-414	134.21
1052	benzene (*tert*)	triMe-Ph-methane	$C_6H_5\cdot C(CH_3)_3$	V-415	134.21
1053	benzoate (*n*)	.....	$C_6H_5CO_2\cdot C_4H_9$	IX-112	178.22
1054	benzoate (*iso*)	.....	$C_6H_5CO_2\cdot C_4H_9$	IX-113	178.22
1055	*o*-benzoylbenzoate (*n*)	.....	$C_6H_5\cdot CO\cdot C_6H_4\cdot CO_2\cdot C_4H_9$	.....	282.32
1056	benzyl ether (*n*)	.....	$C_4H_9\cdot O\cdot CH_2C_6H_5$	.....	164.24
1057	bromide (*n*)	1-bromo-butane	$C_2H_5\cdot CH_2\cdot CH_2Br$	I-119	137.03
1058	bromide (*sec*)	2-bromo-butane	$C_2H_5\cdot CHBr\cdot CH_3$	I-119	137.03
1059	bromide (*iso*)	1-Br-2-Me-propane	$(CH_3)_2CH\cdot CH_2Br$	I-126	137.03
1060	bromide (*tert*)	2-Br-2-Me-propane	$(CH_3)_3CBr$	I-127	137.03
1061	*β*-bromoallyl barbituric acid	pernoston	$(CH_2:CBr\cdot CH_2)\cdot (C_4H_9):C_4H_2O_3N_2$	.....	303.16
1062	*n*-butyrate (*n*)	.....	$C_3H_7CO_2\cdot C_4H_9$	II-271	144.21
1063	*n*-butyrate (*iso*)	.....	$C_3H_7CO_2\cdot C_4H_9$	II-271	144.21
1064	*iso*-butyrate (*iso*)	.....	$(CH_3)_2CHCO_2\cdot C_4H_9$	II-291	144.21
1065	caproate	.....	$C_5H_{11}CO_2\cdot C_4H_9$	II-323	172.26
1066	caprylate	.....	$C_7H_{15}CO_2\cdot C_4H_9$	II-348	200.31
1067	carbamate (*n*)	.....	$NH_2\cdot CO_2\cdot C_4H_9$	*III-14	117.15
1068	carbamate (*iso*)	.....	$NH_2\cdot CO_2\cdot C_4H_9$	III-29	117.15
1069	carbitol acetate	*β*-BuO-*β*-EtO-ethyl-acetate	$CH_3CO(OC_2H_4)_2\cdot O\cdot C_4H_9$	.....	204.26
1070	catechol (*p*)(*tert*)	(4;1,2)	$(CH_3)_3C\cdot C_6H_3(OH)_2$	.....	166.21
1071	cellosolve (*n*)	2-BuO-ethanol-1	$C_4H_9\cdot O\cdot CH_2CH_2OH$	.....	118.17
1072	chloride (*n*)	1-chloro-butane	$C_2H_5\cdot CH_2\cdot CH_2Cl$	I-118	92.57
1073	chloride (*sec*)	2-chloro-butane	$C_2H_5\cdot CHCl\cdot CH_3$	I-119	92.57
1074	chloride (*iso*)	1-Cl-2-Me-propane	$(CH_3)_2CH\cdot CH_2Cl$	I-124	92.57
1075	chloride (*tert*)	2-Cl-2-Me-propane	$(CH_3)_3C\cdot Cl$	I-125	92.57
1076	chloroacetate (*n*)	.....	$Cl\cdot CH_2\cdot CO_2\cdot C_4H_9$	II-198	150.61
1077	chloroformate (*n*)	*n*-Bu-chlorocarbonate	$Cl\cdot CO_2\cdot C_4H_9$	.....	136.58
1078	chloroformate (*iso*)	*iso*-Bu-chlorocarbonate	$Cl\cdot CO_2\cdot C_4H_9$	III-12	136.58
1079	*o*-cresol (*p*)(*tert*)	2-Me-4-*tert*-Bu-phenol	$(CH_3)_3C\cdot C_6H_3(CH_3)\cdot OH$	.....	164.24
1080	*o*-cresyl ether (*n*)	*n*-Bu-*o*-tolyl ether	$CH_3\cdot C_6H_4\cdot O\cdot C_4H_9$	VI-353	164.24
1081	crotonate (*n*)	.....	$CH_3CH:CHCO_2\cdot C_4H_9$	.....	142.19
1082	crotonate (*iso*)	.....	$CH_3CH:CHCO_2\cdot C_4H_9$	.....	142.19
1083	*iso*-cyanide (*iso*)	*iso*-Bu-carbylamine	$(CH_3)_2CH\cdot CH_2\cdot NC$	IV-167	83.13

Butyl borate 6117
Butyl carbamide 1138-9
Butyl carbinol (*n*) 404
Butyl carbinol (*iso*) 406
Butyl carbinol (*sec*) 411
Butyl carbinol (*tert*) 410
Butyl carbitol 2232

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1040	col. lq.	0.724^{20}_{4}°	−104	66^{772mm}	∞	∞	∞
1041	col. lq.	0.732^{20}_{20}°	−85	68-9	∞	∞	∞
1042	col. lq.	0.698^{18}_{4}°	−67.5	45.2	.....	∞	.....
1043	wh. cr. pd.	.....	58-9	$173\text{-}4^{8mm}$	0.013	s.; s. chl.	s.; s. oil
1044	yel. amor. pd./bz.	.....	109-10	.....	0.05	s.; s. chl.	s.; s. bz.
1045	nd./lg.	.....	65	.....	0.022	s.; s. act.	s.; s. bz.
1046	lq.	.....	.....	235^{720mm}	i.	v. s.	v. s.
1047	oil	0.940^{20}_{4}°	.....	231-2	$0.01^{15°}$	v. s.	v. s.
1048	col. fl.	.....	158-9	.....	s.	s.	i.
1049	lq.	0.862^{20}_{4}°	−81.2	183.1	i.	s.	s.
1050	lq.	0.861^{20}_{4}°	−82.7	173-4	i.	s.	s.
1051	lq.	0.867^{20}_{4}°	.....	170.5	i.	s.	s.
1052	col. lq.	0.867^{20}_{4}°	−58	168-9	i.	s.	s.
1053	col. oil	1.005^{25}_{25}°	−22	248.5-9.5	i.	s.	s.
1054	col. oil	0.997^{25}_{25}°	.....	241.5	i.	∞	∞
1055	col. lq.	.....	.....	$229\text{-}32^{15mm}$	.....	.....	.....
1056	col. lq.	0.931^{10}_{4}°	.....	216-20	i.	∞	∞
1057	lq.	1.277^{20}_{4}°	−112.4	101.6	i.	∞	∞
1058	lq.	1.251^{25}_{4}°	.....	91.3	i.	.....	.....
1059	lq.	1.258^{25}_{4}°	−118.5	91.5	i.	∞	∞
1060	lq.	1.211^{20}_{4}°	−16.2	73.3; d. 210	i.	∞	∞
1061	wh. cr. pd.	.....	130-3	.....	v. sl. s.	s.; s. alk.	s.
1062	col. lq.	0.872^{20}_{20}°	.....	165.7^{736mm}	i.	∞	∞
1063	col. lq.	0.863^{18}_{4}°	.....	156.9	i.	∞	∞
1064	col. lq.	0.875^{0}_{4}°	−80.7	148-9	i.	∞	∞
1065	col. lq.	0.882^{0}_{0}°	.....	204.3	i.	.....	.....
1066	col. lq.	0.880^{0}_{0}°	.....	240.5	.....	.....	.....
1067	wh. fl.	.....	53-4	.....	i.	s.	v. s.
1068	col. lf.	0.956^{7}_{4}°	65	206-7	i.	s.	s.
1069	col. lq.	0.981^{20}_{20}°	.....	246	$6.5^{20°}$	.....	.....
1070	col. cr.	1.049^{20}_{20}°	56-7	285	$0.2^{80°}$	s.; v. s. act.	$240^{25°}$
1071	col. lq.	0.903^{20}_{4}°	.....	171.2	∞	∞	∞
1072	col. lq.	$0.887^{20°}$	−123.1	77.9^{763mm}	i.	∞	∞
1073	col. lq.	0.871^{20}_{4}°	.....	67.8^{767mm}	i.	∞	∞
1074	col. lq.	$0.884^{15°}$	−131.2	68.9	i.	∞	∞
1075	lq.	$0.847^{15°}$	−26.5	51-2	i.	∞	∞
1076	col. lq.	$1.081^{15°}$	.....	175	.....	.....	.....
1077	col. lq.	1.074^{25}_{4}°	.....	140-5	d.	d.	∞
1078	lq.	$1.045^{18.5}_{15.5}$°	.....	128.8	slow d.	slow d.; ∞ chl.	∞ ; ∞ bz.
1079	lq.	0.969^{30}_{25}°	27	$137\text{-}8^{25mm}$	i.; ∞ CCl_4	∞ Me al.	∞ ; ∞ bz.
1080	col. lq.	0.944^{0}_{0}°	.....	223	.....	.....	.....
1081	lt. yel. lq.	.....	.....	175-80	.....	.....	.....
1082	lt. yel. oil	.....	.....	170-2	.....	.....	.....
1083	lq.	$0.787^{4°}$	<−60	114-7	sl. s.	s.	s.

Butyl carbonate 1892-4
Butyl chlorocarbonate 1077-8
Butyl citrate 6119
Butyl cyanide (*n*) 6405
Butyl cyanide (*iso*) 6413
Butyl cyanide (*tert*) 6246

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Butyl				
1084	diethanolamine (*n*)	.....	$C_4H_9{\cdot}N(CH_2CH_2OH)_2$	IV-285	161.24
1085	fluoride (*iso*)	1-F-2-Me-propane	$(CH_3)_2CH{\cdot}CH_2F$	I-124	76.11
1086	formate (*n*)	.....	$HCO_2{\cdot}CH_2CH_2C_2H_5$	II-21	102.13
1087	formate, ortho (*n*)	triBu-orthoformate	$HC(O{\cdot}CH_2CH_2C_2H_5)_3$	.....	232.35
1088	formate (*sec*)	.....	$HCO_2CH(CH_3){\cdot}C_2H_5$	.....	102.13
1089	formate (*iso*)	.....	$HCO_2{\cdot}CH_2{\cdot}CH(CH_3)_2$	II-21	102.13
1090	furoate (*n*)	.....	$C_4H_3O{\cdot}CO_2{\cdot}C_4H_9$	.....	168.19
1091	β-furylacrylate (*n*)	.....	$C_4H_3O{\cdot}CH{:}CH{\cdot}CO_2{\cdot}C_4H_9$	.....	194.22
1092	(*o*)-hydroxy-benzoate	*n*-Bu-salicylate	$HO{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_4H_9$	.....	194.22
1093	*p*-hydroxy-benzoate (*n*)	butoben	$HO{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_4H_9$	.....	194.22
1094	α-hydroxy-*iso*-butyrate (*n*)	.....	$(CH_3)_2C(OH){\cdot}CO_2{\cdot}C_4H_9$	.....	160.21
1095	iodide (*n*)	1-iodo-butane	$C_2H_5{\cdot}CH_2{\cdot}CH_2I$	I-123	184.03
1096	iodide (*sec*)	2-iodo-butane	$C_2H_5{\cdot}CHI{\cdot}CH_3$	I-123	184.03
1097	iodide (*iso*)	1-iodo-2-Me-propane	$(CH_3)_2CH{\cdot}CH_2I$	I-128	184.03
1098	iodide (*tert*)	2-iodo-2-Me-propane	$(CH_3)_3CI$	I-129	184.03
1099	lactate (*n*)	.....	$CH_3CHOHCO_2{\cdot}C_4H_9$	.....	146.18
1100	lactate (*iso*)	.....	$CH_3CHOHCO_2{\cdot}C_4H_9$	.....	146.18
1101	levulinate (*n*)	.....	$CH_3CO(CH_2)_2CO_2{\cdot}C_4H_9$	.....	172.22
1102	malonic acid	.....	$C_4H_9{\cdot}CH(CO_2H)_2$	II-673	160.17
1103	mercaptan (*n*)	butanthiol-1	$C_2H_5(CH_2)_2{\cdot}SH$	I-370	90.18
1104	mercaptan (*iso*)	2-Me-propanthiol-1	$(CH_3)_2CH{\cdot}CH_2{\cdot}SH$	I-378	90.18
1105	mercaptan (*tert*)	.....	$(CH_3)_3C{\cdot}SH$	I-383	90.18
1106	*o*-methoxybenzoate (*n*)	.....	$CH_3O{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_4H_9$	.....	208.25
1107	nitrate (*iso*)	.....	$C_4H_9{\cdot}O{\cdot}NO_2$	I-377	119.12
1108	nitrite (*n*)	.....	$C_4H_9{\cdot}O{\cdot}NO$	I-369	103.12
1109	nitrite (*iso*)	.....	$(CH_3)_2CHCH_2{\cdot}O{\cdot}NO$	I-377	103.12
1110	oleate (*n*)	.....	$C_{17}H_{33}CO_2{\cdot}C_4H_9$	.....	338.56
1111	oxamate (*n*)	.....	$H_2N{\cdot}CO{\cdot}CO_2{\cdot}C_4H_9$	.....	145.16
1112	phenoxy-ethanol	(β)(*p*-*tert*)	$(CH_3)_3C{\cdot}C_6H_4{\cdot}O{\cdot}CH_2{\cdot}CH_2OH$	.....	194.26
1113	phenylacetate (*n*)	.....	$C_6H_5{\cdot}CH_2{\cdot}CO_2{\cdot}C_4H_9$	.....	192.25
1114	phenylacetate (*iso*)	.....	$C_6H_5{\cdot}CH_2{\cdot}CO_2{\cdot}C_4H_9$	IX-435	192.25
1115	phenyl carbinol (*n*)	.....	$C_6H_5{\cdot}CHOH{\cdot}C_4H_9$	.....	164.24
1116	phenyl ether (*n*)	*n*-BuO-benzene	$C_4H_9{\cdot}O{\cdot}C_6H_5$	VI-143	150.21
1117	phenyl ketone (*n*)	valerophenone	$C_4H_9{\cdot}CO{\cdot}C_6H_5$	VII-327	162.22
1118	phenyl ketone (*iso*)	*iso*-valerophenone	$C_4H_9{\cdot}CO{\cdot}C_6H_5$	VII-329	162.22
1119	phenol (*m*)(*tert*)	.....	$(CH_3)_3C{\cdot}C_6H_4{\cdot}OH$	.....	150.21
1120	phenol (*p*)(*tert*)	.....	$(CH_3)_3C{\cdot}C_6H_4{\cdot}OH$	VI-524	150.21
1121	*o*-phenylphenol (*tert*)	(1;2,5)	$C_6H_5{\cdot}C_6H_3(OH){\cdot}C(CH_3)_3$	.....	226.30
1122	phthalate (*n*) (mono)	.....	$HO_2C{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_4H_9$	.....	222.23
1123	propionate (*n*)	.....	$C_2H_5{\cdot}CO_2{\cdot}C_4H_9$	II-241	130.18
1124	propionate (*sec*)	.....	$C_2H_5{\cdot}CO_2{\cdot}C_4H_9$	II-241	130.18
1125	propionate (*iso*)	.....	$C_2H_5{\cdot}CO_2{\cdot}C_4H_9$	II-241	130.18

Butyl dibromosuccinate 1896
Butyl disulfide 1897
Butyl ether 1898-9
Butyl ethylene 3655, 3657
Butyl malate 1902
Butyl maleate 1903

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1084	col. lq.	$0.968^{20°}_{4°}$	.....	273-5^{741mm}	∞	∞	∞ ; ∞ bz.
1085	gas	.....	.....	16 ±	.....	.....	.....
1086	lq.	$0.911^{0°}$	.....	106.9	v. sl. s.	∞	∞
1087	lq.	$0.869^{20°}_{4°}$	.....	245-7	.....	.....	.....
1088	lq.	$0.882^{20°}_{4°}$	.....	97	sl. s.	∞	∞
1089	lq.	$0.885^{20°}_{4°}$	-95.3	98.2	1.1$^{22°}$	∞	∞
1090	col. lq.	$1.056^{20°}_{4°}$	.....	118-20^{25mm}	i.	∞	∞
1091	col. lq.	$1.048^{20°}_{4°}$	.....	121^{5mm}	i.	s.	.....
1092	col. lq.	.....	5.9	259-60	.....	.....	.....
1093	wh. pd.	.....	68-9	.....	0.02	s.	s.; s. chl.
1094	col. lq.	.....	.....	64-5^{5mm}	.....	.....	.....
1095	lq.	$1.617^{20°}_{4°}$	-103.5	129.9	i.	∞	∞
1096	lq.	$1.595^{20°}$	.....	118-9	i.	∞	∞
1097	lq.	$1.606^{20°}_{4°}$	-90.7	120	i.	∞	∞
1098	lq.	$1.370^{18.5°}_{15.5°}$	.....	99	i.	∞	∞
1099	col. lq.	0.968	.....	75-6^{6mm}	sl. s.	∞	∞
1100	col. lq.	.....	.....	60-2^{7mm}	.....	.....	.....
1101	lq.	$0.974^{20°}_{4°}$	.....	237.8	.....	.....	.....
1102	pr./aq.	.....	101.5	d. 150	v. s.	v. s.	v. s.
1103	col. lq.	$0.837^{25°}_{4°}$	-116	97-8	sl. s.	v. s.	v. s.
1104	lq.	$0.836^{20°}_{4°}$	<-79	88	v. sl. s.	s.	s.
1105	lq.	.....	.....	65-7	.....	.....	.....
1106	col. lq.	.....	.....	185-6^{20mm}	.....	.....	.....
1107	lq.	$1.015^{20°}_{4°}$	.....	122.9	i.	∞	∞
1108	lq.	$0.911^{0°}$	.....	77-9	.....	∞	∞
1109	lq.	$0.870^{20°}_{20°}$	.....	67-8	sl. s.; d.	∞	.....
1110	lq.	$0.868^{25°}$	.....	227-8^{15mm}	i.	s.	s.
1111	wh. nd.	.....	87-8	.....	i.	s. h.	sl. s.
1112	col. lq.	$1.014^{25°}_{25°}$	13	147-56^{8mm}	i.; ∞ act.	∞ Me al.	∞ bz.
1113	col. lq.	.....	.....	128-32^{18mm}	.....	.....	.....
1114	col. lq.	.....	.....	247	.....	.....	.....
1115	col. lq.	.....	.....	128-30^{8mm}	.....	.....	.....
1116	col. lq.	$0.930^{20°}_{4°}$	.....	210.3	i.	s.	s.
1117	lq.	.....	.....	248.5	i.	s.	s.
1118	lq.	$0.993^{17.5°}$	.....	227-8^{720mm}	i.	∞	∞
1119	col. cr.	.....	40.6	240	.....	.....	.....
1120	nd./aq.	$0.908^{11.2°}_{4°}$	99	236-8	s.	s.	s.
1121	col. cr.	$1.022^{25°}_{25°}$	50	196-9^{25mm}	i.; v. s. bz.	v. s. Me al.; v. s. act.	v. s.; v. s. CCl_4
1122	col. cr.	.....	73-7	.....	s. h.	s.	v. s.
1123	col. lq.	$0.883^{15°}$	.....	146	i.	∞	∞
1124	col. lq.	$0.866^{20°}_{4°}$	.....	132.0-2.5	i.	∞	∞
1125	col. lq.	$0.888^{0°}_{4°}$	-71	136.8	i.	∞	∞

Butyl malonate 1904
Butyl mustard oil 1133-6
Butyl oxalate 1905-6
Butyl phosphate 6121
Butyl phthalate 1908

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Butyl				
1126	pyrrole (*n*)(*N*)	.....	$C_4H_4N{\cdot}C_4H_9$	.....	123.19
1127	ricinoleate (*n*)	.....	$HO{\cdot}C_{17}H_{32}CO_2{\cdot}C_4H_9$	III-388	354.56
1128	ricinoleate (*iso*)	.....	$HO{\cdot}C_{17}H_{32}CO_2{\cdot}C_4H_9$	III-388	354.56
1129	stearate (*n*)	.....	$C_{17}H_{35}CO_2{\cdot}C_4H_9$	.....	340.57
1130	stearate (*iso*)	.....	$C_{17}H_{35}CO_2{\cdot}C_4H_9$	*II-173	340.57
1131	thiocyanate (*n*)	.....	$C_2H_5CH_2CH_2{\cdot}S{\cdot}CN$	.....	115.19
1132	thiocyanate (*iso*)	.....	$(CH_3)_2CHCH_2{\cdot}S{\cdot}CN$	III-177	115.19
1133	*iso*-thiocyanate (*n*)	butyl mustard oil	$C_2H_5CH_2CH_2{\cdot}N{:}CS$	IV-158	115.19
1134	*iso*-thiocyanate	(*sec*)(*d*)	$C_4H_9{\cdot}N{:}CS$	IV-161	115.19
1135	*iso*-thiocyanate (*iso*)	*iso*-Bu mustard oil	$(CH_3)_2CHCH_2{\cdot}N{:}CS$	IV-171	115.19
1136	*iso*-thiocyanate (*tert*)	.....	$(CH_3)_3C{\cdot}N{:}CS$	IV-175	115.19
1137	*p*-toluene sulfonate (*n*)	.....	$CH_3{\cdot}C_6H_4{\cdot}SO_2{\cdot}O{\cdot}C_4H_9$	.....	228.30
1138	urea (*n*)(*N*)	*n*-Bu carbamide	$C_4H_9{\cdot}NH{\cdot}CO{\cdot}NH_2$	IV-371	116.16
1139	urea (*iso*)(*N*)	.....	$C_4H_9{\cdot}NH{\cdot}CO{\cdot}NH_2$	IV-168	116.16
1140	urethane (*n*)(*N*)	Et *N*-*n*-Bu carbamate	$C_4H_9{\cdot}NH{\cdot}CO_2{\cdot}C_2H_5$	IV-158	145.20
1141	urethane (*iso*)	.....	$C_4H_9{\cdot}NH{\cdot}CO_2{\cdot}C_2H_5$	IV-168	145.20
1142	*n*-valerate (*n*)	.....	$CH_3(CH_2)_3CO_2{\cdot}C_4H_9$	II-301	158.23
1143	*iso*-valerate (*n*)	.....	$(CH_3)_2CHCH_2CO_2{\cdot}C_4H_9$	.....	158.23
1144	*iso*-valerate (*sec*)	.....	$(CH_3)_2CHCH_2CO_2{\cdot}C_4H_9$	II-312	158.23
1145	*iso*-valerate (*iso*)	.....	$C_4H_9CO_2{\cdot}C_4H_9$	II-312	158.23
1146	2-xenyl-di (*p*-*tert*-butylphenyl) phosphate (5-*tert*)	phosphen 11	$(CH_3)_3C{\cdot}C_{12}H_8{\cdot}O{\cdot}PO[O{\cdot}C_6H_4{\cdot}C(CH_3)_3]_2$	.....	570.68
1147	**Butylene** (α)	butene-1	$C_2H_5{\cdot}CH{:}CH_2$	I-203	56.10
1148	**Butylene** (β)	butene-2	$CH_3{\cdot}CH{:}CH{\cdot}CH_3$	I-205	56.10
1149	**Butylene** (γ) (*iso*)	2-methyl-propene-1	$(CH_3)_2C{:}CH_2$	I-207	56.10
1150	*iso*-butyracetal (*iso*)	.....	$(CH_3)_2CH{\cdot}CH{\cdot}O{\cdot}C(CH_3)_2{\cdot}CH_2{\cdot}O$	.....	144.21
1151	chlorohydrin (β, γ)	3-chloro-butanol-2	$CH_3CHCl{\cdot}CHOH{\cdot}CH_3$	I-373	108.57
1152	chlorohydrin (α) (*iso*)	1-chloro-2-Me-propanol-2	$(CH_3)_2C(OH){\cdot}CH_2Cl$	I-382	108.57
1153	chlorohydrin (β) (*iso*)	2-chloro-2-Me-propanol-1	$(CH_3)_2CCl{\cdot}CH_2OH$	I-378	108.57
1154	glycol (*iso*)	2-Me-propandiol-1,2	$(CH_3)_2COH{\cdot}CH_2OH$	I-480	90.12
1155	oxide (*iso*)	α,α diMe-ethylene oxide	$(CH_3)_2C{\cdot}CH_2{\cdot}O$	XVII-11	72.10
1156	**Butyne-1**	ethyl-acetylene	$C_2H_5{\cdot}C{:}CH$	I-249	54.09
1157	**Butyne-2**	crotonylene	$CH_3{\cdot}C{:}C{\cdot}CH_3$	I-249	54.09
1158	**Butyrchloral**	triCl-butaldehyde	$CH_3{\cdot}CHCl{\cdot}CCl_2{\cdot}CHO$	I-664	175.45
1159	hydrate	butylchloral hydrate	$CH_3{\cdot}CHCl{\cdot}CCl_2{\cdot}CH(OH)_2$	I-664	193.47
1160	**Butyraldehyde** (*n*)	butanal	$C_2H_5{\cdot}CH_2{\cdot}CHO$	I-662	72.10
1161	oxime (*n*)	butyraldoxime	$C_2H_5{\cdot}CH_2{\cdot}CH{:}NOH$	I-663	87.12

Butyl salicylate 1092
Butyl sebacate 1909
Butyl succinate 1910-2
Butyl sulfate 1913
Butyl sulfide 1914-6
Butyl sulfite 1917
Butyl sulfone 1918
Butyl tartrate 1919-20
Butyl-toluene 4158-60

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1126	yel. lq.	.....	.....	$91\text{-}2^{55mm}$	.....	.....	.....
1127	lq.	$0.906^{22°}$	.....	275^{13mm}	i.	.....	s.
1128	lq.	$0.903^{22°}$	.....	262^{9mm}	i.	s.	s.
1129	col. lq.	$0.855\text{-}8\frac{25}{25}°$	27.5(19.5)	$220\text{-}5^{25mm}$	$0.3^{25°}$	s.	s.
1130	waxy	.....	25	.....	i.	.....	.....
1131	col. lq.	$0.956^{25°}$	.....	185-6	i.	s.	s.
1132	col. lq.	.....	.....	174-6	i.	∞	.....
1133	lq.	$0.956^{11.2°}$	.....	165^{724mm}	i.	s.	s.
1134	lq.	$0.943\frac{20}{4}°$	.....	159-63	i.	s.	s.
1135	lq.	$0.964\frac{14}{4}°$	.....	162	i.	s.	s.
1136	lq.	$0.919^{10°}$	10.5	140^{770mm}	i.	s.	s.
1137	lq.	$1.120\frac{20}{4}°$	.....	$174\text{-}5^{10mm}$	.....	.....	.....
1138	col. nd./bz.	.....	96	.....	s.	s.	s.
1139	nd./act.	.....	140.5-1.5	.....	sl. s. act.	sl. s. bz.	v. sl. s.
1140	col. lq.	$0.951^{15°}$	−22	202-3	.....	s.	s.
1141	col. lq.	$0.943\frac{20}{4}°$	<−65	$95\text{-}6^{15mm}$	i.	s.	.....
1142	lq.	$0.870\frac{15}{4}°$	−93	186	v. sl. s.	∞	∞
1143	lq.	.....	.....	137-71	.....	.....	.....
1144	col. lq.	$0.848\frac{20}{4}°$	.....	$163\text{-}4^{752mm}$	i.	∞	∞
1145	col. lq.	$0.874\frac{0}{4}°$	.....	168.7	i.	∞	∞
1146	resin	$1.07\frac{0.0}{4}°$	.....	$300\text{-}25^{5mm}$	i.; ∞ CCl_4	∞ ; ∞ act.	∞ bz.
1147	col. gas	.....	−130	-5^{758mm}	i.	v. s.	v. s.
1148	col. gas	.....	.....	1(cis ?) 2.5 (trans ?)	.....	.....	.....
1149	col. gas	.....	.....	−6	s. H_2SO_4	.....	.....
1150	lq.	$0.890\frac{20}{4}°$	.....	138	<1	.....	.....
1151	col. lq.	$1.105^{20°}$	.....	136-7.5	$6.6^{20°}$	.....	.....
1152	col. lq.	$1.061\frac{20}{4}°$	−20	127-9	sl. s.	s. HCl	.....
1153	col. lq.	.....	.....	132-3 sl. d.	s. HCl	.....	.....
1154	lq.	$0.994\frac{20}{4}°$	.....	178.6	∞	.....	.....
1155	lq.	$0.805\frac{20}{4}°$	.....	52.4	5.8	s.	s.
1156	col. lq.	$0.668^{0°}$	−130	18.5^{760mm}	i.	s.	s.
1157	col. lq.	.....	.....	$27\text{-}8^{735mm}$	i.	.....	.....
1158	lq.	$1.396\frac{20}{4}°$	.....	$164\text{-}5^{750mm}$	.....	.....	.....
1159	rhb.	$1.694^{4°}$	78 sl. d.	d.	s. h.	v. s.	.....
1160	col. lq.	$0.817\frac{20}{4}°$	−99	75.7	4	∞	∞
1161	lq.	.....	.....	152^{715mm}	.....	.....	.....

Butyl-tolyl ether 1080
Butylene bromide 1821, 1824-5
Butylene chloride 1972, 1976
Butylene chloride (*iso*) 4060
Butylene glycol 2329-30, 2332
Butylidene dichloride 1971, 1974
Butyn 1890
Butynedioic acid 134
Butynoic acid 5871

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Butyraldehyde				
1162	trimer	para-butyraldehyde	$(C_4H_8O)_3$	*XIX-807	216.31
1163	**Butyraldehyde** (*iso*)	2-Me-propanal	$(CH_3)_2CH{\cdot}CHO$	I-671	72.10
1164	semicarbazone (*iso*)	.....	$C_3H_7{\cdot}CH{:}N_3CH_3O$	III-103	129.16
1165	trimer	(para)	$(C_4H_8O)_3$	XIX-390	216.31
1166	**Butyric** acid (*n*)	butanoic acid	$C_2H_5{\cdot}CH_2{\cdot}CO_2H$	II-264	88.10
1167	acid (*iso*)	2-Me-propanoic acid	$(CH_3)_2CH{\cdot}CO_2H$	II-288	88.10
1168	amide (*n*)	*n*-butyramide	$C_2H_5{\cdot}CH_2{\cdot}CO{\cdot}NH_2$	II-275	87.12
1169	amide (*iso*)	*iso*-butyramide	$(CH_3)_2CH{\cdot}CO{\cdot}NH_2$	II-293	87.12
1170	anhydride (*n*)	.....	$(C_2H_5{\cdot}CH_2{\cdot}CO)_2O$	II-274	158.19
1171	anhydride (*iso*)	.....	$[(CH_3)_2CH{\cdot}CO]_2O$	II-292	158.19
1172	anilide (*n*)	*n*-butyranilide	$C_3H_7CO{\cdot}NHC_6H_5$	XII-252	163.21
1173	chloride (*n*)	butyryl chloride	$C_2H_5{\cdot}CH_2{\cdot}CO{\cdot}Cl$	II-274	106.55
1174	chloride (*iso*)	.....	$(CH_3)_2CH{\cdot}CO{\cdot}Cl$	II-293	106.55
1175	nitrile (*n*)	*n*-butyronitrile	$C_2H_5{\cdot}CH_2{\cdot}CN$	II-275	69.10
1176	nitrile (*iso*)	*iso*-propyl cyanide	$(CH_3)_2CH{\cdot}CN$	II-294	69.10
1177	**Butyroin**	.....	$C_3H_7{\cdot}CHOH{\cdot}CO{\cdot}C_3H_7$	I-840	144.21
1178	**Cacodyl**	.....	$(CH_3)_2{:}As{\cdot}As{:}(CH_3)_2$	IV-615	209.96
1179	chloride	diMe-chloroarsine	$(CH_3)_2AsCl$	IV-607	140.44
1180	sulfide	.....	$[(CH_3)_2As]_2S$	IV-608	242.02
1181	trichloride	.....	$(CH_3)_2AsCl_3$	IV-612	211.35
1182	**Cacodylic** acid	.....	$(CH_3)_2AsO{\cdot}OH$	IV-610	137.99
1183	oxide	.....	$[(CH_3)_2As]_2O$	IV-608	225.96
1184	**Cadaverine**	pentamethylene diamine	$H_2N{\cdot}(CH_2)_5{\cdot}NH_2$	IV-266	102.18
1185	**Cadmium** diethyl	.....	$(C_2H_5)_2Cd$	IV-677	170.53
1186	dimethyl	.....	$(CH_3)_2Cd$	IV-677	142.48
1187	**Calciferol**	vitamin D_2	$C_{28}H_{43}OH$	.....	396.63
1188	**Camphane**	.....	$C_{10}H_{18}$	V-93	138.24
1189	**Camphene** (*dl*)	.....	$C_{10}H_{16}$	V-156	136.23
1190	**Campholic acid**	(*d* or *l*)	$C_{10}H_{18}O_2$	IX-34	170.24
1191	**Camphor** (*d*)	.....	$C_{10}H_{16}O$	VII-101	152.23
1192	dichloride (3)(α)	chlorocamphor	$C_{10}H_{16}Cl_2$	VII-117	207.14
1193	dichloride (3)(α')	.....	$C_{10}H_{16}Cl_2$	VII-117	207.14
1194	dichloride (3)(β)	.....	$C_{10}H_{16}Cl_2$	VII-117	207.14
1195	oxime	.....	$C_9H_{16}C{:}NOH$	VII-112	167.24
1196	sulfonic acid	(10 or 6) Reychler	$C_{10}H_{15}O{\cdot}SO_3H$	XI-315	232.29
1197	**Camphoric** acid (*dl*)	paracamphoric acid	$C_8H_{14}(CO_2H)_2$	IX-760	200.23
1198	acid (*d*)	.....	$C_8H_{14}(CO_2H)_2$	IX-745	200.23
1199	acid (*iso*)(*l*)	.....	$C_8H_{14}(CO_2H)_2$	IX-762	200.23
1200	anhydride (*dl*)	.....	$C_{10}H_{14}O_3$	XVII-459	182.21
1201	**Camphoronic acid** (*l*)	.....	$C_9H_{14}O_6$	II-837	218.20
1202	acid (*iso*)	.....	$C_9H_{14}O_6$	II-835	218.20
1203	**Camphyl** amine (α)	.....	$C_8H_{13}{\cdot}CH_2{\cdot}CH_2{\cdot}NH_2$	XII-40	153.26
1204	amine (β)	.....	$C_8H_{13}{\cdot}CH_2{\cdot}CH_2{\cdot}NH_2$	XII-40	153.26
1205	**Capric** acid	decanoic acid	$CH_3{\cdot}(CH_2)_8{\cdot}CO_2H$	II-355	172.26
1206	aldehyde	decanal	$CH_3{\cdot}(CH_2)_8{\cdot}CH{:}O$	I-711	156.26
1207	nitrile	nonyl cyanide	$CH_3{\cdot}(CH_2)_8{\cdot}CN$	II-356	153.26
1208	**Caproic** acid (*n*)	hexanoic acid	$CH_3{\cdot}(CH_2)_4{\cdot}CO_2H$	II-321	116.16

Butyramide 1168-9
Butyranilide 1172
Butyrolactam 3936
Butyrophenone 5439-40
Butyrone 2786
Butyryl chloride 784-5
C β acid 4534
Cacodyl hydride 2456
Caffeic acid 2335

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1162	oil	0.918	<−20	115-7^{17mm}	.....	.....	.....
1163	col. lq.	0.794$^{20°}_{4}$	−65.9	63-4^{757mm}	11$^{20°}$	∞ ; ∞ chl.	∞ ; ∞ bz.
1164	lf.	.....	125.5-6.0	.....	s. bz.	s.	i. pet.
1165	nd./al.	.....	59-60	195 sl. d.	i.	s.	v. s.
1166	col. lq.	0.964$^{20°}_{4}$	−4.7	163.5^{757mm}	∞	∞	∞
1167	col. lq.	0.949$^{20°}_{4}$	−47	154.5	20$^{20°}$	∞ ; ∞ chl.	∞
1168	rhb.	1.032	115-6	216	v. s.	s.	sl. s.
1169	mn. pl.	1.013	129-30	216-20	v. s.	s.	sl. s.
1170	col. lq.	0.968$^{20°}_{20°}$	−75	199.5^{760mm}	d.	d.	∞
1171	col. lq.	0.950$^{25°}_{4}$	−53.5	181.5^{734mm}	d.	d.	∞
1172	mn. pr.	1.134	92	189^{15mm}	i.	s.	s.
1173	col. lq.	1.028$^{20°}_{4}$	−89	101-2	d.	d.	s.
1174	col. lq.	1.017$^{20°}_{4}$	−90	92	d.	d.	s.
1175	col. lq.	0.794$^{20°}_{4}$	−112.6	117-8	.....	.....	.....
1176	col. lq.	.....	.....	107-8	sl. s.	v. s.	v. s.
1177	lq.	0.911$^{16.7°}_{4}$	.....	180-90	.....	.....	.....
1178	col. oil	>1	−6	170 ±	v. sl. s.	s.	s.
1179	col. lq.	>1	<−45	106.5	i.	∞	i.
1180	oil	.....	<−40	211	v. sl. s.	s.	s.
1181	cr./et.	.....	50 d.	.....	d.; s. CS_2	d. abs. al.	s. abs. et.
1182	tri.	.....	200	.....	82.9$^{22°}$	s. abs. al.	i. abs. et.
1183	col. lq.	1.462$^{15°}$	−23	120 ±	sl. s.	s.	s.
1184	syrup	0.873$^{25°}_{4}$	9	178-80	v. s.	v. s.	sl. s.
1185	col. lq.	1.653$^{22°}_{4}$	−21	64$^{19.5mm}$	.....	.....	∞
1186	col. lq.	1.985$^{17°}_{4}$	−4.5	105.5^{758mm}	d.	.....	∞
1187	cr./act.	.....	115-7	.....	i.; s. act.	s.; s. chl.	s.
1188	pr.	.....	152-3	160^{763mm}	i.	s. h.	s.
1189	cr.	0.822$^{78°}$	50	159-60	i.	s.	s.
1190	mn./80% al.	.....	106-7	255-60	0.02$^{19°}$	64.5$^{15°}$, 80% al.	s.
1191	trig.	0.999$^{8°}$	178-9	209.1^{759mm}	0.1	120$^{12°}$	v. s.
1192	mn.	.....	93-4	244-7 sl. d.	sl. s. h.	v. s. h.	v. s.
1193	.....	.....	117	.....	220$^{18°}$	.....	.....
1194	pr./al.	.....	132.5	.....	v. s. bz.	s.	v. s. ac.
1195	mn./al.	1.01$^{116°}$	119-20	249-54 sl. d.	i.	v. s.	v. s.
1196	pr./ac.	.....	195-6	.....	v. s.	sl. s. ac.	v. sl. s.
1197	mn.	1.228	202-3	.....	0.8$^{25°}$; 10$^{100°}$	s.	s.
1198	mn.	1.186	187	.....	0.6$^{12°}$	s.	i. chl.
1199	cr./aq. al.	1.243	172	.....	0.34$^{20°}$	47.5$^{20°}$, abs. al.	.....
1200	nd./al.	.....	221-3	270	25 chl.	1.5	4
1201	nd./aq.	.....	158 ±	195-210^{13mm}	12.5$^{16°}$	75.8$^{16°}$, abs. al.	7.4$^{16°}$, abs. et.
1202	tri.	.....	170	.....	s.	s.	s.
1203	lq.	0.874$^{17.8°}_{4}$	.....	194-6	.....	.....	.....
1204	lq.	0.870$^{20°}_{20°}$	.....	205.5-6.5	.....	.....	.....
1205	col. nd.	0.889$^{37°}$	31.5	268-70	v. s.; s.	s.; s. chl.	s.; s. bz.
1206	lq.	0.828$^{15°}$	.....	207-9^{755mm}	.....	.....	.....
1207	col. lq.	.....	.....	235-7	.....	.....	.....
1208	oily lq.	0.922$^{20°}_{4}$	−1.5	202^{761mm}	1.10$^{20°}$	s.	s.

Caffeine, cf. alkd.
Cajeputole 3217
Camphor, anemone or pulsatilla 510
Camphor, artificial 5319
Camphor chloride 1252
Cane sugar 5663
Canidine, cf. alkd.
C.A.P. gas 1303
Caprinone 2682

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1209	**Caproic** acid (*iso*)	2-Me-pentanoic-5 acid	$(CH_3)_2CH\cdot(CH_2)_2\cdot CO_2H$	II-327	116.16
1210	acid	3-Me-pentanoic-1 acid	$C_2H_5\cdot CH(CH_3)\cdot CH_2\cdot CO_2H$	II-331	116.16
1211	acid	2-Me-pentanoic-1 acid	$C_2H_5\cdot CH_2\cdot CH(CH_3)\cdot CO_2H$	II-326	116.16
1212	aldehyde (*n*)	hexanal	$CH_3\cdot(CH_2)_4\cdot CH{:}O$	I-688	100.16
1213	amide	caproamide	$C_5H_{11}\cdot CO\cdot NH_2$	II-324	115.17
1214	anhydride (*n*)	.....	$(C_5H_{11}CO)_2O$	II-324	214.30
1215	anilide (*n*)	*n*-caproanilide	$C_5H_{11}CO\cdot NH\cdot C_6H_5$	XII-255	191.26
1216	chloride (*n*)	*n*-caproyl chloride	$CH_3\cdot(CH_2)_4\cdot CO\cdot Cl$	II-324	134.61
1217	nitrile (*n*)	*n*-amyl cyanide	$CH_3\cdot(CH_2)_4\cdot CN$	II-324	97.16
1218	nitrile (*iso*)	*iso*-amyl cyanide	$(CH_3)_2CH(CH_2)_2CN$	II-329	97.16
1219	**Capryl** acetate†	(*sec*)-octyl acetate	$CH_3CO_2\cdot C_8H_{17}$	II-134	172.26
1220	**Caprylic** acid (*n*)	octanoic acid	$CH_3\cdot(CH_2)_6\cdot CO_2H$	II-347	144.21
1221	acid	2-Et-hexanoic acid	$CH_3(CH_2)_3CH(C_2H_5)\cdot CO_2H$	II-349	144.21
1222	aldehyde (*n*)	octaldehyde	$CH_3\cdot(CH_2)_6\cdot CH{:}O$	I-704	128.21
1223	amide (*n*)	caprylamide	$C_7H_{15}CO\cdot NH_2$	II-349	143.22
1224	anhydride (*n*)	.....	$(C_7H_{15}CO)_2O$	II-348	270.40
1225	chloride (*n*)	octanoyl chloride	$CH_3\cdot(CH_2)_6\cdot CO\cdot Cl$	II-348	162.66
1226	nitrile (*n*)	heptyl cyanide	$CH_3\cdot(CH_2)_6\cdot CN$	II-349	125.21
1227	**Capsaicine**	(2;1,4)	$CH_3O\cdot C_6H_3(OH)\cdot CH_2\cdot NH\cdot CO\cdot C_9H_{17}$	*XIII-322	305.40
1228	**Carbamic** acid	known only in derivs.	$H_2N\cdot CO\cdot OH$	III-20	61.04
1229	chloride	urea chloride	$H_2N\cdot CO\cdot Cl$	III-31	79.49
1230	**Carbasone**	*p*-carbamylamino-phenyl-arsonic acid	$H_2NCONH\cdot C_6H_4\cdot AsO{:}(OH)_2$	XVI-880	260.07
1231	**Carbazole**	diphenyleneim-ine; dibenzopyrrole	$C_6H_4\cdot NH\cdot C_6H_4$ (_____)	XX-433	167.20
1232	**Carbitol**	diethylene glycol mono-Et ether	$HO\cdot(CH_2)_2\cdot O\cdot(CH_2)_2\cdot O\cdot C_2H_5$	.....	134.17
1233	acetate	.....	$CH_3CO_2\cdot C_6H_{13}O_2$	.....	176.21
1234	**Carbodiphenyl-imide**	(α)	$C_6H_5\cdot N{:}C{:}N\cdot C_6H_5$	XII-449	194.23
1235	(β)	.....	$C_6H_5\cdot N{:}C{:}N\cdot C_6H_5$	XII-450	194.23
1236	**Carbohydrazide**	carbazide	$(H_2N\cdot NH)_2{:}CO$	III-121	90.09
1237	**Carbon** dioxide	carbonic anhydride	CO_2	III-4	44.01
1238	disulfide	.....	CS_2	III-197	76.13
1239	monoxide	.....	CO	I-720	28.01
1240	suboxide	dioxo-allene	$O{:}C{:}C{:}C{:}O$	I-805	68.03
1241	subsulfide	.....	$S{:}C{:}C{:}C{:}S$	III-207	100.15
1242	tetrabromide	tetrabromo-methane	CBr_4	I-69	331.67
1243	tetrachloride	tetrachloro-methane	CCl_4	I-65	153.84

† See also Nos. 4959-60.

Caproamide 1213
Caproanilide 1215
Caproic isonitrile 453
Caprone 1743
Caprophenone (*iso*) 481-2
Capryl alcohol 4962
Caprylamide 1223
Caprylamine 4970-2
Caprylene 4984
Caprylidene 4991
Caprylone 2265
Carbamic nitrile 1577
Carbamide 6386
Carbamides, cf. ureas.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1209	col. oil	$0.925^{20°}_{4°}$	−35	207.7	v. sl. s.	s.	s.
1210	col. lq.	$0.924^{19°}$	.....	197-8	.....	.....	.....
1211	col. lq.	$0.928^{18°}_{0°}$	.....	193^{748mm}	$0.57^{17°}$	.....	.....
1212	col. lq.	$0.834^{20°}_{20°}$	.....	128.6	$0.5^{20°}$	.....	.....
1213	pl.	0.999	100-1	.....	s. h.	s.	s.
1214	col. oil	$0.928^{17°}$	.....	241-3 sl. d.	.....	s.	.....
1215	pr./al.	1.112	95	.....	.....	v. s.	v. s.
1216	col. lq.	.....	.....	$153-4^{738mm}$	d.	d.; s. chl.	s.
1217	col. lq.	$0.809^{20°}$	.....	$162-3^{750mm}$	i.	v. s.	v. s.
1218	lq.	$0.804^{20°}_{4°}$	−51.1	155.5^{760mm}	i.	∞	∞
1219	col. lq.	$0.863^{14°}_{4°}$	.....	$194-5^{744mm}$	i.	s.	s.
1220	col. lf.	$0.910^{20°}_{4°}$	16	237.5	$0.25^{100°}$; i. c.	s.; s. chl.; s. pet.	s.; s. CS_2
1221	lq.	$0.908^{20°}_{20°}$	<0	226.9	$0.25^{20°}$	.....	.....
1222	lq.	$0.821^{20°}$	.....	167-70	.....	.....	.....
1223	col. lf.	.....	105-10	>200 d.	$0.45^{100°}$	s.	s.
1224	lq.	.....	−1	280-5	.....	s.	.....
1225	col. lq.	$0.973^{8°}$	.....	$194-6^{756mm}$	d.	d.	s.
1226	lq.	$0.820^{13°}$	.....	198-200	.....	.....	.....
1227	cr./aq. al.	.....	64-5	>210, in vac.	i. c.; s. bz.	s.; s. alk.	s.; s. chl.
1228	.....	.....	.....	.....	.....	.....	.....
1229	col. lq.	.....	50±	61-2 d.	d.	d.	.....
1230	col. cr.	.....	174	.....	i.	s. alk.	i. HCl
1231	lf. or pl.	.....	244.8	354.8	i.; s. bz.; s. chl.	$0.92^{14°}$; 3.88 h.	sl. s.; s. pet.
1232	col. lq.	$0.990^{20°}_{20°}$	.....	201.9	∞	v. s.	s.
1233	col. lq.	$1.011^{20°}_{20°}$	−25±	217.7	∞	∞	∞
1234	syrup	.....	.....	330-1	v. s. bz.	.....	.....
1235	cr.	.....	168-70	.....	v. sl. s. bz.	v. sl. s.	v. sl. s.
1236	nd./aq. al.	.....	152-3	.....	i. bz.	i. chl.	i.
1237	col. gas	1.53 (A) $1.101^{-37°}$ (lq.) $1.56^{-79°}$ solid	$-56^{5.2atm.}$	subl. −78.5	$179.7^{0°}$ cc. See special table	s. a.	s. alk.
1238	col. lq.	$1.263^{20°}_{4°}$ 2.63(A)	−108.6	46.3	$0.2^{0°}$; $0.014^{50°}$	∞	∞
1239	poison. gas	$0.814^{-18.5°}_{4°}$	−207	−192	$0.0044^{0°}$; $3.5^{0°}$ cc.	s.	s. Cu_2Cl_2
1240	gas	$1.114^{0°}$	−107	77^{61mm}	d.	.....	s.
1241	red lq.	.....	.....	in vac. 60-70*	v. s. bz.	v. s.	v. s.
1242	col. mn.	3.42	α48.4 β90.1	189.5	i.	s.	s.
1243	col. lq.	$1.595^{20°}_{4°}$	−22.6	76.8	$0.097^{0°}$; $0.08^{20°}$	∞	∞

* Partial polymerization.

Carbamidine 3488
Carbamyl-choline chloride 2865
Carbamyl-phenylsemicarbazide 1569
Carbanilide 2759
Carbazide 1236
Carbazotic acid 6310
Carbinol 4100
Carbocinchomeronic acid 5506, 5509
Carbolic acid 5118
Carbon dichloride 5741
Carbon hexachloride 3564
Carbon oxysulfide 1248

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1244	**Carbon** tetrafluoride	tetrafluoro-methane	CF_4	I-59	88.01
1245	tetraiodide	tetraiodo-methane	CI_4	I-74	519.69
1246	**Carbonyl** bromide	.....	$O{:}C{:}Br_2$	III-20	187.84
1247	chloride	phosgene	$O{:}C{:}Cl_2$	III-13	98.92
1248	sulfide	carbon oxysulfide	$O{:}C{:}S$	III-131	60.07
1249	**Carbothialdine**	.....	$NH_2CS{\cdot}S{\cdot}N(CHCH_3)_2$	XXVI-9	162.27
1250	**Carnine**	.....	$C_7H_8O_3N_4{\cdot}H_2O$	.....	214.18
1251	**Carnosine**	*N*(α)-β-alanyl-histidine	$N_2C_3H_3{\cdot}CH_2{\cdot}CH{\cdot}(CO_2H){\cdot}NHC_3H_6ON$	XXV-516	226.23
1252	**Carotene** (α)(*d*)	provitamin A	$C_{40}H_{56}$	XXX-91	536.85
1253	**Carotene** (β)(*dl*)	provitamin A	$C_{40}H_{56}$	XXX-87	536.85
1254	**Carotene** (γ)(*dl*)	provitamin A	$C_{40}H_{56}$	XXX-92	536.85
1255	**Carvacrol**	2-Me-5-*iso*-Pr-phenol	$(CH_3)(C_3H_7)C_6H_3{\cdot}OH$	VI-527	150.21
1256	**Carvacrylamine** (2;1,4)	2-NH_2-*p*-cymene	$H_2N{\cdot}C_6H_3(CH_3){\cdot}C_3H_7$	XII-1171	149.23
1257	**Carvenone** (*dl*)	.....	$C_{10}H_{16}O$	VII-78	152.23
1258	**Carvo**-menthene (*d*)	*p*-menthene-1	$C_{10}H_{18}$	V-84	138.24
1259	menthol	.....	$C_{10}H_{19}OH$	VI-26	156.26
1260	menthone	.....	$C_{10}H_{18}O$	VII-34	154.24
1261	**Carvone** (*d*)	anise oil	$C_{10}H_{14}O$	VII-153	150.21
1262	oxime	carvoxime	$C_{10}H_{14}O{:}NOH$	VII-156	165.23
1263	**Cedrene**	.....	$C_{15}H_{24}$	V-461	204.34
1264	**Cedriret**	cörulignone	$[(CH_3O)_2C_6H_2{\cdot}O{\cdot}]_2$	VIII-537	304.29
1265	**Cellosolve**	2-ethoxy-ethanol-1	$C_2H_5O(CH_2)_2OH$	I-467	90.12
1266	acetate	.....	$CH_3CO_2C_4H_9O$	II-141	132.16
1267	**Cellulose**	.....	$(C_6H_{10}O_5)x$	.....	162.14
1268	acetate, penta-	.....	$C_6H_5(O_2CCH_3)_5$	.....	372.32
1269	acetate, tetra-	.....	$C_6H_6O(O_2CCH_3)_4$	.....	330.28
1270	acetate, tri-	.....	$C_6H_7O_2(O_2CCH_3)_3$	.....	288.25
1271	**Cerotene**	.....	$C_{26}H_{52}$	I-227	364.68
1272	**Cerotic acid**	.....	$C_{25}H_{51}{\cdot}CO_2H$	II-394	396.68
1273	**Ceryl alcohol**	.....	$C_{26}H_{53}{\cdot}OH$	I-432	382.69
1274	**Cetyl** acetate	*n*-hexadecyl acetate	$CH_3CO_2{\cdot}C_{16}H_{33}$	II-136	284.47
1275	alcohol	hexadecanol	$CH_3(CH_2)_{14}CH_2OH$	I-429	242.43
1276	bromide	hexadecyl bromide	$CH_3(CH_2)_{14}CH_2Br$	I-172	305.34
1277	iodide (*n*)	1-iodohexadecane	$CH_3(CH_2)_{14}CH_2I$	I-172	352.34
1278	palmitate	.....	$C_{15}H_{31}CO_2{\cdot}C_{16}H_{33}$	II-373	480.83
1279	**Chaulmoogric acid**	.....	$C_5H_7{\cdot}(CH_2)_{12}{\cdot}CO_2H$	IX-80	280.44
1280	**Chavibetol** (*iso*) (5;1,2)	propenyl guaiacol	$CH_3{\cdot}CH{:}CH{\cdot}C_6H_3{\cdot}(OH)OCH_3$	VI-956	164.20
1281	**Chloral**	trichloro-acetaldehyde	$Cl_3C{\cdot}CH{:}O$	I-616	147.40
1282	alcoholate	.....	$Cl_3C{\cdot}CH(OH){\cdot}OC_2H_5$	I-621	193.47
1283	ammonia	.....	$Cl_3C{\cdot}CH(OH)NH_2$	I-624	164.43
1284	cyanohydrine	tri-Cl-lactic nitrile	$Cl_3C{\cdot}CHOH{\cdot}CN$	III-288	174.43
1285	formamide	chlor(al)amide	$Cl_3C{\cdot}CHOH{\cdot}NH{\cdot}CO{\cdot}H$	II-27	192.44

Carbonyl-disulfethyl 2163
Carbostyril 3820
Carbostyril (*iso*) 3826
Carbylamines, cf. *iso*-cyanides.
Cardiazol 5079
Carminic acid, cf. glcde.
Carotin 1252-4
Carpaine, cf. alkd.
Carpiline, cf. alkd.
Carvoxime 1262
Casella's acid 4510
Casella's acid F 4553
Catechin 2312
Catechol 2312
Catechol diethyl ether 2091
Cebione 586
Cellon 5739
Cephaeline, cf. alkd.
Cerane 3568
Cerberin, cf. glcde.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1244	gas	.....	.....	−128	sl. s.	.....	.....
1245	red, cubic	$4.32^{20.2°}$	d.	subl. in vac. 90-100	i.; d. h.	d. h.	s.
1246	col. lq.	$2.45^{15°}$	−80	64-5	v. sl. d.	.....	.....
1247	poison. gas	$1.392^{-1.9°}_{4}$	−104	8.2^{756mm}	v. sl.; sl. d.	v. s. bz.	v. s. ac.
1248	col. gas	2.105(A) 1.24^{-87}	−138.2	-50.2^{760mm}	$80^{14°}$ cc.	s.	s.
1249	cr./al.	.....	.....	.....	i.	s. h.	i.; s. a.
1250	cr.	.....	d. 230-9	.....	s. h.	i.	i.
1251	col. nd./al.	.....	254 d.	.....	$32.3^{25°}$	sl. s.	.....
1252	red cr./ pet.	$1.000^{20°}_{20}$	187	.....	i.; v. s. chl.	sl. s.; s.bz.	s.; s. CS_2
1253	red/bz.-al.	$1.000^{20°}_{20}$	184	.....	i.; v. s. chl.	sl. s.; s. bz.	s.; s. CS_2
1254	red pr.	.....	177-8	.....	i.; s. chl.	s. bz.	s. CS_2
1255	col. lq.	$0.977^{20°}_{4}$	0.5	238	v. sl. s.	∞	∞
1256	oil	$0.994^{20°}$	.....	241	v. sl. s.	s.	s.
1257	lq.	$0.926^{20°}_{4}$	.....	233	i.	.....	.....
1258	lq.	$0.829^{20°}$	.....	174-6	.....	.....	.....
1259	oil	$0.908^{20°}_{4}$	.....	220	.....	.....	.....
1260	oil	.....	.....	222-3	.....	.....	.....
1261	col. lq.	$0.961^{20°}_{4}$	.....	230^{755mm}	i.	∞; 20, 60% al.	∞
1262	mn. pl./al.	$1.016^{73°}$	71-2	.....	s.	s.	.....
1263	col. lq.	$0.939^{15°}$	.....	$262-3^{750mm}$	.....	.....	.....
1264	b. bl. nd.	.....	d.	.....	i.	s. phenol	s. H_2SO_4
1265	col. lq.	$0.931^{20°}_{4}$	−70	135.1	∞	∞; ∞ chl.	∞; ∞ act.
1266	col. lq.	$0.975^{20°}_{4}$	.....	156.3	22	∞	∞
1267	amor.	1.3-1.4	.....	.....	i.; *	i.	i.
1268	amor.	.....	.....	.....	i.	s. ac.	.....
1269	amor.	.....	softens 150±	.....	i.; i. act.	i.; s. ac.	i.; s. chl.
1270	fl.	.....	.....	.....	i.	s. ac.	i.; s. chl.
1271	cr.	.....	57-8	.....	.....	.....	.....
1272	col. cr.	$0.836^{-9°}_{4}$	82.5	.....	i.	v. s. h.	s. h.
1273	cr.	.....	80	.....	i.	s.	.....
1274	nd.	$0.858^{20°}$	22-3	$200-1^{15mm}$	.....	v. sl. s. c.	.....
1275	lf.	$0.818^{50°}_{4}$	49-50	189.5^{15mm}	i.	s.	s.; s. chl.
1276	col. lq.	.....	15	.....	.....	.....	.....
1277	lf.	$1.123^{20°}_{4}$	22	211^{15mm}	i.	s.	s.
1278	lf.	$0.832^{-0°}_{4}$	53-4	.....	i.	.....	s.
1279	lf./al.	.....	68	$247-8^{20mm}$	i.	v. sl. s.	s.; s. chl.
1280	cr.	.....	95-6	147^{19mm}	.....	.....	.....
1281	col. lq.	$1.505^{25°}_{4}$	−57±	97.6^{768mm}	v. s.	∞	∞
1282	nd.	$1.143^{40°}$	56-7	115-6	s.	s.	s.
1283	col. nd.	.....	63-4	100±, d.	v. sl. s.	s.; s. bz.	v. s.
1284	col. cr./aq.	.....	61	215-20 sl. d.	s.	s.	s.
1285	col. cr.	.....	116-8	d.	5; d. h.	40; d. h.	v. s.

* Soluble in $Cu(NH_3)_4(OH)_2$.

Cerulignone 1264
Cetane 3569
Cetylene 3572
Cevadine, cf. alkd.
Cevitamic acid 586
CG (choky) gas 1247
Chalkone 627
Chaulmestrol 3014
Chavicol 2111
Chelerythrine, cf. alkd.
Chelidonine, cf. alkd.
Chi acid 554
Chicago acid 344
Chinicine, cf. alkd.
Chinidine, cf. alkd.
Chinosol 3827
Chinotine, cf. alkd.
Chinovin, cf. glcde.
Chloral-amide 1285

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1286	**Chloral** hydrate	.....	$Cl_3C{\cdot}CH(OH)_2$	I-619	165.42
1287	imide (trimer)	tri-Cl-ethylidene-imide	$(Cl_3C{\cdot}CH{:}NH)_3$	XXVI-9	439.25
1288	urethane	ural(ine)	$C_2H_2OCl_3{\cdot}NHCO_2{\cdot}C_2H_5$	III-24	236.49
1289	**Chloralose** (α)	glucochloral	$Cl_3C{\cdot}CH{:}O_2{:}C_6H_7O{\cdot}(OH)_3$	XXXI-151	309.54
1290	**Chloramine T**	chlorazone (1,4)	$CH_3{\cdot}C_6H_4{\cdot}S{:}O{\cdot}(ONa){:}NCl{\cdot}H_2O$	XI-107	245.66
1291	**Chloro-**acenaphthene	(3)	$Cl{\cdot}C_{10}H_5(CH_2)_2$	*V-276	188.65
1292	acetal	.....	$ClCH_2{\cdot}CH(OC_2H_5)_2$	I-611	152.62
1293	acetaldehyde	2-chloro-ethanal	$ClCH_2{\cdot}CH{:}O$	I-610	78.50
1294	acetamide	.....	$ClCH_2{\cdot}CO{\cdot}NH_2$	II-199	93.52
1295	acetamide (*N*)	acetochloramide	$CH_3{\cdot}CO{\cdot}NHCl$	II-181	93.52
1296	acetanilide (o)	.....	$Cl{\cdot}C_6H_4{\cdot}NH{\cdot}COCH_3$	XII-599	169.61
1297	acetanilide (m)	.....	$Cl{\cdot}C_6H_4{\cdot}NH{\cdot}COCH_3$	XII-604	169.61
1298	acetanilide (p)	.....	$Cl{\cdot}C_6H_4{\cdot}NH{\cdot}COCH_3$	XII-611	169.61
1299	acetic acid	.....	$Cl{\cdot}CH_2{\cdot}CO{\cdot}OH$	II-194	94.50
1300	acetic anhydride	.....	$(Cl{\cdot}CH_2{\cdot}CO)_2O$	II-199	170.99
1301	acetone	.....	$Cl{\cdot}CH_2{\cdot}CO{\cdot}CH_3$	I-653	92.53
1302	acetophenone (p)	.....	$Cl{\cdot}C_6H_4{\cdot}CO{\cdot}CH_3$	VII-281	154.59
1303	acetophenone (ω)	phenacyl chloride	$C_6H_5{\cdot}CO{\cdot}CH_2Cl$	VII-282	154.59
1304	acetyl chloride	.....	$Cl{\cdot}CH_2{\cdot}CO{\cdot}Cl$	II-199	112.95
1305	acetylene	chloro-ethyne	$CH{:}C{\cdot}Cl$ (or $C{:}CHCl$)	I-244	60.49
1306	acrylic acid (α)	.....	$CH_2{:}CCl{\cdot}CO_2H$	II-401	106.51
1307	acrylic acid (β)	.....	$ClCH{:}CH{\cdot}CO_2H$	II-400	106.51
1308	2-amino-thio-phenol hydro-chloride	(4;1,2)	$Cl{\cdot}C_6H_3(SH){\cdot}NH_2{\cdot}HCl$	.....	196.10
1309	aniline (o)	2-chloroaniline	$Cl{\cdot}C_6H_4{\cdot}NH_2$	XII-597	127.57
1310	aniline (m)	3-chloroaniline	$Cl{\cdot}C_6H_4{\cdot}NH_2$	XII-602	127.57
1311	aniline (p)	4-chloroaniline	$Cl{\cdot}C_6H_4{\cdot}NH_2$	XII-607	127.57
1312	o-anisidine	4-Cl-2-NH_2-anisole	$Cl{\cdot}C_6H_3(OCH_3)NH_2$	XIII-383	157.60
1313	o-anisidine HCl	.....	$C_7H_8ONCl{\cdot}HCl$	.....	194.06
1314	anisole (p)	.....	$Cl{\cdot}C_6H_4{\cdot}OCH_3$	VI-186	142.58
1315	anthranilic acid	5-Cl-2-NH_2-benzoic	$Cl{\cdot}C_6H_3(NH_2)CO_2H$	XIV-365	171.58
1316	anthraquinone (1)	.....	$C_6H_4(CO)_2C_6H_3Cl$	VII-787	242.65
1317	anthraquinone (2)	.....	$C_6H_4(CO)_2C_6H_3Cl$	VII-787	242.65
1318	benzaldehyde (o)	.....	$Cl{\cdot}C_6H_4{\cdot}CH{:}O$	VII-233	140.57
1319	benzaldehyde (m)	.....	$Cl{\cdot}C_6H_4{\cdot}CH{:}O$	VII-234	140.57
1320	benzaldehyde (p)	.....	$Cl{\cdot}C_6H_4{\cdot}CH{:}O$	VII-235	140.57
1321	benzamide (o)	.....	$Cl{\cdot}C_6H_4{\cdot}CO{\cdot}NH_2$	IX-336	155.58
1322	benzamide (m)	.....	$Cl{\cdot}C_6H_4{\cdot}CO{\cdot}NH_2$	IX-338	155.58
1323	benzamide (p)	.....	$Cl{\cdot}C_6H_4{\cdot}CO{\cdot}NH_2$	IX-341	155.58
1324	benzene	phenyl chloride	$C_6H_5{\cdot}Cl$	V-199	112.56
1325	benzene-3,5-di-sulfonic acid	(1;3,5)	$Cl{\cdot}C_6H_3(SO_3H)_2$	*XI-49	272.68

Chloral-antipyrine 567
Chloramide 1285
Chloranil 5746
Chloranol, a mixt. of 1386 and 4117
Chlorazene 1290
Chlorazine 1290
Chlorazone 1290
Chloretone 6145
Chlorex 1996
Chlornol 1386

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1286	mn. pr.	1.619^{50}_{4}°	51.7*	96.3^{764} d.	474^{17}°	v. s.	s.; s. h. CS_2
1287	rhb./bz.-al.	.....	150-5** d.	.....	i.; s. bz.	2; s. chl.	s.; s. oil
1288	lf./al.-et.	.....	103 sl. d.	.....	i.; d. h.	s.	s.
1289	col. nd./al. or et.	.....	187	.....	0.9^{15}°	6.6^{21}°; 0.07^{21}° chl.	v. s.
1290	yel. wh. pd.	.....	anh. expl. 175-80	.....	14c.; 50 h.	d.; i. bz.	i.; i. chl.
1291	nd./al.	1.195^{70}_{4}°	69-70	319^{771mm}	.....	.....	.....
1292	lq.	1.026^{15}°	.....	157	sl. s.	∞	∞
1293	lq.	.....	.....	85^{748mm}	.....	.....	.....
1294	mn. pr.	.....	120-1	224-5 d.	10^{24}°	9.5^{24}° abs.	v. sl. s.
1295	lf.	.....	110	.....	v. s.	.....	s.
1296	nd./aq. ac.	.....	88	.....	i.	s.	s. bz.
1297	nd./aq. ac.	.....	72.5	.....	s. CS_2	s.	s. bz.
1298	rhb.	1.385^{22}°	175-6	.....	sl. s.	s.	v. s.
1299	col. cr.	1.58^{20}_{20}°	α61.2 β56.3 γ50 δ43.8(?)	189.5	v. s.; v. s. bz.	s.; s. chl.	s.
1300	pr./bz.	.....	46	163^{116mm}	v. sl. s. lg.	sl. s. bz.	v. s.
1301	col. lq.	1.162^{16}°	−44.5	121	∞	∞	∞
1302	cr.	1.188^{20}°	20	232	i.	∞	∞
1303	rhb.	1.324^{15}°	58-9	245-7	i.; s. bz.	v. s.	v. s.
1304	col. lq.	1.498^{20}_{20}°	.....	105	d.	d.	.....
1305	gas	.....	.....	expl.	.....	.....	.....
1306	nd.	.....	65	subl.	s.	s.	s.
1307	lf.	.....	84-5	.....	s.	s.	s.
1308	yel. cr.	.....	208 d.	.....	s.	s.	i.
1309	lq.	1.213^{20}_{4}°	0	210.5	i.; s. a.	.....	s.
1310	lq.	1.216^{20}_{4}°	−10.4	230^{767mm}	i.; s. a.	.....	s.
1311	rhb.	1.427^{19}°	70-1	230-1	s. h.	s.; s. act.	s.; s. CS_2
1312	nd.	.....	83-4	.....	i. pet.	s.	s.
1313	col. nd.	.....	.....	.....	s.	sl. s.	i.
1314	lq.	.....	<−18	198	i.	s.	s.; s. chl.
1315	nd./al.	.....	211-2	.....	i.; v. s. act.	10^{25}°; s. bz.	i. c.
1316	yel. nd./al.	.....	162	subl.	i.; s. ac.	sl. s. h.	s. h. bz.
1317	nd./al.	.....	208-9	.....	i.	s. h. bz.	s. ac.
1318	nd.	1.29^{80}°	11	208^{748mm}	v. sl. s.	v. s.	v. s.
1319	pr.	1.250^{15}°	17-8	213-4	v. sl. s.	v. s.	v. s.
1320	pr.	1.196^{61}°	47.8	213^{748mm}	s. h.	v. s.	v. s.
1321	rhb.	1.34^{18}°	142.5	.....	s. h.	s.	s.
1322	nd.	.....	134.5	.....	s. h.	s.	s.
1323	nd./et.	.....	179	.....	s. h.	v. s.	v. s.
1324	col. lq.	1.107^{20}_{4}°	−45.2	132.1	i.; ∞ bz.	∞	∞
1325	hyg. nd.	.....	d. 100	.....	.....	.....	.....

* Variable m. p., depends upon dissociation.
** Mn. pr./al., m. p. 105-6.

Chloro-acetcacetanilide 41
Chloro-acetonitrile 1399
Chloro-allylene 5343
Chloro-aminoanisole 1312
Chloro-aminotoluene 1469-70
Chloro-anthranilic acid 1315

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1326	**Chloro** benzene sulfonic acid (1,4)	.....	$Cl{\cdot}C_6H_4{\cdot}SO_3H$	XI-54	192.62
1327	benzoic acid (*o*)	.....	$Cl{\cdot}C_6H_4{\cdot}CO_2H$	IX-334	156.57
1328	benzoic acid (*m*)	.....	$Cl{\cdot}C_6H_4{\cdot}CO_2H$	IX-337	156.57
1329	benzoic acid (*p*)	chlorodracylic acid	$Cl{\cdot}C_6H_4{\cdot}CO_2H$	IX-340	156.57
1330	benzonitrile (*p*)	.....	$Cl{\cdot}C_6H_4{\cdot}CN$	IX-341	137.57
1331	benzophenone (*p*)	.....	$Cl{\cdot}C_6H_4{\cdot}CO{\cdot}C_6H_5$	VII-419	216.66
1332	benzothiazole (2)	.....	$C_6H_4{\cdot}N{:}C(Cl){\cdot}S$	XXVII-44	169.63
1333	benzoxazole (2)	.....	$C_6H_4{\cdot}N{:}C(Cl){\cdot}O$	XXVII-43	153.57
1334	benzoyl chloride	(1,2)	$Cl{\cdot}C_6H_4{\cdot}CO{\cdot}Cl$	IX-336	175.02
1335	benzoyl chloride	(1,3)	$Cl{\cdot}C_6H_4{\cdot}CO{\cdot}Cl$	IX-338	175.02
1336	benzoyl chloride	(1,4)	$Cl{\cdot}C_6H_4{\cdot}CO{\cdot}Cl$	IX-341	175.02
1337	benzyl bromide	(1,2)	$Cl{\cdot}C_6H_4{\cdot}CH_2Br$	*V-155	205.49
1338	benzyl bromide	(1,4)	$Cl{\cdot}C_6H_4{\cdot}CH_2Br$	V-307	205.49
1339	benzyl chloride	(1,4)	$Cl{\cdot}C_6H_4{\cdot}CH_2Cl$	V-297	161.03
1340	bromobenzene	(1,3)	$Cl{\cdot}C_6H_4{\cdot}Br$	V-209	191.47
1341	bromobenzene	(1,4)	$Cl{\cdot}C_6H_4{\cdot}Br$	V-209	191.47
1342	bromoethane (1,1)	ethylidene chloro-bromide	$CH_3{\cdot}CHClBr$	I-89	143.43
1343	bromoethane (1,2)	.....	$Cl{\cdot}CH_2{\cdot}CH_2{\cdot}Br$	I-89	143.43
1344	bromomethane	.....	$Cl{\cdot}CH_2Br$	I-67	129.40
1345	buta-1,3-diene (2)	chloroprene	$CH_2{:}CCl{\cdot}CH{:}CH_2$	.....	88.54
1346	*tert*-butylphenol	(4;1,2)	$C_4H_9{\cdot}C_6H_3(OH)Cl$	.....	184.66
1347	butyric acid (*α*)(*dl*)	.....	$C_2H_5{\cdot}CHCl{\cdot}CO_2H$	II-276	122.55
1348	butyric acid (*β*)(*dl*)	.....	$CH_3{\cdot}CHCl{\cdot}CH_2{\cdot}CO_2H$	II-277	122.55
1349	butyric acid (*γ*)	.....	$Cl{\cdot}(CH_2)_3{\cdot}CO_2H$	II-278	122.55
1350	*iso*-butyric acid (*α*)	.....	$(CH_3)_2CCl{\cdot}CO_2H$	II-295	122.55
1351	butyronitrile (*γ*)	.....	$Cl{\cdot}(CH_2)_3{\cdot}CN$	II-278	103.55
1352	camphor (*α*)†	3-Cl-*d*-camphor	$Cl{\cdot}C_{10}H_{15}O$	VII-117	186.68
1353	coumarin (6)	.....	$Cl{\cdot}C_6H_3{\cdot}(CH)_2{\cdot}CO{\cdot}O$	XVII-331	180.59
1354	*m*-cresol (*o*)	2-Cl-3-OH-toluene	$CH_3{\cdot}C_6H_3(OH)Cl$	.....	142.58
1355	*m*-cresol (*p*)	4-Cl-3-OH-toluene	$CH_3{\cdot}C_6H_3(OH)Cl$	*VI-187	142.58
1356	*m*-cresol (6)	6-Cl-3-OH-toluene	$CH_3{\cdot}C_6H_3(OH)Cl$	VI-381	142.58
1357	*p*-cresol (*o*)	2-Cl-4-OH-toluene	$CH_3{\cdot}C_6H_3(OH)Cl$	VI-402	142.58
1358	crotonic acid (*α*)	.....	$CH_3{\cdot}CH{:}CCl{\cdot}CO_2H$	II-414	120.54
1359	dibromoethane	(1,1,1)	$CH_3{\cdot}CClBr_2$	I-92	222.33
1360	dibromoethane	(1,1,2)	$BrCH_2{\cdot}CHClBr$	I-92	222.33
1361	dibromomethane	.....	$ClCHBr_2$	I-68	208.31
1362	diethyl ether (*β*)	.....	$C_2H_5O{\cdot}CH_2{\cdot}CH_2Cl$	I-337	108.57
1363	diiodomethane	.....	$ClCHI_2$	I-72	302.32
1364	dinitrobenzene	(3;1,2)	$Cl{\cdot}C_6H_3(NO_2)_2$	*V-137	202.56
1365	dinitrobenzene (*α*)	(4;1,2)	$Cl{\cdot}C_6H_3(NO_2)_2$	V-262	202.56
1366	dinitrobenzene	(2;1,3)	$Cl{\cdot}C_6H_3(NO_2)_2$	V-263	202.56
1367	dinitrobenzene (*α*)	(4;1,3)	$Cl{\cdot}C_6H_3(NO_2)_2$	V-263	202.56

† See also Nos. 1192-4.

Chloro-biphenyl 1373-5
Chloro-bromopropane 6279
Chloro-bromotoluene 913-4
Chloro-butane 1072-5
Chloro-*iso*-butylene 1567, 4060
Chlorocarbonates, cf. chloroformates.
Chloro-cyanogen 1591

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1326	nd.	.....	68	147-8$^{0.1mm}$	s.	s.	i.; i. bz.
1327	mn./aq.	1.544$^{20°}$	141-2	.....	0.1°	s.	s.
1328	pr.	.....	158	.....	0.04$^{0°}$ s. h.	s.	s.
1329	tri.	1.541$^{24°}$	242-3	subl.	0.02	s.	s.
1330	nd./al.	.....	93-4	223^{750mm}	i.; v. s. bz.	v. s.	v. s.
1331	nd./et.-al.	.....	77-8	332^{771mm}	i.; 95$^{25°}$ bz.	32$^{5°}$ Me al.	57$^{25°}$
1332	lq.	.....	24 ±	248	.....	s.	.....
1333	cr.	.....	7	201-2 d.	i.	s. HCl	.....
1334	lq.	.....	−4	229-30^{773mm}	d.	d.	.....
1335	lq.	.....	.....	225	d.	d.	.....
1336	lq.	1.377	15-6	220-2	d.	d.	.....
1337	col. lq.	.....	.....	112-4^{15mm}	.....	.....	.....
1338	nd./al.	.....	49-50	.....	v. s. bz.	s.; v. s. ac.	v. s.
1339	nd.	.....	29	213-4	i.	v. s. h.	v. s.
1340	col. oil	$1.630^{20°}_{4°}$	−21	195-6	i.	v. s.	v. s.
1341	mn. pr.	.....	67.4	196.3	i.	s. h.	s.
1342	lq.	1.667$^{16°}$	.....	82.7	.....	.....	.....
1343	lq.	1.689$^{19°}$	−16.6	106.7	.....	.....	.....
1344	col. lq.	1.991$^{19°}$	< −55	68-9	.....	.....	.....
1345	col. lq.	$0.958^{20°}_{20°}$	.....	59.4	sl. s.	∞	∞
1346	lq.	$1.112^{25°}_{25°}$	< −20*	234-51	i.; ∞ chl.	∞ Me al.	∞ ; ∞ bz.
1347	oily lq.	.....	.....	101.3^{15mm}	s. h.	∞	∞
1348	col. cr.	$1.186^{20°}_{4°}$	16.0-16.5	109-10^{17mm}	.....	s.	s.
1349	cr.	1.250^{10mm}	16	116^{13mm} sl. d.	.....	s.	s.
1350	col. cr.	.....	31	118^{50mm}	v. s.	.....	.....
1351	lq.	1.162$^{10°}$	.....	195-7	i.	s.	s.
1352	mn. cr.	.....	93-4	244-7 sl. d.	v. sl. s. h.	s. h.; s. bz.	s.; s. chl.
1353	nd./al.	.....	161-2	.....	i. aq. NH_3	s. h.; v. s. CS_2	s. h.; v. s. bz.
1354	cr./pet.	.....	55-6	.....	sl. s.	s.	s.
1355	col. pr.	1.215$^{15°}$	46	196	i.	s.	s.
1356	col. cr./lg.	.....	66	235	i.; s. bz.	s.; s. chl.	s.; s. act.
1357	col. nd.	.....	55	228	sl. s.	s.	s.; s. bz.
1358	nd.	.....	99.2-99.5	212	2$^{13°}$	v. s.	v. s.
1359	lq.	2.134$^{16°}$	.....	123-4^{753mm}	.....	.....	.....
1360	lq.	2.268$^{16°}$	.....	162.5-3.0	.....	.....	.....
1361	col. lq.	2.445$^{15°}$	−22 ±	120^{730} sl. d.	.....	.....	.....
1362	lq.	$0.989^{20°}_{4°}$	.....	107-8	.....	.....	.....
1363	col. lq.	3.170°	−4	200 ±, d.	.....	.....	.....
1364	cr./et.	.....	86.8	.....	i.	s.	s.
1365	cr./et.	.....	α36.3 β37.1 γ38.8 δ28	315 d.	i.	v. s. h.	v. s.
1366	yel. nd./al.	.....	87-8	.....	i.	s.	s.
1367	rhb./et.	α1.697$^{22°}$ $\beta 1.680^{20°}_{4°}$	α53.4 β43 γ27	315 sl. d.	i.; s. bz.	s. h.	s.; s. CS_2

* Crysts. $+H_2O$, m. p. 18°.

Chloro-cyclohexane 1613
Chloro-cymene 1572
Chloro-decane 1646
Chloro-dimethylacetophenone 2524

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Chloro				
1368	dinitrobenzene	(5;1,3)	$Cl{\cdot}C_6H_3(NO_2)_2$	V-264	202.56
1369	dinitrobenzene	(2;1,4)	$Cl{\cdot}C_6H_3(NO_2)_2$	V-264	202.56
1370	dinitrobenzoic acid	(5;2,3,1)	$Cl{\cdot}C_6H_2(NO_2)_2CO_2H$	IX-415	246.57
1371	dinitrobenzoic acid	(5;3,4,1)	$Cl{\cdot}C_6H_2(NO_2)_2CO_2H$	IX-416	246.57
1372	dinitrophenol (α)	(4;2,6,1,)	$Cl{\cdot}C_6H_2(NO_2)_2OH$	VI-260	218.56
1373	diphenyl (o)	chloro-biphenyl	$Cl{\cdot}C_6H_4{\cdot}C_6H_5$	V-579	188.65
1374	diphenyl (m)	xenyl chloride	$Cl{\cdot}C_6H_4{\cdot}C_6H_5$	V-579	188.65
1375	diphenyl (p)	.....	$Cl{\cdot}C_6H_4{\cdot}C_6H_5$	V-579	188.65
1376	ethoxy diphenyl	(2)(β)	$C_6H_5{\cdot}C_6H_4{\cdot}O(CH_2)_2Cl$	.....	232.70
1377	ethyl acetate (β)	.....	$CH_3CO_2{\cdot}CH_2{\cdot}CH_2Cl$	II-128	122.55
1378	ethylbenzene (o)	.....	$Cl{\cdot}C_6H_4{\cdot}C_2H_5$	.....	140.61
1379	ethylbenzene (m)	alkazene 20	$Cl{\cdot}C_6H_4{\cdot}C_2H_5$	.....	140.61
1380	ethylbenzene (p)	.....	$Cl{\cdot}C_6H_4{\cdot}C_2H_5$	V-354	140.61
1381	ethyl 2-chloro-4-*tert*-butyl-phenyl ether (β)	(4;2,1)	$(CH_3)_3C{\cdot}C_6H_3(Cl){\cdot}O{\cdot}CH_2CH_2Cl$	.....	247.16
1382	ethyl chloro-formate	β-chloroethyl chlorocarbonate	$Cl{\cdot}CO{\cdot}O{\cdot}CH_2CH_2Cl$	III-11	142.98
1383	ethyl p-toluene-sulfonate (β)	.....	$CH_3{\cdot}C_6H_4{\cdot}SO_2{\cdot}OCH_2CH_2Cl$	.....	234.70
1384	fumaric acid	.....	$CH{:}CCl(CO_2H)_2$	II-744	150.52
1385	furoic acid (5)	5-chloro-pyromucic	$Cl{\cdot}C_4H_2O{\cdot}CO_2H$	XVIII-282	146.53
1386	hydroquinone	(2;1,4)	$Cl{\cdot}C_6H_3(OH)_2$	VI-849	144.56
1387	iodobenzene (o)	.....	$Cl{\cdot}C_6H_4{\cdot}I$	V-220	238.47
1388	iodobenzene (m)	.....	$Cl{\cdot}C_6H_4{\cdot}I$	V-220	238.47
1389	iodobenzene (p)	.....	$Cl{\cdot}C_6H_4{\cdot}I$	V-221	238.47
1390	iodoethane (1,1)	.....	$CH_3{\cdot}CHClI$	I-98	190.43
1391	iodoethane (2,1)	.....	$ClCH_2{\cdot}CH_2I$	I-98	190.43
1392	iodo-hydroxy-quinoline	(5,7,8); nioform	$Cl{\cdot}I{\cdot}OH{\cdot}C_6H{:}C_3H_3N$	XXI-98	305.52
1393	iodomethane	.....	$Cl{\cdot}CH_2{\cdot}I$	I-71	176.40
1394	4-ketodihydro-quinazoline (2)	.....	$C_6H_4{\cdot}N{:}C(Cl){\cdot}NH{\cdot}CO$	.....	180.59
1395	lepidine (α)	2-Cl-4-Me-quinoline	$C_6H_4{:}C_3HN(CH_3)Cl$	XX-396	177.63
1396	maleic acid	.....	$CH{:}CCl(CO_2H)_2$	II-752	150.52
1397	malonic acid	.....	$ClCH(CO_2H)_2$	II-592	138.51
1398	methyl acetate	.....	$CH_3CO_2{\cdot}CH_2Cl$	II-152	108.53
1399	methyl cyanide	chloro-acetonitrile	$ClCH_2{\cdot}CN$	II-201	75.50
1400	methyl ether	.....	$ClCH_2{\cdot}O{\cdot}CH_3$	I-580	80.52
1401	methyl-ethyl ketone	1-Cl-2-butanone	$ClCH_2{\cdot}CO{\cdot}C_2H_5$	I-669	106.55
1402	naphthalene (α)	α-naphthyl chloride	$C_{10}H_7Cl$	V-541	162.61
1403	naphthalene (β)	β-naphthyl chloride	$C_{10}H_7Cl$	V-541	162.61
1404	α-naphthol (2,1)	.....	$Cl{\cdot}C_{10}H_6{\cdot}OH$	VI-611	178.61
1405	α-naphthol (4,1)	.....	$Cl{\cdot}C_{10}H_6{\cdot}OH$	VI-611	178.61
1406	β-naphthol (1,2)	.....	$Cl{\cdot}C_{10}H_6{\cdot}OH$	VI-648	178.61
1407	nitroaniline	(4;2,1)	$Cl{\cdot}C_6H_3(NO_2)NH_2$	XII-729	172.57
1408	nitroaniline HCl	(4;2,1)	$C_6H_5O_2N_2Cl{\cdot}HCl$	.....	209.04
1409	nitroaniline	(4;3,1)	$Cl{\cdot}C_6H_3(NO_2)NH_2$	XII-731	172.57

Chloro-dracylic acid 1329
Chloro-ethane 3015
Chloro-ethanol 3194
Chloro-ethylbenzene 5191
Chloro-ethyl chlorocarbonate 1382
Chloro-ethyl phenyl ether 1426
Chloro-ethylene 6435
Chloro-ethyne 1305
Chloro-heptane 3546-7
Chloro-hexahydrobenzene 1613

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1368	col. nd./al.	.....	59	vol. in steam	.....	v. s.	v. s.
1369	yel. cr./lg.	.....	60	.....	i.	s.	s.
1370	nd./aq.	.....	199-200	expl.	0.26$^{11°}$	.....	.....
1371	pr./bz.	.....	159	.....	v. s. act.	s.	v. s.
1372	yel. mn./al.	1.74$^{22°}$	81-2	subl.	v. sl. s. h.	s.	s.; s. chl.
1373	cr.	.....	34	267-8	i.	v. s. lg.	.....
1374	cr.	.....	89	.....	.....	.....	.....
1375	lf.	.....	75-6	282	i.	s. lig.	.....
1376	col. cr.	1.142$^{50°}_{25°}$	54-7	323	v. sl. s.	12$^{25°}$ Me al.	v. s. bz., act.
1377	col. lq.	1.152$^{25°}_{25°}$	<−20	145	3$^{25°}$	∞	∞
1378	lq.	1.055$^{25°}_{25°}$	−81	179.2	i.	∞	∞
1379	col. lq.	1.045$^{25°}_{25°}$	<−70	183	i.; ∞ bz.	∞ ; ∞ act.	∞ ; ∞ CCl_4
1380	lq.	1.044$^{25°}_{25°}$	−62	184.6	i.	∞	∞
1381	col. lq.	1.149$^{25°}_{25°}$	<−20	176-80^{18mm}	i.; ∞ bz.	∞ ; ∞ act.	∞ ; ∞ CCl_4
1382	lq.	.....	.....	150-60	i.; d.	v. s.	v. s.
1383	col. lq.	.....	19-20	.....	.....	.....	.....
1384	pl./ac.	.....	191.5-2.5	.....	v. s.	v. s.	v. s.
1385	lf.	.....	176-7	.....	0.3$^{20°}$	s.	s.
1386	mn.	.....	106	263 sl. d.	v. s.	v. s.	v. s.
1387	col. oil	1.952$^{25°}_{4°}$	0.7	234-5	.....	.....	.....
1388	yel. lq.	.....	.....	230	.....	.....	.....
1389	col. lf./al.	.....	56-7	227.6^{751mm}	i.	s.	.....
1390	lq.	2.054$^{19°}$	.....	117-9	.....	.....	.....
1391	lq.	2.134$^{15.3°}_{0°}$	−15.6	140.1	.....	.....	.....
1392	yel. nd./ ac.	.....	177-8	.....	i.; s. h. ac.	2.5	s.; s. chl.
1393	oil	2.49$^{20°}$	.....	109	.....	.....	.....
1394	nd.	.....	212	.....	i.; s. NaOH	s.	s. act.
1395	nd./aq. al.	.....	59	296	i.	s.	s.; s. chl.
1396	col. cr.	.....	114-5	.....	.....	v. s.	v. s.
1397	pr.	.....	133	.....	v. s.	v. s.	v. s.
1398	col. lq.	1.195$^{14°}$	.....	115-6^{757mm}	d.	.....	.....
1399	lq.	1.193$^{20°}$	.....	126-7 d.	.....	.....	.....
1400	lq.	1.070$^{20°}_{4°}$	−103.5	59.5^{759mm}	d.	d. h.	.....
1401	lq.	1.08$^{13°}$	.....	137-8	i.	.....	.....
1402	col. lq.	1.194$^{20°}_{4°}$	−20	259.3	i.	s.; ∞ CS_2	∞ ; ∞ bz.
1403	lf./al.	1.266$^{16°}$	56-7	264-6^{751mm}	i.	v. s.	v. s.
1404	nd./lg.	.....	65-70	.....	.....	v. s.	v. s.
1405	nd./aq. al.	.....	117-20	.....	.....	v. s.	v. s.
1406	cr./aq.	.....	70-1	.....	.....	v. s.	v. s. bz.
1407	or. nd./aq.	.....	116-7	.....	v. sl. s. lg.	v. s.	v. s.
1408	or. pr.	.....	.....	.....	sl. s.	s.	i.
1409	yel. nd./aq.	.....	102-3	.....	sl. s. h.	s.; s. chl.	s.

Chloro-hexane 3644-7
Chloro-hydrin 3194, 3395, 6280
Chloro-hydroxydiphenyl 1436-8
Chloro-hydroxytoluene 1354-7
Chloro-isobutylene 1567, 4060
Chloro-mercuri-phenol 4034-5
Chloro-methane 4183
Chloro-methyl ethyl ketone 1401
Chloro-methylquinoline 1395

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1410	**Chloro** nitroaniline	(2;4,1)	$Cl \cdot C_6H_3(NO_2)NH_2$	XII-733	172.57
1411	nitroaniline HCl	(2;4,1)	$C_6H_5O_2N_2Cl \cdot HCl$	XII-733	209.04
1412	nitrobenzene (*o*)	nitrochlorobenzene	$Cl \cdot C_6H_4 \cdot NO_2$	V-241	157.56
1413	nitrobenzene (*m*)	nitrochlorobenzene	$Cl \cdot C_6H_4 \cdot NO_2$	V-243	157.56
1414	nitrobenzene (*p*)	nitrochlorobenzene	$Cl \cdot C_6H_4 \cdot NO_2$	V-243	157.56
1415	nitrobenzene sulfonic acid	(6;3,1)	$Cl \cdot C_6H_3(NO_2)SO_3H \cdot 2H_2O$	XI-73	273.65
1416	nitroethane (1,1)	.....	$CH_3 \cdot CHClNO_2$	I-101	109.52
1417	nitroethane (1,2)	.....	$ClCH_2 \cdot CH_2NO_2$	I-101	109.52
1418	nitronaphthalene	(1,4)	$Cl \cdot C_{10}H_6 \cdot NO_2$	V-555	207.61
1419	nitronaphthalene	(7,1)	$Cl \cdot C_{10}H_6 \cdot NO_2$	V-556	207.61
1420	nitropropane	(1,1)	$C_2H_5 \cdot CH(Cl)NO_2$	I-116	123.54
1421	nitropropane	(2,2)	$(CH_3)_2C(Cl)NO_2$	I-116	123.54
1422	nitrosoethane (1,1)	.....	$CH_3 \cdot CH(Cl)NO$	I-99	93.52
1423	pentabromoethane	.....	$ClCBr_2 \cdot CBr_3$	I-95	459.06
1424	phenetole (*o*)	.....	$Cl \cdot C_6H_4 \cdot O \cdot C_2H_5$	VI-184	156.61
1425	phenetole (*p*)	.....	$Cl \cdot C_6H_4 \cdot O \cdot C_2H_5$	VI-187	156.61
1426	phenetole (*β*)	.....	$C_6H_5 \cdot O \cdot CH_2CH_2Cl$	VI-142	156.61
1427	phenol (*o*)	.....	$Cl \cdot C_6H_4 \cdot OH$	VI-183	128.56
1428	phenol (*m*)	.....	$Cl \cdot C_6H_4 \cdot OH$	VI-185	128.56
1429	phenol (*p*)	.....	$Cl \cdot C_6H_4 \cdot OH$	VI-186	128.56
1430	phenol sulfonic acid	(4;1,2)	$Cl \cdot C_6H_3(OH) \cdot SO_3H \cdot H_2O$	XI-234	226.63
1431	phenol sulfonate Na	(4;1,2)	$C_6H_4OCl(SO_3Na)$	XI-234	230.61
1432	phenoxyacetic acid	(1,2)	$Cl \cdot C_6H_4 \cdot O \cdot CH_2CO_2H$	.....	186.59
1433	phenylenediamine	(2;1,4)	$Cl \cdot C_6H_3(NH_2)_2$	XIII-117	142.59
1434	phenylenediamine	(2;1,4) HCl	$C_6H_7N_2Cl \cdot 2HCl$	XIII-117	215.52
1435	phenylphenacyl bromide	(4;1',4')	$Cl \cdot C_6H_4 \cdot C_6H_4 \cdot CO \cdot CH_2Br$	.....	309.59
1436	*o*-phenylphenol (2)	(2;6,1)	$C_6H_5 \cdot C_6H_3(Cl)OH$	.....	204.65
1437	*o*-phenylphenol (4)	(2;4,1)	$C_6H_5 \cdot C_6H_3(Cl)OH$	.....	204.65
1438	*p*-phenylphenol (2)	(4;2,1)	$C_6H_5 \cdot C_6H_3(Cl)OH$	.....	204.65
1439	phenyl-4-toluenesulfonate (2)	(4,1;1',2')	$CH_3 \cdot C_6H_4 \cdot SO_3 \cdot C_6H_4 \cdot Cl$	.....	282.74
1440	phenyl-4-toluenesulfonate (4)	(4,1;1',4')	$CH_3 \cdot C_6H_4 \cdot SO_3 \cdot C_6H_4 \cdot Cl$	.....	282.74
1441	phthalic acid	(4;1,2)	$Cl \cdot C_6H_3(CO_2H)_2$	IX-816	200.58
1442	propionic acid (*α*)	(*dl*)	$CH_3 \cdot CHCl \cdot CO_2H$	II-248	108.53
1443	propionic acid (*β*)	.....	$ClCH_2 \cdot CH_2 \cdot CO_2H$	II-249	108.53
1444	propionyl chloride	(*β*)	$ClCH_2 \cdot CH_2 \cdot CO \cdot Cl$	II-250	126.98
1445	propyl acetate (*β*)	.....	$CH_3CO_2 \cdot CH_2 \cdot CHCl \cdot CH_3$	II-129	136.58
1446	propyl acetate (*γ*)	.....	$CH_3CO_2 \cdot (CH_2)_2CH_2Cl$	*II-58	136.58
1447	*iso*-propyl acetate	(*β*)	$CH_3CO_2 \cdot CH(CH_3) \cdot CH_2Cl$	II-130	136.58
1448	propyl chloroformate (*γ*)	*γ*-chloropropyl chlorocarbonate	$Cl \cdot CO_2 \cdot (CH_2)_2CH_2Cl$	.....	157.00
1449	propyl *p*-toluenesulfonate (*γ*)	.....	$CH_3 \cdot C_6H_4 \cdot SO_3 \cdot (CH_2)_2CH_2Cl$	.....	248.72

Chloro-nitrophenol 4698-4706
Chloro-nitrotoluene 4682
Chloro-nonane 4928
Chloro-octane 4975-6
Chloro-pentane 442-8
Chloro-phenylacetophenone 5215
Chloro-picrin 4697
Chloro-prene 1345
Chloro-propane 5400-1
Chloro-propanol 5462
Chloro-propene 202, 5345-6
Chloro-propyl alcohol 6280
Chloro-propyl alcohol (*iso*) 5462
Chloro-propyl chlorocarbonate 1448
Chloro-propylene 202, 5345-6
Chloro-propylene oxide 2879
Chloro-propyne 5343
Chloro-pyromucic acid 1385
Chloro-succinimide 5659
Chloro-thymol 5939
Chloro-toluene (ω) 796
Chloro-trinitrobenzene 5308
Chloro-xenol 1436-8

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1410	yel. nd./ aq.	.....	107-8	.....	sl. s. 50% ac.	s.; i. lg.	s.; s. CS_2
1411	pl.	.....	.....	.....	d.	.....	.....
1412	mn. nd.	$1.305^{8}_{4}{}^{0°}$	32.5	245.5^{753mm}	i.; s. bz.	s. h.	s.
1413	yel. rhb. al.	1.534	44.4(23.7)	235.6	i.; s. chl.	v. s. h.	v. s.; s. ac.
1414	mn. pr.	$1.520^{18°}$	83-4	242^{761mm}	i.	v. s. h.	v. s.
1415	tri. aq.	.....	$-2H_2O$, 110	d. 165-70	v. s.	v. sl. s.	sl. s.
1416	col. lq.	$1.258^{20°}_{20°}$	.....	124-5^{758mm}	<0.4	s. alk.	.....
1417	col. lq.	$1.405^{7°}$	.....	173-4	i.	d. HCl	.....
1418	yel. nd./al.	.....	85	.....	i.	s.	s.
1419	yel. nd./al.	.....	116	.....	i.	s.	s.
1420	lq.	$1.209^{20°}_{20°}$	.....	140-3	$<0.8^{20°}$	.....	.....
1421	lq.	$1.193^{20°}_{20°}$	.....	134 sl. d.*	$<0.5^{20°}$	s.; i. alk.	s.
1422	col. lf. or b. lq.	.....	65	.....	i. c. NaOH	v. s. Me al.	v. s.; v. s. pet.
1423	cr.	.....	170 d.	.....	.....	.....	.....
1424	col. lq.	.....	.....	208	s. bz.	s.	s.
1425	lq.	.....	21	212	.....	s.	s.
1426	col. lq.	$1.147^{25°}_{25°}$	27-8	221^{754mm}	v. sl. s.	v. s.; s. bz.	v. s.; s. act.
1427	col. lq.	$1.241^{18}_{18}{}^{-2°}$	α7; β0; γ4.1	175-6	sl. s.	s.	s. alk.
1428	nd.	$1.268^{25°}$	32-3	214	sl. s.	s.	s.
1429	nd.	$1.306^{20°}_{4}$	41-3	217	v. sl. s.	v. s.	v. s.
1430	hyg. pl./ aq.	.....	75-6	.....	v. s.; i. bz.	v. sl. s.; i. chl.	v. sl. s.
1431	nd./aq.	.....	.....	.....	s.	sl. s.	.....
1432	col. nd./aq.	.....	146-7	.....	$0.5^{80°}$	$21^{25°}$	$9^{25°}$; i. bz.
1433	nd./bz. lg.	.....	64	.....	s.	.....	.....
1434	nd.	.....	.....	.....	.....	.....	.....
1435	col. nd.	.....	126-7	.....	i.	s. h.	i.
1436	col. lq.	$1.234^{25°}_{25°}$	6	317-8	i.; s. alk.	∞	∞
1437	yel. nd.	.....	67-71	312	i.; s. CCl_4	$85^{25°}$	$250^{25°}$
1438	col. cr.	.....	78-80	323	$0.03^{25°}$; s. al.	$>100^{25°}$ act.	$>100^{25°}$
1439	col. rhb.	.....	68-70	.....	.....	.....	.....
1440	col. rhb.	.....	78-80	.....	i.	s. h.	v. s.
1441	nd./al.	.....	150.5	$-H_2O$, >150	s.	s.	.....
1442	col. lq.	$1.306^{9°}$	<-20	186	∞	∞	∞
1443	col. lf.	.....	40-2.5	203-5^{764mm}	v. s.	v. s.	v. s.
1444	col. lq.	$1.331^{13°}$	.....	143-5^{763mm}	d.	d.	.....
1445	col. lq.	$1.098^{20°}$	.....	152-3^{750mm}	i.	s.	s.
1446	lq.	$1.250^{19°}$	.....	163-5^{747mm}	.....	.....	.....
1447	col. lq.	.....	.....	149-50	.....	.....	.....
1448	lt. yel. lq.	.....	.....	58-60^{8mm}	d.	d.	.....
1449	col. lq.	.....	.....	150-1$^{2.5mm}$	.....	.....	.....

* Explodes on rapid heating.

Chloro-xylene 6488-90
Chloroprene 1345
Chlorylene 6155
Choky gas 1247
Cholaic acid 5697
Cholalic acid 1487
Cholesterin 1480
Choline sinapate, cf. alkd.
Cholyl-cholic acid 3440
Cholyl-glycine 3440
Chondodendrine, cf. alkd.
C. H. Q. 1386
Chromogen-I 2359
Chromotrope-2B 4647
Chromotrope acid 2359
Chromotropic acid 2359
Chrysanthranol 2296
Chrysatropic acid 5604
Chrysazin 2301
Chrysazin carboxylic acid 2306
Chrysazol 2294
Chryseic acid 4776

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Chloro				
1450	pyridine (2)(α)	.....	$Cl \cdot C_5H_4N$	XX-230	113.55
1451	pyridine (3)(β)	.....	$Cl \cdot C_5H_4N$	XX-230	113.55
1452	pyridine (4)(γ)	.....	$Cl \cdot C_5H_4N$	XX-231	113.55
1453	quinoline (2)	.....	$Cl \cdot C_9H_6N$	XX-359	163.60
1454	quinoline (3)	.....	$Cl \cdot C_9H_6N$	XX-359	163.60
1455	quinoline (4)	.....	$Cl \cdot C_9H_6N$	XX-360	163.60
1456	quinoline (5)	.....	$Cl \cdot C_9H_6N$	XX-360	163.60
1457	quinoline (6)	.....	$Cl \cdot C_9H_6N$	XX-360	163.60
1458	quinoline (7)	.....	$Cl \cdot C_9H_6N$	XX-361	163.60
1459	quinoline (8)	.....	$Cl \cdot C_9H_6N$	XX-361	163.60
1460	resorcinol	(4;1,3)	$Cl \cdot C_6H_3(OH)_2$	.....	144.56
1461	salicylaldehyde	(5;2,1)	$Cl \cdot C_6H_3(OH)CHO$	VIII-53	156.57
1462	styrene (α)	.....	$C_6H_5 \cdot CCl:CH_2$	V-476	138.59
1463	styrene (ω)	.....	$C_6H_5 \cdot CH:CHCl$	V-476	138.59
1464	succinic acid (*dl*)	.....	$(CHCl \cdot CH_2):(CO_2H)_2$	II-619	152.54
1465	tetrabromoethane	(1,1,2,2)	$Br_2CH \cdot CBr_2Cl$	I-95	380.15
1466	toluene (*o*)	tolyl chloride	$Cl \cdot C_6H_4 \cdot CH_3$	V-290	126.58
1467	toluene (*m*)	tolyl chloride	$Cl \cdot C_6H_4 \cdot CH_3$	V-291	126.58
1468	toluene (*p*)	tolyl chloride	$Cl \cdot C_6H_4 \cdot CH_3$	V-292	126.58
1469	*o*-toluidine (*m*)	(5;1,2)	$Cl \cdot C_6H_3(CH_3)NH_2$	XII-835	141.60
1470	*p*-toluidine (*m*)	(3;1,4)	$Cl \cdot C_6H_3(CH_3)NH_2$	XII-989	141.60
1471	tribromoethane	(1,1,2)	$BrCH_2 \cdot CClBr_2$	I-94	301.24
1472	tribromomethane	.....	$Cl \cdot CBr_3$	I-68	287.22
1473	vinylarsine dichloride	Lewisite	$ClCH:CH \cdot AsCl_2$	.....	207.32
1474	*o*-xylene (3)	xylyl chloride (*o*)	$Cl \cdot C_6H_3(CH_3)_2$	V-363	140.61
1475	*o*-xylene (4)	(4;1,2)	$Cl \cdot C_6H_3(CH_3)_2$	V-363	140.61
1476	*p*-xylene (2)	(2;1,4)	$Cl \cdot C_6H_3(CH_3)_2$	V-384	140.61
1477	**Chloroform**	trichloromethane	$CHCl_3$	I-61	119.39
1478	**Chlorogenin** (pseudo)	.....	$C_{27}H_{44}O_4$	.....	432.62
1479	**Cholеic acid**	deoxycholic acid	$C_{24}H_{40}O_4$	.....	392.56
1480	**Cholesterol**	cholesterin	$C_{27}H_{45}OH \cdot H_2O$	.....	404.65
1481	**Cholesterol** (eppiallo)	.....	$C_{27}H_{45}OH$	.....	386.64
1482	**Cholesterol** (*iso*)	.....	$C_{27}H_{45}OH$	.....	386.64
1483	**Cholesteryl** acetate	.....	$CH_3CO_2 \cdot C_{27}H_{45}$	.....	428.67
1484	benzoate	.....	$C_6H_5CO_2 \cdot C_{27}H_{45}$	.....	490.74
1485	benzoate (*iso*)	.....	$C_6H_5CO_2 \cdot C_{27}H_{45}$	.....	490.74
1486	propionate	.....	$C_2H_5CO_2 \cdot C_{27}H_{45}$	.....	442.70
1487	**Cholic acid**†	cholalic acid	$C_{23}H_{36}(OH)_3CO_2H \cdot H_2O$	.....	426.58
1488	**Choline**	bilineurine	$(CH_3)_3N(OH)CH_2 \cdot CH_2OH$	IV-277	121.18
1489	hydrochloride	.....	$C_5H_{14}ON \cdot Cl$	IV-280	139.63
1490	**Chromone**	benzo-γ-pyrone	$C_6H_4 \cdot CO \cdot CH:CH \cdot O$ (ring)	XVII-327	146.14
1491	**Chrysammic acid** (2,4,5,7;1,8)	tetranitro-chrysazine	$(NO_2)_4C_{14}H_2(OH)_2O_2$	VIII-461	420.20
1492	**Chrysarobine**	dihydroxy-methyl-anthranol	$C_{15}H_{12}O_3$	VIII-335	240.25
1493	**Chrysene**	.....	$C_{18}H_{12}$	V-718	228.28

† See also No. 3440.

Chrysoidine 1698
Chrysoidine orange 1699
Chrysaphanol 1495
Cicutine, cf. alkd.
Cignolin 2296
Cincholepidine 4370
Cinchomeronic acid 5499, 5501
Cinchonamine, cf. alkd.
Cinchonidine, cf. alkd.
Cinchonine, cf. alkd.
Cinchophen 5234
Cinchotine, cf. alkd.
Cinchovatine, cf. alkd.
Cineole 3217
Cinnamein 798

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1450	oil	$1.205^{15°}$	.....	166^{714mm}	s.	.....	.....
1451	lq.	.....	.....	148^{744mm}	s.	.....	.....
1452	lq.	.....	.....	147-8	s.	.....	.....
1453	nd./aq. al.	.....	37-8	275^{751mm}	i.; v. s. bz.	s.; v. s. lg.	v. s.
1454	hyg. lq.	.....	.....	255^{743mm}	.....	.....	.....
1455	cr.	$1.251^{\frac{20°}{4°}}$	34	$260\text{-}1^{744mm}$	s. HCl	v. s.	v. s.
1456	nd.	.....	45	256	.....	.....	.....
1457	nd.	.....	40-1	$261\text{-}2^{740mm}$	.....	.....	.....
1458	nd./al.	.....	31-2	267-8	.....	.....	.....
1459	yel. oil	.....	< 20	288	.....	v. s.	v. s.
1460	wh. amor. pd.	.....	105-7	.....	s.	s.	s.
1461	pl./al.	.....	99	.....	i.; s. alk.	s.	s.
1462	lq.	$1.102^{\frac{18°}{4°}}$	.....	199	i.	s.	s.
1463	lq.	$1.110^{\frac{18°}{4°}}$	.....	199	i.	s.	s.
1464	col. cr.	1.679	153-4	.....	v. s.	v. s. ac.	v. sl. s. chl.
1465	cr.	$3.366^{16°}$	32-3	$200\text{-}5^{285mm}$	v. s. chl.	v. s.	v. s.
1466	col. lq.	$1.082^{\frac{20°}{4°}}$	-34	159.5	i.; ∞ bz.	s.; ∞ chl.	∞
1467	col. lq.	$1.072^{\frac{20°}{4°}}$	-47.8	161.6	i.; ∞ bz.	s.; ∞ chl.	∞
1468	col. lq.	$1.070^{\frac{20°}{4°}}$	7.5	162.2	i.; ∞ bz.	s.; ∞ chl.	∞
1469	lf./al.	.....	29-30	$236\text{-}8^{730mm}$	.....	.....	.....
1470	lq.	$1.151^{20°}$	7	222-3	i.	.....	.....
1471	lq.	$2.602^{16°}$	.....	$165\text{-}7^{285mm}$	i.	.....	.....
1472	lf.	$2.71^{15°}$	55	160	i.	.....	.....
1473	col. lq.	$1.888^{\frac{20°}{4°}}$	.....	190	i.	.....	.....
1474	col. lq.	.....	<-20	189.5	i.	∞	∞
1475	col. lq.	$1.069^{\frac{15°}{15°}}$	<-20	191.5	.....	.....	.....
1476	col. lq.	.....	.....	186.8	.....	.....	.....
1477	col. lq.	$1.489^{20°}$	-63.5	61.2	$0.82^{20°}$	∞	∞
1478	cr.	.....	268-70	.....	i.	sl. s.	v. sl. s.
1479	col. cr./al.	.....	172	.....	sl. s. c.	s.; s. alk.	s. ac.; s. act.
1480	rhb./al.	1.067	149-51 (anh.)	$subl.^{1.0mm}$	$0.26^{20°}$	$1.1^{17°}$; $11^{78°}$	18; s. bz.
1481	nd./act.	.....	84	.....	i.; s. bz.	s.; s. chl.	v. s.
1482	nd./et.	.....	137-8	.....	s. h. ac.	s. h.	v. s.
1483	col. nd.	.....	113-4	.....	i.	sl. s. h.	v. s.
1484	tet. cr.	.....	146.6	.....	.....	v. sl. s. h.	s.
1485	wh. pd.	.....	191-5	.....	.....	sl. s. h.	s.
1486	col. fl.	.....	95-7	.....	i.	sl. s.	s.
1487	rhb. cr./aq.	.....	195 (anh.)	.....	0.03; s. ac.	5; s. act.	1.4; s. alk.
1488	syrup	.....	.....	.....	v. s.	v. s. abs.	i.
1489	delq. nd./al.	.....	.....	.....	v. s.	v. s.	.....
1490	nd./pet.	.....	58-9	.....	i.; s. bz.	s.	s.; s. chl.
1491	yel. mn.	.....	d.	expl.	v. sl. s. h.	s.	s.
1492	yel. lf.	.....	202-6	.....	i. aq. Na_2CO_3	sl. s. c.; s. H_2SO_4	sl. s. c. bz.
1493	col. rhb.	.....	251	448	i.	$0.1^{16°}$ abs.	v. sl. s.

Cinnamene 5646
Cinnamic acid dibromide 1830
Cinnamide 1502
Cinnamol 5646
Cinnamon oil 1501
Cinnamone 1775
Cinnamoyl cocaine, cf. alkd.
Cinnamoyl ecgonine methyl ester, cf. alkd.
Cinnamyl cocaine, cf. alkd.
Cinnamyl eugenol 3221
Cinnamylidene acetophenone 1506
Cinnyl cinnamate 1508
Citramide 1517
Citrene 3973
Citridic acid 141
Citronin-A 3241

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1494	**Chrysin**	5,7-diOH-flavone	$C_{15}H_{10}O_4$	XVIII-124	254.23
1495	**Chrysophanic acid**	2,4-diOH-2-Me-anthraquinone	$C_{14}H_5(OH)_2(CH_3)O_2$	VIII-470	254.23
1496	**Chrysoquinone**	.....	$C_{10}H_6(CO)_2C_6H_4$	VII-827	258.26
1497	**Cinnamic** acid (*cis*)	allocinnamic acid	$C_6H_5{\cdot}CH{:}CH{\cdot}CO_2H$	IX-591	148.15
1498	acid (*trans*)	β-phenyl-acrylic acid	$C_6H_5{\cdot}CH{:}CH{\cdot}CO_2H$	IX-572	148.15
1499	Na salt	.....	$C_6H_5{\cdot}CH{:}CH{\cdot}CO_2Na$	IX-580	170.14
1500	acid (*iso*)	.....	$C_6H_5{\cdot}CH{:}CH{\cdot}CO_2H$	IX-592	148.15
1501	aldehyde	phenyl acrolein	$C_6H_5{\cdot}CH{:}CH{\cdot}CHO$	VII-348	132.15
1502	amide	cinnamide	$C_6H_5{\cdot}C_2H_2{\cdot}CO{\cdot}NH_2$	IX-587	147.17
1503	anhydride	.....	$(C_6H_5CH{:}CH{\cdot}CO)_2O$	IX-586	278.29
1504	carboxylic acid (*o*)	.....	$(\cdot C_6H_4C_2H_2\cdot)(CO_2H)_2$	IX-898	192.16
1505	chloride	.....	$C_6H_5{\cdot}CH{:}CH{\cdot}CO{\cdot}Cl$	IX-587	166.60
1506	**Cinnamal acetophenone**	cinnamylidene acetophenone	$C_6H_5{\cdot}(CH{:}CH)_2{\cdot}CO{\cdot}C_6H_5$	VII-499	234.28
1507	**Cinnamyl** alcohol	styryl carbinol	$C_6H_5{\cdot}CH{:}CH{\cdot}CH_2OH$	VI-570	134.17
1508	cinnamate	styracin	$C_8H_7CO_2{\cdot}C_9H_9$	IX-585	264.31
1509	**Cinnamoyl-*p*-hydroxyphenyl urea**	elbon	$C_6H_5{\cdot}CH{:}CH{\cdot}CO_2{\cdot}C_6H_4{\cdot}NHCONH_2$	.....	282.29
1510	**Citraconic** acid (*cis*)	methyl-maleic acid	$CH_3{\cdot}C(CO_2H){:}CH{\cdot}CO_2H$	II-768	130.10
1511	anhydride	.....	$CH_3{\cdot}C{:}CH{\cdot}CO{\cdot}O{\cdot}CO$	XVII-440	112.08
1512	**Citral** (α)	geranial	$C_9H_{15}{\cdot}CHO$	I-753	152.23
1513	semicarbazone	.....	$C_{10}H_{16}{:}N{\cdot}NHCONH_2$	III-109	209.29
1514	**Citramalic acid** (*dl*)	methyl-malic acid	$CH_3{\cdot}C(OH)(CO_2H){\cdot}CH_2{\cdot}CO_2H$	III-444	148.11
1515	**Citric** acid	.....	$HO_2C{\cdot}CH_2{\cdot}C(OH){\cdot}(CO_2H){\cdot}CH_2{\cdot}CO_2H$	III-556	192.12
1516	acid (*iso*)	.....	$HO_2C{\cdot}CHOH{\cdot}CH{\cdot}(CO_2H){\cdot}CH_2CO_2H$	III-555	192.12
1517	amide	citramide	$C_3H_5O(CONH_2)_3$	III-569	189.17
1518	**Citronellal** (*d*)	rhodinal	$C_9H_{17}{\cdot}CHO$	I-745	154.24
1519	**Citronellol** (*d*)	2,6-dimethyl-octene-1-ol-8	$C_{10}H_{20}O$	I-451	156.26
1520	**Citronellyl acetate**	.....	$C_{12}H_{22}O_2$	II-139	198.30
1521	**Citrulline** (*dl*)	α-NH_2-δ-carbamido-valeric acid	$NH_2CONH(CH_2)_3{\cdot}CH{\cdot}(NH_2){\cdot}CO_2H$	.....	175.19
1522	Cu salt	.....	$(C_6H_{12}O_3N_3)_2Cu$	.....	411.93
1523	**Cofebrin** hydrochloride	2,4-diOH-phenyl-propanolamine HCl	$(HO)_2C_6H_3{\cdot}CH(OH){\cdot}CH(NH_2){\cdot}CH_3{\cdot}HCl$	.....	219.67
1524	**Collidine** (α)	2-Me-4-Et-pyridine	$CH_3{\cdot}C_5H_3N{\cdot}C_2H_5$	XX-248	121.18
1525	**Collidine** (β)	4-Me-3-Et-pyridine	$CH_3{\cdot}C_5H_3N{\cdot}C_2H_5$	XX-250	121.18
1526	**Collidine** (γ)	2,4,6-triMe-pyridine	$(CH_3)_3C_5H_2N$	XX-250	121.18
1527	**Congo red**	diPh-bis-azonaph-thionic acid	$[C_{10}H_5(NH_2)(SO_3Na){\cdot}N{:}N{\cdot}C_6H_4]_2$	XVI-410	696.66

Citrophen 5108
Citropten 3971
Citrylidene acetone 3915
Claus and Volz *o*-acid 4512
Clavicepsin, cf. glcde.
Cleve's acids 4545-7
CN (cry now) gas 1303
Cocaine, cf. alkd.
Coclaurine, cf. alkd.
Codamine, cf. alkd.
Codeine, cf. alkd.
Coerulignone 1264
Coffearin, cf. alkd.
Colchicine, cf. alkd.
Colocynthin, cf. glcde.
Cologne spirit 2946
Colognegite 1247
Colonial spirit 4100
Columbamine, cf. alkd.
Columbian spirit 4100
Conchinine, cf. alkd.
Conessine, cf. alkd.
Conhydrine, cf. alkd.
Conicine, cf. alkd.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1494	yel. pl.	.....	275	subl.	i.; s. alk.	0.6 c.; 2.5 h.	sl. s.; i. bz.
1495	yel. lf./al.	.....	195	subl. sl. d.	i. c.; s. bz.	s. h.; s. act.	sl. s.; sl. s. pet.
1496	or. nd.	.....	235-40	subl.	i.	s. h.	v. sl. s.
1497	mn. pr.	$1.284^{4°}$	68	125^{19mm}	.....	.....	s. pet.
1498	mn. pr.	1.245	133	300	$0.04^{18°}$	$24^{20°}$ abs.	v. s.
1499	wh. cr. pd.	.....	d. >115	.....	9 c.; 5 h.	0.6	s. gly.
1500	mn. pr.	.....	58-9(42)	256 d.	16.6 c. pet.	s.	s.
1501	lq.	$1.110^{\frac{20}{20}°}$	-7.5	252±, sl. d.	v. sl. s.	4, 50% al.	∞
1502	nd./bz.	.....	145-6	.....	sl. s. h.	s.	s.
1503	nd./al.	.....	135-6	.....	i.	v. sl. s. c.	v. s. h. bz.
1504	nd./et.	.....	173-5 d.	$-H_2O$, d.	v. sl. s.	s.; i. bz.	v. sl. s.
1505	cr.	.....	35-6	251-3 sl. d.	d.	s. CCl_4	s. pet.
1506	yel. nd./ al.	.....	α102; β235	.....	s. H_2SO_4	sl. s.	sl. s.
1507	nd.	$1.040^{\frac{35}{35}°}$	33	257.5	sl. s.	v. s.	v. s.
1508	nd. or pr.	$1.085^{16.5°}$	44	.....	i.	4 c.; 33 h.	33; s. bz.
1509	wh. cr. pd.	.....	204	.....	i.; i. alk.	s.; s. act.	s. oil
1510	nd.	1.617	91 d.	.....	$>8.3^{20°}$	s.; v. sl. s. chl.	s.; i. bz.; i. CS_2
1511	lq.	$1.25^{\frac{15}{4}°}$	7-8	213-4	d.	v. s.	v. s.
1512	col. oil	$0.890^{\frac{17}{4}°}$	.....	228-9 sl. d.	i.	∞	∞
1513	cr./ac.	.....	α164 β171*	.....	.....	.....	.....
1514	mn. pr.	.....	117-9	.....	s.; i. bz.	v. s. abs.	v. s. act.
1515	cr.**	$1.542^{\frac{20}{4}°}$	153	d.	133 c.	$76^{15°}$, abs.	$2.2^{15°}$, abs.
1516	cr.	.....	d. 100	.....	s.	.....	.....
1517	cr./aq.	.....	210-5 d.	.....	$2.7^{18°}$; $33.3^{100°}$	i.	i.
1518	col. oil	$0.855^{17.5°}$	.....	204-8	v. sl. s.	∞	∞
1519	col. oil	$0.856^{8°}$	.....	221.5^{755mm}	v. sl. s.	∞	∞
1520	col. lq.	$0.893^{17.5°}$	.....	$172-3^{34mm}$	.....	.....	.....
1521	col. pr./ aq. Me al.	.....	202-26±	.....	s.	i. abs.	i.
1522	cr./aq.	.....	257-8 d.	.....	i. c.	.....	.....
1523	wh. cr. pd.	.....	178-9 d.	.....	66	7	i.
1524	lq.	$0.935^{0°}$	.....	177.8^{758mm}	sl. s. c.; v. sl. s. h.	s.	s.; s. bz.
1525	lq.	$0.966^{0°}$	.....	$195-6^{753mm}$	i.	s.	v. s.
1526	lq.	$0.917^{15°}$	.....	171-2	sl. s. h.	v. s.	.....
1527	red	.....	.....	.....	sl. s. h.	sl. s. h. alk.	i.

* Mixture of $\alpha + \beta$, m. p. 135°.
** Crysts./aq. $+1H_2O$; $-H_2O$, 100-32°.
Coniferin, cf. glcde.
Coniine, cf. alkd.
Conquinine, cf. alkd.
Convallamarin, cf. glcde.
Convallarin, cf. glcde.
Convolvulin, cf. glcde.
Conydrine, cf. alkd.
Conyrine 5443
Coprosterol 2276
Corallin(e) 5931
Cordianine 181
Cordol 6110
Coriamyrtin, cf. glcde.
Coriandrol 3974
Corn sugar 3618
Cornutine, cf. alkd.
Corporin 5334
Corulignone 1264
Corybulbine, cf. alkd.
Corycavine, cf. alkd.
Corydaline, cf. alkd.
Corynine, cf. alkd.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1528	**Coniferin**	.....	$C_{16}H_{22}O_8 \cdot 2H_2O$	.....	378.37
1529	**Coniferyl alcohol**	.....	$C_{10}H_{12}O_3$	VI-1131	180.20
1530	**Conylene**	octadiene-x,x	C_8H_{14}	I-258	110.19
1531	**Coumaric** acid (*o*) (*trans*)	*o*-hydroxy-cinnamic acid	$HOC_6H_4 \cdot C_2H_2 \cdot CO_2H$	X-288	164.15
1532	acid (*m*)	*m*-hydroxy-cinnamic	$HOC_6H_4 \cdot C_2H_2 \cdot CO_2H$	X-294	164.15
1533	acid (*p*)	*p*-hydroxy-cinnamic	$HOC_6H_4 \cdot C_2H_2 \cdot CO_2H$	X-297	164.15
1534	**Coumarin**	.....	$C_9H_6O_2$	XVII-328	146.14
1535	**Coumarin** (*iso*)	.....	$C_6H_4 \cdot CH{:}CH \cdot CO \cdot O$ (ring)	XVII-333	146.14
1536	3-carboxylic acid	.....	$C_6H_4 \cdot CH{:}C(CO_2H) \cdot CO \cdot O$ (ring)	XVIII-429	190.15
1537	**Coumarinic acid** (*o*)(*cis*)	*o*-hydroxy-cinnamic acid	$HO \cdot C_6H_4 \cdot CH{:}CH \cdot CO_2H$	X-291	164.15
1538	**Coumarone**	.....	$C_6H_4 \cdot CH{:}CH \cdot O$ (ring)	XVII-54	118.13
1539	**Creatine**	methyl-guanyl-glycine	$HN{:}C(NH_2)N(CH_3) \cdot CH_2 \cdot CO_2H \cdot H_2O$	IV-363	149.15
1540	**Creatinine**	methyl-glycocyamidine	$HN{:}C.N(CH_3) \cdot CH_2 \cdot CO \cdot NH$ (ring)	XXIV-245	113.12
1541	picrate	.....	$C_4H_7ON_3 \cdot C_6H_3O_7N_3$	XXIV-246	342.23
1542	picrate	.....	$C_4H_7ON_3 \cdot 2C_6H_3O_7N_3$	XXIV-246	571.34
1543	**Creosole**	(3;1,4)	$CH_3O \cdot C_6H_3(CH_3)OH$	VI-878	138.16
1544	**Cresidine**	2-NH_2-4-Me-anisole	$CH_3 \cdot C_6H_3(OCH_3)NH_2$	XIII-602	137.18
1545	**Cresol** (*o*)	*o*-methyl-phenol	$CH_3 \cdot C_6H_4 \cdot OH$	VI-349	108.13
1546	**Cresol** (*m*)	*m*-methyl-phenol	$CH_3 \cdot C_6H_4 \cdot OH$	VI-373	108.13
1547	**Cresol** (*p*)	*p*-methyl-phenol	$CH_3 \cdot C_6H_4 \cdot OH$	VI-389	108.13
1548	phthalein (*o*)	.....	$C_6H_4 \cdot CO \cdot O \cdot C{:}(C_6H_3 \cdot CH_3 \cdot OH)_2$ (ring)	XVIII-153	346.36
1549	phthalin (*o*)	(4',4''-diOH, 2-CO_2H, 3',3''-diMe)	$HO_2C \cdot C_6H_4 \cdot CH{:}(C_6H_3 \cdot CH_3 \cdot OH)_2$	X-456	348.38
1550	sulfonphthalein (*o*)	cresol red	$C_6H_4 \cdot SO_2 \cdot O \cdot C{:}[C_6H_3 \cdot CH_3 \cdot OH]_2$ (ring)	XIX-91	382.41
1551	sulfonphthalein (*m*)	metacresol purple	$C_{21}H_{18}O_5S$	.....	382.41
1552	**Cresyl**† acetate (*o*)	*o*-tolyl acetate	$CH_3 \cdot C_6H_4 \cdot O_2CCH_3$	VI-355	150.17
1553	acetate (*m*)	cresatin	$CH_3 \cdot C_6H_4 \cdot O_2CCH_3$	VI-379	150.17
1554	*p*-toluenesulfonate (*o*)	(4;1',2')	$CH_3 \cdot C_6H_4 \cdot SO_3C_6H_4 \cdot CH_3$	XI-100	262.31
1555	**Crocetin** (α)	gardenin	$C_{20}H_{24}O_4$	XXX-106	328.39
1556	**Croconic acid**	crocic acid	$C_5O_3(OH)_2 \cdot 3H_2O$	VIII-488	196.11
1557	**Crotonic** acid (α)	butenoic acid	$CH_3 \cdot CH{:}CH \cdot CO_2H$	II-408	86.09
1558	acid (β) (*cis*)	*iso*-crotonic acid	$CH_3 \cdot CH{:}CH \cdot CO_2H$	II-412	86.09
1559	aldehyde (α)	2-butene-1-al	$CH_3 \cdot CH{:}CH \cdot CHO$	I-728	70.09
1560	amide	crotonamide	$CH_3 \cdot CH{:}CH \cdot CONH_2$	II-412	85.10
1561	anhydride	.....	$(CH_3 \cdot CH{:}CH \cdot CO)_2O$	II-411	154.16

† See also under tolyl.

Corytuberine, cf. alkd.
Cotarnine, cf. alkd.
Cotoin 2347
Cotton red-4B 733
Cresatin 1553
Cresol purple 1551
Cresol red 1550
Cresorcinol 2371
Cresot(in)ic acid 3836, 3839, 3841
Cresyl-, cf. also tolyl.
Cresyl benzoate 6013-5
Cresyl ethyl ether 3173-5
Cresyl ethyl sulfide 3176
Cresyl methyl ether 4399-4401

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1528	nd.	.....	185 (anh.)	d.	0.5 c.; v. s. h.	sl. s. abs.	i.
1529	pr.	.....	73-4	.....	sl. s. h.	s.	s.
1530	lq.	$0.761^{15°}$	.....	126 (738mm)	.....	s.	.....
1531	nd./aq.	.....	207-8	subl.	sl. s. c.	s.	v. sl. s.
1532	pr./aq.	.....	191	.....	s. h.	s.	s.; s. bz.
1533	cr./aq.	.....	206-7 d.	.....	s. h.	v. s. h.	v. s.; i. lg.
1534	rhb./et.	$0.935^{20°}_{4°}$	70	290-1	0.3 c.; 2 h.	v. s.	s.
1535	pl./bz.	.....	47	285-6 (719mm sl. d.)	i.; s. CS_2	v. s.; v. s. bz.	v. s.
1536	col. nd./aq.	.....	189-90 d.	>290, $-CO^2$	v. sl. s.; 0.725° bz.	0.925°; 0.125° CCl_4	v. sl. s.; v.sl.s.act.
1537	unstable	changes to coumarin	.....	.....	.....	.....	.....
1538	oil	$1.078^{\frac{15}{15}°}$	<-18	173-4	i.	i. alk.	s.
1539	mn./aq.	.....	295 (anh.)	$-H_2O$, 100	$1.4^{18°}$	$0.011^{17°}$	i.
1540	mn.	.....	260 d.	.....	$8.7^{16°}$	$1^{16°}$ abs.	s. h. al.
1541	yel. nd./aq.	.....	220	.....	.....	.....	.....
1542	yel. pl./al.	.....	161-6	.....	.....	.....	.....
1543	pr.	$1.092^{20°}_{20°}$	5.5	221-2 (765mm)	v. sl. s.	∞ ; ∞ chl.	∞ ; ∞ bz.
1544	nd./pet.	.....	93-4	235	v. sl. s.	s.; s. bz.	s.
1545	cr.	$1.048^{20°}_{4°}$	30.8	190.8	2.5	∞ 30°	∞ 30°
1546	lq.	$1.034^{20°}_{4°}$	10.9	202.8	0.5	∞	∞
1547	pr.	$1.035^{20°}_{4°}$	35-6	202	1.8	∞ 36°	∞ 36°
1548	red yel. cr./al.	.....	213-4	.....	sl. s. h.; s. al. KOH	s.; s. al. NH_3	s.; v. sl. s. bz.
1549	nd.	.....	217-8	.....	.....	.....	.....
1550	red cr./ac.	.....	.....	.....	sl. s.	s.	s. alk.
1551	gn. fl.	.....	.....	.....	sl. s.	sl. s.	i.
1552	col. lq.	.....	.....	208	v. sl. s.	v. s.	v. s.
1553	col. lq.	.....	.....	212	s. h.	v. s.	v. s.
1554	nd.	.....	.....	53-4	.....	.....	.....
1555	red rhb.	.....	283-5 d.	.....	s. Ac_2O	s. dil. alk.	i. 10% alk.
1556	yel. lf.	.....	$-3H_2O$, 100	.....	s.	s.	.....
1557	col. mn.	$0.964^{79.7°}$	72	189	$8.3^{15°}$	s. h. lg.	.....
1558	nd.	$1.031^{\frac{15}{4}°}$	15.5	170-1 d.	40	s.	.....
1559	col. lq.	$0.853^{20°}_{20°}$	-69	102.2	15	s.	.....
1560	nd./act.	.....	159-60	.....	2.8 c.	v. s. 0.08 c. bz.	0.09 c.
1561	col. lq.	$1.040^{20°}$	.....	246-8 (766mm)	.....	.....	.....

Cresyl methyl sulfide 4402
Cresyl phosphate 6351-3
Cresyl phosphite 6354-5
Cresyl phthalate 2841
Cresyl salicylate 6038-40
Cresyl thiophosphate 6356-8
Cresylic acid, mixt. of 1545-7
Crocelc acid 4512
Crocein(e) acid 4512
Crocic acid 1556
Crocin, cf. glcde.
Crotonaldehyde 1559

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1562	**Crotonic** chloride	.....	$CH_3{\cdot}CH{:}CH{\cdot}CO{\cdot}Cl$	II-411	104.54
1563	nitrile	propenyl cyanide	$CH_3{\cdot}CH{:}CH{\cdot}CN$	II-412	67.09
1564	**Crotonyl** acetate	crotyl acetate	$CH_3CO_2{\cdot}C_4H_7$	II-137	114.14
1565	alcohol	2-butene-1-ol	$CH_3{\cdot}CH{:}CH{\cdot}CH_2OH$	I-442	72.10
1566	chloride	crotyl chloride	$CH_3{\cdot}CH{:}CH{\cdot}CH_2Cl$	I-205	90.55
1567	chloride (*iso*)	*iso*-crotyl chloride	$(CH_3)_2C{:}CH{\cdot}Cl$	I-209	90.55
1568	iodide	1-iodo-butene-2	$CH_3{\cdot}CH{:}CH{\cdot}CH_2I$	I-206	182.02
1569	**Cryogenine**	3-semicarbazido-benzamide	$H_2N{\cdot}CO{\cdot}NH{\cdot}NH{\cdot}C_6H_4{\cdot}CO{\cdot}NH_2$	.....	194.19
1570	**Cryptoxanthin**	provitamin A	$C_{40}H_{56}O$	XXX-93	552.85
1571	**Cuminyl** alcohol	cumin alcohol (*p*)	$(CH_3)_2CH{\cdot}C_6H_4{\cdot}CH_2OH$	VI-543	151.21
1572	chloride	1′-chlorocymene	$C_3H_7{\cdot}C_6H_4{\cdot}CH_2Cl$	V-423	168.66
1573	**Cumyl** phenol (*p*)	(1,4)	$HO{\cdot}C_6H_4{\cdot}C(CH_3)_2{\cdot}C_6H_5$	.....	212.28
1574	**Cupferon**	.....	$C_6H_5{\cdot}N(NO){\cdot}ONH_4$	XVI-669	155.16
1575	**Curcumin**	.....	$C_{21}H_{20}O_6$	VIII-554	368.37
1576	**Cyamelide**	.....	$(CNOH)_x$ or $(CNOH)_3$	III-35	$(43.03)_x$
1577	**Cyanamide**	carbamic nitrile	$H_2N{\cdot}CN$	III-75	42.04
1578	**Cyananilide**	phenyl cyanamide	$C_6H_5{\cdot}NH{\cdot}CN{\cdot}\frac{1}{2}H_2O$	XII-368	127.14
1579	**Cyanic acid**	.....	HOCN†	III-33	43.03
1580	**Cyanine**	1,1′-di-*iso*-amyl-4,4′-quinocyanine iodide	$C_{29}H_{35}N_2I$	XXIII-299	538.51
1581	**Cyano**-acetamide	.....	$NC{\cdot}CH_2{\cdot}CO{\cdot}NH_2$	II-589	84.08
1582	acetanilide	.....	$C_6H_5{\cdot}NH{\cdot}CO{\cdot}CH_2CN$	XII-294	160.17
1583	acetic acid	nitrilomalonic acid	$HO_2C{\cdot}CH_2{\cdot}CN$	II-583	85.06
1584	acetoacetic ester	.....	$CH_3CO{\cdot}CH(CN){\cdot}CO_2{\cdot}C_2H_5$	III-796	155.15
1585	benzoic acid (*p*)	.....	$HO_2C{\cdot}C_6H_4{\cdot}CN$	IX-845	147.13
1586	benzyl chloride (*o*)	.....	$ClCH_2{\cdot}C_6H_4{\cdot}CN$	IX-468	151.59
1587	propionic acid (α)	.....	$CH_3{\cdot}CH(CN){\cdot}CO_2H$	II-630	99.09
1588	**Cyanogen**	oxalic nitrile	$NC{\cdot}CN$	II-549	52.04
1589	**Cyanogen** (para)	.....	$(CN)_x$	II-553	$(26.02)_x$
1590	bromide	.....	$Br.CN$	III-39	105.93
1591	chloride	.....	$Cl{\cdot}CN$	III-38	61.48
1592	iodide	.....	$I{\cdot}CN$	III-41	152.94
1593	sulfide	.....	$NC{\cdot}S{\cdot}CN$	III-180	84.10
1594	**Cyanuric acid**	.....	$(HNCO)_3{\cdot}2H_2O$	XXVI-239	165.11
1595	**Cyclo**-butane	tetramethylene	$CH_2{\cdot}CH_2{\cdot}CH_2{\cdot}CH_2$	V-17	56.10
1596	heptane	suberane	$CH_2{\cdot}(CH_2)_5{\cdot}CH_2$	V-29	98.18
1597	heptanone	suberone	$CH_2{\cdot}(CH_2)_5{\cdot}CO$	VII-13	112.17

† HOCN in aq.; NH:C:O (isocyanic acid) as vapor or in ether soln.

Crotonic acid dibromide 1826-7
Crotonic acid dichloride 1978-9
Crotonyl, cf. also crotyl.
Crotonyl chloride 1562
Crotonylene 1157
Crotyl, cf. also crotonyl.
Crotoyl alcohol 1565
Cry now gas 1303
Cryptopine, cf. alkd.
Crystal violet base 3592
Crystal violet dye salt 3593
Crystal violet leuco base 3595
Cumene 5379
Cumene (pseudo) 6254
Cumenol 5433-5
Cumenol (pseudo) 6265
Cumic acid 5383, 5385
Cumic alcohol 1571
Cumidine 5375
Cumidine (pseudo) 6250
Cumin alcohol 1571
Cuminic acid 5383, 5385
Cuminic aldehyde 5377
Cuminic amide 5386
Cumylic acid 6259

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1562	col. lq.	$1.091^{20°}$	.....	$124\text{-}5^{759mm}$	.....	.....	.....
1563	col. lq.	$0.826^{23°}_{4°}$	.....	$117\text{-}8^{744mm}$	d.	d.	.....
1564	col. lq.	$0.934^{0°}$	.....	128.5-9.5	2.3	s.	s.
1565	col. lq.	$0.853^{20°}_{4°}$	<-30	117-8	16.6	∞	.....
1566	col. lq.	$0.934^{20°}_{4°}$	.....	84	i.	∞	∞
1567	lq.	$0.919^{20°}_{4°}$	.....	68	<0.1; d. h.	.....	.....
1568	lq.	$1.682^{20°}$	.....	132-3 d.	.....	.....	.....
1569	col. cr.	.....	172±	.....	1	s.; s. act.	s.; s. chl.
1570	pr./bz.-al.	.....	168-9	.....	i.	s. CS_2	s.; s. chl.
1571	lq.	$0.975^{25°}_{4°}$	.....	247-8	i.	∞	∞
1572	lq.	.....	.....	225-9	.....	.....	.....
1573	col. nd.	.....	74-5	187^{10mm}	i.; s. bz.	v. s.	s.; s. act.
1574	col. nd./al.	.....	163-4	subl.	v. s.	s. h.	.....
1575	red yel. pr.	.....	183	.....	i.; 0.05 bz.; s. alk.	sl. s. c.; s. ac.	v. sl. s.; i. lg.
1576	wh. amor.	.....	.....	.....	$0.01^{15°}$	i.; sl. s. NH_4OH	i.
1577	col. nd.	$1.073^{4°}_{4°}$	44-5	140^{19mm}	v. s.	v. s.	v. s.
1578	cr.	.....	47	.....	sl. s.	v. s.	v. s.
1579	col. gas	$1.140^{0°}$ (lq.)	.....	d.	sl. s.	s. ac.	s.
1580	hyg., mn., gn.	.....	100±	d. >150	i.; s. chl.	s. h.	i.; s. act.
1581	nd./al.	.....	118-9	d.	15 c.	2 c.	.....
1582	cr./al.	.....	199-200	.....	$0.03^{25°}$	.....	.....
1583	col. hyg. cr.	.....	65-6	$108^{0.15mm}$ d. 165	s.	s.	s.
1584	col. nd.	$1.111^{20°}_{4°}$ (lq.)	26	195-7	v. sl. s.	v. s.	v. s.
1585	lf./al.	.....	219	.....	s. h.	s.	s.; s. h. ac.
1586	mn. pr.	.....	60-1.5	252^{759mm}	s. h.	s.	.....
1587	oil	$1.14^{20°}$	.....	$142\text{-}5^{11mm}$	s.	s.	.....
1588	col. gas	$0.866^{17.2°}$ 1.804 (A)	-34.4	-21	$450^{20°}$ cc.	$2300^{20°}$ cc.	$500^{20°}$ cc.
1589	brn. bl.	.....	$(CN)_2$ at 860	.....	i.	i.	sl. s. alk.
1590	nd.	$2.015^{20°}_{4°}$	52	61.3^{750mm}	s.	s.	s.
1591	poison. gas	$1.222^{0°}$	-6.5	12.5-13	$2500^{20°}$ cc.	$10{,}000^{20°}$ cc.	$5000^{20°}$ cc.
1592	col. nd.	.....	146.5*	subl. >m. p.	s. h.	v. s.	v. s.
1593	pl. or lf.	.....	60	d.	v. s. d.	s.	s.
1594	mn./aq.	$2.50^{19°}$ anh.	>360	d. to HNCO	$0.27^{17°}$	$0.1^{22°}$	.....
1595	col. gas	$0.703^{0°}_{4°}$	-50	$11\text{-}12^{726mm}$	i.	v. s.	v. s. act.
1596	oil	$0.810^{20°}_{4°}$	-12	118-20	i.	.....	.....
1597	lq.	$0.950^{21°}$	.....	179-81	i.	s.	s.

* Sealed tube.

Cupreine, cf. alkd.
Cupron 720
Curangin, cf. glcde.
Cuscohygrine, cf. alkd.
Cuskhygrine, cf. alkd.
Cuspidatin, cf. glcde.
Cyanacetic ester 3030
Cyanethyl carbonate 3032
Cyano-acetophenone (ω) 742
Cyano-benzene 716
Cyano-diallylamine 1682
Cyano-diethylamine 2143
Cyano-furan 3345
Cyano-guanidine 2080
Cyano-phenyl chloride (*iso*) 5168
Cyano-propyl alcohol 3758
Cyano-propylene oxide 2880
Cyanuramide 4019
Cyanuric acid (*iso*) 3313
Cyanuric chloride 6172
Cyclamin, cf. glcde.
Cyclo-form 1045

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1598	**Cyclo** heptene	suberene	$CH_2(CH_2)_4CH{:}CH$	V-65	96.17
1599	hexadiene-1,3	*o*-dihydrobenzene	C_6H_8	V-113	80.12
1600	hexadiene-1,4	*p*-dihydrobenzene	C_6H_8	V-113	80.12
1601	hexane	benzene hexahydride	$CH_2{\cdot}(CH_2)_4{\cdot}CH_2$	V-20	84.16
1602	hexanhexol	*d*-inositol	$(CHOH)_6$	VI-1192	180.16
1603	hexanhexol	*i*-inositol; dambose	$(CHOH)_6$	VI-1192	180.16
1604	hexanhexone	triquinoyl	$(CO)_6{\cdot}8H_2O$	VII-907	312.19
1605	hexanol	hexahydro-phenol	$CH_2{\cdot}(CH_2)_4{\cdot}CHOH$	VI-5	100.16
1606	hexanone	pimelin ketone	$CH_2(CH_2)_4{\cdot}CO$	VII-8	98.14
1607	hexanone oxime	.....	$CH_2(CH_2)_4C{:}NOH$	VII-10	113.16
1608	hexanpentol	*d*-quercitol	$CH_2(CHOH)_4{\cdot}CHOH$	VI-1186	164.16
1609	hexene	benzene tetrahydride	$CH_2(CH_2)_3CH{:}CH$	V-63	82.14
1610	hexyl acetate	.....	$CH_3CO_2{\cdot}C_6H_{11}$	VI-7	142.19
1611	hexyl anisole (*p*)	.....	$CH_3O{\cdot}C_6H_4{\cdot}C_6H_{11}$	.....	190.27
1612	hexyl bromide	.....	$C_6H_{11}Br$	V-24	163.06
1613	hexyl chloride	chloro-cyclohexane	$C_6H_{11}Cl$	V-21	118.61
1614	hexyl iodide	.....	$C_6H_{11}I$	V-25	210.07
1615	hexyl phenol (*o*)	.....	$HO{\cdot}C_6H_4{\cdot}C_6H_{11}$	.....	176.25
1616	hexyl phenol (*p*)	.....	$HO{\cdot}C_6H_4{\cdot}C_6H_{11}$	VI-583	176.25
1617	octane	octamethylene	$CH_2{\cdot}(CH_2)_6{\cdot}CH_2$	V-35	112.21
1618	pentadiene-1,3	.....	$CH_2{\cdot}CH{:}CH{\cdot}CH{:}CH$	V-112	66.10
1619	pentane	pentamethylene	$CH_2{\cdot}(CH_2)_3{\cdot}CH_2$	V-19	70.13
1620	pentanone	keto-pentamethylene	$CH_2{\cdot}(CH_2)_3{\cdot}CO$	VII-5	84.11
1621	propane	trimethylene	$CH_2{\cdot}CH_2{\cdot}CH_2$	V-15	42.08
1622	**Cymene** (*o*)	isopropyl-toluene	$CH_3{\cdot}C_6H_4{\cdot}CH(CH_3)_2$	V-419	134.21
1623	**Cymene** (*m*)	*iso*-cymene	$CH_3{\cdot}C_6H_4{\cdot}CH(CH_3)_2$	V-419	134.21
1624	**Cymene** (*p*)	cymene	$CH_3{\cdot}C_6H_4{\cdot}CH(CH_3)_2$	V-420	134.21
1625	**Cysteine** (*l*)	.....	$HS{\cdot}CH_2{\cdot}CH(NH_2){\cdot}CO_2H$	IV-506	121.15
1626	hydrochloride	.....	$C_3H_7O_2NS{\cdot}HCl$	IV-506	157.62
1627	**Cystine** (*l*)	.....	$[HO_2C{\cdot}CH(NH_2){\cdot}CH_2S{\cdot}]_2$	IV-507	240.29
1628	**Daphnetin**	7,8-diOH-coumarin	$O{\cdot}CO{\cdot}CH{:}CH{\cdot}C_6H_2{:}(OH)_2$	XVIII-100	178.14
1629	**Deca**-chlorodiphenyl	.....	$Cl_5C_6{\cdot}C_6Cl_5$	V-580	498.69
1630	diene-1,3	.....	$CH_3{\cdot}(CH_2)_5{\cdot}CH{:}CH{\cdot}CH{:}CH_2$	I-260	138.24
1631	hydronaphthalene	decalin (*cis*)	$C_{10}H_{18}$	V-92	138.24
1632	hydronaphthalene	decalin (*trans*)	$C_{10}H_{18}$	V-92	138.24

Cyclo-hexane carboxylic acid 3577
Cyclo-hexylamine 326
Cyclo-hexyl benzene 5179
Cystamin 3599
Cysteine thioformacetal 2654
Cystogen 3599
Cytisine, cf. alkd.
D. A. gas 2712
Dagenan 5668
Dahl's acid 4550-1

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1598	oil	$0.823^{20°}_{4°}$	.....	114-5	i.	s.	s.
1599	lq.*	$0.842^{20°}_{20°}$	-98	79-80	i.	s.	s.
1600	lq.*	$0.848^{20°}_{4°}$	.....	85.5	i.	s.	s.
1601	col. lq.	$0.779^{20°}_{4°}$	6.5	80-1	i.; ∞ act.	∞ ; ∞ bz.	∞ ; $57^{25°}$ Me al.
1602	mn.	.....	253	319 in vac.	$4.5^{15°}$	v. sl. s.	i.
1603	mn./aq.	1.752	253	319^{15mm}	$2^{12°}$	i. abs.	i.
1604	nd./aq. HNO_3	.....	95-100 d.	.....	v. sl. s.; s. alk.	v. sl. s.	v. sl. s.
1605	col. hyg. nd.	$0.962^{20°}_{4°}$	23.9	160-1	$3.6^{20°}$	s.	s.
1606	col. oil	$0.947^{15.4°}_{4°}$	-45	155-6	s.	s.	s.
1607	pr./lg.	.....	89-90	204 sl. d.	s.; sl. s. lg.	v. s.	v. s.
1608	mn./aq.	$1.585^{13°}$	234-5	.....	s.	s. h.	i.
1609	lq.	$0.810^{20°}_{4°}$	-103.7	83.3	v. sl. s.	v. s.	v. s.
1610	oil	$0.985^{0°}_{4°}$	.....	174^{750mm}	i.	∞	∞
1611	yel. rhb.	.....	58-9	.....	i.	s.	v. s.
1612	col. lq.	$1.324^{20°}_{20°}$	.....	165^{714mm} sl. d.	i.	s.	s.
1613	col. lq.	$0.977^{18°}_{4°}$	.....	142	i.	∞ bz.	∞
1614	lq.	$1.626^{15°}_{15°}$	.....	192^{742mm}	.....	.....	.....
1615	cr.	.....	50-5	148^{10mm}	v. sl. s.	v. s.	v. s.; s. CCl_4
1616	col. nd./bz.	.....	132-3	$155\text{-}8^{13mm}$	i.; $4^{25°}$ bz.	$70^{25°}$ act.	$40^{25°}$
1617	cr.	$0.839^{20°}_{4°}$	14.4	$150\text{-}170^{9mm}$	.....	.....	.....
1618	col. lq.	$0.805^{18°}_{4°}$	.....	41-2	i.	∞	∞
1619	col. oil	$0.745^{20°}_{4°}$	-93.3	49-50	i.	.....	.....
1620	oil	$0.948^{20°}$	.....	129-30	sl. s.	.....	.....
1621	col. gas	$0.720^{-79°}$	-126.6	-34^{749mm}	i.	s.	s.
1622	col. lq.	$0.875^{20°}_{4°}$	.....	177	i.	s.	s.
1623	col. lq.	$0.862^{20°}$	<-25	175-6	i.	s.	s.
1624	col. lq.	$0.857^{20°}_{4°}$	-73.5	176-7	i.	s.	s.
1625	cr. pd.	.....	.....	.....	s.	s. NH_3	s. ac.
1626	col. cr.	.....	175-8 d.	.....	v. s.	s.	s. act.
1627	pl./aq. HCl	.....	d. 258-61	.....	$0.01^{19°}$	i.	s. alk.
1628	yel. nd./ aq. al.	.....	255-6	subl.	s. h.	v. s. h.; i. chl.	v. sl. s.; i. bz.
1629	rhb.	.....	340	.....	i.	v. sl. s.	v. sl. s.
1630	lq.	$0.750^{20°}$	.....	168-70	.....	.....	.....
1631	lq.	$0.895^{18°}_{4°}$	-125	193.3	i.	s.	s.
1632	lq.	$0.872^{20°}_{4°}$	.....	185.3	i.	s.	s.

* Probably mixt. of isomers.

Dahlin 3872
Dambose 1603
Daphnin, cf. glcde.
Datiscin, cf. glcde.
Datiscosid, cf. glcde.
Daturine, cf. alkd.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1633	**Deca** hydroquinoline	.....	$C_9H_{17}N$	XX-156	139.23
1634	methylene glycol	decandiol-1,10	$HOCH_2(CH_2)_8CH_2OH$	I-494	174.28
1635	**Decane** (*n*)	.....	$CH_3{\cdot}(CH_2)_8{\cdot}CH_3$	I-168	142.28
1636	**Decane** (*iso*)	2-methyl-nonane	$(CH_3)_2CH(CH_2)_6CH_3$	I-168	142.28
1637	**Decane**	2,6-diMe-octane	$(CH_3)_2CH(CH_2)_3{\cdot}CH(CH_3){\cdot}C_2H_5$	I-168	142.28
1638	**Decane** (di-*iso*-amyl)	2,7-diMe-octane	$[(CH_3)_2CH{\cdot}CH_2CH_2]_2$	I-169	142.28
1639	**Decyl** acetate (*n*)	.....	$CH_3CO_2{\cdot}C_{10}H_{21}$	II-135	200.31
1640	alcohol (*n*)(*prim*)	decanol-1	$CH_3(CH_2)_8CH_2OH$	I-425	158.28
1641	alcohol (*sec*)	decanol-4	$C_2H_5{\cdot}CH_2{\cdot}CHOH{\cdot}(CH_2)_5{\cdot}CH_3$	I-426	158.28
1642	alcohol (*tert*)	2-Et-octanol-3	$(C_2H_5)_2COH(CH_2)_4{\cdot}CH_3$	I-426	158.28
1643	alcohol (*tert*)	4-Pr-heptanol-4	$(C_2H_5{\cdot}CH_2)_3COH$	I-426	158.28
1644	alcohol(*prim*)	2,6-diMe-3-methylolheptane	$(CH_3)_2CH{\cdot}CH(CH_2{\cdot}OH)(CH_2)_2{\cdot}CH{:}(CH_3)_2$	I-427	158.28
1645	amine (*n*)	.....	$CH_3(CH_2)_8CH_2NH_2$	IV-199	157.29
1646	chloride (*n*)(*prim*)	1-chlorodecane	$CH_3(CH_2)_8CH_2Cl$	I-168	176.73
1647	iodide (*n*)(*prim*)	1-iododecane	$CH_3(CH_2)_8CH_2I$	I-168	268.19
1648	nitrate (*n*)	.....	$C_9H_{19}CH_2{\cdot}O{\cdot}NO_2$	I-425	203.28
1649	nitrite (*n*)	.....	$C_9H_{19}CH_2{\cdot}O{\cdot}NO$	I-425	187.28
1650	**Decylene** (α)	decene-1	$CH_2{:}CH(CH_2)_7CH_3$	I-223	140.26
1651	**Decylene**	2,7-diMe-octene-2	$(CH_3)_2CH(CH_2)_3{\cdot}CH{:}C(CH_3)_2$	I-224	140.26
1652	**Decylene**	2-Me-5-Et-heptene-5	$(CH_3)_2CH(CH_2)_2{\cdot}C(C_2H_5){:}CHCH_3$	I-224	140.26
1653	**Decylene**	3,3,5-trimethyl-heptene-4	$C_2H_5{\cdot}C(CH_3)_2CH{:}C(CH_3){\cdot}C_2H_5$	I-224	140.26
1654	glycol	.....	$CH_3{\cdot}CHOH{\cdot}C(C_2H_5){\cdot}(C_4H_9)CH_2OH$	.....	174.28
1655	**Deguelin**	.....	$C_{23}H_{22}O_6$	.....	394.41
1656	**Dehydracetic acid**	6-Me-3-aceto-2,4-pyrandione	$C_8H_8O_4$	XVII-559	168.14
1657	**Dehydro**-androsterone	dehydro-*iso*-androsterone	$C_{19}H_{28}O_2$	.....	288.41
1658	benzoylacetic acid	.....	$C_6H_5CO{\cdot}CH{\cdot}CO{\cdot}CH{:}C(C_6H_5){\cdot}O{\cdot}CO$	XVII-575	292.28
1659	**Desoxalic acid**	.....	$\cdot CHOH{\cdot}C(OH)_2{:}(CO_2H)_3$	III-586	194.10
1660	**Desoxybenzoin**	phenyl-benzyl-ketone	$C_6H_5{\cdot}CO{\cdot}CH_2{\cdot}C_6H_5$	VII-431	196.24
1661	**Dextrin**	starch gum	$(C_6H_{10}O_5)_x$	.....	(162.14)
1662	**Diacetamide**	.....	$(CH_3CO)_2NH$	II-181	101.10
1663	**Diacetone** alcohol	diacetone	$(CH_3)_2COH{\cdot}CH_2{\cdot}CO{\cdot}CH_3$	I-836	116.16
1664	amine	2-NH_2-2-Me-pentanone-4	$(CH_3)_2C(NH_2)CH_2{\cdot}CO{\cdot}CH_3$	IV-322	115.17
1665	amine acid oxalate	.....	$C_6H_{13}ON{\cdot}C_2H_2O_4{\cdot}H_2O$	IV-322	223.22
1666	glucose	glucose bis-diMe-ketal	$C_{12}H_{20}O_6$	.....	260.28

Decalin 1631-2
Decanal 1206
Decandioic acid 5605
Decanediol 1634
Decanoic acid 1205
Decanol 1640-4
Decanone 4326, 5414
Decene 1650-3
Decyl cyanide 6381
Dehydranone 1656
Dehydro-morphine, cf. alkd.
Dekaline 1631-2
Delphinine, cf. alkd.
Delta acid 4533, 4553
Deoxy-cholic acid 1479

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1633	pr./lg.	.....	48.2-8.5	204^{714mm}	s. h.	v. s.	v. s.
1634	nd./aq. al.	.....	72-3	179^{15mm}	i. c.	s.; i. pet.	s. h.
1635	col. lq.	$0.730^{20°}$	−29.7	174.0	i.	∞	∞
1636	col. lq.	$0.728^{20°}_{4°}$	−74.7	166.8	.....	.....	.....
1637	col. lq.	$0.730^{20°}_{4°}$	.....	159.0	.....	.....	.....
1638	col. lq.	$0.725^{20°}_{4°}$	−52.8	159.7	.....	.....	.....
1639	col. lq.	.....	187-90	.....	i.	s.	s.; s. bz.
1640	col. oil	$0.830^{20°}_{4°}$	7	231	.....	s.	.....
1641	col. oil	$0.826^{20°}_{0°}$	.....	210-1	.....	.....	.....
1642	col. oil	.....	.....	199	.....	.....	.....
1643	col. oil	$0.834^{21°}_{4°}$	.....	190-2	.....	.....	.....
1644	col. oil	$0.849^{20°}$	.....	210-2	.....	.....	.....
1645	cr.	.....	17	216-8	i.	.....	.....
1646	lq.	$0.887^{20°}$	.....	$180\text{-}90^{720mm}$	i.	.....	.....
1647	lq.	$1.260^{18°}_{4°}$	.....	132^{15mm}	.....	.....	.....
1648	lq.	$0.951^{0°}_{4°}$	.....	$127\text{-}8^{11mm}$	.....	.....	.....
1649	lq.	.....	.....	$105\text{-}8^{12mm}$	.....	.....	.....
1650	col. lq.	$0.740^{30°}$	.....	172	i.	∞	∞
1651	col. lq.	$0.748^{20°}_{0°}$	.....	$159\text{-}62^{650mm}$	i.	.....	.....
1652	col. lq.	$0.752^{11°}_{4°}$	.....	$157\text{-}8^{750mm}$	i.	.....	.....
1653	col. lq.	$0.773^{21°}_{21°}$	.....	157.5^{759mm}	.....	.....	.....
1654	lq.	$0.945^{20°}_{20°}$	.....	130^{3mm}	sl. s.	.....	.....
1655	pa. gn./al.	.....	171	.....	i.	s.	.....
1656	rhb.	.....	108.5-9.0	269.9	$0.1^{20°}$; s. h.	v. s. h.	s.
1657	col. cr.	.....	148(138)	.....	i.	s.	s.
1658	yel. nd./ al.	.....	171-2	.....	i.; s. chl.; s. NH_4OH	sl. s.; s. bz.; s. alk.	s.; sl. s. lg.; s. CS_2
1659	hyg. cr.	.....	d. 45	.....	v. s.	v. s.	.....
1660	pl./al.	.....	60	320-2	sl. s. h.	v. s.	v. s.
1661	amor.	1.038	.....	.....	s.	i. abs.	i.
1662	col. nd.	.....	78-9	222.5-3.5	v. s.	sl. s. lg.	sl. s.
1663	lq.	$0.931^{25°}$	−47	167.9	∞	∞	∞
1664	col. lq.	.....	.....	$25^{0.14mm}$ d. h.	s.	∞	∞
1665	pr./aq.	.....	125-6	.....	v. s. h.	s. h.	.....
1666	col. mn. nd./lg.	.....	110-1	.....	s.	s.	s.; s. act.

Deseptyl 527
Destriol 2902
Destrone 2903
Dextrose 3618
Dextrose pentaacetate 3362-3
Diabetic sugar 3618
Diacetanilide 1670
Diacetin 3383
Diacetoethyl acetate 3034
Diacetone 1663

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1667	**Diacetyl**	butandione	$CH_3{\cdot}CO{\cdot}CO{\cdot}CH_3$	I-769	86.09
1668	acetone	.....	$(CH_3CO{\cdot}CH_2)_2CO$	I-808	142.15
1669	*p*-aminophenol	.....	$CH_3CO_2{\cdot}C_6H_4{\cdot}NHCOCH_3$	XIII-464	193.20
1670	aniline (*N*)	*N*-Ph-diacetamide	$C_6H_5N{:}(COCH_3)_2$	XII-250	177.20
1671	benzidine	.....	$(CH_3CO{\cdot}NH{\cdot}C_6H_4)_2$	XIII-227	268.30
1672	carbinol	.....	$(CH_3CO)_2{:}CHOH$	I-852	116.11
1673	glucose	.....	$(CH_3CO)_2{:}C_6H_{10}O_6$	.....	264.23
1674	monomethoxime	.....	$CH_3CO{\cdot}C(:NOCH_3){\cdot}CH_3$	I-772	115.13
1675	oxyphenyl-isatin	isacen	$C_6H_4{\cdot}N{:}COH{\cdot}C{:}(C_6H_4O_2C{\cdot}CH_3)_2$	.....	401.40
1676	phenylenediamine	(*o*)	$C_6H_4(NHCOCH_3)_2$	XIII-20	192.21
1677	phenylenediamine	(*p*)	$C_6H_4(NHCOCH_3)_2$	XIII-97	192.21
1678	urea (*sym*)	.....	$(CH_3CO{\cdot}NH)_2CO$	*III-29	144.13
1679	**Diacetylene**	butadiyne	$HC{:}C{\cdot}C{:}CH$	I-266	50.06
1680	**Diallyl** amine	.....	$(CH_2{:}CH{\cdot}CH_2)_2{:}NH$	IV-208	97.16
1681	barbituric acid (5,5)	dial	$CO{\cdot}NH{\cdot}CO{\cdot}NH{\cdot}CO{\cdot}C{:}(C_3H_5)_2$	*XXIV-422	208.21
1682	cyanamide	.....	$(C_3H_5)_2{:}N{\cdot}CN$	.....	122.17
1683	oxalate	.....	$(CO{\cdot}O{\cdot}C_3H_5)_2$	II-540	170.16
1684	sulfide	thioallyl ether	$(CH_2{:}CH{\cdot}CH_2)_2S$	I-440	114.20
1685	trisulfide	.....	$(C_3H_5)_2S_3$	I-441	178.32
1686	**Dialuric acid**	tartronyl urea	$C_4H_4O_4N_2$	XXV-85	144.09
1687	**Diamino**-anisole	(1;2,4)	$CH_3O{\cdot}C_6H_3(NH_2)_2$	*XIII-204	138.17
1688	anisole HCl	(1;2,4)	$C_7H_{10}ON_2{\cdot}2HCl$	*XIII-204	211.10
1689	anisole HCl	(1;2,5)	$C_7H_{10}ON_2{\cdot}2HCl$	.....	211.10
1690	anthraquinone (1,4)	.....	$C_6H_4(CO)_2C_6H_2{:}(NH_2)_2$	XIV-197	238.24
1691	anthraquinone (1,5)	.....	$(H_2N{\cdot}C_6H_3)_2(CO)_2$	XIV-203	238.24
1692	anthraquinone (1,8)	.....	$(H_2N{\cdot}C_6H_3)_2(CO)_2$	XIV-212	238.24
1693	anthraquinone (2,3)	.....	$C_6H_4(CO)_2C_6H_2{:}(NH_2)_2$	XIV-215	238.24
1694	anthraquinone (2,6)	.....	$H_2NC_6H_3(CO)_2C_6H_3{\cdot}NH_2$	XIV-215	238.24
1695	anthraquinone (2,7)	.....	$H_2NC_6H_3(CO)_2C_6H_3{\cdot}NH_2$	XIV-216	238.24
1696	azobenzene (2,2′)	.....	$(H_2N{\cdot}C_6H_4{\cdot}N{:})_2$	XVI-303	212.25
1697	azobenzene (4,4′)	azoaniline	$(H_2N{\cdot}C_6H_4{\cdot}N{:})_2$	XVI-334	212.25
1698	azobenzene (2,4)	chrysoidine	$(H_2N)_2C_6H_3{\cdot}N_2{\cdot}C_6H_5$	XVI-383	212.25
1699	azobenzene HCl	chrysoidine orange	$C_{12}H_{12}N_4{\cdot}HCl$	XVI-383	248.71
1700	benzoic acid (2,3)	.....	$(H_2N)_2C_6H_3{\cdot}CO_2H$	XIV-447	152.15
1701	benzoic acid (2,4)	.....	$(H_2N)_2C_6H_3{\cdot}CO_2H$	XIV-448	152.15
1702	benzoic acid (2,5)	.....	$(H_2N)_2C_6H_3{\cdot}CO_2H$	XIV-448	152.15

Diacetoxy-ethane 3214
Diacetyl-, cf. also acetyl.
Diacetyl-dioxime 2490
Diacetyl-disulfide 85
Diacetyl-fluorescein 3253
Diacetyl-hydroquinone 3716
Diacetyl-methane 68
Diacetyl-monoxime 4888
Diacetyl-monoxime methyl ether 1674
Diacetyl-morphine, cf. alkd.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1667	yel. gn. lq.	$0.981^{18.5°}_{4}$	.....	87-8	$25^{15°}$	∞	∞
1668	col. lf.	$1.068^{49°}_{4°}$	49	121^{10mm}	s. aq. Na_2CO_3	v. s.	v. s.
1669	lf./aq.	.....	150-1	.....	.....	.....	.....
1670	pl./lg.	.....	37-8	$199\text{-}200^{100mm}$	sl. s. c.	s. bz.	s. lg.
1671	nd./ac.	.....	330-1	subl. d.	i.	v. sl. s.	v. sl. s.
1672	rhb. nd.	.....	67-72	.....	v. s. alk.	s. lg.	.....
1673	lt. yel. amor.	.....	.....	.....	v. s.	s.	i. bz.
1674	yel. lq.	.....	.....	125	.....	.....	.....
1675	col. cr.	.....	241-2	.....	i.; i. dil. HCl	sl. s.	i.
1676	nd./aq.	.....	185-6	.....	s. h.; s. chl.	s.; s. a.	v. sl. s.
1677	cr./ac.	.....	303-5	.....	v. sl. s.	v. sl. s.	v. sl. s.
1678	nd./50% ac.	.....	153.5	d. 170-80	v. sl. s.	s.	.....
1679	gas	.....	.....	.....	.....	.....	.....
1680	lq.	.....	.....	111-2	.....	.....	.....
1681	col. lf./aq.	.....	171-3	.....	0.33 c.; 2 h.	s.; i. pet.	s.; s. act.
1682	col. lq.	.....	.....	$140\text{-}5^{90mm}$	i.	s.	s.
1683	oil	$1.055^{15.5°}$	.....	217^{759mm}	i.	s.	.....
1684	col. oil	$0.888^{4.7°}_{4}$	-83	138.6^{758mm}	sl. s.	∞	∞
1685	lq.	$1.085^{15°}$	.....	$112\text{-}22^{16mm}$	.....	.....	.....
1686	pr.	.....	214 d.	.....	sl. s. c.	.....	.....
1687	nd./et.	.....	67-8	.....	.....	.....	.....
1688	tan, rhb.	.....	.....	.....	v. s.	i.	i.
1689	wh. pd.	.....	.....	.....	v. s.	s.	i.
1690	cr./al.	.....	268	.....	s. h.	s.	v. s. bz.
1691	red nd.	.....	319	subl.	v. sl. s.	sl. s.	sl. s.
1692	cr./al.	.....	262	.....	i.	s.	sl. s.
1693	cr./ $PhNO_2$	.....	>320	.....	s. H_2SO_4	sl. s. chl.	s. C_5H_5N
1694	red pr./ C_5H_5N	.....	310-20 d.	.....	s. H_2SO_4	sl. s. h.	i. chl.
1695	or. nd./al.	.....	>330	subl.	i.	sl. s.	s. conc. a.
1696	red lf./al.	.....	134	.....	v. sl. s.	s. h.	v. s.; v. s. act.
1697	yel. nd./ aq. al.	.....	241-3	.....	v. sl. s.	s.	sl. s. bz., sl. s. lg.
1698	yel. cr.	.....	117.5	.....	sl. s. h.	s.	s.; v. s. chl.
1699	bl. cr. or red pd.	.....	.....	.....	s.	s.	.....
1700	nd.	.....	190-1 d.	.....	v. sl. s.	.....	.....
1701	cr.	.....	140±	.....	v. sl. s.	.....	.....
1702	pr./aq.	.....	d. 200	.....	v. sl. s. h.	v. sl. s.	v. sl. s.

Diacetyl-peroxide 106
Diacetyl-resorcinol 5552
Dial 1681
Diallyl-, cf. also allyl.
Diallyl 3574
Dialuramide 6384
Diamine-H 5261
Diamine-P 5260
Diamino-benzene 5256-61
Diamino-benzene sulfonic acid 5262

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Diamino				
1703	benzoic acid (3,4)	.....	$(H_2N)_2C_6H_3\cdot CO_2H$	XIV-450	152.15
1704	benzoic acid (3,5)	.....	$(H_2N)_2C_6H_3\cdot CO_2H\cdot H_2O$	XIV-453	170.17
1705	benzoic HCl (3,5)	.....	$(H_2N)_2C_6H_3\cdot CO_2H\cdot 2HCl$	XIV-453	225.08
1706	benzophenone (2,2′)	.....	$(NH_2\cdot C_6H_4)_2CO$	XIV-87	212.24
1707	benzophenone (3,3′)	.....	$(NH_2\cdot C_6H_4)_2CO$	XIV-88	212.24
1708	benzophenone (4,4′)	.....	$(NH_2\cdot C_6H_4)_2CO$	XIV-88	212.24
1709	2-butyloxy-5,5′-azopyridine (2′,6′)	niazo; neotropin	$C_4H_9O\cdot C_5H_3(N)\cdot N_2\cdot C_5H_2(N)(NH_2)_2$	.....	286.33
1710	diphenyl (2,2′)	.....	$H_2N\cdot C_6H_4\cdot C_6H_4\cdot NH_2$	XIII-210	184.23
1711	diphenyl (2,4′)	diphenyline	$H_2N\cdot C_6H_4\cdot C_6H_4\cdot NH_2$	XIII-211	184.23
1712	diphenyl (3,3′)	.....	$H_2N\cdot C_6H_4\cdot C_6H_4\cdot NH_2$	XIII-213	184.23
1713	diphenyl (4,4′)	benzidine	$(H_2N\cdot C_6H_4)_2\cdot H_2O$†	XIII-214	202.25
1714	diphenyl (4,4′)	benzidine	$(H_2N\cdot C_6H_4)_2$‡	XIII-214	184.23
1715	diphenyl (4,4′) HCl	benzidine HCl	$(H_2N\cdot C_6H_4)_2\cdot 2HCl$	XIII-219	257.16
1716	diphenyl H_2SO_4	benzidine sulfate	$(H_2N\cdot C_6H_4)_2\cdot H_2SO_4$	XIII-219	282.31
1717	diphenylamine (2,4)	.....	$C_6H_4\cdot NH\cdot C_6H_3(NH_2)_2$	XIII-295	199.25
1718	diphenylamine (4,4′)	.....	$(H_2N\cdot C_6H_4)_2NH$	XIII-110	199.25
1719	diphenylethane (4,4′)	diamino-dibenzyl	$(H_2N\cdot C_6H_4\cdot CH_2)_2$	XIII-248	212.28
1720	diphenyl ether	(4,4′)	$H_2N\cdot C_6H_4\cdot O\cdot C_6H_4\cdot NH_2$	XIII-441	200.23
1721	diphenylmethane	4,4′-diaminoditane	$(H_2N\cdot C_6H_4)_2CH_2$	XIII-238	198.26
1722	hydrazobenzene (*p*)	biphenin	$(H_2N\cdot C_6H_4\cdot NH)_2$	XV-653	214.26
1723	phenol (2,4)	.....	$(NH_2)_2C_6H_3\cdot OH$	XIII-549	124.14
1724	phenol (2,4) HCl	amidol	$(NH_2)_2C_6H_3OH\cdot 2HCl$	XIII-550	197.07
1725	phenol (2,5)	.....	$(NH_2)_2C_6H_3\cdot OH$	XIII-553	124.14
1726	phenol (3,4)	.....	$(NH_2)_2C_6H_3\cdot OH$	XIII-564	124.14
1727	phenol (3,5)	.....	$(NH_2)_2C_6H_3\cdot OH$	XIII-567	124.14
1728	phenylacetic acid HCl	.....	$(NH_2)_2C_6H_3CH_2\cdot CO_2H\cdot 2HCl$	.....	239.11
1729	stilbene (2,2′)(*α*)	.....	$(H_2N\cdot C_6H_4\cdot CH:)_2$	XIII-267	210.27
1730	stilbene (2,2′)(*β*)	.....	$(H_2N\cdot C_6H_4\cdot CH:)_2$	XIII-267	210.27
1731	stilbene (4,4′)	.....	$(H_2N\cdot C_6H_4\cdot CH:)_2$	XIII-267	210.27
1732	stilbene-disulfonic acid	(4,4′-diNH$_2$-2,2′-diS)	$[H_2N\cdot C_6H_3(SO_3H)\cdot CH]_2$	XIV-798	370.39
1733	triphenylmethane	(4,4′); diamino-tritane	$(H_2N\cdot C_6H_4)_2CH\cdot C_6H_5$	XIII-274	274.35
1734	**Diamyl** amine (*n*)	.....	$(C_5H_{11})_2NH$	*IV-378	157.29
1735	amine (*iso*)	.....	$(C_5H_{11})_2NH$	IV-182	157.29
1736	amine (*d*)	.....	$[C_2H_5CH(CH_3)\cdot CH_2]_2NH$	IV-179	157.29
1737	carbonate (*n*)	amyl carbonate	$(C_5H_{11}O)_2CO$	.....	202.29
1738	carbonate (*iso*)	*iso*-amyl carbonate	$(C_5H_{11}O)_2CO$	III-7	202.29
1739	benzene§	.....	$(C_5H_{11})_2C_6H_4$	V-470	218.37

† Cryst. from aq. < 60°; ‡ cryst. from aq. > 80°.
§ Mixt. of isomers.

Diamino-butane 5474
Diamino-caproic acid 3986
Diamino-chlorobenzene 1433
Diamino-dibenzyl 1719
Diamino-diphenylsulfide 5886
Diamino-ditane 1721
Diamino-naphthalene 4571-9
Diamino-propane 5464, 6282

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1703	lf.	.....	210 d.	.....	s. h.	.....	.....
1704	nd./aq.	.....	228-36 (anh.)	$-H_2O$, 110	$1.1^{8°}$	s.	s.
1705	nd.	.....	253?	.....	s.	s.	.....
1706	yel. lf./aq. al.	.....	134-5	.....	i.	s.	.....
1707	lt. yel. nd./al.	.....	173-4	.....	v. sl. s.	s.	s.
1708	yel. nd./aq. al.	.....	237-9	.....	v. sl. s. h.	s.	s.
1709	red cr.	.....	129	.....	sl. s.	s.	s.
1710	nd./al.	.....	81	.....	.....	.....	.....
1711	nd./aq. al.	.....	45	363	v. sl. s.	s.	s.
1712	oil	.....	.....	.....	v. sl. s.	.....	s.
1713	cr./aq.	.....	105-20	.....	.....	.....	.....
1714	cr./aq.	.....	127.5-8.7	$400\text{-}1^{740mm}$	1 h.	1 h.	2.2abs.
1715	col. lf.	.....	.....	.....	s., d.	s.; i. HCl	i.
1716	col. pl.	.....	.....	.....	$0.0008^{100°}$	v. sl. s. h.	i.
1717	nd.	.....	130	.....	.....	.....	.....
1718	lf./aq.	.....	158	d.	sl. s.	s.	s.
1719	pl./aq.	.....	134-5	subl. sl. d.	sl. s. h.	v. s.	.....
1720	cr./al.	.....	186-7 d.	.....	i.	$i.^{25°}$; $15^{25°}$ act.	i. bz.; i. CCl_4
1721	nd./aq.	.....	93-4	$249\text{-}53^{15mm}$	sl. s. c.	s.	s.
1722	yel. cr.	.....	145	.....	s. h.	s.	s.
1723	lf.	.....	78-80 d.	.....	s. ac.	s.; s. alk.	sl. s.
1724	nd.	.....	.....	.....	s.	sl. s.	.....
1725	cr.	.....	68	.....	.....	.....	.....
1726	cr.	.....	167-8 d.	.....	.....	.....	.....
1727	pr.	.....	168-70	.....	s.	.....	sl. s.
1728	tan nd.	.....	.....	.....	v. s.	sl. s.	i.
1729	yel. pr./al.	.....	176	.....	s. bz.	s.	s.
1730	red nd./aq.	.....	123	.....	.....	.....	.....
1731	yel. lf./al.	.....	227-8	sl. d.	sl. s. h.	s. Me al.	sl. s. bz.
1732	yel. nd.	.....	.....	.....	v. sl. s.	.....	.....
1733	cr./et.	.....	139*	.....	v. sl. s.	s.	s.
1734	col. lq.	.....	.....	$202\text{-}3^{745mm}$	v. sl. s.	v. s.	∞
1735	col. lq.	$0.767^{\frac{21}{4}°}$	-44	188-90	sl. s.	s.; s. chl.	∞
1736	col. lq.	$0.788^{0°}$	.....	182-4	sl. s.	s.	s.
1737	col. lq.	.....	.....	$130\text{-}2^{20mm}$	.....	.....	.....
1738	col. lq.	$0.912^{15°}$	.....	228.7	.....	.....	.....
1739	col. lq.	.....	.....	265±	i.	s.	s.

* Crysts. $+1C_6H_6$/bz., m. p. 104-6°.
Diamino-propanol 3384
Diamino-toluene 6003, 6005, 6007
Diamino-tritane 1733
Diamino-valeric acid 5000
Diamol 1724 or 5260
Diamond green-G base 5672
Diamorphine, cf. alkd.
Di-*iso*-amyl 1638

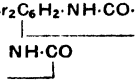
No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1740	**Diamyl** ether (*n*)	amyl ether	$(C_5H_{11})_2O$	I-387	158.28
1741	ether (*iso*)	*iso*-amyl ether	$[(CH_3)_2CH(CH_2)_2]_2O$	I-401	158.28
1742	hydroquinone (*tert*)	.....	$[C_2H_5C(CH_3)_2]_2$: $C_6H_2(OH)_2$	VI-952	250.37
1743	ketone (*n*)	caprone	$(C_5H_{11})_2CO$	I-714	170.29
1744	ketone (*iso*)	.....	$(C_5H_{11})_2CO$	I-714	170.29
1745	oxalate (*iso*)	.....	$(CO_2{\cdot}C_5H_{11})_2$	II-540	230.30
1746	phthalate (*n*)	amyl phthalate	$C_6H_4(CO_2{\cdot}C_5H_{11})_2$	.....	306.39
1747	phthalate (*iso*)	.....	$C_6H_4(CO_2{\cdot}C_5H_{11})_2$	.....	306.39
1748	succinate (*n*)	amyl succinate	$(CH_2CO_2{\cdot}C_5H_{11})_2$	.....	258.35
1749	succinate (*iso*)	.....	$(CH_2CO_2{\cdot}C_5H_{11})_2$	II-611	258.35
1750	succinate (*act*)	.....	$(CH_2CO_2{\cdot}C_5H_{11})_2$	II-611	258.35
1751	sulfide (*n*)	amyl sulfide	$(C_5H_{11})_2S$	.....	174.34
1752	sulfide (*iso*)	.....	$(C_5H_{11})_2S$	I-405	174.34
1753	sulfide, di- (*n*)	amyl disulfide	$(C_5H_{11}S)_2$	.....	206.40
1754	sulfide, di- (*iso*)	.....	$(C_5H_{11}S)_2$	I-406	206.40
1755	sulfite (*n*)	amyl sulfite	$(C_5H_{11}O)_2SO$	.....	222.34
1756	sulfone (*iso*)	amyl sulfone	$(C_5H_{11})_2SO_2$	I-406	206.34
1757	tartrate (*iso*)	amyl tartrate	$(HO{\cdot}CH{\cdot}CO_2{\cdot}C_5H_{11})_2$	*III-179	290.35
1758	**Dianisalacetone**	.....	$(CH_3OC_6H_4CH$: $CH)_2CO$	VIII-354	294.33
1759	**Dianisidine** (*o*)	(3,3'-MeO; 4,4'-NH_2)	$(CH_3O{\cdot}C_6H_3{\cdot}NH_2)_2$	XIII-807	244.28
1760	**Dianisyl**-phenetyl-guanidine HCl	guanicaine	$(C_{23}H_{25}O_3N_3{\cdot}HCl$	XIII-487	427.92
1761	**Diazidoethane** (1,2)	1,2-bistriazo-ethane	$(CH_2N_3)_2$	I-103	112.10
1762	**Diazo**-aminoben-zene	benzene-di-azoanilide	$C_6H_5{\cdot}N$:$N{\cdot}NHC_6H_5$	XVI-687	197.23
1763	aminonaphthalene	(*β*)	$C_{10}H_7{\cdot}N_2{\cdot}NH{\cdot}C_{10}H_7$	.....	297.34
1764	aminotoluene	(2,2')	$C_7H_7{\cdot}N_2NHC_7H_7$	XVI-703	225.28
1765	benzene chloride	.....	$C_6H_5{\cdot}N_2Cl$	XVI-431	140.57
1766	benzene cyanide	.....	$C_6H_5{\cdot}N_2CN$	XVI-432	131.13
1767	benzene nitrate	.....	$C_6H_5{\cdot}N_2NO_3$	XVI-432	167.12
1768	benzene per-bromide	.....	$C_6H_5N(Br_3)$:N	XVI-431	344.86
1769	benzene sulfonic acid (*o*)	.....	$C_6H_4{\cdot}N_2{\cdot}O{\cdot}SO_2$ | _____ |	XVI-557	184.17
1770	benzene sulfonic acid (*m*)	.....	$C_6H_4{\cdot}N_2{\cdot}O{\cdot}SO_2$ | _____ |	XVI-559	184.17
1771	benzene sulfonic acid (*p*)	sulfanilic acid diazide	$C_6H_4{\cdot}N_2{\cdot}O{\cdot}SO_2$ | _____ |	XVI-561	184.17
1772	methane	.....	CH_2N_2	XXIII-25	42.04
1773	salicylic acid (5)	.....	$HO_2C{\cdot}C_6H_2(OH)N_2$	.....	164.12
1774	uracil (5)	.....	$CO{\cdot}NH{\cdot}CO{\cdot}NH{\cdot}$ | _____ $CH{:}C{\cdot}N{:}N{\cdot}OH$ | ____ |	XXV-565	156.10
1775	**Dibenzalacetone**	cinnamone	$(C_6H_5{\cdot}CH{:}CH)_2CO$	VII-500	234.28
1776	**Dibenzamide**	.....	$(C_6H_5{\cdot}CO)_2NH$	IX-213	225.24
1777	**Dibenzanthracene**	(1,2,5,6)	$C_{22}H_{14}$	*V-369	278.33

Dianilino-methane 4431
Diathesin 3750
Diatol 2138

Diazine 5477, 5482, 5513
Diazo-acetic ester 3035
Diazo-benzeneimide 6079

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1740	lq.	$0.774^{20°}_{4°}$	−69	190	i.	∞	∞
1741	col. lq.	$0.718^{15°}_{15°}$	.....	171-2^{748mm}	i.	∞ ; ∞ chl.	∞
1742	cr./bz.	.....	185	.....	i. aq. NaOH	s.; s. chl.	s.; v. sl. s. lg.
1743	lf.	$0.831^{20°}_{4°}$	14	225-6	i.	v. s.	v. s.
1744	yel. oil	.....	.....	226	i.	s.	s.
1745	col. lq.	$0.968^{11°}_{11°}$	.....	265-7	i.	s.	s.
1746	col. lq.	.....	.....	204-6^{11mm}	.....	.....	.....
1747	col. lq.	1.03	.....	225^{40mm}	i.	s.	s.
1748	col. lq.	.....	−9	172^{16mm}	.....	.....	.....
1749	col. lq.	$0.961^{13°}$	.....	289.9^{728mm}	i.	s.	s.
1750	col. lq.	$0.959^{20°}_{4°}$	.....	178-80^{25mm}	i.	s.	s.
1751	col. lq.	.....	.....	103-5^{12mm}	.....	.....	.....
1752	lq.	$0.843^{20°}_{4°}$	.....	216	i.	∞	∞
1753	yel. lq.	.....	.....	128-30^{12mm}	.....	.....	.....
1754	lq.	$0.918^{18°}$	.....	250 sl. d.	.....	.....	.....
1755	col. lq.	.....	.....	136-8^{15mm}	.....	.....	.....
1756	nd.	.....	31	295	v. sl. s.	v. s.	v. s.
1757	lq.	$1.063^{14.8°}_{4°}$	.....	195^{16mm}	i.	.....	.....
1758	yel. lf./ EtOAc	.....	129-30	.....	s. chl., s. bz.	sl. s.	sl. s.
1759	col. lf.	.....	131.5	.....	i.; s. bz.	s.	s.
1760	col. cr.	.....	176	.....	6	s.	i. oil
1761	oil	$1.170^{24.9°}$	.....	53^{9mm}	.....	.....	.....
1762	yel. lf./al.	.....	96-8	d. 150; expl.	i.; v. s. bz.	s. h.	v. s.
1763	red nd./ xylene	.....	156	.....	s. H_2SO_4	.....	.....
1764	or. cr.	.....	51	.....	0.05	.....	.....
1765	hyg. cr./ al. et.	.....	expl.	.....	v. s.	s. abs.	i.; s. act.
1766	yel.	.....	69	.....	sl. s.	.....	.....
1767	nd./al. et.	1.37	expl.	.....	v. s.	sl. s.	i.
1768	yel. lf.	.....	63.5 d.	.....	i. d.	sl. s. d.	i. d.
1769	col.	.....	expl.	.....	d. h.	d. h.	.....
1770	col. nd./ aq.	.....	expl.	.....	s.; d. 60°	d. h.	.....
1771	col. nd./ aq.	.....	expl.	.....	s. h.	i.; d. h.	s. dil. alk.
1772	gas	expl. 200°	−145	−23	d.	.....	s.
1773	yel. cr.	.....	expl. 155	.....	s. c.	s. Na_2CO_3	i.
1774	red or yel. pl./aq.	.....	expl.	.....	d. h. a.	.....	.....
1775	lt. yel. mn.	.....	112	d.	v. s. act.	s. h.	sl. s.
1776	rhb./bz.	.....	148	.....	$0.12^{15°}$	s.	s.
1777	lf./ac.	.....	262	.....	sl. s. ac.	v. s. bz.	.....

Diazo-ethyl acetate 3035
Diazo-resorcinol 5551
Diazo-resorufine 5554
Dibenzal-hydrazine 633

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1778	**Dibenzeneazore-sorcinol**	.....	$(C_6H_5\cdot N_2)_2$: $C_6H_2(OH)_2$	XVI-185	318.32
1779	**Dibenzoyl** disulfide	.....	$(C_6H_5\cdot CO)_2S_2$	IX-424	274.34
1780	ethylenediamine	.....	$(C_6H_5CO\cdot NHCH_2)_2$	IX-262	268.30
1781	methane	β-hydroxy chalkone	$(C_6H_5\cdot CO)_2CH_2$	VII-769	224.25
1782	**Dibenzyl**-acetic acid	.....	$(C_6H_5CH_2)_2$: $CHCO_2H$	IX-682	240.29
1783	amine	.....	$(C_6H_5\cdot CH_2)_2NH$	XII-1035	197.27
1784	aniline	.....	$(C_6H_5\cdot CH_2)_2N\cdot C_6H_5$	XII-1037	273.36
1785	fumarate	benzyl fumarate	$(:CH\cdot CO_2\cdot CH_2C_6H_5)_2$	VI-437	296.31
1786	hydroxylamine (β,β)	.....	$(C_6H_5CH_2)_2$:NOH	XV-19	213.27
1787	ketone	α,α'-diphenyl acetone	$(C_6H_5CH_2)_2$:CO	VII-445	210.26
1788	maleate	benzyl maleate	$(:CH\cdot CO_2\cdot CH_2C_6H_5)_2$	VI-437	296.31
1789	phthalate (o)	benzyl phthalate	$C_6H_4(CO_2\cdot C_7H_7)_2$	IX-802	346.36
1790	succinate	.....	$(\cdot CH_2CO_2\cdot C_7H_7)_2$	VI-436	298.32
1791	sulfide	.....	$(C_6H_5CH_2)_2S$	VI-455	214.31
1792	tartrate (d)	.....	$(CHOHCO_2C_7H_7)_2$	.....	330.32
1793	**Dibromo**-acetamide	.....	$Br_2CH\cdot CO\cdot NH_2$	II-219	216.88
1794	acetamide (N)	acetdibromamide	$CH_3\cdot CO\cdot NBr_2$	II-182	216.88
1795	acetic acid	.....	$Br_2CH\cdot CO_2H$	II-218	217.87
1796	acetylene	dibromoethyne	$BrC{:}CBr$	I-246	183.85
1797	aminophenol	(4;2,6,1)	$NH_2\cdot C_6H_2Br_2OH$	XIII-517	266.94
1798	aniline (2,3)	.....	$Br_2C_6H_3\cdot NH_2$	XII-655	250.94
1799	aniline (2,4)	.....	$Br_2C_6H_3\cdot NH_2$	XII-655	250.94
1800	aniline (2,6)	.....	$Br_2C_6H_3\cdot NH_2$	XII-659	250.94
1801	aniline (3,4)	.....	$Br_2C_6H_3\cdot NH_2$	XII-660	250.94
1802	aniline (3,5)	.....	$Br_2C_6H_3\cdot NH_2$	XII-660	250.94
1803	anthracene (9,10)	.....	$C_{14}H_8Br_2$	V-665	336.04
1804	anthranilic acid	(3,5)	$Br_2C_6H_2(NH_2)CO_2H$	XIV-371	294.95
1805	anthraquinone (1,3)	.....	$Br_2C_{14}H_6O_2$	*VII-414	366.02
1806	anthraquinone (1,5)	.....	$Br_2C_{14}H_6O_2$	VII-789	366.02
1807	anthraquinone (2,6)	.....	$Br_2C_{14}H_6O_2$	VII-790	366.02
1808	anthraquinone (β)	(2,3)	$Br_2C_6H_2(CO)_2C_6H_4$	VII-790	366.02
1809	anthraquinone (α)	(2,7)	$BrC_6H_3(CO)_2C_6H_3Br$	VII-790	366.02
1810	barbituric acid	(5,5); dibromin	$Br_2C(CONH)_2CO$	XXIV-472	285.90
1811	benzene (o)	.....	$C_6H_4Br_2$	V-210	235.92
1812	benzene (m)	.....	$C_6H_4Br_2$	V-211	235.92
1813	benzene (p)	.....	$C_6H_4Br_2$	V-211	235.92
1814	benzoic acid (2,3)	.....	$Br_2C_6H_3\cdot CO_2H$	IX-357	279.93
1815	benzoic acid (2,4)	.....	$Br_2C_6H_3\cdot CO_2H$	IX-358	279.93
1816	benzoic acid (2,5)	.....	$Br_2C_6H_3\cdot CO_2H$	IX-358	279.93
1817	benzoic acid (2,6)	.....	$Br_2C_6H_3\cdot CO_2H$	IX-358	279.93
1818	benzoic acid (3,4)	.....	$Br_2C_6H_3\cdot CO_2H$	IX-359	279.93
1819	benzoic acid (3,5)	.....	$Br_2C_6H_3\cdot CO_2H$	IX-359	279.93
1820	benzoylene urea (6,8)	.....	$Br_2C_6H_2\cdot NH\cdot CO\cdot$ 	.....	319.96

Dibenzo-furane 2763
Dibenzo-pyranol 6453
Dibenzo-pyrone 6451
Dibenzo-pyrrole 1231
Dibenzo-thioxine 5129
Dibenzoyl 697
Dibenzoyl-resorcinol 5553
Dibenzyl-, cf. also benzyl.
Dibenzyl 2717
Dibenzyl disulfide 805

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1778	red nd./ chl.-al.	.....	221-2	.....	s. h. chl.	i.	v. sl. s. dil. alk.
1779	pr./CS_2	.....	133-5	d.	i.; i. NH_4OH	sl. s. h.	sl. s. h.; s. CS_2
1780	nd./al.	.....	250-1	d.	i.	$0.08^{22°}$	.....
1781	rhb./al.	.....	78(72-3)*	219-21 18mm	i.	$4.4^{19.5°}$	s.
1782	nd./aq.	.....	85-6	.....	v. sl. s. h.	s.; s. bz.	s.; s. ac.
1783	col. oil	$1.028^{\frac{25}{25}°}$	-26	268-71 250mm	i.	s.	s.
1784	pr./al.	.....	70-1	>300 sl. d.	i.	v. s. h.	v. s.
1785	col. pr./lg.	.....	64	239 14mm	i.	s.	v. sl. s. c.
1786	nd.	.....	124	.....	sl. s. h.	s.	s.
1787	cr./aq. al.	.....	34-5	330.6	.....	.....	.....
1788	oil	.....	.....	241 14mm	.....	.....	.....
1789	pr./al.	.....	42-3	274 12mm	v. sl. s.	s.	s.
1790	col. lf./al.	.....	45-6	238 14mm	i.	s.	s.; s. bz.
1791	rhb./et.	$1.071^{\frac{50}{50}°}$	49	.....	i.	s.	s.
1792	cr.	$1.204^{72°}$	50±	250-70 4mm	.....	.....	.....
1793	nd.	.....	156	.....	.....	.....	.....
1794	yel. nd.	.....	100	.....	s. h.	s.	s.
1795	col. cr.	.....	48-50	232-4 d.	v. s.	v. s.	v. s.
1796	poison. lq.	2±	expl. with trace O_2	76±	i.	s.	s.
1797	nd./al.	.....	192-3	.....	i.; s. bz.	s.	sl. s.
1798	pl./aq. al.	.....	43	.....	v. sl. s.	v. s.	v. s.
1799	rhb.	$2.260^{20°}$	.....	79.5	.....	s.	s. ac.
1800	nd./al.	.....	83-4	262-4	.....	v. s. abs.	v. s.
1801	lf./aq. al.	.....	80-1	subl. 100	i.	s.	.....
1802	nd.	.....	56.5	.....	.....	.....	.....
1803	yel. nd.	.....	221	subl.	s. h. bz.	v. sl. s.	v. sl. s.
1804	nd./al.	.....	235-6	.....	i.; s. alk.	s.	s.
1805	yel. nd./ac.	.....	210	.....	s. H_2SO_4	v. sl. s.	v. sl. s.
1806	nd.	.....	.....	.....	.....	.....	.....
1807	yel. cr./ Am. al.	.....	289-90	.....	.....	v. sl. s.	s. h. bz.
1808	yel. nd.	.....	269-70	subl.	s. bz.	v. sl. s.	s. chl.
1809	yel. nd./ac.	.....	245	.....	.....	v. sl. s. h.	sl. s. h. ac.
1810	cr./aq. HNO_3	.....	234	.....	3	s.	s.
1811	col. lq.	$1.956^{\frac{20}{4}°}$	1.8	221-2	i.	s.	s.
1812	col. lq.	$1.952^{\frac{20}{4}°}$	-6.9	219 755mm	i.	s.	s.
1813	col. pl./al.	$2.261^{18°}$	87-8	218.6 758mm	i.; s. chl.	1.6; s. bz.	$71^{25°}$
1814	nd./aq.	.....	147-9	.....	s. h. lg.	.....	.....
1815	lf./aq.	.....	171-2	subl.	sl. s. h.	.....	.....
1816	nd./aq.	.....	153	.....	v. sl. s. c.	s.	s.
1817	nd./aq.	.....	146-7	.....	s. h.	v. s.	v. s.; v. s. chl.
1818	nd./aq.	.....	232-3	subl.	v. sl. s. c.	s.	s.
1819	nd./aq.	.....	219-20	subl.	v. sl. s. c.	v. s.	sl. s. c. bz.
1820	yel. nd./ glycol	.....	305-6	.....	i.; i. aq. NaOH	i.; s. h. glycol	i.; s. h. $PhNO_2$

* Enol form, two m. p's.; keto, m. p. 81°.
Dibenzyl ether 806
Dibenzyl sulfone 835
Dibromide of cinnamic acid 1830
Dibromin 1810
Dibromo-acetophenone 967

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Dibromo				
1821	butane (1,2)	α-butylene bromide	$C_2H_5{\cdot}CHBr{\cdot}CH_2Br$	I-120	215.94
1822	butane (1,3)	.....	$CH_3CHBr{\cdot}CH_2CH_2Br$	I-120	215.94
1823	butane (1,4)	.....	$Br(CH_2)_4Br$	I-120	215.94
1824	butane (2,3)(*dl*)	β-butylene bromide	$(CH_3{\cdot}CHBr{\cdot})_2$	.....	215.94
1825	butane (*iso*)	1,2-diBr-2-Me-propane	$(CH_3)_2CBr{\cdot}CH_2Br$	I-127	215.94
1826	butyric acid (α,β)	crotonic acid diBr	$CH_3(CHBr)_2CO_2H$	II-284	245.92
1827	butyric acid	*iso*-crotonic diBr	$CH_3(CHBr)_2CO_2H$	II-285	245.92
1828	camphor (α,α')	(3,3-diBr-*d*)	$Br_2C_9H_{14}CO$	VII-125	310.04
1829	cinnamic acid (α,β)	"α-acid"	$C_6H_5CBr{:}CBrCO_2H$	IX-601	305.97
1830	cinnamic acid (*dl*)	†	$C_6H_5(CHBr)_2CO_2H$	IX-518	307.99
1831	*o*-cresol (4,6)	(4,6;2,1)	$Br_2C_6H_2(CH_3)OH$	VI-360	265.95
1832	*o*-cresolsulfonphthalein	bromcresol purple	$C_{21}H_{16}O_5Br_2S$	.....	540.23
1833	diphenyl (4,4')	.....	$BrC_6H_4{\cdot}C_6H_4Br$	V-580	312.02
1834	diphenyl ether (4,4')	.....	$(Br{\cdot}C_6H_4)_2O$	VI-200	328.02
1835	diphenylsulfone	(4,4')	$(Br{\cdot}C_6H_4)_2SO_2$	VI-331	376.11
1836	ethane (1,1)	ethylidenedibromide	$CH_3{\cdot}CHBr_2$	I-90	187.88
1837	ethane (1,2)	ethylene bromide	$BrCH_2{\cdot}CH_2Br$	I-90	187.88
1838	fluorescein	(2,4)	$C_{20}H_{10}O_5Br_2$	XIX-228	490.11
1839	fluorescein	(4,5)	$C_{20}H_{10}O_5Br_2$	XIX-228	490.11
1840	fumaric acid	.....	$(:CBr{\cdot}CO_2H)_2$	II-747	273.89
1841	gallic acid	(2,6;3,4,5;1)	$Br_2C_6(OH)_3CO_2H{\cdot}H_2O$	X-490	345.95
1842	hexane (1,2)	α-hexylene dibromide	$CH_3(CH_2)_3CHBr{\cdot}CH_2Br$	I-144	243.99
1843	hexane (1,5)	.....	$CH_3CHBr{\cdot}(CH_2)_3{\cdot}CH_2Br$	I-145	243.99
1844	hexane (1,6)	hexamethylene diBr	$(\cdot CH_2{\cdot}CH_2{\cdot}CH_2Br)_2$	I-145	243.99
1845	hexane	3,3-dibromo-2,2-dimethyl-butane	$(CH_3)_3C{\cdot}CBr_2{\cdot}CH_3$	I-151	243.99
1846	hexane	3,4-dibromo-2,2-dimethyl-butane	$(CH_3)_3C{\cdot}CHBr{\cdot}CH_2Br$	I-151	243.99
1847	hexane	2,3-dibromo-2,3-dimethyl-butane	$(CH_3)_2CBr{\cdot}CBr(CH_3)_2$	I-152	243.99
1848	8-hydroxyquinoline (5,7)	.....	$Br_2C_9H_4(OH)N$	XXI-97	302.97
1849	iodomethane	.....	$ICHBr_2$	I-71	299.77
1850	maleic acid	.....	$(:CBr{\cdot}CO_2H)_2$	II-756	273.89
1851	malonic acid	.....	$Br_2C(CO_2H)_2$	II-595	261.88
1852	naphthalene (1,4)	β-dibromonaphthalene	$C_{10}H_6Br_2$	V-549	285.98
1853	α-naphthol (2,4)	.....	$Br_2C_{10}H_5{\cdot}OH$	VI-614	301.98
1854	nitromethane	.....	$Br_2CH{\cdot}NO_2$	I-77	218.86
1855	nitrophenol (2,6;4)	.....	$Br_2{:}C_6H_2(NO_2)OH$	VI-247	296.92
1856	pentane (1,4)	.....	$CH_3{\cdot}CHBr{\cdot}CH_2{\cdot}CH_2{\cdot}CH_2Br$	I-131	229.96
1857	pentane (1,5)	pentamethylene diBr	$Br(CH_2)_5Br$	I-131	229.96

†Dibromide of cinnamic acid.

Dibromo-diphenyl 1833
Dibromo-ethene 131-3
Dibromo-ethylbenzene 5647
Dibromo-ethylene 131-3
Dibromo-ethyne 1796

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1821	lq.	$1.820^{\frac{20°}{0°}}$	−65	166	i.	∞	.....
1822	lq.	$1.807^{18.5°}$	.....	174-5	.....	.....	.....
1823	col. lq.	$1.819^{\frac{18.5°}{0°}}$	−20	197-8	.....	.....	.....
1824	col. lq.	$1.783^{\frac{20°}{4°}}$	−34.5	157-8	i.	.....	.....
1825	col. lq.	$1.759^{20°}$	−70.3	148-9^{737mm}	i.	.....	.....
1826	mn. nd.	.....	87	.....	sl. s. c.	v. s.	v. s.
1827	nd.	.....	58-9	.....	sl. s. c.	v. s.	v. s.
1828	col. rhb./lg.	$1.854^{\frac{21}{4}+6°}$	64	subl. >64	i.; s. lg.	22$^{20°}$ abs.	s.; s. bz.
1829	pl./chl. pet.	.....	138-9 *	.....	i.	s.; s. chl.	s.; sl. s. pet.
1830	mn./chl.	.....	199-201	d.	i.; d. h.	s.	s.
1831	nd.	.....	56-7	.....	v. sl. s.	s.; s. alk.	s.; s. bz.
1832	pink pd.	.....	241-2	.....	v. sl. s.	s.; s. alk.	i.
1833	mn. pr.	1.897	164-5	355-60	i.	v. sl. s. h.	v. s. bz.
1834	cr.	.....	53-4	338-40	v. s. bz.	s.	s.
1835	mn. nd./al.	.....	172	.....	.....	sl. s. h.	.....
1836	lq.	$2.055^{\frac{20°}{4°}}$	.....	108-10	i.	v. s.	v. s.
1837	col. lq.	$2.180^{\frac{20°}{4°}}$	10	131.5	v. sl. s.	∞	∞
1838	red cr. + EtOH/al.	.....	300 ± (anh.)	.....	i.; s. ac.	s. h.	v. sl. s.
1839	red cr./al.	.....	285	.....	sl. s.; s. ac.	s. h.	v. sl. s.
1840	cr./aq.	.....	227-9 d.	.....	.....	v. s.	v. s.
1841	cr./aq.	.....	150	−H_2O, 120	12.4$^{15°}$; 200$^{100°}$	s.; i. chl.	s.
1842	lq.	$1.596^{13.5°}$	.....	77-8^{15mm}	.....	.....	.....
1843	lq.	$1.599^{\frac{20°}{4°}}$	.....	153-4^{100mm}	.....	.....	.....
1844	lq.	$1.595^{15°}$	.....	243	.....	.....	.....
1845	cr.	.....	187 **	subl.	.....	.....	.....
1846	col. lq.	$1.616^{00°}$	.....	91-2^{14mm}	i.; v. s. bz.	v. s.	v. s.; v. s. chl.
1847	long nd.	.....	169-92 d.	.....	d.	s.	v. s.; s. bz.
1848	nd./al.	.....	196	subl.	i. c.	sl. s.; s. a.	s.; s. bz.
1849	tablets	.....	22.5	101-4^{50mm}	soln. d. by light	sl. s. pet.	.....
1850	nd./et.	.....	123.5	.....	v. s.	v. s.	v. s.; i. chl.
1851	pr. or nd.	.....	136-7 d.	.....	v. s.	v. s.	v. s.
1852	nd./al.	.....	82-3	310 d.	.....	$1.3^{11°}$	v. s.
1853	nd./al.	.....	111	.....	i.	s.	s.; s. ac.
1854	lq.	.....	.....	58.5-60^{13mm}	.....	.....	.....
1855	col. pr./al.	.....	143-4	d. >145	v. sl. s.; v. sl. s. bz.	s. h.; sl. s. ac.	s. h.; s. h. CS_2
1856	lq.	$1.622^{\frac{20°}{4°}}$	.....	196-8^{746} d.	.....	.....	.....
1857	lq.	$1.706^{18°}$	−35	221^{763} sl. d.	.....	.....	.....

* β or allo-acid, m. 100°.
** In sealed tube.
Dibromo-hydrin 3388-9
Dibromo-methane 4428
Dibromo-pene 1869

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1858	**Dibromo** pentane	2,3-dibromo-2-methyl-butane	$(CH_3)_2CBr{\cdot}CHBr{\cdot}CH_3$	I-137	229.96
1859	phenol (2,4)	.....	$Br_2C_6H_3{\cdot}OH$	VI-202	251.92
1860	phenol (2,6)	.....	$Br_2C_6H_3{\cdot}OH$	VI-202	251.92
1861	phenol (3,4)	.....	$Br_2C_6H_3{\cdot}OH$	VI-203	251.92
1862	phenol (3,5)	.....	$Br_2C_6H_3{\cdot}OH$	VI-203	251.92
1863	propane (1,1)	propylidene diBr	$C_2H_5{\cdot}CHBr_2$	I-109	201.91
1864	propane (1,2)	propylene bromide	$CH_3{\cdot}CHBr{\cdot}CH_2Br$	I-109	201.91
1865	propane (1,3)	trimethylene diBr	$BrCH_2{\cdot}CH_2{\cdot}CH_2Br$	I-110	201.91
1866	propane (2,2)	bromacetol	$(CH_3)_2CBr_2$	I-111	201.91
1867	propionic acid (α,α)	.....	$CH_3{\cdot}CBr_2{\cdot}CO_2H$	II-257	231.89
1868	propionic acid (α,β)	.....	$CH_2Br{\cdot}CHBr{\cdot}CO_2H$	II-258	231.89
1869	propylene (β,γ)	epidibromohydrin (α)	$CH_2{:}CBr{\cdot}CH_2Br$	I-201	199.89
1870	propylene (α,γ)	epidibromohydrin (β)	$CH_2Br{\cdot}CH{:}CHBr$	I-201	199.89
1871	propyne-1 (1,3)	.....	$CH_2Br{\cdot}C{\vdots}CBr$	I-248	197.88
1872	pyridine (2,5)	.....	$Br_2C_5H_3N$	XX-233	236.91
1873	pyridine (2,6)	.....	$Br_2C_5H_3N$	.....	236.91
1874	pyridine (3,5)(α)	.....	$Br_2C_5H_3N$	XX-233	236.91
1875	pyruvic acid	.....	$CHBr_2{\cdot}CO{\cdot}CO_2H$	III-624	245.88
1876	quinonechloroimide	(2,6)	$Cl{\cdot}N{:}C_6H_2{:}OBr_2$	VII-640	299.37
1877	succinic acid (***allo***)	.....	$Br_2C_2H_2(CO_2H)_2$	II-625	275.90
1878	succinic acid (***meso***)	.....	$(CHBr{\cdot}CO_2H)_2$	II-623	275.90
1879	thymol-sulfon-phthalein	bromthymol blue	$C_{27}H_{28}O_5Br_2S$	*XIX-650	624.39
1880	toluene (2,5)	.....	$Br_2C_6H_3{\cdot}CH_3$	V-308	249.95
1881	tyrosine (3,5)	*l* (–)	$C_9H_9O_3NBr_2{\cdot}2H_2O$	XIV-619	375.03
1882	*m*-xylene (4,6)	.....	$Br_2C_6H_2(CH_3)_2$	V-374	263.98
1883	**Dibutyl** adipate (*n*)	butyl adipate	$(CH_2CH_2CO_2{\cdot}C_4H_9)_2$	.....	258.35
1884	amine (*n*)	.....	$(C_4H_9)_2NH$	IV-157	129.24
1885	amine (***sec***)	.....	$(C_4H_9)_2NH$	IV-162	129.24
1886	amine (***iso***)	.....	$(C_4H_9)_2NH$	IV-166	129.24
1887	aminoethyl alcohol (β)(*n*)	.....	$(C_4H_9)_2N{\cdot}CH_2{\cdot}CH_2OH$	.....	173.29
1888	aminopropyl alcohol (β)(*n*)	.....	$(C_4H_9)_2N{\cdot}CH(CH_3){\cdot}CH_2OH$	.....	187.32
1889	aminopropyl alcohol (γ)(*n*)	.....	$(C_4H_9)_2N{\cdot}CH_2CH_2{\cdot}CH_2OH$	.....	187.32
1890	aminopropyl-*p*-aminobenzoate H_2SO_4	butyn	$H_2N{\cdot}C_6H_4{\cdot}CO_2{\cdot}(CH_2)_3{\cdot}N(C_4H_9)_2{\cdot}\frac{1}{2}H_2SO_4$	.....	355.47
1891	aniline (*n*)(*N*)	.....	$C_6H_5N(C_4H_9)_2$	*XII-160	205.33
1892	carbonate (*n*)	butyl carbonate	$CO(OC_4H_9)_2$	III-6	174.23
1893	carbonate (***iso***)	.....	$CO(OC_4H_9)_2$	III-6	174.23
1894	carbonate (***sec***)	.....	$CO(OC_4H_9)_2$	III-6	174.23
1895	cyanamide (*n*)	.....	$(C_4H_9)_2N{\cdot}CN$	.....	154.25
1896	α,α'-dibromo-succinate (*n*)	.....	$(CHBrCO_2C_4H_9)_2$	.....	388.11
1897	disulfide (*n*)	.....	$C_4H_9{\cdot}S{\cdot}S{\cdot}C_4H_9$	.....	178.34
1898	ether (*n*)	butyl ether	$(C_2H_5{\cdot}CH_2{\cdot}CH_2)_2O$	I-369	130.22

Dibromo-propanol 3388-9
Dibromo-propyl alcohol 3388-9
Dibromo-sulfobenzide 1835
Dibromo-xylene (ω) 6491-3

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1858	lq.	$1.573^{25°}$	7	$64\text{-}6^{16mm}$	.....	.....	.....
1859	cr.	.....	40	238-9	$0.2^{15°}$	v. s.	v. s.
1860	nd./aq.	.....	55-6	162^{21mm}	.....	v. s.	v. s.
1861	nd./aq.	.....	79-80	.....	.....	v. s.	v. s.
1862	cr./lg.	.....	81	.....	v. sl. s.	v. s.	v. s.
1863	lq.	.....	.....	130±	.....	.....	.....
1864	col. lq.	$1.933^{20°}_{4°}$	-55.5	141.6	$0.25^{20°}$	s.	v. s.
1865	lq.	$1.987^{15°}_{4°}$	-34.4	167.5	.....	s.	s.
1866	lq.	$1.783^{20°}$	.....	114.5^{740mm}	.....	.....	.....
1867	rhb.	.....	61	200-21 sl. d.	.....	.....	.....
1868	pl.	.....	64 (51)	220-40 d.	1945^{11mm}	v. s.	$304^{100°}$
1869	lq.	$1.934^{20°}_{4°}$	.....	140-2	.....	.....	.....
1870	lq.	$1.995^{25°}_{4°}$	-52	155-6	.....	.....	.....
1871	lq.	$2.137^{0°}$	.....	$73\text{-}4^{30mm}$	.....	.....	.....
1872	nd./al.	.....	94-5	subl.	i.	s.	s.
1873	cr.	.....	118-9	.....	.....	.....	.....
1874	cr./al.	.....	110-2; subl. >100	222	sl. s. h.	s. h.	s.; s. H_2SO_4
1875	nd./et.	.....	90-1	.....	s.	.....	.....
1876	yel. pr./al.	.....	83	d. 121	0.0006	sl. s. h.	sl. s. h. ac.
1877	cr.	.....	166-7	d. 180	$>2^{17°}$	v. s.	v. s.
1878	cr.	.....	255-6 * d.	subl. >250	$2.0^{17°}$	v. s.	v. s.
1879	yel. cr.	.....	.....	.....	v. sl. s.; s. a.	s.	i.; s. alk.
1880	lq.	$1.813^{19°}$	<-20	236	i.	.....	.....
1881	rhb./aq.	.....	245±, d.	$-2H_2O$, 120	$5^{16°}$; $3.9^{100°}$	v. sl. s.; s. a.	i.; s. alk.
1882	cr.	.....	72	255-6	i.	v. s. h.	.....
1883	col. lq.	$0.965^{20°}_{4°}$	-38	183^{14mm}	i.	∞	∞
1884	col. lq.	$0.768^{20°}_{20°}$	.....	159^{761mm}	∞	∞	∞
1885	col. lq.	$0.783^{0°}_{0°}$	.....	132^{758mm}	v. s.	.....	.....
1886	col. lq.	$0.741^{25°}_{4°}$	-70	139-40	v. sl. s.	s.	s.
1887	col. lq.	.....	.....	$91\text{-}6^{7mm}$	.....	.....	.....
1888	col. lq.	.....	.....	$80\text{-}6^{6mm}$	.....	.....	.....
1889	col. lq.	.....	.....	$110\text{-}6^{8mm}$	.....	.....	.....
1890	wh. pd.	.....	98-100	.....	100; sl. s. chl.	s.; s. act.	i.
1891	lq.	.....	.....	262.8	i.	∞	∞
1892	col. lq.	$0.924^{20°}$	.....	207^{740mm}	i.	s.	.....
1893	col. lq.	$0.919^{15°}$	.....	190	i.	.....	.....
1894	col. lq.	.....	.....	178-80	.....	.....	.....
1895	lq.	.....	.....	$128\text{-}30^{20mm}$	i.	s.	s.
1896	col. lq.	.....	.....	$171\text{-}4^{8mm}$	.....	.....	.....
1897	col. lq.	.....	.....	$117\text{-}8^{20mm}$	i.	∞	∞
1898	lq.	$0.769^{20°}_{20°}$	-98	142.4	<0.05	∞	∞

* In sealed tube.

Dibutyl carbinol (*n*) 4921

Dibutyl carbinol (*iso*) 4925

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
1899	**Dibutyl** ether (*iso*)	*iso*-butyl ether	$[(CH_3)_2CH\cdot CH_2]_2O$	I-376	130.22
1900	ketone (*n*)	nonanone-5	$(C_2H_5\cdot CH_2\cdot CH_2)_2CO$	*I-709	142.23
1901	ketone (*iso*)	valerone	$(C_4H_9)_2CO$	I-710	142.23
1902	*l*-malate (−)(*n*)	butyl malate	$C_4H_4O_5(C_4H_9)_2$	III-433	246.30
1903	maleate (*n*)	butyl maleate	$(CHCO_2C_4H_9)_2$	.....	228.28
1904	malonate (*n*)	butyl malonate	$CH_2(CO_2C_4H_9)_2$	II-581	216.27
1905	oxalate (*n*)	.....	$(CO_2C_4H_9)_2$	II-540	202.24
1906	oxalate (*iso*)	.....	$(CO_2C_4H_9)_2$	II-540	202.24
1907	phenyl-phenyl-phosphate (*tert*) (*p*)	phosphen-2	$(C_4H_9\cdot C_6H_4O)_2PO\cdot O\cdot C_6H_5$	.....	438.49
1908	*o*-phthalate (*n*)	butyl phthalate	$C_6H_4(CO_2C_4H_9)_2$	.....	278.34
1909	sebacate (*n*)	butyl sebacate	$[(CH_2)_4CO_2C_4H_9]_2$	II-719	314.45
1910	succinate (*n*)	butyl succinate	$(CH_2CO_2C_4H_9)_2$	.....	230.30
1911	succinate (*iso*)	.....	$(CH_2CO_2C_4H_9)_2$	II-611	230.30
1912	succinate (*sec*)	.....	$(CH_2CO_2C_4H_9)_2$	II-611	230.30
1913	sulfate (*n*)	butyl sulfate	$(C_4H_9O)_2SO_2$	.....	210.28
1914	sulfide (*n*)	butyl sulfide	$(C_2H_5\cdot CH_2CH_2)_2S$	I-370	146.28
1915	sulfide (*sec*)	.....	$(C_4H_9)_2S$	I-373	146.28
1916	sulfide (*iso*)	.....	$[(CH_3)_2CH\cdot CH_2]_2S$	I-379	146.28
1917	sulfite (*n*)	butyl sulfite	$(C_4H_9O)_2SO$	.....	194.28
1918	sulfone (*n*)	butyl sulfone	$(C_4H_9)_2SO_2$	I-371	178.28
1919	tartrate (*d*)(*n*)	butyl tartrate	$(CHOH\cdot CO_2C_4H_9)_2$	III-518	262.30
1920	tartrate (*d*)(*iso*)	.....	$(CHOH\cdot CO_2C_4H_9)_2$	III-518	262.30
1921	thiourea (*n*)	.....	$(C_4H_9\cdot NH)_2CS$	.....	188.33
1922	urea (*n*)(*N,N*)	.....	$(C_4H_9)_2N\cdot CO\cdot NH_2$	*IV-372	172.27
1923	**Di-*iso*-butylene** †	.....	$(CH_3)_2C{:}CH\cdot C(CH_3)_3$	I-222	112.21
1924	**Dicapryl adipate**	(*n*)(*sec*)	$[\cdot(CH_2)_2CO_2CH\cdot(CH_3)\cdot(CH_2)_5\cdot CH_3]_2$	.....	370.56
1925	**Dichloro**-acetal	.....	$Cl_2CH\cdot CH(OC_2H_5)_2$	I-614	187.07
1926	acetaldehyde	2,2-dichloro-ethanal	$Cl_2CH\cdot CHO$	I-613	112.95
1927	acetamide	.....	$Cl_2CH\cdot CO\cdot NH_2$	II-205	127.97
1928	acetic acid	.....	$Cl_2CH\cdot CO_2H$	II-202	128.95
1929	acetone (α)(*uns*)	.....	$Cl_2CH\cdot CO\cdot CH_3$	I-654	126.98
1930	acetone (β)(*sym*)	.....	$(ClCH_2)_2CO$	I-655	126.98
1931	acetyl chloride	.....	$Cl_2CH\cdot CO\cdot Cl$	II-204	147.40
1932	aniline (2,3)	.....	$Cl_2C_6H_3\cdot NH_2$	XII-621	162.02
1933	aniline (2,4)	.....	$Cl_2C_6H_3\cdot NH_2$	XII-621	162.02
1934	aniline (2,5)	.....	$Cl_2C_6H_3\cdot NH_2$	XII-625	162.02
1935	aniline (2,6)	.....	$Cl_2C_6H_3\cdot NH_2$	XII-626	162.02
1936	aniline (3,4)	.....	$Cl_2C_6H_3\cdot NH_2$	XII-626	162.02
1937	aniline (3,5)	.....	$Cl_2C_6H_3\cdot NH_2$	XII-626	162.02
1938	aniline sulfonic	3,6-diCl-sulfanilic	$Cl_2C_6H_2(NH_2)SO_3H$	XIV-707	242.08
1939	anthracene (2,3)	.....	$C_{14}H_8Cl_2$	V-664	247.12
1940	anthracene (9,10)	.....	$C_{14}H_8Cl_2$	V-664	247.12
1941	anthraquinone (1,3)	.....	$C_6H_4(CO)_2C_6H_2Cl_2$	VII-787	277.10
1942	anthraquinone (1,4)	.....	$C_6H_4(CO)_2C_6H_2Cl_2$	VII-787	277.10
1943	anthraquinone (1,5)	.....	$(ClC_6H_3)_2(CO)_2$	VII-787	277.10
1944	anthraquinone (1,6)	.....	$(ClC_6H_3)_2(CO)_2$	*VII-412	277.10
1945	anthraquinone (1,8)	.....	$(ClC_6H_3)_2(CO)_2$	VII-788	277.10
1946	anthraquinone (2,3)	.....	$C_6H_4(CO)_2C_6H_2Cl_2$	VII-788	277.10
1947	anthraquinone (2,6)	.....	$(ClC_6H_3)_2(CO)_2$	VII-788	277.10
1948	anthraquinone (2,7)	.....	$(ClC_6H_3)_2(CO)_2$	VII-788	277.10

† See also octylene.

'Dibutyl mercury 4042

Dibutyl urethane 3038

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1899	lq.	$0.762^{15°}$	.....	122-2.5	i.	∞	∞
1900	lq.	$0.827^{\frac{1}{4}\frac{3}{4}°}$	.....	188-92	i.; v. s. CS_2	v. s. chl.	v. s.
1901	oil	$0.805^{\frac{2}{4}\frac{1}{4}°}$	.....	168.1	<0.06	∞	∞
1902	lq.	$1.038^{\frac{2}{4}\frac{0}{4}°}$	.....	170-1 ^{13mm}	v. sl. s.	.....	.....
1903	col. lq.	.....	.....	141-2 ^{9mm}	.....	.....	.....
1904	lq.	$1.005^{\frac{0}{0}°}$	.....	251.5	i.	s.	s.
1905	col. lq.	$1.010^{\frac{0}{0}°}$	−29.6	243	i.	s.	s.
1906	col. lq.	$1.002^{14°}$	.....	228-9	i.	s.	s.
1907	col. lq.	$1.11^{\frac{2}{2}\frac{5}{5}°}$	<0	260-75 ^{5mm}	i.; ∞ CCl_4	v. s.	∞ bz.
1908	col. lq.	$1.045^{21°}$	.....	340	$0.04^{25°}$	∞ ; ∞ bz.	∞ ; ∞ act.
1909	lq.	$0.933^{15°}$	.....	344-5	.....	.....	.....
1910	lq.	$0.965^{20°}$	−29.3	274.5	.....	.....	.....
1911	col. lq.	$0.974^{15°}$	.....	265-6	.....	.....	.....
1912	col. lq.	$0.974^{\frac{2}{4}\frac{0}{4}°}$	.....	256-7 ^{750mm}	.....	.....	.....
1913	col. lq.	$1.059^{\frac{2}{2}\frac{5}{5}°}$	.....	130-2 ^{11mm}	i.	.....	.....
1914	lq.	$0.839^{\frac{1}{0}\frac{6}{0}°}$	−79.7	182	i.	.....	.....
1915	lq.	$0.832^{23°}$	.....	165	.....	.....	.....
1916	lq.	$0.836^{100°}$	.....	172-3 ^{747mm}	i.	∞	∞
1917	col. lq.	.....	.....	108-10 ^{15mm}	.....	.....	.....
1918	pl./aq.	.....	44	.....	v. sl. s.	.....	.....
1919	pr.	$1.098^{15°}$	22-2.5	200-3 ^{18mm}	.....	.....	.....
1920	cr.	$1.031^{\frac{7}{4}\frac{5}{4}°}$	73-4	323-5	.....	.....	.....
1921	col. nd./al.	.....	66-7	.....	i.	s.	sl. s.
1922	col. hyg. cr.	.....	149-50	118-9 ^{2mm}	.....	s.	s.
1923	col. lq.	$0.721^{\frac{2}{4}\frac{0}{4}°}$	−106.5	102.5 ^{756mm}	.....	.....	.....
1924	lt. yel. lq.	.....	.....	192-4 ^{3mm}	.....	.....	.....
1925	lq.	$1.138^{14°}$	.....	183-4	.....	.....	.....
1926	col. lq.*	.....	.....	88-90	i.	.....	.....
1927	mn. pr.	.....	98	233-4 ^{745mm}	v. s. h.	v. s.	v. s.
1928	lq.	$1.560^{\frac{2}{2}\frac{5}{5}°}$	9.7 (−4)	194.4	∞	∞	∞
1929	lq.	$1.234^{15°}$	.....	120	v. sl. s.	s.	s.
1930	pl. or nd.	$1.383^{\frac{4}{4}\frac{6}{4}°}$	45	173.0-3.4	s.	v. s.	v. s.
1931	lq.	.....	.....	107-8	d.	d.	∞
1932	nd./lg.	.....	23-4	252	sl. s. bz.	s.	v. sl. s.
1933	rhb.	$1.567^{\frac{2}{4}\frac{0}{4}°}$	62-3	245 ^{759mm}	sl. s.	s.	s.
1934	nd./lg.	.....	50	251	v. sl. s.	s.	s.
1935	nd./al.	.....	39	.....	.....	.....	.....
1936	nd./lg.	.....	71.5	272	i.; sl. s. bz.	$70^{25°}$	v. s.
1937	nd.	.....	50.5	259-60	i.	s.	.....
1938	nd./aq.	.....	.....	.....	s. h.	.....	.....
1939	yel. lf.	.....	255	subl. sl. d.	s. ac.	s. h.	.....
1940	yel. nd.	.....	209-10	.....	s. bz.	sl. s.	sl. s.
1941	yel. nd./ac.	.....	208-9	.....	i.; s. ac.	i.	s. $PhNO_2$
1942	yel. nd./ac.	.....	187.5	.....	i.; s. h. bz.	v. sl. s.	v. sl. s.
1943	yel. nd./ ac.	.....	251	.....	i.; s. H_2SO_4	sl. s.	s. PhMe
1944	yel. nd./ac.	.....	203-4	.....	i.	.....	.....
1945	pa. yel. nd.	.....	202-3	.....	s. PhMe	sl. s.	s. $PhNO_2$
1946	yel. nd./ac.	.....	268-70	.....	i.	sl. s.	s. h. bz.
1947	yel. nd./ac.	.....	282	.....	i.	.....	.....
1948	yel. nd.	.....	210-1	.....	i.	s. PhOMe	.....

* Polymerizes on standing.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Dichloro				
1949	azo-dicarbonamide	azochloramide	$[Cl{\cdot}N{:}C(NH_2){\cdot}N{:}]_2$	.....	183.01
1950	azoxybenzene	(4,4′)	$(ClC_6H_4)_2N_2O$	XVI-625	267.11
1951	barbituric acid (5,5)	dichloromalonyl-urea	$Cl_2C(CONH)_2CO$	XXIV-472	196.99
1952	benzene (*o*)	.....	$C_6H_4Cl_2$	V-201	147.01
1953	benzene (*m*)	.....	$C_6H_4Cl_2$	V-202	147.01
1954	benzene (*p*)	.....	$C_6H_4Cl_2$	V-203	147.01
1955	benzene sulfonic acid (2,5)	.....	$Cl_2C_6H_3{\cdot}SO_3H$	XI-55	227.07
1956	benzene sulfonyl chloride (3,4)	.....	$Cl_2C_6H_3{\cdot}SO_2Cl$	*XI-16	245.52
1957	benzidine (3,3′)	.....	$(H_2N{\cdot}C_6H_3Cl)_2$	XIII-234	253.13
1958	benzidine HCl	(3,3′)	$C_{12}H_{10}N_2Cl_2{\cdot}2HCl$	XIII-234	326.06
1959	benzoic acid (2,3)	.....	$Cl_2C_6H_3{\cdot}CO_2H$	IX-342	191.02
1960	benzoic acid (2,4)	.....	$Cl_2C_6H_3{\cdot}CO_2H$	IX-342	191.02
1961	benzoic acid (2,5)	.....	$Cl_2C_6H_3{\cdot}CO_2H$	IX-342	191.02
1962	benzoic acid (2,6)	.....	$Cl_2C_6H_3{\cdot}CO_2H$	IX-343	191.02
1963	benzoic acid (3,4)	.....	$Cl_2C_6H_3{\cdot}CO_2H$	IX-343	191.02
1964	benzoic acid (3,5)	.....	$Cl_2C_6H_3{\cdot}CO_2H$	IX-344	191.02
1965	benzophenone (2,4′)	.....	$(Cl{\cdot}C_6H_4)_2CO$	VII-420	251.11
1966	benzophenone (4,4′)	.....	$(Cl{\cdot}C_6H_4)_2CO$	VII-420	251.11
1967	benzoylene urea (6,8)	Sheibley's reagent	$Cl_2C_6H_2{\cdot}NH{\cdot}CO{\cdot}NH{\cdot}CO$	.....	231.04
1968	1-bromoethane (1,1)	.....	$CH_3{\cdot}CCl_2Br$	I-90	177.87
1969	1-bromoethane (2,2)	.....	$Cl_2CH{\cdot}CH_2Br$	I-90	177.87
1970	bromomethane	.....	Cl_2CHBr	I-67	163.85
1971	butane (1,1)(*n*)	butylidene di-chloride	$C_2H_5CH_2CHCl_2$	I-119	127.02
1972	butane (1,2)(*n*)	butylene chloride	$C_2H_5{\cdot}CHCl{\cdot}CH_2Cl$	*I-38	127.02
1973	butane (1,4)(*n*)	tetramethylene diCl	$ClCH_2(CH_2)_2CH_2Cl$	I-119	127.02
1974	butane (*iso*)	1,1-dichloro-2-methyl-propane	$(CH_3)_2CH{\cdot}CHCl_2$	I-126	127.02
1975	butane (*iso*)	1,3-dichloro-2-methyl-propane	$(ClCH_2)_2CH{\cdot}CH_3$	.....	127.02
1976	butane (*iso*)	1,2-dichloro-2-methyl-propane	$(CH_3)_2CCl{\cdot}CH_2Cl$	I-126	127.02
1977	butyl alcohol (*tert*)	.....	$(CH_2Cl)_2COH{\cdot}CH_3$	I-382	143.02
1978	butyric acid (α,β)	crotonic acid diCl	$CH_3(CHCl)_2CO_2H$	II-279	157.00
1979	butyric acid	*iso*-crotonic acid diCl	$CH_3(CHCl)_2CO_2H$	II-279	157.00
1980	1,2-dibromoethane	(1,1)	$BrCH_2{\cdot}CBrCl_2$	I-93	256.78
1981	1,2-dibromoethane	(1,2)	$ClBrCH{\cdot}CHBrCl$	I-93	256.78
1982	1,1-dibromoethane	(2,2)	$Br_2CH{\cdot}CHCl_2$	I-93	256.78
1983	dibromomethane	.....	Cl_2CBr_2	I-68	242.76
1984	diethyl carbonate	(β,β')	$(ClCH_2CH_2O)_2CO$	.....	187.03
1985	diethyl sulfide (β,β')	mustard gas	$(Cl{\cdot}CH_2CH_2)_2S$	I-349	159.08

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1949	yel. nd.	.....	expl. 155	.....	i.	s.	sl. s.
1950	yel. nd./al.	.....	155-6	subl.	i.	sl. s.	s.
1951	rhb. pr./aq.	.....	219-20 d.	.....	sl. s.; v. sl. s. bz.	v. s.; v. sl. s. chl.	v. s.; v. s. ac.
1952	col. lq.	$1.305^{\frac{20}{4}°}$	−17.6	179	i.; ∞ bz.	∞	∞
1953	col. lq.	$1.288^{\frac{20}{4}°}$	−24.8	172^{766mm}	i.	s.	s.
1954	col. mn.	$1.458^{21°}$	53	174^{764mm}	i.; s. bz.	∞ h. abs.	v. s.
1955	nd./aq.	.....	>100	.....	v. s.	.....	v. sl. s.
1956	mn./bz.	.....	22.4	$170\text{-}4^{20mm}$	d.	d.	.....
1957	nd./al.	.....	132-3	.....	i.	s.; s. bz.	s. ac.
1958	nd.	.....	.....	.....	v. sl. s.	s.	.....
1959	nd.	.....	166	.....	sl. s. h.	s.	s.
1960	nd./aq.	.....	164	subl.	s. h.	s.	s.
1961	nd./aq.	.....	154	301	$0.09^{14°}$	s.	s. alk.
1962	nd./al.	.....	140-3	subl.	s. h.	s. bz.	s. alk.
1963	nd./aq.	.....	203-4	.....	s. h.	v. s.	s. alk.
1964	nd./al.	.....	182-3	subl.	.....	v. s.	.....
1965	col. mn./al.	$1.393^{14°}$	66-7	$214\text{-}5^{22mm}$	i.; s. act.	$190^{25°}$ bz.	$48^{25°}$
1966	col. lf./al.	.....	145	353^{757mm}	i.; s. act.	$12^{35°}$ bz.	$2^{25°}$
1967	col. nd./al.	.....	296	.....	i.; i. aq. NaOH	1 h.; s. aq. KOH	i.; v. sl. s. h. gly.
1968	lq.	$1.752^{16°}$	.....	$98\text{-}9^{758mm}$	.....	.....	.....
1969	lq.	.....	.....	138	.....	.....	.....
1970	col. lq.	$1.925^{15°}$	−56	91-2	.....	.....	.....
1971	oil	.....	.....	113-5	i.	s.	s.; s. chl.
1972	lq.	.....	.....	121-5	.....	.....	.....
1973	lq.	.....	.....	161-3	.....	.....	.....
1974	lq.	$1.011^{12°}$	.....	103-5 d.	.....	.....	.....
1975	col. lq.	$1.138^{20°}$	.....	135-9	.....	.....	.....
1976	col. lq.	$1.097^{20°}$	.....	107-8	.....	.....	.....
1977	col. lq.	$1.277^{\frac{20}{4}°}$	.....	174-5	8.2	s.	s.
1978	pr.	.....	62.5-3.0	$124\text{-}5^{20mm}$	sl. s.	v. s.	$328^{10.5°}$
1979	long pr.	.....	78 (73)	131.5^{20mm}	sl. s.	v. s.	v. s.
1980	lq.	$2.270^{16°}$	.....	176-8	i.	.....	.....
1981	lq.	.....	−26	194-5	i.	.....	.....
1982	lq.	$2.391^{19°}$	.....	195-200	i.	.....	.....
1983	nd.	$2.42^{\frac{25}{0}°}$	22	135 ±	i.	.....	.....
1984	pa. yel. lq.	.....	.....	$109\text{-}12^{12mm}$	.....	.....	.....
1985	col. oil	$1.199^{\frac{1}{4}°}$	8	217 sl. d.	v. sl. s.	s.	.....

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Dichloro				
1986	diiodomethane	.....	Cl_2CI_2	I-72	336.76
1987	2,2'-dinitrodiphenyl disulfide	(4,4')	$(O_2N{\cdot}C_6H_3Cl{\cdot}S)_2$	VI-341	377.22
1988	dioxane (2,3)	.....	$O{\cdot}(CHCl)_2O(CH_2)_2$	.....	157.00
1989	diphenyl (3,3')	.....	$Cl{\cdot}C_6H_4{\cdot}C_6H_4{\cdot}Cl$	V-579	223.10
1990	diphenyl (4,4')	.....	$Cl{\cdot}C_6H_4{\cdot}C_6H_4{\cdot}Cl$	V-579	223.10
1991	dipropyl ether (*n*)	(γ,γ')	$(ClCH_2CH_2CH_2)_2O$	.....	171.07
1992	dipropyl ether (*iso*)	(β,β')	$[ClCH_2(CH_3)CH]_2O$	.....	171.07
1993	ethane (1,1)	ethylidene dichloride	$CH_3{\cdot}CHCl_2$	I-83	98.97
1994	ethane (1,2)	ethylene chloride	$ClCH_2{\cdot}CH_2Cl$	I-84	98.97
1995	ether (α,β)	.....	$ClCH_2{\cdot}CHCl{\cdot}O{\cdot}C_2H_5$	I-612	143.02
1996	ether (β,β')(*sym*)	diCl-Et ether	$(ClCH_2{\cdot}CH_2)_2O$	.....	143.02
1997	ethyl alcohol (β,β)	2,2-dichloroethanol-1	$Cl_2CH{\cdot}CH_2OH$	I-338	114.97
1998	ethylene (α,α)	1,1-dichloro-ethene	$CH_2{:}CCl_2$	I-186	96.95
1999	fluorescein (2,7)	.....	$C_{20}H_{10}O_5Cl_2$	*XIX-722	401.19
2000	fluorescein (3',6')	.....	$C_{20}H_{10}O_5Cl_2$	XIX-227	401.19
2001	hexane	2,3-dichloro-2,3-dimethyl-butane	$[(CH_3)_2CCl]_2$	I-152	155.07
2002	hexane	3,3-dichloro-2,2-dimethyl-butane	$(CH_3)_3C{\cdot}CCl_2{\cdot}CH_3$	I-150	155.07
2003	hydroquinone (2,3)	.....	$(HO)_2C_6H_2Cl_2$	VI-849	179.01
2004	hydroquinone (2,5)	.....	$(HO)_2C_6H_2Cl_2$	VI-850	179.01
2005	1-iodoethane (2,2)	.....	$ICH_2{\cdot}CHCl_2$	I-98	224.88
2006	iodomethane	.....	Cl_2CHI	I-71	210.85
2007	maleic acid	.....	$(:CCl{\cdot}CO_2H)_2$	II-753	184.97
2008	methyl ether (*sym*)	.....	$ClCH_2{\cdot}O{\cdot}CH_2Cl$	I-582	114.97
2009	naphthalene (1,2)	.....	$C_{10}H_6Cl_2$	V-542	197.06
2010	naphthalene (1,3)	θ-dichloronaphthalene	$C_{10}H_6Cl_2$	V-542	197.06
2011	naphthalene (1,4)	β-dichloronaphthalene	$C_{10}H_6Cl_2$	V-542	197.06
2012	naphthalene (1,5)	γ-dichloronaphthalene	$C_{10}H_6Cl_2$	V-543	197.06
2013	naphthalene (1,6)	η-dichloronaphthalene	$C_{10}H_6Cl_2$	V-543	197.06
2014	naphthalene (1,7)	θ'-dichloronaphthalene	$C_{10}H_6Cl_2$	V-543	197.06
2015	naphthalene (1,8)	ζ-dichloronaphthalene	$C_{10}H_6Cl_2$	V-544	197.06
2016	naphthalene (2,3)	ι-dichloronaphthalene	$C_{10}H_6Cl_2$	V-544	197.06
2017	naphthalene (2,6)	ϵ-dichloronaphthalene	$C_{10}H_6Cl_2$	V-544	197.06
2018	naphthalene (2,7)	δ-dichloronaphthalene	$C_{10}H_6Cl_2$	V-544	197.06
2019	α-naphthol (2,4)	.....	$Cl_2C_{10}H_5OH$	VI-612	213.06
2020-	α-naphthoquinone	(2,3)	$O{:}C_{10}H_4Cl_2{:}O$	VII-729	227.05

Dichloro-ethanal 1926
Dichloro-ethane 1993-4
Dichloro-ethanol 1997
Dichloro-ethene 135-6, 1998
Dichloro-ethyl ether 1996
Dichloro-ethylene 135-6

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
1986	scales	.....	85 d.	.....	i.	s. d.	.....
1987	yel. cr./ act.-al.	.....	213-4	.....	v. sl. s. CS_2	v. sl. s.	v. sl. s. lg.; sl. s. bz.
1988	col. lq.	.....	.....	88-9^{19mm}	.....	.....	.....
1989	nd./al.	.....	23	322-4	i.	v. s.	v. s.
1990	pr. or nd.	1.439	148	315-9	i.; 14$^{25°}$bz.	v. sl. s.	4$^{25°}$
1991	oil	$1.140^{\frac{20°}{20°}}$	.....	215^{745mm}	.....	.....	.....
1992	col. lq.	$1.112^{\frac{20°}{20°}}$	.....	187.3	0.17$^{20°}$	.....	.....
1993	col. lq.	$1.175^{\frac{20°}{4°}}$	−96.7	57.3	0.7$^{00°}$; 0.5$^{30°}$	∞	∞
1994	col. lq.	$1.256^{\frac{20°}{20°}}$	−35.3	83.7	0.9$^{00°}$; 0.9$^{30°}$	∞ ; ∞ chl.	∞
1995	lq.	1.174$^{23°}$	.....	140-5	.....	.....	.....
1996	lq.	$1.222^{\frac{20°}{20°}}$	.....	178.5	1.07$^{20°}$	s.	s.
1997	lq.	1.145$^{15°}$	.....	146	sl. s.	s.	s.
1998	lq.	1.250$^{15°}$	.....	37	i.	.....	.....
1999	or. pd.	.....	.....	.....	sl. s.	sl. s.	sl. s.
2000	or. pd.	.....	.....	.....	v. s. alk.	.....	.....
2001	cr.	.....	159-60	.....	i.	.....	.....
2002	cr.	.....	151	subl.	i.	.....	.....
2003	nd./aq.	.....	144-5	subl.	i. c. lg.	s.	s.
2004	mn. nd./ act.	1.815$^{24°}$	166-70	subl.	s. h.; s. ac.	v. s.	v. s.
2005	lq.	2.219	.....	171-2	i.	.....	.....
2006	lq.	2.403$^{21.5°}$	.....	131	i.	.....	.....
2007	nd.	.....	d. 119-20	.....	v. s.; i. chl.	v. s.	v. s.
2008	col. lq.	$1.328^{\frac{15°}{4°}}$	.....	104-5	d.	.....	.....
2009	nd./al.	$1.315^{\frac{18.2°}{4°}}$	37	282	.....	.....	.....
2010	nd./al.	.....	61.5	291^{775mm}	.....	.....	.....
2011	nd./al.	$1.300^{\frac{78°}{4°}}$	67-8	286-7^{740mm}	v. s. act.	v. sl. s.	.....
2012	lf./al.	.....	107	.....	i.	s.	s.
2013	nd./al.	.....	48-9	.....	.....	.....	.....
2014	lf./aq. al.	$1.261^{\frac{100°}{4°}}$	63-4	285-6	.....	s.	s.
2015	cr./al.	$1.292^{\frac{100°}{4°}}$	88	d.	.....	.....	.....
2016	lf.	.....	120	.....	.....	s. h.	s.
2017	nd./al.	.....	135-6	285	.....	sl. s.	v. s.
2018	pr.	.....	114	.....	.....	v. s. h.	.....
2019	nd./aq. al.	.....	106-7	.....	s. bz.	s.; s. ac.	s.
2020	yel. nd./al.	.....	192-3	.....	i.	s. h.	sl. s.

Dichloro-fluoran 3252
Dichloro-hydrin 3393-4
Dichloro-malonyl urea 1951
Dichloro-methane 4429

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Dichloro				
2021	4-nitroaniline	(2,6;4,1)	$Cl_2C_6H_2(NO_2)NH_2$	XII-735	207.02
2022	nitrobenzene (2,4)	NO_2-Cl-benzene	$Cl_2C_6H_3 \cdot NO_2$	V-245	192.01
2023	nitrobenzene (2,5)	.....	$Cl_2C_6H_3 \cdot NO_2$	V-245	192.01
2024	nitrobenzene (2,6)	.....	$Cl_2C_6H_3 \cdot NO_2$	V-246	192.01
2025	nitrobenzene (3,4)	.....	$Cl_2C_6H_3 \cdot NO_2$	V-246	192.01
2026	nitrobenzene (3,5)	.....	$Cl_2C_6H_3 \cdot NO_2$	V-246	192.01
2027	1-nitroethane (1,1)	.....	$Cl_2C(NO_2) \cdot CH_3$	.....	143.97
2028	nitrohydrin	diCl-Pr-nitrate	$ClCH_2 \cdot CHCl \cdot CH_2 \cdot NO_3$	I-356	173.99
2029	nitrophenol	(4,6;2,1)	$Cl_2C_6H_2(NO_2)OH$	VI-241	208.01
2030	nitrophenol	(2,6;4,1)	$Cl_2H_6H_2(NO_2)OH$	VI-241	208.01
2031	nitropropane	(1,1,1)	$C_2H_5 \cdot C(NO_2)Cl_2$	.....	157.99
2032	1-nitrosoethane (1,1)	.....	$CH_3 \cdot CCl_2 \cdot NO$	I-99	127.97
2033	pentane (1,4)	.....	$CH_3CHCl(CH_2)_3Cl$	I-131	141.04
2034	pentane (1,5)	amylene chloride	$ClCH_2(CH_2)_3CH_2Cl$	I-131	141.04
2035	pentane (2,3)	.....	$C_2H_5(CHCl)_2CH_3$	I-131	141.04
2036	pentane (2,4)	.....	$(CH_3CHCl)_2:CH_2$	*I-43	141.04
2037	pentane	1,4-dichloro-2-methyl-butane	$ClCH_2 \cdot CH(CH_3) \cdot CH_2 \cdot CH_2Cl$	*I-47	141.04
2038	pentane	2,3-dichloro-2-methyl-butane	$(CH_3)_2CCl \cdot CHCl \cdot CH_3$	I-135	141.04
2039	pentane	2,4-dichloro-2-methyl-butane	$(CH_3)_2CCl \cdot CH_2 \cdot CH_2Cl$	I-135	141.04
2040	pentane	3,4-dichloro-2-methyl-butane	$(CH_3)_2CH \cdot CHCl \cdot CH_2Cl$	I-135	141.04
2041	pentane	4,4-dichloro-2-methyl-butane	$(CH_3)_2CH \cdot CH_2 \cdot CHCl_2$	I-135	141.04
2042	phenol (2,4)	.....	$Cl_2C_6H_3 \cdot OH$	VI-189	163.01
2043	phenyl-3,4-dichlorobenzene sulfonate (2,4)	.....	$Cl_2C_6H_3SO_3 \cdot C_6H_3Cl_2$	.....	372.06
2044	phenylhydrazine	(2,5)	$Cl_2C_6H_3 \cdot NH \cdot NH_2$	XV-431	177.04
2045	phenylhydrazine-4-sulfonic acid	(2,5)	$Cl_2C_6H_2(SO_3H) \cdot NH \cdot NH_2$	XV-643	257.10
2046	phenyl-phenyl phosphate (o,o')	phosphen 4	$C_6H_5 \cdot O \cdot PO:(ClC_6H_4 \cdot O)_2$	.....	395.18
2047	phenyl-4-toluene sulfonate	.....	$CH_3 \cdot C_6H_4 \cdot SO_3 \cdot C_6H_3Cl_2$	.....	317.18
2048	*p*-phenylenediamine	(2,6)	$Cl_2C_6H_2(NH_2)_2$	XIII-118	177.04
2049	*p*-phenylenediamine HCl	(2,6)	$Cl_2C_6H_2(NH_2)_2 \cdot HCl$	.....	213.50
2050	propane (1,1)	propylidene diCl	$C_2H_5 \cdot CHCl_2$	I-105	112.99
2051	propane (1,2)	propylene chloride	$CH_3 \cdot CHCl \cdot CH_2Cl$	I-105	112.99
2052	propane (1,3)	trimethylene diCl	$ClCH_2 \cdot CH_2 \cdot CH_2Cl$	I-105	112.99
2053	propane (2,2)	acetone chloride	$(CH_3)_2CCl_2$	I-105	112.99
2054	propionic acid (α,α)	.....	$CH_3 \cdot CCl_2 \cdot CO_2H$	II-250	142.98
2055	propionic acid (α,β)	.....	$ClCH_2 \cdot CHCl \cdot CO_2H$	II-252	142.98
2056	propionitrile (α,α)	.....	$CH_3 \cdot CCl_2 \cdot CN$	II-251	123.98
2057	propyl carbonate	(γ,γ')	$[Cl(CH_2)_3O]_2CO$	.....	215.08
2058	propylene (α,α)	1,1-diCl-propene-1	$CH_3 \cdot CH:CCl_2$	I-199	110.98
2059	propylene (α,β)	allylene dichloride	$CH_3 \cdot CCl:CHCl$	I-199	110.98

Dichloro-propanol 3393-4
Dichloro-propene 2058-61
Dichloro-propyl acetate 45
Dichloro-propyl carbamate 171

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2021	yel. nd./ac.	.....	194-5	.....	i. h. HCl	s.	.....
2022	nd./al.	$1.439^{80°}$	33	258.5	i.	v. s. h.	∞
2023	tri./al.	$1.669^{22°}$	54.6	266	i.	v. s. h.	v. s. bz.
2024	mn. pr.	$1.603^{17°}$	72.5	130^{8mm}	i.	s.	s. CS_2
2025	nd./al.	$1.456^{\frac{7}{4}5°}$	42-3(α)*	255-6	.....	.....	.....
2026	yel. mn.	$1.692^{14°}$	65.4	.....	i.	s.	s. ac.
2027	lq.	$1.405^{\frac{20°}{20°}}$	.....	122-5	<0.5$^{20°}$	.....	.....
2028	lq.	$1.37^{0°}$	.....	180	.....	.....	.....
2029	yel. mn./al.	$1.822^{\frac{20°}{4°}}$	122-3	subl. <100	sl. s.	sl. s.; s. bz.	s; s. chl.
2030	yel. pl./et.	.....	125 d.	.....	i.; sl. s. bz.	s. h.	v. s.
2031	lq.	$1.314^{\frac{20°}{20°}}$	.....	141-4	<0.5$^{20°}$	.....	.....
2032	b. oil	$1.252^{19°}$	.....	68	i.	.....	.....
2033	col. lq.	.....	.....	$58\text{-}60^{15mm}$	i.	∞	∞
2034	col. lq.	$1.094^{\frac{25°}{4°}}$	.....	180-1	i.; s. CS_2	s.; s. chl.	s.
2035	col. lq.	.....	.....	138-9	i.	∞	∞
2036	col. lq.	$1.063^{18°}$	.....	147-50	i.	∞	∞
2037	col. lq.	.....	.....	170-2	i.	∞	∞
2038	lq.	$1.068^{\frac{15°}{4°}}$	.....	130-5	i.	∞	∞
2039	col. lq.	$1.065^{\frac{20°}{4°}}$	.....	152-4 sl. d.	i.	∞	∞
2040	col. lq.	$1.092^{17.5°}$	.....	143-5	i.	∞	∞
2041	col. lq.	$1.05^{24°}$	.....	130	i.	∞	∞
2042	nd./bz.	$1.383^{\frac{60°}{25°}}$	45	209-10	0.45$^{20°}$ v. s. chl.	v. s.; $160^{25°}$ CCl_4	v. s.; v. s. bz.
2043	col. cr.	.....	81-2	.....	i.	s. h.	s.
2044	nd./aq.	.....	105	.....	sl. s. h.	s.	s.; s. ac.
2045	nd./aq. HCl	.....	.....	.....	.....	.....	.....
2046	col. lq.	$1.34^{\frac{25°}{25°}}$	<0	$255\text{-}75^{mm}$	i.; ∞ bz.	v. s.	∞ CCl_4
2047	col. nd.	.....	118-9	.....	i.	s. h.	i.
2048	nd./aq. al.	.....	123.5	.....	.....	s.	s.
2049	col. pd.	.....	.....	.....	s.	sl. s.	i.
2050	lq.	$1.143^{100°}$	.....	87	v. sl. s.	s.	.....
2051	col. lq.	$1.159^{\frac{20°}{0°}}$	<-70	96.8	0.27$^{20°}$	v. s.	v. s.
2052	lq.	$1.201^{15°}$	.....	119^{740mm}	i.	s.	s.
2053	lq.	$1.093^{\frac{20°}{0°}}$	-34.6	69.7	i.	s.	∞ CS_2
2054	col. lq.	.....	.....	185-90	v. s.	v. s.	.....
2055	nd.	.....	50	210 d.	s.	s.	.....
2056	col. lq.	$1.431^{15°}$	.....	105	i.	∞	∞
2057	col. lq.	.....	.....	265-70	.....	.....	.....
2058	lq.	$1.176^{\frac{18.5°}{0°}}$	.....	78	i.	.....	.....
2059	lq.	.....	.....	75	i.	.....	.....

*β modification, liquid, changes to α at 15°.
Dichloro-propyl nitrate 2028

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Dichloro				
2060	propylene (β,γ)	epidichlorohydrin (α)	$CH_2{:}CCl{\cdot}CH_2Cl$	I-199	110.98
2061	propylene (α,γ)	epidichlorohydrin (β)	$CH_2Cl{\cdot}CH{:}CHCl$	I-199	110.98
2062	quinazoline (2,4)	.....	$C_6H_4{\cdot}N{:}CCl{\cdot}N{:}CCl$	XXIII-176	199.04
2063	quinoline (2,3)	.....	$C_9H_5NCl_2$	XX-361	198.05
2064	quinoline (2,4)	.....	$C_9H_5NCl_2$	XX-361	198.05
2065	quinoline (2,7)	.....	$C_9H_5NCl_2$	XX-361	198.05
2066	quinoline (5,6)	.....	$C_9H_5NCl_2$	XX-361	198.05
2067	quinoline (5,8)	.....	$C_9H_5NCl_2$	XX-362	198.05
2068	quinoline (6,8)	.....	$C_9H_5NCl_2$	XX-362	198.05
2069	quinoline (7,8)	.....	$C_9H_5NCl_2$	.....	198.05
2070	quinone (2,5)	.....	$Cl_2C_6H_2O_2$	VII-633	176.99
2071	quinone (2,6)	.....	$Cl_2C_6H_2O_2$	VII-633	176.99
2072	quinone-chloro-imide	.....	$O{:}C_6H_2Cl_2{:}NCl$	VII-634	210.46
2073	tetrabromoethane	(2,2;1,1,1,2)	$Br_3C{\cdot}CCl_2Br$	I-95	414.60
2074	*p*-toluenesulfon-amide (*N,N*)	dichloramine T	$CH_3{\cdot}C_6H_4{\cdot}SO_2NCl_2$	.....	240.11
2075	tribromoethane	.....	$Br_2CCl{\cdot}CHBrCl$	I-94	335.69
2076	tribromoethane	.....	$Br_2CH{\cdot}CCl_2Br$	I-94	335.69
2077	tyrosine (3,5)(*dl*)	.....	$Cl_2C_6H_2(OH){\cdot}CH_2{\cdot}CHNH_2CO_2H{\cdot}2H_2O$	*XIV-670	286.12
2078	**Dicinnamalacetone**	.....	$[C_6H_5(CH{:}CH)_2]_2CO$	VII-524	286.35
2079	**Dicresol** (*o*)	4,4′-diOH;3,3′-diMe	$(CH_3{\cdot}C_6H_3OH)_2$	VI-1009	214.25
2080	**Dicyandiamide**	param	$H_2N{\cdot}C(:NH){\cdot}NH{\cdot}CN$	III-91	84.08
2081	**Dicyano**-diamidine	guanyl urea; biuret-amidine	$H_2N{\cdot}C(:NH){\cdot}NH{\cdot}CONH_2$	III-89	102.10
2082	diamidine H_2SO_4	.....	$C_2H_6ON_4{\cdot}\frac{1}{2}H_2SO_4{\cdot}H_2O$	III-90	338.31
2083	**Dicyclohexyl**	decahydro-diPh	$(CH_2(CH_2)_4CH{\cdot})_2$	V-108	166.30
2084	adipate	.....	$(CH_2CH_2CO_2C_6H_{11})_2$	.....	310.42
2085	amine	.....	$(C_6H_{11})_2NH$	XII-6	181.31
2086	maleate	.....	$(:CHCO_2C_6H_{11})_2$	.....	280.35
2087	oxalate	.....	$(CO_2C_6H_{11})_2$	*VI-6	254.32
2088	phthalate	.....	$C_6H_4(CO_2C_6H_{11})_2$	IX-799	330.41
2089	**Dicyclopentadiene**	.....	$(\cdot CH{:}CH{\cdot}CH_2{\cdot}CH{:}CH)_2$	V-495	132.20
2090	**Diethanolamine**	iminoethyl alcohol	$HN(CH_2{\cdot}CH_2OH)_2$	IV-283	105.14
2091	**Diethoxy**-benzene (*o*)	.....	$(C_2H_5O)_2C_6H_4$	VI-771	166.21
2092	benzene (*m*)	.....	$(C_2H_5O)_2C_6H_4$	VI-814	166.21
2093	benzene (*p*)	.....	$(C_2H_5O)_2C_6H_4$	VI-844	166.21
2094	ethyl carbonate	.....	$(C_2H_5O{\cdot}C_2H_4)_2CO_3$	.....	206.23
2095	ethyl maleate	.....	$(:CHCO_2C_2H_4OC_2H_5)_2$	.....	260.28
2096	ethyl phthalate	.....	$C_6H_4(CO_2C_2H_4OC_2H_5)_2$	.....	310.34
2097	ethyl sebacate	.....	$[C_2H_5OC_2H_4CO_2{\cdot}CH_2(CH_2)_2CH_2{\cdot}]_2$	.....	346.45
2098	quinazoline (2,4)	.....	$C_{12}H_{14}O_2N_2$	XXIII-486	218.25

Dichloro-sulfanilic acid 1938
Dichloro-xylene (ω) 6494-6

Dicresyl carbonate 2835
Dicresyl phthalate 2841

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2060	col. lq.	$1.204^{25°}$	.....	94	i.	∞	∞
2061	col. lq.	$1.233^{17.5°}$	.....	106-9	.....	.....	.....
2062	nd.	.....	120	.....	i.	s.; i. lg.	s.; s. bz.
2063	cr./aq. al.	.....	104-5	.....	i.; i. alk.	s.; s. bz.	s.; sl. s. lg.
2064	nd./aq. al.	.....	67	280-2	v. sl. s. h.	s.; s. chl.	s.; s. bz.
2065	nd./al.	.....	98	.....	sl. s.	s.	.....
2066	nd.	.....	85	.....	sl. s.	s.	s. pet.
2067	nd./al.	.....	92-3	.....	.....	s.	s.
2068	nd./al.	.....	103-4	.....	.....	s.	.....
2069	nd.	.....	85.5	.....	.....	.....	.....
2070	lt. yel./bz.	.....	155-60	.....	sl. s. h.	v. s.	v. s.; sl. s. bz.
2071	rhb./al.	.....	120-1	subl. <120	sl. s. h.	v. s. h.	s. chl.
2072	yel. nd./al.	.....	67-8	d. 170	v. sl. s.	s. h.	v. s.; s. chl.
2073	cr.	.....	180 d.	.....	.....	.....	.....
2074	pr./chl.-pet.	.....	83	.....	v. sl. s.	d. h.; s. chl.	120 bz.
2075	col. lq.	$2.626^{21.5°}$	-5	133^{35mm}	.....	.....	.....
2076	col. lq.	.....	.....	215-20	.....	.....	.....
2077	pr./aq.	.....	252 ±, d.	.....	4; sl. s. bz.	v. sl. s.	v. sl. s.
2078	yel. nd./al.	.....	146	.....	i.; s. ac.	s. h.	sl. s.
2079	cr./PhMe	.....	161	.....	s. h.; s. ac.	s.; s. h. bz.	s.
2080	mn. pl.	$1.40^{14°}$	207-8	d.	$2.3^{13°}$	$1.3^{13°}$	$0.01^{13°}$
2081	cr./al.	.....	105	d. 160	s. h.	sl. s. c.	i.
2082	col. nd.	.....	193-5	$-H_2O$, 110	5 c.; 33 h.	sl. s.; s. dil. a.	i.
2083	lq.	$0.886^{21°}_{4}$	4	236^{758mm}	i.; ∞ act.	$7^{25°}$ MeOH	∞ ; ∞ bz.
2084	col. nd.	.....	33-5	.....	i.	s.	s.
2085	col. lq.	$0.925^{18°}$	20 ±	$254-6^{745mm}$	$0.16^{28°}$	v. s.; s. bz.	∞
2086	col. pl.	.....	82-3	.....	i.	sl. s.	v. s.
2087	cr./MeOH	.....	42-3	$190-1^{73mm}$	.....	v. s.	v. s.
2088	pr./al.	.....	66	.....	i.	s.	.....
2089	col. cr.	$0.976^{35°}$	32.9	170 sl. d.	.....	v. s.	v. s.
2090	pr.	$1.097^{20°}_{4}$	28	270^{748mm}	∞ ; i. bz.	∞	v. sl. s.
2091	cr./pet.	.....	43-5	.....	.....	.....	.....
2092	pr.	.....	12.4	$234-5^{756mm}$	i.	s.	s.
2093	mn. lf.	.....	71-2	246	i.	s.; s. bz.	s.; s. chl.
2094	col. lq.	.....	.....	$124-7^{15mm}$	.....	.....	.....
2095	col. lq.	.....	.....	$174-7^{11mm}$	.....	.....	.....
2096	col. lq.	.....	31-3	.....	i.	s.	s.
2097	col. lq.	.....	-1 ±	$224-6^{8mm}$	.....	.....	.....
2098	nd.	.....	55	.....	i.	s.	s.

Diethoxy-ethane 2139
Diethoxy-methane 2172

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2099	**Diethyl**-acetaldehyde	2-Et-butyraldehyde	$(C_2H_5)_2CH{\cdot}CHO$	I-693	100.16
2100	acetamide (*N,N*)	acetyl diEt-amine	$CH_3CO{\cdot}N(C_2H_5)_2$	IV-110	115.17
2101	acetic acid	.....	$(C_2H_5)_2CH{\cdot}CO_2H$	II-333	116.16
2102	acetoacetic ester	.....	$CH_3CO{\cdot}C(C_2H_5)_2{\cdot}CO_2C_2H_5$	III-710	186.24
2103	acetonedicarboxylate	.....	$CO(CH_2CO_2C_2H_5)_2$	III-791	202.20
2104	acetonitrile	3-cyano-pentane	$(C_2H_5)_2CH{\cdot}CN$	II-334	97.16
2105	acetyl succinate	.....	$CH_3CO{\cdot}C_2H_3:(CO_2C_2H_5)_2$	III-801	216.23
2106	adipate	.....	$[\cdot(CH_2)_2CO_2C_2H_5]_2$	II-652	202.24
2107	allyl-acetamide	novonal	$(C_2H_5)_2C_3H_5{:}C{\cdot}CONH_2$	.....	155.23
2108	allyl-malonate	.....	$C_3H_5{\cdot}CH(CO_2C_2H_5)_2$	II-776	200.23
2109	amine	.....	$(C_2H_5)_2NH$	IV-95	73.14
2110	amine hydrochloride	.....	$(C_2H_5)_2NH{\cdot}HCl$	IV-97	109.60
2111	aminobenzaldehyde	(*p*)	$(C_2H_5)_2N{\cdot}C_6H_4{\cdot}CHO$	XIV-36	177.24
2112	aminoethanol (β)	.....	$(C_2H_5)_2N{\cdot}CH_2CH_2{\cdot}OH$	IV-282	117.19
2113	aminoglycerol (α)	1-diethylamino-2,3-propandiol	$(C_2H_5)_2N{\cdot}CH_2{\cdot}CHOH{\cdot}CH_2OH$	IV-302	147.21
2114	aminophenetole (*m*)	diEt-*m*-phenetidine	$C_2H_5O{\cdot}C_6H_4{\cdot}N(C_2H_5)_2$	XIII-410	193.28
2115	aminophenol (*m*)	.....	$(C_2H_5)_2N{\cdot}C_6H_4{\cdot}OH$	XIII-408	165.23
2116	aminophenol oxalate (*m*)	hydroxy-diEt-aniline oxalate	$(C_2H_5)_2N{\cdot}C_6H_4{\cdot}OH{\cdot}H_2C_2O_4$	XIII-410	255.26
2117	aminopropyl alcohol (β)	.....	$(C_2H_5)_2N{\cdot}CH(CH_3){\cdot}CH_2OH$	.....	131.21
2118	aminopropyl alcohol (γ)	.....	$(C_2H_5)_2N{\cdot}CH_2{\cdot}CH_2{\cdot}CH_2OH$	IV-288	131.21
2119	aminopropyl cinnamate HCl	apothesine	$(C_2H_5)_2N(CH_2)_3O{\cdot}CO{\cdot}C_8H_7{\cdot}HCl$	.....	297.82
2120	ammonium diethyldithiocarbamate	.....	$(C_2H_5)_2N{\cdot}CS{\cdot}S{\cdot}NH_2(C_2H_5)_2$	.....	222.40
2121	aniline (*N*)	.....	$(C_2H_5)_2N{\cdot}C_6H_5$	XII-164	149.23
2122	aniline sulfonic acid (*m*)	diethylaminobenzene sulfonic	$(C_2H_5)_2N{\cdot}C_6H_4{\cdot}SO_3H$	XIV-690	229.29
2123	azelate	ethyl azelate	$(CH_2)_7(CO_2C_2H_5)_2$	II-709	244.32
2124	barbituric acid (5,5)	veronal; barbital	$C_8H_{12}O_3N_2$	XXIV-485	184.19
2125	barbituric Na	medinal	$C_8H_{11}O_3N_2Na$	XXIV-487	206.18
2126	benzene (*o*)	.....	$(C_2H_5)_2C_6H_4$	V-426	134.21
2127	benzene (*m*)	.....	$(C_2H_5)_2C_6H_4$	V-426	134.21
2128	benzene (*p*)	.....	$(C_2H_5)_2C_6H_4$	V-426	134.21
2129	benzoylene urea (1,3)	.....	$C_6H_4{\cdot}N(C_2H_5){\cdot}CO{\cdot}$ | ——— $N(C_2H_5){\cdot}CO$ ——— |	XXIV-376	218.25
2130	benzylmalonate	.....	$C_7H_7{\cdot}CH(CO_2C_2H_5)_2$	IX-869	250.28
2131	bromoacetamide (α)	neuronal	$(C_2H_5)_2CBr{\cdot}CO{\cdot}NH_2$	II-334	194.08
2132	bromomaleate	.....	$CH{:}CBr(CO_2C_2H_5)_2$	II-755	251.08

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2099	lq.	$0.816^{\frac{20}{20}°}$	.....	117-8	$0.3^{20°}$	∞	∞
2100	lq.	$0.925^{8.5°}$	.....	185-6	.....	.....	.....
2101	col. lq.	$0.920^{\frac{18}{0}°}$	<−15	195-7	sl. s.	s.	s.
2102	col. lq.	$0.965^{\frac{25}{4}°}$	.....	218	.....	.....	.....
2103	oil	$1.113^{\frac{20}{4}°}$	.....	250	v. sl. s.	∞	∞
2104	oil	.....	.....	144-6	.....	∞	∞
2105	lq.	$1.080^{\frac{25}{5}°}$	.....	254-6 d.	i.	s.	.....
2106	col. lq.	$1.009^{\frac{20}{4}°}$	−21	$239\text{-}41^{761mm}$	$0.43^{30°}$	s.	s.
2107	wh. pd.	.....	75-6	.....	0.9	s.	s.
2108	col. lq.	$1.006^{\frac{25}{25}°}$	.....	222-3	i.	s.	s.
2109	col. lq.	$0.712^{\frac{15}{15}°}$	−38.9	55.5^{759mm}	v. s.*	∞	∞
2110	lf./al. et.	$1.048^{\frac{21}{4}°}$	228-9	320-30	$232^{25°}$	sl. s. c.	i.
2111	yel. nd./ aq.	.....	41	174^{7mm}	.....	s.	s.
2112	lq.	$0.885^{\frac{20}{20}°}$	.....	162.1	∞	∞	s.
2113	syrup	.....	.....	233-5	s.	s.	s.; s. chl.
2114	oil	.....	.....	286	i.	s.	s. ac.
2115	rhb./CS_2-lg.	.....	78	276-80	s.; s. chl.	s. CS_2	i. lg.
2116	cr.	.....	.....	155-6	.....	.....	.....
2117	lq.	.....	.....	$61\text{-}3^{25mm}$	.....	.....	.....
2118	lq.	.....	.....	189.5	v. s.	.....	.....
2119	col. cr.	.....	136	.....	s.	s.; sl. s. act.	sl. s.
2120	pa. yel. pl.	.....	70-2	.....	v. s.	v. s.	v. sl. s.
2121	oil	$0.934^{\frac{20}{4}°}$	−34.4	216	$1.4^{12°}$	s.	s.
2122	cr.	.....	270 d.	.....	s.	.....	.....
2123	lq.	$0.973^{\frac{20}{4}°}$	.....	291-2	i.	s.	s.
2124	col. cr.	.....	191	subl. vac.	0.7 c.; 8 h.	s. h.	s.; s. alk.
2125	col. cr.	.....	.....	.....	20 c.; 40 h.	0.25	i.
2126	col. lq.	$0.881^{\frac{20}{4}°}$	<−20	176.5	i.	s.	s.
2127	col. lq.	$0.860^{\frac{20}{4}°}$	<−20	181-2	i.	s.	s.
2128	col. lq.	$0.865^{\frac{20}{4}°}$	−35	182-3	i.	s.	s.
2129	nd.	.....	110-11	.....	i.	s.	.....
2130	lq.	$1.077^{\frac{15}{15}°}$	.....	298-300	i.	.....	.....
2131	col. cr.	.....	66-7	d. 160-70	0.8 c.; s. h.	v. s.; s. bz.	v. s.
2132	col. lq.	$1.410^{17.5°}$	.....	256	.....	.....	.....

* Forms a hydrate $+1H_2O$, m. p. −19°.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Diethyl				
2133	bromomalonate	Et bromomalonate	$CHBr(CO_2C_2H_5)_2$	II-594	239.07
2134	*n*-butylmalonate	.....	$C_4H_9{\cdot}CH(CO_2C_2H_5)_2$	*II-282	216.27
2135	butylmalonate	(*sec*)	$C_5H_{10}(CO_2C_2H_5)_2$	II-679	216.27
2136	butylmalonate	(*iso*)	$C_5H_{10}(CO_2C_2H_5)_2$	II-683	216.27
2137	carbanilide	.....	$[(C_2H_5)(C_6H_5)N]_2CO$	XII-422	268.35
2138	carbonate	.....	$CO(OC_2H_5)_2$	III-5	118.13
2139	cellosolve	diEtO-ethane	$(C_2H_5O{\cdot}CH_2)_2$	I-468	118.17
2140	chlorofumarate	.....	$CH{:}CCl(CO_2C_2H_5)_2$	II-745	206.63
2141	chloromaleate	.....	$CH{:}CCl(CO_2C_2H_5)_2$	II-753	206.63
2142	citraconate	.....	$CH_3{\cdot}C_2H(CO_2C_2H_5)_2$	II-771	186.20
2143	cyanamide	cyano-diEt-amine	$(C_2H_5){\cdot}N{\cdot}CN$	IV-121	98.15
2144	*iso*-cyanine iodide	ethyl red	$C_{23}H_{23}N_2{\cdot}I{\cdot}C_2H_5OH$	XXIII-298	500.42
2145	cyclohexylamine (*N,N*)	hexahydro-diethyl-aniline	$CH_2(CH_2)_4CH{\cdot}N(C_2H_5)_2$	XII-6	155.28
2146	diacetosuccinate	.....	$(CH_3CO)_2(CHCO_2{\cdot}C_2H_5)_2$	III-840	258.26
2147	diacetosuccinate	.....	$(CH_3CO)_2(CHCO_2{\cdot}C_2H_5)_2$	III-840	258.26
2148	diacetosuccinate	.....	$(CH_3CO)_2(CHCO_2{\cdot}C_2H_5)_2$	III-840	258.26
2149	diacetosuccinate	.....	$(CH_3CO)_2(CHCO_2{\cdot}C_2H_5)_2$	III-840	258.26
2150	diacetosuccinate	.....	$(CH_3CO)_2(CHCO_2{\cdot}C_2H_5)_2$	III-840	258.26
2151	diacetosuccinate	.....	$(CH_3CO)_2(CHCO_2{\cdot}C_2H_5)_2$	III-840	258.26
2152	diacetyl tartrate	.....	$(CH_3CO)_2(O{\cdot}CH{\cdot}CO_2C_2H_5)_2$	III-515	290.26
2153	dibenzyl malonate	.....	$(C_7H_7)_2C(CO_2C_2H_5)_2$	IX-937	340.40
2154	dibromomaleate	.....	$(:CBr_2CO_2C_2H_5)_2$	II-757	329.99
2155	dibromomalonate	.....	$Br_2C(CO_2C_2H_5)_2$	II-595	317.98
2156	dibromosuccinate	(α,α')	$(CHBr{\cdot}CO_2C_2H_5)_2$	II-624	332.01
2157	dibutylmalonate	(*n*)	$(C_4H_9)_2C(CO_2C_2H_5)_2$	*II-295	272.37
2158	diethylmalonate	.....	$(C_2H_5)_2C(CO_2C_2H_5)_2$	II-686	216.27
2159	1,4-dihydrocollidine dicarboxylate	(3,5)	$(CH_3)_2C_5H_2N{:}(CO_2C_2H_5)_2$	XXII-147	267.32
2160	dihydroxymalonate	diEt-mesoxalate	$(HO)_2C(CO_2C_2H_5)_2$	III-769	192.17
2161	dimethylmalonate	.....	$(CH_3)_2C(CO_2C_2H_5)_2$	II-648	188.22
2162	dithiocarbamate †	.....	$(C_2H_5)_2N{\cdot}CS{\cdot}SH$	.....	149.27
2163	dithiocarbonate	carbonyl-disulfethyl	$CO(SC_2H_5)_2$	III-211	150.25
2164	dithiocarbonate	Et-xanthate	$C_2H_5O{\cdot}CS{\cdot}SC_2H_5$	III-210	150.25
2165	dithiooxalate	.....	$(CO{\cdot}SC_2H_5)_2$	II-565	178.26
2166	disulfide	.....	$C_2H_5S{\cdot}SC_2H_5$	I-347	122.24
2167	ethyl-*iso*-amylmalonate	.....	$C_5H_{11}{\cdot}C(C_2H_5){:}(CO_2C_2H_5)_2$	.....	258.35
2168	ethyl-*n*-butylmalonate	.....	$C_4H_9{\cdot}C(C_2H_5){:}(CO_2C_2H_5)_2$	II-712	244.32
2169	ethylmalonate	.....	$C_2H_5{\cdot}CH(CO_2C_2H_5)_2$	II-644	188.22

† Free acid unstable; Na and K salts s. in aq.
Diethyl cadmium 1185
Diethyl *iso*-butyl carbinol 4924
Diethyl carbinol 408

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2133	lq.	1.402^{25}_{4}°	<−54	233-5 d.	i.	∞	∞
2134	col. lq.	.....	.....	235-40^{760mm}	i.	v. s.	v. s.
2135	col. lq.	0.988^{15}°	.....	233-4^{774mm}	v. sl. s.	v. s.	v. s.
2136	col. lq.	0.983^{17}°	.....	225	v. sl. s.	v. s.	v. s.
2137	cr./al.	.....	79	.....	i.	.....	.....
2138	col. lq.	0.975^{20}_{4}°	−43	126^{759mm}	i.	∞	∞
2139	col. lq.	0.842^{20}_{20}°	.....	124^{759mm}	$21^{20°}$	.....	.....
2140	col. lq.	1.189^{20}_{20}°	.....	250 sl. d.	.....	.....	.....
2141	col. lq.	1.191^{25}_{4}°	.....	235 sl. d.	.....	.....	.....
2142	col. lq.	1.062^{20}_{4}°	.....	230.3	.....	.....	.....
2143	lq.	0.854^{20}_{4}°	.....	188-9^{748mm}	i.; d. HCl	s.	s.
2144	hyg. gn. met./al.	.....	150-2 d.	.....	v. sl. s; v. s. aq. a.	s.; s. act.; s. ac.	i.; i. CS_2
2145	lq.	0.872^{0}_{0}°	.....	193	.....	.....	.....
2146	α_1-oil	.....	.....	.....	v. sl. s.	s.	s.; 10 lg.
2147	α_2-cr.	.....	20-2	.....	v. sl. s.	v. s.	v. s.
2148	α_3-pr./lg.	.....	31-2	.....	v. sl. s.	v. s.	v. s.; 35 lg.
2149	α_4-oil	.....	.....	.....	.....	.....	.....
2150	β-stable, mn./al.	1.209^{20}_{4}°	89-90	.....	.....	$6^{20°}$ abs.	2 abs.
2151	meta-stable	1.176^{20}_{4}°	.....	.....	.....	.....	.....
2152	mn.	1.081^{20}_{4}°	67-8	288.5^{727mm}	s. h.	v. s. h.	v. s.
2153	oil	1.093^{20}_{4}°	13-14	243-6$^{18°}$	.....	.....	.....
2154	col. lq.	1.698^{25}_{25}°	.....	170-5^{15mm}	.....	.....	.....
2155	lq.	.....	.....	250-6 sl. d.	.....	.....	.....
2156	rhb. nd.	.....	68	d. >130	.....	.....	.....
2157	col. lq.	.....	.....	153-4^{14mm}	.....	.....	.....
2158	col. lq.	0.985^{20}_{4}°	.....	230	i.	∞	∞
2159	mn. pr./ al.	.....	131	>315 d.	v. sl. s.; s. chl.	s. h.; s. bz.	sl. s.; sl. s. CS_2
2160	col. pl./bz.	.....	57	200	$130^{22°}$	v. s. abs.	v. s.
2161	col. lq.	0.994^{25}_{25}°	.....	196.2-6.7	i.	∞	∞
2162	.....	.....	.....	.....	.....	.....	.....
2163	yel. lq.	1.085^{19}°	.....	198.6-200.1	i.	s.	s.
2164	yel. lq.	1.085^{19}°	.....	200	i.	s.	s.
2165	yel. nd./et.	.....	27-8	238-40^{757mm}	.....	.....	.....
2166	oil	0.993^{20}_{4}°	.....	152.8-3.4	v. sl. s.	.....	.....
2167	col. lq.	.....	.....	131-3^{15mm}	.....	.....	.....
2168	lq.	.....	.....	235-45	.....	.....	.....
2169	col. lq.	1.004^{20}_{20}°	.....	211^{748mm}	.....	.....	.....

Diethyl carbinol acetate 401
Diethyl carbitol 2233

Diethyl ether 2911

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2170	**Diethyl** ethyl-phenylmalonate	.....	$C_6H_5{\cdot}C(C_2H_5):(CO_2C_2H_5)_2$	*IX-384	264.31
2171	ethyl-*iso*-propylmalonate	.....	$C_3H_7{\cdot}C(C_2H_5):(CO_2C_2H_5)_2$	II-706	230.30
2172	formal	diEtO-methane	$CH_2(OC_2H_5)_2$†	I-574	104.15
2173	formamide	formyl-diethylamine	$HCO_2N(C_2H_5)_2$	IV-109	101.15
2174	fumarate	.....	$(:CH{\cdot}CO_2C_2H_5)_2$	II-742	172.18
2175	glutaconate	.....	$C_3H_4(CO_2C_2H_5)_2$	II-759	186.20
2176	glutarate	.....	$(CH_2)_3(CO_2C_2H_5)_2$	II-633	188.22
2177	*n*-heptylmalonate	.....	$C_7H_{15}CH(CO_2C_2H_5)_2$	.....	258.35
2178	hydrazine (*uns*)	.....	$(C_2H_5)_2N{\cdot}NH_2$	IV-550	88.15
2179	itaconate	.....	$C_3H_4(CO_2C_2H_5)_2$	II-762	186.20
2180	ketone	pentanone-3	$(C_2H_5)_2CO$	I-679	86.13
2181	ketone semicarbazone	.....	$(C_2H_5)_2C{:}N{\cdot}NH{\cdot}CO{\cdot}NH_2$	III-103	143.19
2182	malate (*dl*)	.....	$(CHOH{\cdot}CH_2):(CO_2C_2H_5)_2$	III-437	190.19
2183	maleate	.....	$(:CH{\cdot}CO_2C_2H_5)_2$	II-751	172.18
2184	malonate	malonic ester	$CH_2(CO_2C_2H_5)_2$	II-573	160.17
2185	malonic acid	....	$(C_2H_5)_2C(CO_2H)_2$	II-686	160.17
2186	mesaconate	.....	$CH_3{\cdot}C_2H(CO_2C_2H_5)_2$	II-766	186.20
2187	methyl-ethyl-malonate	.....	$C_2H_5{\cdot}C(CH_3):(CO_2C_2H_5)_2$	II-664	202.24
2188	muconate	.....	$(CH{:}CH{\cdot}CO_2C_2H_5)_2$	II-804	198.21
2189	α-naphthylamine (*N*)	.....	$C_{10}H_7{\cdot}N(C_2H_5)_2$	XII-1223	199.28
2190	4-nitrophthalate	.....	$NO_2{\cdot}C_6H_3(CO_2C_2H_5)_2$	IX-831	267.23
2191	nitrosamine	nitroso-diethylamine	$(C_2H_5)_2N{\cdot}NO$	IV-129	102.14
2192	oxalacetate	oxalacetic ester	$(CH_2CO)(CO_2C_2H_5)_2$	III-782	188.18
2193	oxalate	ethyl oxalate	$(CO_2C_2H_5)_2$	II-535	146.14
2194	oxamide (*sym*)	.....	$(CO{\cdot}NHC_2H_5)_2$	IV-112	144.17
2195	oxomalonate	.....	$CO(CO_2C_2H_5)_2$	III-769	174.15
2196	peroxide	.....	$C_2H_5O{\cdot}OC_2H_5$	I-324	90.12
2197	phosphine	.....	$(C_2H_5)_2PH$	IV-582	90.11
2198	phosphoric acid	.....	$(C_2H_5O)_2PO{\cdot}OH$	I-332	154.11
2199	phthalate (*o*)	ethyl phthalate	$C_6H_4(CO_2C_2H_5)_2$	IX-798	222.23
2200	phthalate (*m*)	ethyl isophthalate	$C_6H_4(CO_2C_2H_5)_2$	IX-834	222.23
2201	phthalate (*p*)	ethyl terephthalate	$C_6H_4(CO_2C_2H_5)_2$	IX-844	222.23
2202	pimelate	.....	$(CH_2)_5(CO_2C_2H_5)_2$	II-671	216.27
2203	propylmalonate	.....	$C_3H_7{\cdot}CH(CO_2C_2H_5)_2$	II-657	202.24
2204	*iso*-propylmalonate	.....	$C_3H_7{\cdot}CH(CO_2C_2H_5)_2$	II-669	202.24
2205	quinolinate (2,3)	.....	$C_5H_3N(CO_2C_2H_5)_2$	XXII-151	223.22
2206	sebacate	ethyl sebacate	$(CH_2)_8(CO_2C_2H_5)_2$	II-719	258.35
2207	selenide, mono-	selenium ethyl	$(C_2H_5)_2Se$	I-349	137.08
2208	selenide, di-	ethyl diselenide	$(C_2H_5Se)_2$	I-349	216.04
2209	stilboestrol (*trans*)	stilboestrol	$[HOC_6H_4(C_2H_5)C:]_2{\cdot}C_2H_5OH$	.....	314.41
2210	suberate	.....	$(CH_2)_6(CO_2C_2H_5)_2$	II-693	230.30
2211	succinate	ethyl succinate	$(CH_2{\cdot}CO_2C_2H_5)_2$	II-609	174.19
2212	*iso*-succinate	.....	$CH_3{\cdot}CH(CO_2C_2H_5)_2$	II-629	174.19
2213	sulfate	ethyl sulfate	$(C_2H_5O)_2SO_2$	I-327	154.18
2214	sulfide	.....	$(C_2H_5)_2S$	I-344	90.18
2215	sulfite	.....	$(C_2H_5O)_2SO$	I-325	138.18

† Hydrate $+1H_2O$, s. aq., al., et., chl., bz.

Diethyl mercury 4043
Diethyl mesoxalate 2160, 3084
Diethyl phenetidine 2114

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2170	col. lq.	.....	.....	166^{12mm}	.....	.....	.....
2171	lq.	.....	.....	232-3	.....	.....	.....
2172	lq.	0.824^{25}_{4}°	−66.5	89	$9^{18°}$; $7^{30°}$	∞	∞
2173	col. lq.	$0.908^{19°}$	.....	177-8	∞	v. s.	v. s.
2174	col. lq.	$1.054^{20°}_{20°}$	0.6	218.5	.....	.....	.....
2175	col. lq.	$1.050^{20°}_{4°}$	.....	236-8	i.	s.	s.
2176	syrup	$1.025^{21°}$	.....	237	v. sl. s.	v. s.	s.
2177	pa. yel. lq.	.....	.....	$144\text{-}6^{8mm}$	.....	.....	.....
2178	hyg. lq.	.....	.....	96-9	v. s.	v. s.	v. s.
2179	col. lq.	1.050^{15}_{15}°	.....	228-9	.....	.....	.....
2180	col. lq.	0.816^{15}_{4}°	−42	102.7	4	∞	∞
2181	nd./bz.	.....	139	.....	.....	.....	s. bz.
2182	col. lq.	1.124^{21}_{4}°	.....	253-5	s.	∞	∞
2183	col. lq.	$1.070^{20°}_{20°}$	.....	225	i.	s.	s.
2184	col. lq.	$1.055^{20°}_{4°}$	−49.8	198.9	v. sl. s.	∞	∞
2185	pr./aq.	.....	125	d. 170-80	$65^{16°}$	v. s.	v. s.
2186	col. lq.	$1.047^{20°}_{4°}$	.....	229	.....	.....	.....
2187	col. lq.	$0.994^{15°}_{15°}$	.....	207-8	.....	.....	.....
2188	pr./al.	$0.983^{98°}_{4°}$	63 (13)	200^{12mm}	.....	v. s.	.....
2189	col. oil	1.005	.....	285-90	∞ bz.	∞	∞
2190	pl./al.	.....	33-4	$208\text{-}10^{15mm}$	i.	s.	s.
2191	yel. oil	$0.943^{20°}_{4°}$	.....	176.9	s.	∞	∞
2192	col. oil	$1.131^{20°}_{4°}$	.....	$131\text{-}2^{24mm}$	i.	∞; ∞ bz.	∞
2193	col. lq.	$1.079^{20°}_{4°}$	−40.6	186	v. sl. s.	∞	∞
2194	nd./al.	$1.169^{4°}$	.....	179	.....	.....	.....
2195	yel. gn. oil	$1.119^{30°}_{20°}$	−30 ±	220 ±	.....	s.	s.
2196	lq.	$0.827^{15°}_{4°}$	.....	65	v. sl. s.	∞	∞
2197	col. lq.	<1	.....	85	.....	.....	.....
2198	lq.	$1.175^{0°}$	.....	203.3	.....	.....	.....
2199	col. lq.	$1.121^{25°}_{25°}$	.....	298-9	i.	∞	∞
2200	col. lq.	$1.123^{25°}_{25°}$	11.5	302	i.	∞	∞
2201	pr./al.	$1.110^{15°}_{15°}$	43-4	302	i.	s.	s.
2202	col. oil	$0.999^{15°}_{15°}$	.....	$252\text{-}5^{748mm}$	i.	s.	s.
2203	col. lq.	$0.993^{15°}_{15°}$	.....	$225\text{-}6^{771mm}$	i.	s.	s.
2204	col. lq.	$0.993^{15°}_{15°}$	.....	213-4	i.	s.	s.
2205	yel. oil	.....	.....	280-5 sl. d.	s.	s.	s.; s. bz.
2206	col. lq.	$0.965^{20°}_{4°}$	1.3	306^{773mm}	0.008	s.	s.
2207	lq.	$1.230^{25°}_{4°}$	.....	108	i.	.....	.....
2208	red yel. lq.	.....	.....	186	.....	.....	.....
2209	col. cr./al.	.....	169-71	.....	i.; s. alk.	s.	s.
2210	col. lq.	$0.982^{20°}_{4°}$	.....	282^{763mm}	i.	s.	s.
2211	col. lq.	$1.040^{20°}_{4°}$	−20.8	216.5	i.	∞	∞
2212	col. lq.	$1.021^{15°}_{15°}$	.....	201.2-1.4	i.	∞	∞
2213	col. lq.	$1.172^{25°}_{4°}$	−25	210.2 sl. d.	i.; sl. d.	s.; d. h.	∞
2214	col. lq.	$0.837^{20°}_{4°}$	−99.5	$92\text{-}3^{754mm}$	i.	∞	∞
2215	col. lq.	$1.077^{25°}_{4°}$	.....	159-60	s. d.	s.	.....

Diethyl phenylenediamine 303
Diethyl *n*-propyl carbinol 4966
Diethyl *iso*-propyl carbinol 4963
Diethyl pyridine 5040-1

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2216	**Diethyl** sulfone	.....	$(C_2H_5)_2SO_2$	I-346	122.18
2217	sulfoxide	.....	$(C_2H_5)_2SO$	I-346	106.18
2218	tartrato (*d*)	ethyl tartrate	$(CHOH{\cdot}CO_2C_2H_5)_2$	III-512	206.19
2219	telluride	tellurium ethyl	$(C_2H_5)_2Te$	I-350	185.73
2220	thiourea (*sym*)	.....	$(C_2H_5NH)_2CS$	IV-118	132.22
2221	toluene (3,5)	.....	$(C_2H_5)_2C_6H_3{\cdot}CH_3$	V-441	148.24
2222	urea (*sym*)	.....	$(C_2H_5NH)_2CO$	IV-115	116.16
2223	urea (*uns*)	.....	$(C_2H_5)_2N{\cdot}CO{\cdot}NH_2$	IV-120	116.16
2224	**Diethylene**-di-acetate	.....	$(CH_2CH_2O_2C{\cdot}CH_3)_2$	II-143	174.19
2225	diamine	piperazine	$NH{\cdot}C_2H_4{\cdot}NH{\cdot}C_2H_4$	XXIII-4	86.14
2226	diamine hydrate	piperazine hydrate	$C_4H_{10}N_2{\cdot}6H_2O$	XXIII-4	194.23
2227	dilaurate	.....	$(C_{11}H_{23}CO_2C_2H_4)_2$	.....	454.71
2228	disulfide	dithian-1,4	$S{\cdot}C_2H_4{\cdot}S{\cdot}C_2H_4$	XIX-3	120.22
2229	glycol diacetate	.....	$(CH_3CO_2C_2H_4)_2O$	II-141	190.19
2230	glycol dinitrate	.....	$(O_2N{\cdot}O{\cdot}C_2H_4)_2O$	.....	196.12
2231	glycol monoben-zyl ether	.....	$HOCH_2CH_2{\cdot}O{\cdot}CH_2{\cdot}CH_2{\cdot}O{\cdot}CH_2C_6H_5$	.....	196.24
2232	glycol *n*-butyl ether	butyl carbitol	$HOCH_2CH_2{\cdot}O{\cdot}CH_2{\cdot}CH_2{\cdot}O{\cdot}C_4H_9$	.....	162.22
2233	glycol diethyl ether	diethyl carbitol	$(C_2H_5O{\cdot}CH_2CH_2)_2O$	.....	162.22
2234	glycol monolaur-ate	glaurin	$C_{11}H_{23}CO_2C_2H_4{\cdot}O{\cdot}C_2H_4OH$	.....	288.42
2235	imide oxide	morpholine	$NH{\cdot}(CH_2)_2{\cdot}O{\cdot}(CH_2)_2$	XXVII-5	87.12
2236	imide oxide ethanol	morpholine ethanol	$C_4H_8O{:}N{\cdot}C_2H_4OH$	.....	131.17
2237	oxide	dioxan-1,4	$O{:}(CH_2)_4{:}O$	XIX-3	88.10
2238	triamine	.....	$(NH_2{\cdot}C_2H_4)_2NH$	IV-255	103.17
2239	**Difluoro**-acetic acid	.....	$F_2CH{\cdot}CO_2H$	II-193	96.04
2240	1-bromoethane (2,2)	.....	$F_2CH{\cdot}CH_2Br$	I-89	144.96
2241	1-chloroethane (2,2)	.....	$F_2CH{\cdot}CH_2Cl$	I-83	100.50
2242	1,2-dibromoethane	(2,2)	$F_2CBr{\cdot}CH_2Br$	I-92	223.87
2243	1,1-dibromoethane	(2,2)	$Br_2CH{\cdot}CHF_2$	I-92	223.87
2244	1,1-dichloroethane	(2,2)	$F_2CH{\cdot}CHCl_2$	I-85	134.95
2245	1,2-dichloroethyl-ene (1,2)	.....	$FClC{:}CClF$	.....	132.93
2246	dichloromethane	"freon"	F_2CCl_2	I-61	120.92
2247	diphenyl (2,2')	.....	$F{\cdot}C_6H_4{\cdot}C_6H_4{\cdot}F$	.....	190.18
2248	diphenyl (4,4')	.....	$F{\cdot}C_6H_4{\cdot}C_6H_4{\cdot}F$	V-579	190.18
2249	ethane (1,2)	ethylene fluoride	$FCH_2{\cdot}CH_2F$	I-82	66.05
2250	ethylene (α,α)	1,1-difluoro-ethene	$CH_2{:}CF_2$	I-186	64.04
2251	1-iodoethane (2,2)	.....	$F_2CH{\cdot}CH_2I$	I-98	191.96
2252	tetrabromoethane	(1,1,2,2;1,2)	$FBr_2C{\cdot}CFBr_2$	I-95	381.68
2253	tetrachloroethane	(1,1,1,2;2,2)	$Cl_3C{\cdot}CF_2Cl$	I-86	203.85
2254	tetrachloroethane	(1,1,2,2;1,2)	$FCl_2C{\cdot}CFCl_2$	.....	203.85
2255	tribromoethane	(1,1,2;1,2)	$Br_2FC{\cdot}CHBrF$	I-94	302.78
2256	**Diformyl hydrazine**	(*sym*)	$(\cdot NH{\cdot}CHO)_2$	II-93	88.07
2257	**Difurfural**-cyclo-hexanone	.....	$(C_4H_3O{\cdot}CH{:})_2{:}$ C_6H_6O	.....	254.27

Diethyl tin 5949
Diethyl toluidine 4216-8
Diethyl zinc 6503
Diethylene glycol 3453

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2216	rhb. pl.	$1.357^{\frac{20}{4}\circ}$	73-4	248	$15.6^{16\circ}$	v. s. bz.	s. h.
2217	syrup	.....	.....	d.	v. s.	s.	s.
2218	lq.	$1.204^{\frac{20}{4}\circ}$	17	280	sl. s.	∞	∞
2219	red-yel. lq.	$1.599^{\frac{15}{4}\circ}$	.....	137-8	i.	s.	.....
2220	cr.	.....	77	.....	s.	s.	.....
2221	lq.	$0.879^{\frac{20}{4}\circ}$	.....	198-200	i.	∞	∞
2222	nd./al.	1.042	112.5	263	v. s.	v. s.	v. s.
2223	nd./et.	.....	74	.....	v. s.	v. s.	$2.6^{22\circ}$
2224	lq.	$1.048^{15\circ}$	12	230^{751mm}	.....	.....	.....
2225	rhb./al.	.....	105-6	145-6	$15^{20\circ}$	v. s.	i.
2226	col. cr.	.....	44	125-30	v. s.	s.	i.
2227	.....	.....	28-30	.....	.....	.....	.....
2228	mn./et.	.....	111-2	199-200	i.; v. s. CS_2	s.	s.
2229	lq.	$1.116^{\frac{20}{20}\circ}$	.....	250	∞	.....	.....
2230	.....	$1.377^{\frac{25}{4}\circ}$	-11.3	.....	i.	.....	.....
2231	col. lq.	.....	.....	$176\text{-}9^{18mm}$	.....	.....	.....
2232	col. lq.	$0.956^{\frac{20}{20}\circ}$	.....	231	∞; ∞ oils	v. s.	v. s.
2233	col. lq.	$0.909^{\frac{20}{20}\circ}$	.....	188	∞	v. s.	v. s.
2234	straw colrd. oil	0.960	17-8	>270	i.	s.	s.
2235	col. oil	$1.002^{\frac{20}{20}\circ}$	.....	128.9	∞	∞	s.
2236	col. lq.	$1.072^{\frac{20}{20}\circ}$	.....	226	∞	.....	.....
2237	col. lq.	$1.033^{\frac{20}{4}\circ}$	9.5-10.5	101.1	∞	s.	s.
2238	lq.	.....	.....	208 sl. d.	∞	∞	i.
2239	col. lq.	$1.536^{10\circ}$	-0.35	134.2^{766mm}	∞	∞	∞
2240	col. lq.	$1.824^{18.5\circ}$	-74.5	57.3	v. sl. s.	∞	∞
2241	col. lq.	>1	.....	36	.....	.....	.....
2242	col. lq.	$2.242^{12.2\circ}$	-56.5	93	i.	.....	.....
2243	col. lq.	$2.312^{20\circ}$	.....	107.5^{760mm}	.....	.....	.....
2244	col. lq.	$1.494^{17\circ}$	.....	60	i.	∞	∞
2245	gas	.....	-112	20.9	.....	.....	.....
2246	gas	$1.486^{-30\circ}$	-155	-29.2	i.	s.	s.
2247	cr.	.....	117	.....	.....	.....	.....
2248	col. mn./al.	1.361	88-9	254-5	i.; s. oil	s.; s. chl.	s.
2249	gas	.....	.....	.....	.....	.....	.....
2250	col. gas	.....	.....	.....	i.	$150^{18\circ}$ cc.	$150^{18\circ}$ cc., chl.
2251	col. lq.	$2.243^{12.2\circ}$	.....	89.5	i.	.....	.....
2252	col. cr.	.....	62.5	186.5^{758mm}	i.	s.	s. ac.
2253	col. cr.	.....	52	91	i.	sl. s. c.	v. s.
2254	col. cr.	$1.64^{30\circ}$	26.5	91^{740mm}	i.; v. s. bz.	v. s.	v. s.
2255	col. lq.	$2.603^{20\circ}$	.....	146	i.	.....	.....
2256	pr.	.....	159-60	.....	v. s.	sl. s.	i.
2257	yel. nd.	.....	144-5	.....	i.	s. h.	sl. s.

Diethylene glycol ethyl ether 1232
Diethylene glycol methyl ether 4177

Difluoro-ethene 2250
Difluoro-methane 4433

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2258	**Difurfural** cyclopentanone (1,3;5)	pyroxanthin	$(C_4H_3O{\cdot}CH{:})_2{:}$ C_5H_4O	XIX-140	240.25
2259	**Diglycerol**	.....	$[(HO)_2C_3H_5]_2O$	I-513	166.17
2260	**Diglycol chlorohydrin**	Cl-OH-diEt ether	$Cl{\cdot}CH_2CH_2{\cdot}O{\cdot}$ CH_2CH_2OH	I-467	124.57
2261	**Diglycolic acid**	.....	$(HO_2C{\cdot}CH_2)_2O{\cdot}H_2O$	III-234	152.10
2262	**Diglycyl glycine**	.....	$H_2N(CH_2CONH)_2{\cdot}$ CH_2CO_2H	IV-374	189.17
2263	**Diheptyl**-acetic acid (*n*)	.....	$(C_7H_{15})_2CH{\cdot}CO_2H$	II-376	256.42
2264	ether (*n*)	heptyl ether	$(C_7H_{15})_2O$	I-414	214.38
2265	ketone (*n*)	caprylone	$[CH_3(CH_2)_6]_2CO$	I-717	226.39
2266	sulfide (*n*)	heptyl sulfide	$(C_7H_{15})_2S$	I-415	230.44
2267	**Dihexyl ketone** (*n*)	oenanthone	$[CH_3(CH_2)_5]_2CO$	I-715	198.34
2268	**Dihydracrylic acid**	Na salt	$O(CH_2CH_2CO_2Na)_2$	III-297	206.12
2269	**Dihydrazino**-diphenyl	(2,2′)	$(H_2N{\cdot}NH{\cdot}C_6H_4)_2$	XV-584	214.26
2270	diphenyl	(4,4′)	$(H_2N{\cdot}NH{\cdot}C_6H_4)_2$	XV-585	214.26
2271	**Dihydro**-acridine (9,10)	.....	$C_6H_4{\cdot}NH{\cdot}C_6H_4{\cdot}CH_2$	XX-443	181.23
2272	anthracene (9,10)	.....	$C_6H_4{:}(CH_2)_2{:}C_6H_4$	V-641	180.24
2273	anthranol (9,10;9)	.....	$C_6H_4{\cdot}CH_2{\cdot}C_6H_4{\cdot}CHOH$	VI-697	196.24
2274	carveol	.....	$C_{10}H_{18}O$	VI-63	154.24
2275	carvone (*l*)	.....	$C_{10}H_{16}O$	VII-83	152.23
2276	cholesterol	coprosterol	$C_{27}H_{47}OH$	.....	388.65
2277	ethylanthracene (9,10;9)	.....	$C_6H_4{:}C_2H_3(C_2H_5){:}$ C_6H_4	V-649	208.29
2278	naphthalene (1,4)	.....	$C_{10}H_{10}$	V-519	130.18
2279	phenazine (9,10)	hydrazophenylene	$NH{\cdot}C_6H_4{\cdot}NH{\cdot}C_6H_4$	XXIII-209	182.22
2280	*o*-phthalic acid (1,4)	.....	$C_6H_6(CO_2H)_2$	IX-781	168.14
2281	*o*-phthalic acid (2,4)	.....	$C_6H_6(CO_2H)_2$	IX-781	168.14
2282	*o*-phthalic acid (2,6)	.....	$C_6H_6(CO_2H)_2$	IX-782	168.14
2283	*p*-phthalic acid (1,4)	dihydro-terephthalic	$C_6H_6(CO_2H)_2$	IX-785	168.14
2284	quinoline	.....	C_9H_9N	.....	131.17
2285	resorcinol (*m*)	hydroresorcin	$CO{\cdot}(CH_2)_3{\cdot}COCH_2$	VII-554	112.12
2286	toluene (1,2)	Me-cyclohexadiene	$CH_3{\cdot}C_6H_7$	V-115	94.15
2287	toluene (1,3)	.....	$CH_3{\cdot}C_6H_7$	V-115	94.15
2288	toluene (2,4)	.....	$CH_3{\cdot}C_6H_7$	V-115	94.15
2289	*o*-xylene (*x,x*)	diMe-cyclohexadiene	C_8H_{12}	V-118	108.18
2290	*m*-xylene (1,5)	.....	C_8H_{12}	V-119	108.18
2291	*p*-xylene (1,3)	.....	C_8H_{12}	V-120	108.18
2292	**Dihydroxy**-acetone	.....	$(HO{\cdot}CH_2)_2CO$	I-846	90.08
2293	anthracene (*β*)(1,5)	rufol	$C_{14}H_8(OH)_2$	VI-1032	210.22
2294	anthracene (*α*)(1,8)	chrysazol	$C_{14}H_8(OH)_2$	VI-1033	210.22

Difurfuroyl 3328
Difuryl-diketone 3328
Digallic acid 5687
Digitalin, cf. glcde.
Digitin, cf. glcde.
Digitonin, cf. glcde.
Digitoxin, cf. glcde.
Dihexyl 2856
Dihydro-benzene 1599-1600

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2258	or. nd./al.; red yel./ bz.	.....	162-3	d.	i.	s. h.	v. sl. s.; v. sl. s. CS_2
2259	lq.	.....	.....	220-30^{10mm}	s. h.	.....	i.
2260	lq.	$1.170^{20°}_{20°}$	.....	196.8	∞	.....	.....
2261	cr.	.....	148	d.	v. s.	v. s.	sl. s.
2262	nd.	.....	246 d.	.....	v. s. h.	i.	i.
2263	cr.	.....	26-7	240-50^{85mm}	v. sl. s.	v. s.	v. s.; v. s. bz.
2264	lq.	$0.806^{20°}$	.....	261.9	i.	s.	s.
2265	cr./al.	.....	39-40	178	.....	s.	.....
2266	lq.	.....	.....	298	.....	.....	.....
2267	lf./al.	$0.825^{30°}$	33	264	v. s. chl.	v. s.; s. lg.	v. s.
2268	cr.	.....	.....	.....	i. c. 95% al.	s. h. 90% al.	.....
2269	lf./bz.	.....	110	.....	s. h.; v. s. chl.	v. s.; v. s. h. bz.	i. pet.
2270	lf.	.....	165-7 d.	.....	sl. s. h.	v. sl. s.	v. sl. s.
2271	col. cr./al.	.....	169	subl.; d. 300	i.	s. h.	s.
2272	mn. pr.	$0.897^{\frac{1}{4}°}$	108.5	305	i.; v. s. bz.	v. s.	v. s.
2273	nd./pet.	.....	76	.....	s. h.	s.	s.; s. bz.
2274	lq.	$0.927^{20°}_{4°}$	.....	224-5	.....	.....	.....
2275	oil	$0.925^{20°}_{4°}$	.....	221-2	.....	.....	.....
2276	nd.	.....	104-5	210-20^{1mm}	s. chl., pet.	s. abs.	s.; s. bz.
2277	oil	$1.049^{\frac{8}{18}°}$	.....	320-3 sl. d.	i.; ∞ bz.	∞	∞
2278	col. pl.	$0.997^{\frac{1}{4}°}$	15.5	211-2	i.	s.	s.
2279	rhb. lf.	.....	212	.....	i.	v. sl. s.	i. bz.
2280	mn.	.....	153	.....	$1.6^{60°}$	.....	.....
2281	mn. pr.	.....	179-80	.....	sl. s. h.	s.	.....
2282	tri.	.....	215	.....	$0.3^{25°}$; 6 h.	s.	s. act.
2283	nd./aq.	.....	subl. d.	.....	0.01 c.	.....	.....
2284	lq.	.....	.....	220-6	.....	.....	.....
2285	pr./bz.	.....	105-6 sl. d.	.....	v. s.; s. act.	v. s.; s. h. bz.	v. sl. s. abs.
2286	lq.	.....	.....	108	.....	.....	.....
2287	lq.	0.835	.....	110	.....	.....	.....
2288	lq.	$0.827^{20°}_{4°}$	.....	106	.....	.....	.....
2289	col. lq.	.....	.....	134-5	.....	.....	s.
2290	col. lq.	$0.823^{20°}_{4°}$	.....	129-30^{745mm}	.....	.....	.....
2291	col. lq.	$0.830^{20°}_{4°}$	.....	135-8	.....	.....	.....
2292	cr.	.....	68-75	.....	v. s.; i. lg.	sl. s.	sl. s.
2293	yel./aq. al.	.....	265 ±, d.	.....	s. alk.	s.	s.; s. bz.
2294	yel./aq. al.	.....	225 d.	.....	s. alk.	s.	s.; s. bz.

Dihydro-estrone 2900
Dihydro-ketoacridine 145
Dihydro-morphinone hydrochloride, cf. alkd.
Dihydro-myrcene 2514
Dihydro-naringenin 5264
Dihydro-phytol 5295
Dihydro-pyrrole 5524
Dihydroxy-acetophenone 5550

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2295	**Dihydroxy** 9-anthranol (3,4)	anthrarobin	$C_{14}H_7(OH)_3$	VIII-330	226.22
2296	*x*-anthranol (1,8)	anthralin	$C_{14}H_7(OH)_3$	VIII-332	226.22
2297	anthraquinone (1,2)	alizarin	$C_6H_4(CO)_2C_6H_2$: $(OH)_2$	VIII-439	240.20
2298	anthraquinone (1,3)	purpuroxanthin	$C_6H_4(CO)_2C_6H_2$: $(OH)_2$	VIII-448	240.20
2299	anthraquinone (1,4)	quinizarin	$C_6H_4(CO)_2C_6H_2$: $(OH)_2$	VIII-450	240.20
2300	anthraquinone (1,5)	anthrarufin	$(HO{\cdot}C_6H_3)_2(CO)_2$	VIII-453	240.20
2301	anthraquinone (1,8)	chrysazin	$(HO{\cdot}C_6H_3)_2(CO)_2$	VIII-458	240.20
2302	anthraquinone (2,3)	hystazin; hystazarin	$C_6H_4(CO)_2C_6H_2$: $(OH)_2$	VIII-462	240.20
2303	anthraquinone (2,6)	anthraflavic acid	$(HO{\cdot}C_6H_3)_2(CO)_2$	VIII-463	240.20
2304	anthraquinone (2,7)	*iso*-anthraflavic acid	$C_{14}H_8O_4{\cdot}H_2O$	VIII-466	258.22
2305	anthraquinone carboxylic acid †	(2,4;1 or 1,3;2) munjistin	$C_6H_4(CO)_2C_6H$: $(OH)_2(CO_2H)$	X-1036	284.21
2306	anthraquinone carboxylic acid	(1;8,3) rheic acid; rhein	$HO{\cdot}C_6H_3(CO)_2C_6H_2$: $(OH)(CO_2H)$	X-1033	284.21
2307	azobenzene-4′-sulfonic acid (2,4)	.....	$(HO)_2C_6H_3{\cdot}N{:}N{\cdot}C_6H_4{\cdot}SO_3H$	XVI-275	294.28
2308	azobenzene-4′-sulfonate Na (2,4)	tropeolin O; resorcin yellow	$C_{12}H_9O_5N_2SNa{\cdot}2\frac{1}{2}H_2O$	XVI-275	361.31
2309	behenic acid	.....	$C_{22}H_{44}O_4$	III-410	372.57
2310	benzaldehyde (2,4)	*β*-resorcyl aldehyde	$(HO)_2C_6H_3{\cdot}CHO$	VIII-241	138.12
2311	benzaldehyde (3,4)	protocatechuic ald.	$(HO)_2C_6H_3{\cdot}CHO$	VIII-246	138.12
2312	benzene (*o*)	pyrocatechin	$C_6H_4(OH)_2$	VI-759	110.11
2313	benzene (*m*)	resorcinol	$C_6H_4(OH)_2$	VI-796	110.11
2314	benzene (*p*)	hydroquinone	$C_6H_4(OH)_2$	VI-836	110.11
2315	benzoic acid (2,3)	.....	$(HO)_2C_6H_3CO_2H{\cdot}aq.$	X-375	154.12
2316	benzoic acid (2,4)	resorcylic acid (*β*)	$(HO)_2C_6H_3CO_2H{\cdot}aq.$	X-377	154.12
2317	benzoic acid (2,5)	gentisic acid	$(HO)_2C_6H_3{\cdot}CO_2H$	X-384	154.12
2318	benzoic acid (2,6)	resorcylic acid (*γ*)	$(HO)_2C_6H_3{\cdot}CO_2H{\cdot}H_2O$	X-388	172.13
2319	benzoic acid (3,4)	protocatechuic acid	$(HO)_2C_6H_3{\cdot}CO_2H{\cdot}H_2O$	X-389	172.13
2320	benzoic acid (3,5)	resorcylic acid (*α*)	$(HO)_2C_6H_3{\cdot}CO_2H{\cdot}1\frac{1}{2}H_2O$	X-404	181.14
2321	benzophenone (2,4)	benzoyl resorcin (4)	$(HO)_2C_6H_3{\cdot}CO{\cdot}C_6H_5$	VIII-312	214.21
2322	benzophenone (2,5)	benzoyl hydroquinone (2)	$(HO)_2C_6H_3{\cdot}CO{\cdot}C_6H_5$	VIII-312	214.21
2323	benzophenone (2,2′)	salicyl-phenol (2)	$(HO{\cdot}C_6H_4)_2CO$	VIII-313	214.21
2324	benzophenone (2,3′)	salicyl-phenol (3)	$(HO{\cdot}C_6H_4)_2CO$	VIII-315	214.21
2325	benzophenone (2,4′)	salicyl-phenol (4)	$(HO{\cdot}C_6H_4)_2CO$	VIII-315	214.21

† See also No. 176.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2295	yel. nd./ aq. al.	.....	208	.....	sl. s.; s. ac.	s.; s. alk.	s.; s. act.
2296	yel. pd.	.....	178-80	.....	i.; s. fat	s. h.; s. bz.	s. dil. alk.
2297	red rhb.	.....	289-90	430	$0.03^{100°}$	v. s.	v. s.; s. alk.
2298	yel. lf./bz.	.....	263-4	.....	i.; s. act.	sl. s.	s. h. ac.
2299	red nd./al.	.....	200-2	subl. sl. d.	s. alk.	s. H_2SO_4	s.
2300	yel. lf.	.....	280	subl.	i.	sl. s.	s.
2301	red-yel./ al.	.....	191	.....	s. H_2SO_4	s.; s. alk.	s.; s. ac.
2302	yel. brn. nd.	.....	>280	.....	s. H_2SO_4	v. sl. s. h.	v. sl. s.
2303	yel. nd./ al.	.....	>330	.....	s. H_2SO_4	$1.4^{17°}$	i.
2304	yel. nd./ aq. al.	.....	>330; subl.	d. $-H_2O$, 100	s. H_2SO_4	sl. s.	v. sl. s.
2305	yel. lf./ac.	.....	230-1	subl. d. > m. p.	s. h.; s. alk.	s. h.; s. H_2SO_4	s.; s. chl.
2306	yel. nd./ Me al.	.....	321-2	subl.	i.; s. alk.; s. pyr.	sl. s.; sl. s. bz.	sl. s.; sl. s. chl.
2307	red lf.	.....	.....	.....	$0.2^{19°}$; i. aq. HCl	v. sl. s.	i.
2308	brn. lf.	.....	.....	.....	$0.4^{23°}$; $20^{100°}$	.....	.....
2309	cr./al.	.....	132-3 (99)	.....	.....	$0.1^{18°}$ abs.	i.
2310	yel. nd./aq.	.....	135-6	220-8 ^{22mm}	v. s.	v. s.	v. s.
2311	cr./aq.	.....	153-4	.....	5 c.; 33 h.	100 h.	v. s.
2312	nd./aq.	$1.344^{4°}$	104-5	240-5	v. s.	v. s.; s. chl.	v. s.; s. bz.
2313	col. rhb.	$1.272^{15°}$	110.7 (108)	276.5	$147.3^{12.5°}$	v. s.	v. s.
2314	cr.	$1.332^{15°}$	170.3	285^{730mm}	$6^{15°}$	v. s.	v. s.
2315	cr./aq.	.....	204(anh.)	-aq. 100	.....	.....	.....
2316	cr.	.....	194-200 (anh.) d.	.....	$0.26^{17°}$; s. h.	s.	s.
2317	nd./aq.	.....	199-200	.....	s.; i. CS_2	s.; i. chl.	s.; i. bz.
2318	nd./aq.	.....	148-67 (anh.) d.	.....	v. s. h.	.....	.....
2319	nd./aq.	1.542	199 d.	.....	$2^{14°}$	v. s.	s.
2320	pr. or nd.	.....	237 (anh.)	.....	v. s. h.	v. s.	v. s.
2321	nd./h. aq.	.....	143-4	.....	i. c.	s.	s.; sl. s. bz.
2322	yel. nd./ aq. al.	.....	122-4	.....	s. bz.	s.	s.
2323	yel. pr./lg.	.....	59-60	330-40 sl. d.	i.; v. s. chl.	v. s.	v. s.
2324	yel. cr./et.	.....	126	.....	.....	.....	.....
2325	lt. yel./aq.	.....	147-8	.....	sl. s. h.	s. h.; s. bz.	$44^{25°}$

Dihydroxy-azobenzene 609-11, 662 Dihydroxy-benzaldehyde dimethyl ether 2405

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2326	**Dihydroxy** benzophenone (3,3′)	.....	$(HO{\cdot}C_6H_4)_2CO$	VIII-316	214.21
2327	benzophenone (3,4′)	.....	$(HO{\cdot}C_6H_4)_2CO$	VIII-316	214.21
2328	benzophenone (4,4′)	.....	$(HO{\cdot}C_6H_4)_2CO$	VIII-316	214.21
2329	butane (1,2)	α-butylene glycol	$C_2H_5{\cdot}CHOH{\cdot}CH_2OH$	I-477	90.12
2330	butane (1,3)	β-butylene glycol	$CH_3{\cdot}CHOH{\cdot}CH_2{\cdot}CH_2OH$	I-477	90.12
2331	butane (1,4)	butandiol-1,4	$HO(CH_2)_4OH$	I-478	90.12
2332	butane (2,3)	butylene glycol (pseudo)	$CH_3{\cdot}(CHOH)_2{\cdot}CH_3$	I-479	90.12
2333	cinnamic acid (2,4)	umbellic acid	$(HO)_2C_6H_3{\cdot}C_2H_2{\cdot}CO_2H$	X-434	180.15
2334	cinnamic acid (2,5)	.....	$(HO)_2C_6H_3{\cdot}C_2H_2{\cdot}CO_2H$	X-435	180.15
2335	cinnamic acid (3,4)	caffeic acid	$C_9H_8O_4$	X-436	180.15
2336	dinaphthyl (α)	α-dinaphthol	$(HO{\cdot}C_{10}H_6{\cdot})_2$	VI-1053	286.31
2337	dinaphthyl (2,2′, 1,1′)	β-dinaphthol	$(HO{\cdot}C_{10}H_6{\cdot})_2$	VI-1051	286.31
2338	diphenyl (2,5)	Ph-hydroquinone	$(HO)_2C_6H_3{\cdot}C_6H_5$	VI-989	186.20
2339	diphenyl (3,4)	Ph-catechol (4)	$(HO)_2C_6H_3{\cdot}C_6H_5$	VI-990	186.20
2340	diphenyl (2,2′)	o,o′-diphenol	$(HO{\cdot}C_6H_4{\cdot})_2$	VI-989	186.20
2341	diphenyl (2,4′)	δ-diphenol	$(HO{\cdot}C_6H_4{\cdot})_2$	VI-990	186.20
2342	diphenyl (3,3′)	.....	$(HO{\cdot}C_6H_4{\cdot})_2$	VI-991	186.20
2343	diphenyl (4,4′)	γ-diphenol	$(HO{\cdot}C_6H_4{\cdot})_2$	VI-991	186.20
2344	diphenylmethane	(4,4′)	$(HO{\cdot}C_6H_4)_2CH_2$	VI-995	200.23
2345	ethylamino-1-hydroxy-benzene	(4)	$HO{\cdot}C_6H_4{\cdot}N(CH_2{\cdot}CH_2OH)_2$	.....	197.23
2346	hexane (2,3)	2,3-hexandiol	$CH_3(CH_2)_2(CHOH)_2{\cdot}CH_3$	I-484	118.17
2347	4-methoxy-benzophenone (2,6)	cotoin	$C_6H_5{\cdot}CO{\cdot}C_6H_2{:}(OH)_2(OCH_3)$	VIII-419	244.24
2348	naphthalene (1,2)	β-naphthohydroquinone	$C_{10}H_6(OH)_2$	VI-975	160.16
2349	naphthalene (1,3)	naphthoresorcinol	$C_{10}H_6(OH)_2$	VI-978	160.16
2350	naphthalene (1,4)	α-naphthohydroquinone	$C_{10}H_6(OH)_2$	VI-979	160.16
2351	naphthalene (1,5)	.....	$C_{10}H_6(OH)_2$	VI-980	160.16
2352	naphthalene (1,6)	.....	$C_{10}H_6(OH)_2$	VI-981	160.16
2353	naphthalene (1,7)	.....	$C_{10}H_6(OH)_2$	VI-981	160.16
2354	naphthalene (1,8)	.....	$C_{10}H_6(OH)_2$	VI-981	160.16
2355	naphthalene (2,3)	.....	$C_{10}H_6(OH)_2$	VI-982	160.16
2356	naphthalene (2,6)	.....	$C_{10}H_6(OH)_2$	VI-984	160.16
2357	naphthalene (2,7)	.....	$C_{10}H_6(OH)_2$	VI-985	160.16
2358	naphthalene diacetate (1,5)	.....	$(CH_3CO_2)_2C_{10}H_6$	VI-981	244.24
2359	naphthalene-3,6-disulfonic acid	(1,8); chromotropic acid	$(HO)_2C_{10}H_4{:}(SO_3H)_2{\cdot}2H_2O$	XI-307	356.32
2360	phenanthrene (3,4)	morphol	$C_{14}H_8(OH)_2$	VI-1034	210.22
2361	phenyl-α-alanine (3,4)(*l*–)	hydroxytyrosine; dopa	$(HO)_2C_6H_3{\cdot}CH_2{\cdot}CHNH_2{\cdot}CO_2H$	*XIV-681	197.19

Dihydroxy-chlorobenzene 1460
Dihydroxy-coumarin 1628, 2898
Dihydroxy-diethylsulfide 5900
Dihydroxy-ethylamine 2090
Dihydroxy-ethyl ether 3453
Dihydroxy-flavone 1494
Dihydroxy-fluoran 3253
Dihydroxy-fluorane 3720

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2326	nd./aq.	.....	163-4	.....	sl. s.	s. alk.	.....
2327	nd./aq.	.....	197-200	.....	.....	.....	.....
2328	cr./aq.	.....	207-10	.....	s. h.	s.; i. CS_2	s.; i. chl.
2329	lq.	$1.006^{\frac{17.5}{0}}$°	.....	192-4	v. s.	v. s.	.....
2330	oil	$1.006^{\frac{20}{20}}$°	.....	206.5	∞	v. s.	i.
2331	oil	$1.020^{20°}$	16	230^{759mm}	∞	.....	v. sl. s.
2332	lq.	$1.048^{0°}$	21-3	183-4	∞	∞	∞
2333	yel. pd.	.....	d. 240-60	.....	s. h.	s.; i. bz.	i.; i. lg.
2334	cr./aq.	.....	207 d.	.....	.....	.....	.....
2335	yel. pr./aq.	.....	195-213 d.	.....	s. h.	s.	sl. s.
2336	pl./al.	.....	300	.....	i.; s. alk.	s.; sl. s. bz.	v. s.; sl. s. chl.
2337	nd./al.	.....	218	subl.	i.; s. alk.	s.	v. s.
2338	nd./aq. al.	.....	96-8	.....	.....	.....	.....
2339	cr./pet.	.....	136-7	>360	s. h.	v. s.; s. CS_2	v. s.; s. chl.
2340	pr./toluene	.....	103-9	$325-6^{755mm}$	s.	v. s.	v. s.
2341	mn. pr.	.....	160-1	324	sl. s. h.	v. s.	v. s.
2342	nd./aq.	.....	123	247^{18mm}	s. h.	v. s.	v. s.
2343	rhb./al.	1.25	270-2	.....	sl. s.	v. s.	v. s.
2344	lf./aq.	.....	158 (148)	.....	i. CS_2	s.	v. s.
2345	col. fl.	.....	140-1	.....	i.	sl. s.	sl. s.
2346	cr.	$0.967^{0°}$	60	206-7	∞	s.	.....
2347	yel. pr./al.	.....	130-1	.....	sl. s. h.; s. alk.	s.; s. bz.; s. CS_2	s.; s. chl.; s. act.
2348	lf.	.....	60 ±	.....	s. alk.	.....	.....
2349	lf.	.....	124-5	.....	v. s.	v. s.	v. s.
2350	long nd.	.....	173-6	.....	s. h.	v. s.	v. s.
2351	pr./aq.	.....	258-60 d.	.....	sl. s.	s.	v. s.
2352	pr./bz.	.....	137-8	.....	.....	sl. s. c.	v. s.
2353	nd./aq.	.....	178	.....	v. s. h.	v. s.	v. s.
2354	nd. or lf.	.....	140	.....	sl. s. h.	v. s. bz.	v. s.
2355	mn.	.....	159-60	.....	sl. s. h.	v. s.	v. s.
2356	rhb./aq.	.....	216-8	.....	v. s. h.	v. s.	v. s.
2357	nd./aq.	.....	190	subl. sl. d.	s. h.	v. s.	v. s.
2358	cr./bz.	.....	159-60	.....	.....	.....	.....
2359	nd. or lf.	.....	.....	.....	v. s.; i. aq. NaCl	i.	i.
2360	nd.	.....	143	.....	s.	s. alk.	.....
2361	pr. or nd./ aq.; lf./ aq. al.	.....	280 d.	.....	$0.5^{20°}$; $2.5^{100°}$	i.; i. chl.; v. sl. s. bz.	i.; i. pet.; v. sl. s. CS_2

Dihydroxy-fuchsone 593
Dihydroxy-malonic acid 4055
Dihydroxy-methylanthranol 1492
Dihydroxy-methylanthraquinone 1495
Dihydroxy-methylfuchsone 5573
Dihydroxy-naphthoquinone 4477-8
Dihydroxy-phenylacetic acid 3673

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Dihydroxy				
2362	pyridine (2,4)	.....	$(HO)_2C_5H_3N$	XXI-160	111.10
2363	pyridine (2,6)	.....	$(HO)_2C_5H_3N \cdot \frac{1}{2}H_2O$	XXI-161	120.11
2364	quinone (2,5)	.....	$(HO)_2C_6H_2O_2$	VIII-377	140.09
2365	stearic acid (4,9) (*dl*)	.....	$C_{18}H_{36}O_4$	III-407	316.47
2366	stearic acid (*dl*)	(9,10)	$C_{18}H_{36}O_4$	III-408	316.47
2367	tartaric acid	.....	$[(HO)_2C \cdot CO_2H]_2$	III-830	182.09
2368	tartaric Na salt	.....	$[(HO)_2C \cdot CO_2Na]_2 \cdot 3H_2O$	III-832	280.11
2369	thiazole	mustard oil acetic acid	HO·C:CH·S·C(OH):N	XXVII-233	117.12
2370	toluene (2,3)	.....	$CH_3 \cdot C_6H_3(OH)_2$	VI-872	124.13
2371	toluene (2,4)	4-Me-resorcinol	$CH_3 \cdot C_6H_3(OH)_2$	VI-872	124.13
2372	toluene (2,5)	toluhydroquinone	$CH_3 \cdot C_6H_3(OH)_2$	VI-874	124.13
2373	toluene (2,6)	2-Me-resorcinol	$CH_3 \cdot C_6H_3(OH)_2$	VI-878	124.13
2374	toluene (3,4)	homocatechol	$CH_3 \cdot C_6H_3(OH)_2$	VI-878	124.13
2375	*o*-xylene (3,5)	4,5-diMe-resorcinol	$(CH_3)_2C_6H_2(OH)_2$	VI-908	138.16
2376	*o*-xylene (3,6)	2,3-diMe-hydroquinone	$(CH_3)_2C_6H_2(OH)_2$	VI-908	138.16
2377	*m*-xylene (2,4)	2,4-diMe-resorcinol	$(CH_3)_2C_6H_2(OH)_2$	VI-911	138.16
2378	*m*-xylene (2,5)	2,6-diMe-hydroquinone	$(CH_3)_2C_6H_2(OH)_2$	VI-911	138.16
2379	*p*-xylene (2,5)	hydrophloron	$(CH_3)_2C_6H_2(OH)_2$	VI-915	138.16
2380	*p*-xylene (2,6)	*β*-orcin	$(CH_3)_2C_6H_2(OH)_2$	VI-918	138.16
2381	**Diiodo**-acetic acid	.....	$I_2CH \cdot CO_2H$	II-224	311.88
2382	acetylene	diiodo-ethyne	IC:CI	I-246	277.86
2383	anthranilic acid	(3,5;2,1)	$I_2C_6H_2(NH_2)CO_2H$	*XIV-554	388.96
2384	atophan	*p*-iodophenyl-6-iodoquinoline-4-carboxylic acid	$C_{16}H_9O_2NI_2$	.....	501.08
2385	aniline (2,4)	.....	$I_2C_6H_3 \cdot NH_2$	XII-675	344.95
2386	benzene (*o*)	*o*-phenylene iodide	$C_6H_4I_2$	V-225	329.93
2387	benzene (*m*)	.....	$C_6H_4I_2$	V-225	329.93
2388	benzene (*p*)	.....	$C_6H_4I_2$	V-227	329.93
2389	butane (1,4)	tetramethylene di-iodide	$I(CH_2)_4I$	I-123	309.94
2390	ethane (1,1)	ethylidene diiodide	$CH_3 \cdot CHI_2$	I-99	281.89
2391	ethane (1,2)	ethylene iodide	$ICH_2 \cdot CH_2I$	I-99	281.89
2392	fluorescein	.....	$C_{20}H_{10}O_5I_2$	.....	584.12
2393	hexane (1,6)	hexamethylene di-iodide	$I(CH_2)_6I$	I-147	338.00
2394	2-hydroxybenzoic acid (3,5)	3,5-diI-salicylic acid	$I_2C_6H_2(OH)CO_2H$	X-113	389.94
2395	4-hydroxybenzoic	(3,5;4,1)	$I_2C_6H_2(OH)CO_2H$	X-180	389.94
2396	pentane (1,5)	pentamethylene di-iodide	$I(CH_2)_5I$	I-133	323.97
2397	propane (1,2)	propylene iodide	$CH_3 \cdot CHI \cdot CH_2I$	I-115	295.92
2398	propane (2,2)	iodoacetol	$(CH_3)_2CI_2$	I-115	295.92
2399	propane (1,3)	trimethylene diiodide	$I(CH_2)_3I$	I-115	295.92
2400	thiophene (2,5)	.....	$I_2C_4H_2S$	XVII-35	335.96
2401	tyrosine (3,5)(*l*)	iodogorgonic acid	$C_9H_9O_3NI_2$	XIV-619	433.01

Dihydroxy-propane 5465, 6286
Dihydroxy-propionic acid 3379
Dihydroxy-purine, cf. alkd.
Dihydroxy-xanthone 3227
Diiodo-ethene 137-8
Diiodo-ethyne 2382

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2362	yel. nd./aq.	.....	255-65 d.	.....	s. h.	s.	v. sl. s.
2363	nd./aq.	.....	195 d.	.....	sl. s.	s. h.	i.
2364	yel. nd.	.....	subl. 215-20 sl. d.	.....	i. c.	s.	i. c.
2365	lf./al.	.....	136.5	.....	v. s. h. al.	$0.6^{19°}$	$0.2^{18°}$
2366	lf.	.....	99-100	.....	v. sl. s. c.	$3.6^{18°}$	sl. s.
2367	wh. pd.	.....	114-5 d.	.....	v. s.; d. h.	.....	.....
2368	cr.	.....	d., $-H_2O$, $-CO^2$	.....	$0.04^{0°}$	.....	.....
2369	rhb.	.....	126-8	179^{19mm}; subl.	v. s. h.	s.	s.
2370	lf./bz.	.....	68	238-40 sl. d.	s.; v. s. chl.	v. s.	s.; v. s. bz.
2371	cr./bz. pet.	.....	104-5	267-70	s.; i. pet.	s.	s.; sl. s. bz.
2372	lf./bz.	.....	124-5	.....	s.	s.	s.; sl. s. bz.
2373	cr.	.....	116	264	v. s.	v. s.	v. s.
2374	pr./bz.	$1.129^{\frac{7}{4}4°}$	65	252	v. s.	v. s.	v. s.
2375	nd./bz.*	.....	136-7	subl.	s.; sl. s. lg.	s.	s.
2376	cr./aq.	.....	221 sl. d.	.....	.....	.....	.....
2377	nd.	.....	149-50	.....	s.	v. s.	v. s.
2378	nd./ xylene	.....	150-1	.....	.....	.....	.....
2379	lf./aq.	.....	213	subl.	s. h.	v. s.	v. s.; i. bz.
2380	cr. aq. al.	.....	163	277-80	s. h.	s.	s.
2381	lt. yel. nd.	.....	110 (95-6)	.....	s.	s.	s.
2382	col. rhb.	.....	78-82	d. 80-100	sl. s. c. lg.	.....	.....
2383	pr./al.	.....	230-2	.....	i. h.	sl. s. h. bz.	v/s.
2384	yel. pd.	.....	291-2	.....	i.	s. h.	v. sl. s.
2385	rhb.	2.75	95-6	.....	s. h.	v. s. h.	v. s.
2386	cr./lg.	.....	27	286.5	i.	sl. s. c.	.....
2387	cr./al. et.	.....	40.4	284.7^{757mm}	i.	sl. s.	.....
2388	lf./al.	.....	129.4	285	i.	sl. s.	.....
2389	lq.	$2.307^{18°}$	5.8	$120\text{-}5^{12mm}$	.....	.....	.....
2390	lq.	$2.84^{0°}$	.....	177-9	i.	v. s.	v. s.
2391	yel. mn.	$2.132^{10°}$	81-2	d.	sl. s.	s.	s.
2392	or.-red pd.	.....	.....	.....	sl. s.	s.	s. alk.
2393	col. nd.	$2.05^{18°}$	9.5	$163^{17.5}$	.....	.....	.....
2394	yel.-wh. nd./al.	.....	230 +, d.	.....	0.07 c.; 0.15 h.	s.	s.
2395	nd./aq. al.	.....	278-9 d.	.....	i. h.	v. s.	v. s.
2396	oil	$2.194^{18°}$	9	149^{20mm}	.....	.....	.....
2397	lq.	$2.490^{18.5°}$	.....	d.	.....	.....	.....
2398	lq.	$2.15^{0°}$	.....	147-8 d.	.....	.....	.....
2399	lq.	$1.091\frac{4}{15}^{0°}$	22.5	207.1	v. sl. s.	s.	s.
2400	col. lf./al.	.....	40-1	.....	i.	s.	s.; s. chl.
2401	nd./aq. al.	.....	213 d.	.....	$0.288^{15°}$	d. h. aq.	s. dil. alk.

* Cryst./aq. + $1H_2O$, m. p. 115-7°.

Diiodoform 5812
Diiodo-methane 4434
Diiodo-phenol sulfonic acid 5626
Diiodo-propanol 3401
Diiodo-salicylic acid 2394

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Diiodo				
2402	tyrosine (3,5)(*dl*)	.....	$C_9H_9O_3NI_2$	XIV-622	433.01
2403	**Dimethallyl ether** (*β*)	.....	$[CH_2{:}C(CH_3)\cdot CH_2]_2O$	.....	126.19
2404	**Dimethoxy**-aniline	(2,5;1)	$(CH_3O)_2C_6H_3\cdot NH_2$	XIII-738	153.18
2405	benzaldehyde (2,4)	2-MeO-anisaldehyde	$(CH_3O)_2C_6H_3\cdot CHO$	VIII-242	166.17
2406	benzene (*o*)	veratrole	$(CH_3O)_2C_6H_4$	VI-771	138.16
2407	benzene (*m*)	resorcinol diMe ether	$(CH_3O)_2C_6H_4$	VI-813	138.16
2408	benzene (*p*)	hydroquinone diMe ether	$(CH_3O)_2C_6H_4$	VI-843	138.16
2409	benzophenone (4,4′)	*p*-anisoyl-anisole	$(CH_3O\cdot C_6H_4)_2CO$	VIII-317	242.26
2410	ethyl adipate	.....	$[(CH_2)_2\cdot CO_2(CH_2)_2\cdot OCH_3]_2$	.....	262.30
2411	ethyl carbonate	.....	$[CH_3O(CH_2)_2O]_2CO$	.....	178.18
2412	ethyl phthalate	.....	$[CH_3O(CH_2)_2O_2C]_2\cdot C_6H_4$	.....	282.28
2413	2-methyl-3,4-dihydroisoquinoline chloride (6,7)	lodal	$C_{12}H_{16}O_2N\cdot Cl\cdot 3\frac{1}{2}H_2O$	XXI-170	304.77
2414	quinazoline (2,4)	.....	$(CH_3O)_2C_8H_4N_2$	XXIII-486	190.20
2415	**Dimethyl**-acetal	dimethyl aldehyde	$CH_3\cdot CH(OCH_3)_2$	I-603	90.12
2416	acetamide (*N,N*)	acet-dimethylamide	$CH_3CO\cdot N(CH_3)_2$	IV-59	87.12
2417	acetanilide (2,3)	aceto-*o*-xylidide (*vic*)	$(CH_3)_2C_6H_3NH\cdot COCH_3$	XII-1101	163.21
2418	acetanilide (2,4)	aceto-*m*-xylidide (*uns*)	$(CH_3)_2C_6H_3NH\cdot COCH_3$	XII-1118	163.21
2419	acetanilide (2,5)	aceto-*p*-xylidide	$C_8H_9NH\cdot COCH_3$	XII-1137	163.21
2420	acetanilide (2,6)	aceto-*m*-xylidide (*vic*)	$C_8H_9NH\cdot COCH_3$	XII-1109	163.21
2421	acetanilide (3,4)	aceto-*o*-xylidide (*uns*)	$C_8H_9NH\cdot COCH_3$	XII-1104	163.21
2422	acetanilide (3,5)	aceto-*m*-xylidide (*sym*)	$C_8H_9NH\cdot COCH_3$	XII-1131	163.21
2423	acetoacetic ester	.....	$CH_3CO\cdot C(CH_3)_2CO_2\cdot C_2H_5$	III-695	158.19
2424	acrylic acid (*β,β*)	.....	$(CH_3)_2C{:}CH\cdot CO_2H$	II-432	100.11
2425	acrylic acid (*α,β*) (*cis*)	angelic acid	$CH_3\cdot CH{:}C(CH_3)\cdot CO_2H$	II-428	100.11
2426	acrylic acid (*α,β*) (*trans*)	tiglic acid	$CH_3\cdot CH{:}C(CH_3)\cdot CO_2H$	II-430	100.11
2427	acrylic aldehyde (*trans*)	tiglic aldehyde	$CH_3\cdot CH{:}C(CH_3)\cdot CHO$	I-733	84.11
2428	adipate	methyl adipate	$[(CH_2)_2CO_2CH_3]_2$	II-652	174.19
2429	amine	.....	$(CH_3)_2NH$	IV-39	45.08
2430	amine hydrochloride	.....	$(CH_3)_2NH\cdot HCl$	IV-41	81.55
2431	amino-azobenzene (*p*)	benzene-azo-diMe-aniline	$(CH_3)_2N\cdot C_6H_4\cdot N{:}N\cdot C_6H_5$	XVI-312	225.28
2432	amino-azobenzene (*p*) HCl	.....	$C_{14}H_{15}N_3\cdot HCl$	XVI-312	261.75

Diketo-hydrindene 3854
Diketo-piperazine 3439
Diketo-tetrahydroquinazoline 779
Dilactide 3945
Dilactone 2872
Dilantin 2724
Dilaudid, cf. alkd.
Dilituric acid 4632
Dimercapto-thiodiazol 5898
Dimethoxy-azobenzene 598
Dimethoxy-benzaldehyde 6424
Dimethoxy-benzoic acid 6423
Dimethoxy-coumarin 3971
Dimethoxy-ethane 3459
Dimethoxy-methane 4424

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2402	pl./aq.	.....	>200 d.	.....	$0.56^{75°}$	.....	.....
2403	lq.	$0.816^{20°}_{4°}$	.....	134	<0.1	.....	.....
2404	sc./pet.	.....	80-1	270 sl. d.	s.	v. s. h.	v. s. h. pet.
2405	nd./aq. al.	.....	69-70	165^{10mm}	i.; s. bz.	s.; s. lg.	s.
2406	cr.	$1.091\frac{15°}{15°}$	22.5	207.1	v. sl. s.	s.	s.
2407	lq.	$1.062\frac{25°}{15°}$	-52	216.5-7.5	v. sl. s.	v. s.	v. s.
2408	lf.	$1.053\frac{25°}{25°}$	56	212.6	v. sl. s.	v. s.	v. s.
2409	nd./al.	.....	144-5	.....	s. bz.	s. h.	s. chl.
2410	col. lq.	.....	.....	$194-6^{20mm}$	.....	.....	.....
2411	col. lq.	.....	.....	$115-7^{13mm}$	.....	.....	.....
2412	col. lq.	.....	.....	$178-80^{1mm}$	.....	.....	.....
2413	yel. nd. aq. act.	.....	61-2; 186 d. (anh.)	.....	v. s.	v. s.	sl. s. chl.
2414	col. nd.	.....	75	.....	i.	s.	s.
2415	lq.	$0.850^{20°}_{4°}$	.....	64^{748mm}	∞	∞	∞
2416	col. lq.	$0.943^{20°}_{4°}$	.....	165.5^{754mm}	.....	.....	.....
2417	nd./al.	.....	132-3	.....	s. h.	s.	s.
2418	nd./aq. al.	.....	128-9	.....	v. sl. s. c.	s.	.....
2419	nd./aq.	.....	138-9	.....	s. h.	s. h. toluene	.....
2420	nd.	.....	174-6	.....	.....	.....	.....
2421	pr./aq. al.	.....	98-9	.....	i.	v. s.	.....
2422	nd./al.	.....	144.5	.....	i.	s.	.....
2423	oil	$0.977\frac{18°}{4°}$	.....	184-5	v. sl. s.	s.	s.
2424	mn./aq.	$1.006^{24°}$	69-70	194-5	s.	s.	s.
2425	mn. nd.	$0.983^{47°}$	45	185	s. h.	s.	s.
2426	tri. pl.	$0.964^{70°}_{4°}$	64.5	198.5	s. h.	s.	s.
2427	lq.	$0.870^{18°}_{4°}$	.....	115.8^{739mm}	2.5	∞	∞
2428	col. lq.	$1.063^{20°}_{4°}$	10-1	115^{13mm}	i.	.....	.....
2429	col. lq.	$0.680^{0°}_{4°}$	-96	7.4	v. s.	s.	s.
2430	nd./al.	.....	170-1	.....	$369^{25°}$	v. s.	i.; $16.9^{25°}$ chl.
2431	yel. lf./al.	.....	116-7	d.	i.; s. oil	s.; s. bz.	s.; s. chl.
2432	red-vl. cr.	.....	168-74	.....	.....	.....	.....

Dimethoxy-methyl ether 4077
Dimethoxy-phenol 5515
Dimethoxy-phthalic acid 3502
Dimethoxy-phthalide 4017
Dimethoxy-strychnine, cf. alkd.
Dimethoxy-tetraglycol 5769
Dimethyl-aldehyde 2415
Dimethyl-aldine 2533
Dimethyl-allene 4155
Dimethyl-amino-antipyrine 363

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Dimethyl				
2433	amino-azobenzene-arsinic acid (*p*)	.....	$(CH_3)_2N{\cdot}C_6H_4{\cdot}N{:}N{\cdot}C_6H_4{\cdot}As(OH)_2$	.....	333.20
2434	amino-azo-benzene-arsonic acid (*p*)	.....	$(CH_3)_2N{\cdot}C_6H_4{\cdot}N{:}N{\cdot}C_6H_4{\cdot}AsO(OH)_2$	XVI-885	349.20
2435	amino-benzaldehyde	(1,2)	$(CH_3)_2N{\cdot}C_6H_4{\cdot}CHO$	XIV-25	149.19
2436	amino-benzaldehyde (1,4)	Ehrlich's reagent	$(CH_3)_2N{\cdot}C_6H_4{\cdot}CHO$	XIV-31	149.19
2437	amino-bonzal-rhodanine-5 (*p*)	.....	$(CH_3)_2N{\cdot}C_6H_4{\cdot}CH{:}C_3HONS_2$	XXVII-433	264.35
2438	amino-benzene-1-azo-1-naphthalene (4)	butter yellow	$(CH_3)_2N{\cdot}C_6H_4{\cdot}N{:}N{\cdot}C_{10}H_7$	XVI-321	275.34
2439	amino-benzene-1-azo-2-naphthalene (4)	.....	$(CH_3)_2N{\cdot}C_6H_4{\cdot}N{:}N{\cdot}C_{10}H_7$	XVI-321	275.34
2440	amino-benzoic acid (*o*)	*N*,*N*-diMe-anthranilic acid	$(CH_3)_2N{\cdot}C_6H_4{\cdot}CO_2H$	XIV-325	165.19
2441	amino-benzoic acid	(*p*)	$(CH_3)_2N{\cdot}C_6H_4{\cdot}CO_2H$	XIV-426	165.19
2442	amino-benzophenone (*p*)	.....	$(CH_3)_2N{\cdot}C_6H_4{\cdot}CO{\cdot}C_6H_5$	XIV-82	225.28
2443	amino-ethanol	.....	$(CH_3)_2N{\cdot}CH_2{\cdot}CH_2OH$	IV-276	89.14
2444	amino-glycerol (*α*)	γ-dimethylamino-propylene glycol	$(CH_3)_2N{\cdot}CH_2{\cdot}CHOH{\cdot}CH_2OH$	IV-302	119.16
2445	amino-phenol (*m*)	.....	$(CH_3)_2N{\cdot}C_6H_4{\cdot}OH$	XIII-405	137.18
2446	amino-phenol (*p*)	.....	$(CH_3)_2N{\cdot}C_6H_4{\cdot}OH$	XIII-442	137.18
2447	amino-phenol H_2SO_4	(*p*)	$C_8H_{11}ON{\cdot}\frac{1}{2}H_2SO_4$	XIII-442	186.21
2448	amino-phenyl acetate (*p*)	.....	$CH_3CO_2{\cdot}C_6H_4{\cdot}N(CH_3)_2$	XIII-443	179.21
2449	ammonium-di-methyl-dithiocarbamate	.....	$(CH_3)_2N{\cdot}CS{\cdot}S{\cdot}NH_2(CH_3)_2$	.....	166.30
2450	aniline †	.....	$(CH_3)_2N{\cdot}C_6H_5$	XII-141	121.18
2451	aniline sulfonic acid (*m*)	.....	$(CH_3)_2N{\cdot}C_6H_4{\cdot}SO_3H$	XIV-690	201.24
2452	aniline sulfonic acid (*p*)	.....	$(CH_3)_2N{\cdot}C_6H_4{\cdot}SO_3H{\cdot}H_2O$	XIV-699	219.25
2453	anthracene (1,3)	.....	$(CH_3)_2C_{14}H_8$	V-678	206.27
2454	anthracene (2,3)	.....	$(CH_3)_2C_{14}H_8$	V-678	206.27
2455	anthracene (2,6)	.....	$(CH_3)_2C_{14}H_8$	V-678	206.27
2456	arsine	cacodyl hydride	$(CH_3)_2AsH$	IV-599	105.99
2457	benzamide (*N*)	.....	$C_6H_5CO{\cdot}N(CH_3)_2$	IX-201	149.19
2458	benzoic acid (2,3)	hemellitic acid	$(CH_3)_2C_6H_3{\cdot}CO_2H$	IX-531	150.17
2459	benzoic acid (2,4)	xylic acid	$(CH_3)_2C_6H_3{\cdot}CO_2H$	IX-531	150.17
2460	benzoic acid (2,5)	.....	$(CH_3)_2C_6H_3{\cdot}CO_2H$	IX-534	150.17
2461	benzoic acid (2,6)	.....	$(CH_3)_2C_6H_3{\cdot}CO_2H$	IX-531	150.17
2462	benzoic acid (3,4)	.....	$(CH_3)_2C_6H_3{\cdot}CO_2H$	IX-535	150.17

† See also xylidine.

Dimethyl-amino-azobenzene carboxylic acid 4376
Dimethyl-amino-benzophenonimide 592
Dimethyl-amino-propylene glycol 2444
Dimethyl-*n*-amyl carbinol 4967
Dimethyl-aniline 6471-5, 6477

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2433	vl. cr.	.....	.....	.....	i.	sl. s.	i.
2434	red pd.	.....	.....	.....	s. a.	s. alk.	.....
2435	yel. oil	.....	.....	244	s. dil. ac.	s.	s.
2436	lf./aq.	.....	74-5	176-7^{17mm}	i.; s. ac.	s.	s.
2437	red nd./ al.	.....	240-70 d.	.....	i.; s. conc. a.	sl. s. h.; v. sl. s. bz.	v. sl. s.; v. sl. s. chl.
2438	red-bl. pr./act.	.....	.....	.....	s. conc. H_2SO_4	sl. s.; s. chl.	sl. s.; s. act.
2439	yel. brn. cr./bz.-lg.	.....	174	.....	.....	.....	.....
2440	nd./et.	.....	70	.....	s.	s.	sl. s. h.
2441	nd./al.	.....	238-9	.....	s.	s.	sl. s.
2442	lf./al.	.....	90-2	.....	i.	v. s. h.	v. s.
2443	col. lq.	$0.887^{20°}_{4}$	.....	135^{758mm}	.....	.....	.....
2444	syrup	.....	.....	220^{749mm}	s.	s.	s.; s. chl.
2445	nd./lg.	.....	85	265-8	sl. s. h.	s.	s.
2446	cr./et.-lg.	.....	78	.....	v. sl. s. lg.	s.	s.
2447	cr.	.....	209-10	.....	v. s.	sl. s.	.....
2448	nd. or pl./ aq. al.	.....	78-9	.....	v. sl. s.; v. sl. s. ac.	s.; v. s. bz.	s.; s. lg.; v. s. chl.
2449	pa. yel. pl.	.....	129-30 d.	.....	v. s.	v. s.	v. sl. s.
2450	yel. lq.	$0.956^{20°}_{4}$	2.5	193	i.	s.; s. chl.	s.
2451	.....	.....	d. 266	.....	s.	.....	.....
2452	pr. or lf.	.....	270 (anh.) $-H_2O$, 135°	.....	s. h.; s. ac.	v. sl. s.	v. sl. s.
2453	lf.	.....	202-3	.....	.....	.....	.....
2454	lf.	.....	246	.....	v. s. bz.	.....	.....
2455	red-yel.; gn.-yel. or silvery	.....	243-4	.....	.....	sl. s.	s. bz.
2456	col. lq.	$1.213^{29°}$	.....	35.6^{747mm}	.....	∞	∞
2457	col. cr.	.....	41-2	272-3	v. s.	.....	.....
2458	pr./al.	.....	144	.....	v. sl. s. h.	s.	.....
2459	mn. or tri.	.....	126-7	267^{727mm}	sl. s. h.	s. h.	s. bz., chl.
2460	nd al.	$1.069^{20°}_{4}$	132	268	v. sl. s. h.	v. s. c.	.....
2461	col. nd./lg.	.....	116	.....	.....	sl. s. c. lg.	v. s.
2462	pr./al.	.....	165-6	subl.	v. sl. s. h.	s.	.....

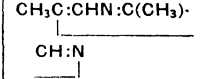
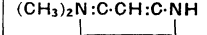
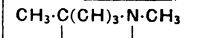
Dimethyl-anthranilic acid 2440
Dimethyl-azobenzene 612-4
Dimethyl-benzene 6454, 6457, 6462
Dimethyl-benzene sulfonyl chloride 6461
Dimethyl-benzidine 5955, 5959
Dimethyl-benzophenone 2838

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2463	**Dimethyl** benzoic acid (3,5)	mesitylenic acid	$(CH_3)_2C_6H_3\cdot CO_2H$	IX-536	150.17
2464	benzoylene urea	.....	$C_6H_4\cdot N(CH_3)\cdot CO\cdot N(CH_3)\cdot CO$	XXIV-375	190.20
2465	benzylamine (*N*)	.....	$C_6H_5\cdot CH_2\cdot N(CH_3)_2$	XII-1019	135.20
2466	benzyl carbinol	.....	$C_6H_5CH_2\cdot C(CH_3)_2OH$	VI-523	150.21
2467	carbanilide	*N,N'*-diMe-*N,N'*-diPh urea	$[C_6H_5(CH_3)N]_2CO$	XII-418	240.29
2468	carbonate	methyl carbonate	$CO(OCH_3)_2$	III-4	90.08
2469	citraconate	.....	$CH_3\cdot C_2H(CO_2CH_3)_2$	II-770	158.15
2470	cyclohexan-3,5-diol (1,1)	.....	$(CH_2\cdot CHOH)_2CH_2\cdot C(CH_3)_2$	*VI-371	144.21
2471	cyclohexane (*o*)	hexahydro-*o*-xylene	$(CH_3)_2C_6H_{10}$	V-36	112.21
2472	cyclohexane (*m*)	hexahydro-*m*-xylene	$(CH_3)_2C_6H_{10}$	V-36	112.21
2473	cyclohexane (*p*)	hexahydro-*p*-xylene	$(CH_3)_2C_6H_{10}$	V-39	112.21
2474	2,4-dicarbethoxypyrrole (3,5)	.....	$C_{12}H_{17}O_4N$	XXII-133	239.26
2475	dihydroresorcinol (5,5)	1,1-diMe-cyclohexan-3,5-dione	$(CH_3)_2C_6H_6O_2$	VII-559	140.18
2476	1,3-diphenylcyclobutane (1,3)	α-Me-styrene dimer	$[C_6H_5(CH_3)C\cdot CH_2]_2$	V-652	236.34
2477	dithiocarbamate Na	.....	$(CH_3)_2N\cdot CS_2Na\cdot 2\frac{1}{2}H_2O$	IV-75	188.24
2478	ether	methyl ether	$CH_3\cdot O\cdot CH_3$	I-281	46.07
2479	6-ethoxyquinoline	(2,4)	$C_2H_5O\cdot C_9H_4N(CH_3)_2$	.....	201.26
2480	6-ethoxyquinoline ethiodide (2,4)	.....	$C_{13}H_{15}ON\cdot C_2H_5I$	.....	357.24
2481	ethylacetic acid	.....	$(CH_3)_2(C_2H_5):C\cdot CO_2H$	II-335	116.16
2482	ethylamine	.....	$(CH_3)_2N\cdot C_2H_5$	IV-94	73.14
2483	ethylbenzene (3,4)	4-Et-*o*-xylene	$C_2H_5\cdot C_6H_3(CH_3)_2$	V-427	134.21
2484	ethylbenzene (3,5)	5-Et-*m*-xylene	$C_2H_5\cdot C_6H_3(CH_3)_2$	V-429	134.21
2485	ethylbenzene (2,4)	6-Et-*m*-xylene	$C_2H_5\cdot C_6H_3(CH_3)_2$	V-428	134.21
2486	ethylbenzene (2,5)	2-Et-*p*-xylene	$C_2H_5\cdot C_6H_3(CH_3)_2$	V-428	134.21
2487	fumarate	methyl fumarate	$(:CH\cdot CO_2\cdot CH_3)_2$	II-741	144.12
2488	furan (2,5)	α,α'-diMe-furan	$(CH_3)_2C_4H_2O$	XVII-41	96.12
2489	glutaric acid (α,α)	.....	$(CH_3)_2C_3H_4(CO_2H)_2$	II-676	160.17
2490	glyoxime	diacetyl-dioxime	$(CH_3\cdot C:NOH)_2$	I-772	116.12
2491	guanidine H_2SO_4 (*uns*)	.....	$(CH_3)_2N\cdot C(NH)\cdot NH_2\cdot\frac{1}{2}H_2SO_4$	.....	136.16
2492	1,3-heptadiene-(2,6)	*iso*-geraniolene	C_9H_{16}	I-260	124.22
2493	1,5-hexadiene (2,5)	.....	$[CH_2:C(CH_3)\cdot CH_2\cdot]_2$	I-259	110.19
2494	hydrazine (*sym*)	hydrazomethane	$CH_3NH\cdot NHCH_3$	IV-547	60.10
2495	hydrazine (*uns*)	.....	$(CH_3)_2N\cdot NH_2$	IV-547	60.10
2496	hydrazine HCl	(*uns*)	$(CH_3)_2N\cdot NH_2\cdot HCl$	IV-547	96.57
2497	2-(2-hydroxyphenyl)-imidazole (4,5)	.....	$CH_3\cdot C:C(CH_3)\cdot N:C\cdot(C_6H_4OH)\cdot NH$	XXIII-391	188.22

Dimethyl-benzyl phenol 1573
Dimethyl-butadiene 2769
Dimethyl-butandiol 5312
Dimethyl-butyl carbinol (*n*) 3535
Dimethyl-butyl carbinol (*iso*) 3530
Dimethyl-butyl carbinol (*tert*) 3528
Dimethyl-cadmium 1186
Dimethyl-chloroarsine 1179
Dimethyl-cyclohexadiene 2289-91
Dimethyl-diazine 2533

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2463	mn./aq. al.	.....	166	subl.	v. sl. s. h.	v. s. c.	.....
2464	col. nd.	.....	167-8	.....	i.	s.	.....
2465	lq.	$0.915^{0°}$	.....	183-4^{765mm}	sl. c.; v. sl. h.	∞	∞
2466	nd.	$0.979^{\frac{18}{4}°}$	24	228	.....	.....	.....
2467	mn. pr./al.	.....	121	350	i.	s.	s.; s. bz.
2468	col. lq.	$1.070^{\frac{20}{4}°}$	0.5	89-90	i.	∞	∞
2469	col. oil	$1.121^{\frac{15}{15}°}$	.....	210.5	$3^{15°}$	.....	.....
2470	pl./act.	.....	146-7	.....	s.; s. bz.	s.; s. chl.	v. sl. s.
2471	lq.	$0.779^{\frac{20}{4}°}$	−57.5	129.4	i.	∞	∞
2472	lq.	$0.771^{\frac{20}{4}°}$	−85	123.7	i.	∞	∞
2473	lq.	$0.769^{\frac{20}{4}°}$	−86	119-20	.....	.....	.....
2474	cr./aq. al. or ac.	.....	134-5	.....	i.; s. chl.; s. H_2SO_4	s.; s. bz.; i. HCl	v. sl. s.; s. ac.
2475	yel. mn. nd./aq.	.....	148-9	.....	$0.416^{25°}$; s. chl.	6.6 h. bz.; s. EtOAc	v. sl. s.
2476	cr./et.	.....	52.6	307.5^{760mm}	i.; $125^{25°}$ act.	$5^{25°}$; $190^{25°}$ bz.	$147^{25°}$; $104^{25°}$ CCl_4
2477	cr.	.....	$-2H_2O$, 115	$-2\frac{1}{2}H_2O$, 130	.....	.....	.....
2478	gas	1.617(A)	−138.5	−23.7	$3700^{18°}$ cc.	s.	s.
2479	col. nd.	.....	86-8	.....	i.	v. s.	v. s.
2480	yel. rhb.	.....	163-4	.....	i.	s.	i.
2481	lq.	.....	−14	187	v. sl. s.	s.	s.
2482	col. lq.	.....	.....	37.5	.....	.....	.....
2483	col. lq.	$0.874^{\frac{20}{4}°}$	<−20	188-91	i.	s.	s.
2484	col. lq.	$0.861^{\frac{20}{4}°}$	<−20	185	i.	s.	s.
2485	lq.	$0.869^{\frac{20}{4}°}$	<−20	184-5	i.	s.	s.
2486	lq.	$0.8821^{\frac{7}{4}°}$	<−20	185.5^{759mm}	i.	s.	s.
2487	col. tri.	.....	102	192	s. c. chl.	sl. s.	sl. s.
2488	col. lq.	$0.888^{\frac{20}{4}°}$	.....	93-4	i.; i. alk.	∞	∞
2489	nd./HCl	.....	90	.....	v. s.	v. s.	v. s.
2490	col. cr.	.....	240-6	.....	i.	v. s.	v. s.
2491	col. cr.	.....	285-7 d.	.....	v. s.	i.	i.
2492	lq.	$0.765^{\frac{10}{4}°}$	.....	143-5^{755mm}	i.	.....	.....
2493	lq.	$0.749^{\frac{21}{21}°}$	.....	113-4^{755mm}	i.	.....	.....
2494	hyg. lq.	$0.827^{\frac{20}{4}°}$	.....	81^{747mm}	∞	∞	∞
2495	hyg. lq.	$0.791^{22°}$	.....	62.5^{717mm}	v. s.	v. s.	v. s.
2496	col. cr.	.....	82-3	.....	s.	s.	i.
2497	nd./aq. al.	.....	218	.....	.....	.....	.....

Dimethyl-diphenyl urea 2467
Dimethyl-disulfide 4222
Dimethyl-ethyl carbinol 409
Dimethyl-ethylene 1148-9
Dimethyl-ethylene glycol 1154
Dimethyl-ethylene oxide 1155
Dimethyl-furfurane carboxylic acid 6396
Dimethyl-hexyl carbinol (*n*) 4922
Dimethyl-hydantoin 66
Dimethyl-hydroquinone 2376, 2380

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2498	**Dimethyl** itaconate	.....	$C_3H_4(CO_2CH_3)_2$	II-762	158.15
2499	ketene	.....	$(CH_3)_2C{:}CO$	I-731	70.09
2500	malate (*l*)	methyl malate	$C_2H_4O(CO_2CH_3)_2$	III-429	162.14
2501	maleate	methyl maleate	$(:CH{\cdot}CO_2{\cdot}CH_3)_2$	II-751	144.12
2502	malonate	methyl malonate	$CH_2(CO_2{\cdot}CH_3)_2$	II-572	132.11
2503	malonic acid	.....	$(CH_3)_2C(CO_2H)_2$	II-647	132.11
2504	mesaconate	.....	$CH_3{\cdot}C_2H(CO_2CH_3)_2$	II-765	158.15
2505	naphthylamine (α)	.....	$(CH_3)_2N{\cdot}C_{10}H_7$	XII-1221	171.23
2506	naphthylamine (β)	.....	$(CH_3)_2N{\cdot}C_{10}H_7$	XII-1273	171.23
2507	naphthalene (1,4)	.....	$(CH_3)_2C_{10}H_6$	V-570	156.22
2508	naphthalene (2,3)	guajen	$(CH_3)_2C_{10}H_6$	*V-268	156.22
2509	naphthalene (2,6)	.....	$(CH_3)_2C_{10}H_6$	V-570	156.22
2510	α-naphthoquinoline	(2,4)	$(CH_3)_2C_{13}H_7N$	XX-475	207.26
2511	β-naphthoquinoline	(2,4)	$(CH_3)_2C_{13}H_7N$	XX-476	207.26
2512	4-nitrophthalate	.....	$NO_2C_6H_3(CO_2CH_3)_2$	IX-830	239.18
2513	nitrosamine	nitroso-dimethyl-amine	$(CH_3)_2N{\cdot}NO$	IV-84	74.08
2514	2,6-octadiene (2,6)	dihydromyrcene	$C_{10}H_{18}$	I-260	138.24
2515	2,7-octadiene (2,6)	linaloolene	$C_{10}H_{18}$	I-261	138.24
2516	2,6-octadiene-8-ol (2,6)	nerol	$C_{10}H_{18}O$	I-459	154.24
2517	2,6-octadiene-8-ol (2,6)	geraniol	$C_{10}H_{18}O$	I-457	154.24
2518	2,7-octadiene-6-ol (2,6)	*l*-linalool	$C_{10}H_{18}O$	I-460	154.24
2519	octanol-6 (2,6)	linalool tetrahydride	$C_{10}H_{22}O$	I-426	158.28
2520	octanol-8 (2,6)	geraniol tetrahydride	$C_{10}H_{22}O$	I-426	158.28
2521	oxalate	methyl oxalate	$(CO_2{\cdot}CH_3)_2$	II-534	118.09
2522	oxamide (*sym*)	.....	$(CO{\cdot}NHCH_3)_2$	IV-61	116.12
2523	oxamide (*uns*)	.....	$(CH_3)_2N{\cdot}(CO)_2NH_2$	IV-61	116.12
2524	phenacyl chloride (2,4)	ω-Cl-2,4-di Me-acetophenone	$(CH_3)_2C_6H_3{\cdot}CO{\cdot}CH_2Cl$	VII-324	182.65
2525	phenanthrene (9,10)	.....	$(CH_3)_2C_{14}H_8$	V-680	206.27
2526	phenyl carbinol	.....	$C_6H_5{\cdot}C(CH_3)_2{\cdot}OH$	VI-506	136.19
2527	*p*-phenylenedi-amine	(*sym*)	$(CH_3NH)_2C_6H_4$	.....	136.19
2528	*p*-phenylenedi-amine oxalate	(*sym*)	$(CH_3NH)_2C_6H_4{\cdot}2H_2C_2O_4$	.....	316.26
2529	phosphine	.....	$(CH_3)_2PH$	IV-580	62.06
2530	*o*-phthalate	methyl phthalate	$C_6H_4(CO_2CH_3)_2$	IX-797	194.18
2531	*m*-phthalate	Me *iso*-phthalate	$C_6H_4(CO_2CH_3)_2$	IX-834	194.18
2532	*p*-phthalate	Me-terephthalate	$C_6H_4(CO_2CH_3)_2$	IX-843	194.18
2533	pyrazine (2,5)	ketine; glycoline		XXIII-96	108.14
2534	pyrazole (3,5)	.....		XXIII-74	96.13
2535	pyrrol (1,2)	.....		.....	95.14
2536	pyrrol (2,3)	.....	$(CH_3)_2C_4H_2NH$	XX-172	95.14
2537	pyrrol (2,4)	.....	$(CH_3)_2C_4H_2NH$	XX-172	95.14

Dimethyl-itaconic acid 5700
Dimethyl-ketazine 3932
Dimethy-ketol 43
Dimethyl ketone 56

Dimethyl mercury 4044
Dimethyl-octane 1637-8
Dimethyl-octenol 1519
Dimethyl-pentanol 3529-31

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2498	mn./Me al.	1.124^{18}_{4}°	38	208	.....	.....	.....
2499	yel. lq.	.....	−97.5	34^{750mm}	d.	d.	s.
2500	lq.	1.233^{20}_{4}°	.....	242	s.	∞	∞
2501	col. lq.	1.151^{21}°	.....	205	.....	.....	.....
2502	col. lq.	1.154^{20}_{4}°	−62	180-1	i.	∞	∞
2503	col. pr.	1.357^{18}°	192-3 d.	d. > 130	10^{13}°	v. s. abs.	v. s.
2504	col. lq.	1.121^{20}_{20}°	.....	205.5-6.5	.....	.....	.....
2505	col. oil	1.042^{20}°	.....	274.5^{711mm}	i.	s.	s.
2506	col. cr.	1.039^{70}_{70}°	46-7	304-5	i.	s.	s.
2507	lq.	1.016^{20}_{4}°	<−18	264-6	i.	.....	.....
2508	lf./al.	.....	104.0-4.5	.....	i.	sl. s.	.....
2509	lf./al.	.....	110-1	$261-2^{762mm}$	i.	sl. s.	.....
2510	nd./pet.	.....	43-4	.....	v. s. h. pet.	i. 90% al.	v. s.
2511	nd./et.	.....	126-7	>300 d.	v. sl. s. h.	s.; s. ac.	s.; s. act.
2512	cr./aq. al.	.....	66-7.5	.....	.....	.....	.....
2513	yel. oil	1.006^{20}_{4}°	.....	153^{774mm}	s.	s.	s.
2514	lq.	0.775^{21}_{4}°	.....	171.5-3.5	.....	.....	.....
2515	lq.	0.788^{20}°	.....	165-8	.....	.....	.....
2516	oil	0.881^{15}°	.....	$224-5^{745mm}$	.....	.....	.....
2517	col. lq.	0.883^{15}°	<−15	230	i.	∞	∞
2518	oil	0.862^{20}°	.....	$197-200^{736mm}$	v. sl. s.	∞	∞
2519	lq.	0.836^{15}_{4}°	.....	196-7	.....	.....	.....
2520	lq.	0.849^{0}_{4}°	.....	212-3	.....	.....	.....
2521	col. mn.	1.148^{54}°	54	163.3	6	s.	s.
2522	nd./aq.	1.3^{4}°	212-7	subl.	$2.5^{9.4}$°; v. s. h.	s.; d. h. alk.	v. sl. s.
2523	pl./bz.	.....	104	.....	v. s.	v. s.	v. sl. s.
2524	lf.	.....	62-3	.....	.....	s.	.....
2525	pr./dil. ac.	.....	139	subl.	s. ac.	sl. s.; s. bz.	s. chl.
2526	pr.	0.972^{19}_{4}°	23	215-20 sl. d.	.....	.....	.....
2527	cr.	.....	53	150^{17mm}	.....	.....	.....
2528	col. cr.	.....	194-6 d.	.....	s.	sl. s.	i.
2529	col. lq.	<1	.....	25	i.	.....	.....
2530	col. lq.	1.189^{25}_{25}°	.....	280^{734mm}	0.43	.....	.....
2531	nd./aq. al.	.....	67-8	.....	i.	.....	.....
2532	rhb./al.	.....	140	>300; subl.	0.3 h.	s. h.	s.
2533	pl.	0.990^{18}_{4}°	15	155	∞	∞	∞
2534	pl.	0.884^{26}_{4}°	106-7	218^{759mm}	s.; s. bz.	s.; s. chl.	s.
2535	lq.	.....	.....	65^{14mm}	.....	.....	.....
2536	lq.	.....	.....	165	.....	.....	.....
2537	lq.	0.927^{14}_{4}°	.....	171	sl. s.	s.	s.; s. bz.

Dimethyl-phenol 6465-70
Dimethyl-phenyl hydrazine 6500-2
Dimethyl-phenylenediamine 305-7
Dimethyl-propyl carbinol (*n*) 3631
Dimethyl-propyl carbinol (*iso*) 3629
Dimethyl-pyridine 3981-4

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2538	**Dimethyl** pyrrol (2,5)	.....	$(CH_3)_2C_4H_2NH$	XX-172	95.14
2539	quinolinate (2,3)	.....	$C_5H_3N(CO_2CH_3)_2$	XXII-151	195.17
2540	quinoline (2,3)	.....	$(CH_3)_2C_9H_5N$	XX-406	157.21
2541	quinoline (2,4)	4-Me-quinaldine	$(CH_3)_2C_9H_5N$	XX-407	157.21
2542	quinoline H_2SO_4	(2,4)	$C_{11}H_{11}N\cdot\frac{1}{2}H_2SO_4$	XX-408	206.24
2543	quinoline EtI	(2,4)	$C_{11}H_{11}N\cdot C_2H_5I$	XX-408	313.19
2544	quinoline (2,6)	6-Me-quinaldine	$(CH_3)_2C_9H_5N$	XX-408	157.21
2545	quinoline EtI	(2,6)	$C_{11}H_{11}N\cdot C_2H_5I$	XX-409	313.19
2546	quinoline (3,4)	.....	$(CH_3)_2C_9H_5N$	XX-410	157.21
2547	quinoline (5,8)	.....	$(CH_3)_2C_9H_5N$	XX-411	157.21
2548	quinoline (6,8)	.....	$(CH_3)_2C_9H_5N$	XX-411	157.21
2549	quinone (2,3)	*o*-xyloquinone	$(CH_3)_2C_6H_2O_2$	VII-656	136.14
2550	quinone (2,5)	*p*-xyloquinone	$(CH_3)_2C_6H_2O_2$	VII-658	136.14
2551	quinone (2,6)	*m*-xylo-*p*-quinone	$(CH_3)_2C_6H_2O_2$	VII-657	136.14
2552	sebacate	methyl sebacate	$(CH_2)_8(CO_2CH_3)_2$	*II-293	230.30
2553	selenide	selenium methyl	$(CH_3)_2Se$	I-291	109.03
2554	succinate	methyl succinate	$(CH_2CO_2\cdot CH_3)_2$	II-609	146.14
2555	*iso*-succinate	.....	$CH_3\cdot CH(CO_2\cdot CH_3)_2$	II-628	146.14
2556	succinic acid (*meso*)	.....	$(CH_3CH)_2(CO_2H)_2$	II-665	146.14
2557	succinic acid (α,α)	.....	$(CH_3)_2C\cdot CH_2(CO_2H)_2$	II-661	146.14
2558	succinic acid (*dl*)	.....	$(CH_3CH)_2(CO_2H)_2$	II-667	146.14
2559	sulfate	methyl sulfate	$(CH_3O)_2SO_2$	I-283	126.13
2560	sulfide	methyl sulfide	$(CH_3)_2S$	I-288	62.13
2561	sulfite	.....	$(CH_3O)_2SO$	I-282	110.13
2562	sulfone	.....	$(CH_3)_2SO_2$	I-289	94.13
2563	sulfoxide	.....	$(CH_3)_2SO$	I-289	78.13
2564	tartrate (*d*)	.....	$(CHOH\cdot CO_2CH_3)_2$	III-510	178.14
2565	tartrate (racemic)	di Me-racemate	$(CH_3)_2C_4H_4O_6$	III-527	178.14
2566	telluride	tellurium methyl	$(CH_3)_2Te$	I-291	157.68
2567	thetin	.....	$HO\cdot S(CH_3)_2\cdot CH_2\cdot CO_2H$	III-247	138.18
2568	thiourea (*sym*)	.....	$(CH_3NH)_2C:S$	IV-70	104.17
2569	toluidine (*o*)(*N*)	.....	$CH_3\cdot C_6H_4\cdot N(CH_3)_2$	XII-785	135.20
2570	toluidine (*m*)(*N*)	.....	$CH_3\cdot C_6H_4\cdot N(CH_3)_2$	XII-857	135.20
2571	toluidine (*p*)(*N*)	.....	$CH_3\cdot C_6H_4\cdot N(CH_3)_2$	XII-902	135.20
2572	urea (*sym*)	.....	$(CH_3NH)_2C:O$	IV-65	88.11
2573	urea (*uns*)	.....	$(CH_3)_2N\cdot CO\cdot NH_2$	IV-73	88.11
2574	**Dinaphthyl** (1,1′)	α,α'-binaphthyl	$C_{10}H_7\cdot C_{10}H_7$	V-726	254.31
2575	**Dinaphthyl** (2,2′)	.....	$C_{10}H_7\cdot C_{10}H_7$	V-727	254.31
2576	amine (β,β')	.....	$C_{10}H_7\cdot NH\cdot C_{10}H_7$	XII-1278	269.33
2577	ketone (α,α')	.....	$(C_{10}H_7)_2CO$	VII-539	282.32
2578	ketone (α,β')	.....	$(C_{10}H_7)_2CO$	VII-539	282.32
2579	ketone (β,β')	.....	$(C_{10}H_7)_2CO$	VII-539	282.32
2580	methane (α,α')	.....	$(C_{10}H_7)_2CH_2$	V-728	268.34
2581	methane (α,β')	.....	$(C_{10}H_7)_2CH_2$	*V-360	268.34
2582	methane (β,β')	.....	$(C_{10}H_7)_2CH_2$	V-729	268.34
2583	sulfide (α,α')	.....	$(C_{10}H_7)_2S$	VI-623	286.37
2584	sulfide (β,β')	.....	$(C_{10}H_7)_2S$	VI-659	286.37
2585	urea (α)(*sym*)	α,α dinaphthyl carbamide	$(C_{10}H_7NH)_2CO$	XII-1238	312.35

Dimethyl-resorcinol 2375, 2377, 2380, 6479
Dimethyl-thiophene 5928-31
Dimethyl-xanthine, cf. alkd.
Dimethyl zinc 6504
Dinaphthol 2336-7
Dinaphthyl carbamide 2585

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2538	oil	0.935^{20}_{4}°	.....	169	v. sl. s.	v. s.	v. s.; v. sl. s. alk.
2539	col. pl./bz.	.....	53-4	.....	s.; s. CS_2	s.; i. lg.	s.; s. bz.
2540	pl.	.....	68-9	261^{729mm}	sl. s.	v. s.	s.; s. lg.
2541	lq.	1.061^{15}°	.....	264-5	i.	s.	s.
2542	nd./al.	.....	225-8 d.	.....	v. s. h.	v. sl. s.	.....
2543	yel. nd./al.	.....	226-7	.....	.....	s. h.	.....
2544	cr./et.	.....	60	266-7	v. sl. s. h.	s.	s.
2545	cr.	.....	225-7	.....	.....	.....	.....
2546	cr.	.....	65	290^{737mm}	i.	.....	.....
2547	lq.	1.070^{21}°	4-5	265^{736mm}	i.	.....	.....
2548	lq.	1.067^{4}°	.....	268-9	i.	.....	.....
2549	yel. nd.	.....	55	subl.	sl. s.	s.	s.
2550	yel. tri.	.....	124-5	subl.	sl. s. h.	v. s. h.	s.; s. bz.
2551	yel. nd.	.....	72-3	subl.	.....	.....	.....
2552	nd. or pl./et.	0.988^{28}_{4}°	38 (26)	293^{754mm}	.....	.....	.....
2553	lq.	>1	.....	58.2	i.	.....	.....
2554	col. cr.	1.126^{15}_{15}°	19.5	195.3	0.9	3	.....
2555	lq.	1.028^{25}_{25}°	.....	179	i.	∞	∞
2556	tri.	1.314	209	d.	$<3^{14}$°	v. s.	v. s.
2557	tri.	1.323	142	d. 165	7.5^{14}°	v. s.	v. sl. s.
2558	rhb. pr.	1.339	129	d. to anhyd.	3^{14}°	v. s.	v. s.
2559	poison. oil	1.352^{20}_{4}°	−26.8	188.3-8.6	v. sl. s.	∞	∞
2560	oil	0.846^{21}_{4}°	−83.2	38	i.	s.	s.
2561	lq.	$1.046^{16}_{4}\cdot{}^{20}_{1}$°	.....	126.5^{756mm}	d.	s.	s.
2562	pr.	.....	109	238	.....	.....	.....
2563	oil	.....	.....	volt. 100 d.	v. s.	v. s.	v. s.
2564	cr.	1.328^{20}_{4}°	61.5 (48)	280	s.*	v. s.	v. s. bz.*
2565	mn./al.	$1.260^{89.6}_{4}$°	89	282	.....	s.	.....
2566	lt. yel. oil	.....	.....	82	s.	s.	s.
2567	delq. cr.	.....	d. $-H_2O$	.....	s.	sl. s.	.....
2568	hyg., delq.	.....	61-2	.....	v. s.	v. s.	sl. s. et.
2569	lq.	0.929^{20}_{4}°	−61	185-6	i.	s.	s.
2570	yel. oil	0.941^{20}_{4}°	.....	213-5	i.	s.	s.
2571	lq.	0.937^{20}_{4}°	.....	210-1	i.	s.	s.
2572	pr./chl. et.	1.142	106	268-70	v. s.	v. s.	v. sl. s.
2573	mn./al.	1.255	182-5	.....	s.	sl. s. c.	v. sl. s.
2574	lf./al.	.....	160	$240-4^{12mm}$	i.; s. bz.	s. h.	s.
2575	pl.	.....	187.8	452^{753mm}	i.	v. sl. s. c.	v. sl. s. c.
2576	lf./bz.	.....	171-2	471	i.	sl. s. h.	v. s. h. bz.
2577	nd./et.	.....	104	.....	s. H_2SO_4	s. h.	v. s. bz.
2578	nd./al.	.....	135-6	.....	s. bz.	1.3^{14}°	sl. s. h.
2579	lf. or nd.	.....	α125.5 β164.5	.....	.....	$\alpha 0.419^{20}$° $\beta 0.0819^{20}$°	v. sl. s.; v. s. chl.
2580	pr. or nd./al.	.....	109	>360	v. s. bz.	0.8 c.; 6.6 h.	v. s.
2581	pr./al.	.....	95-6	.....	s. bz.	s. EtOAc	.....
2582	nd./al.	.....	92	.....	.....	s.	s. bz.
2583	nd./al.	.....	110	$289-90^{15mm}$	.....	v. sl. s.	v. s. CS_2
2584	lf./al.	.....	151	$295-6^{15mm}$	i.	v. sl. s.	v. s. CS_2
2585	nd./ac.	.....	297-8	subl.	.....	sl. s. h.	.....

* Modification m. p. 61.5° less soluble.

Dinaphthyl ether 4560-2
Dinaphthyl hydrazine 3690-1
Dinaphthyl mercury 4045
Dinicotinic acid 5502

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2586	**Dinitro**-acetanilide (2,4)	.....	$(NO_2)_2C_6H_3\cdot NH\cdot COC_6H_5$	XII-754	225.16
2587	aniline (2,3)	.....	$(NO_2)_2C_6H_3\cdot NH_2$	XII-747	183.12
2588	aniline (2,4)	.....	$(NO_2)_2C_6H_3\cdot NH_2$	XII-747	183.12
2589	aniline (2,5)	.....	$(NO_2)_2C_6H_3\cdot NH_2$	XII-757	183.12
2590	aniline (2,6)	.....	$(NO_2)_2C_6H_3\cdot NH_2$	XII-758	183.12
2591	aniline (3,4)	.....	$(NO_2)_2C_6H_3\cdot NH_2$	XII-758	183.12
2592	aniline (3,5)	.....	$(NO_2)_2C_6H_3\cdot NH_2$	XII-759	183.12
2593	anisole (2,4)	α-dinitroanisole	$CH_3O\cdot C_6H_3(NO_2)_2$	VI-254	198.13
2594	anthranilic acid (3,5)	.....	$C_6H_2(CO_2H)(NO_2)_2\cdot NH_2$	XIV-379	227.13
2595	anthraquinone (1,5)	.....	$(NO_2C_6H_3)_2(CO)_2$	VII-793	298.20
2596	anthraquinone (1,8)	.....	$(NO_2\cdot C_6H_3)_2(CO)_2$	VII-795	298.20
2597	anthraquinone (2,7)	β-diNO_2-anthraquinone	$(NO_2\cdot C_6H_3)_2(CO)_2$	VII-795	298.20
2598	azoxybenzene (4,4′)	.....	$(NO_2\cdot C_6H_4)_2N_2O$	XVI-628	288.22
2599	benzalacetone (3,3′)	.....	$(NO_2C_6H_4CH{:}CH)_2{:}CO$	VII-506	324.28
2600	benzaldehyde (2,4)	.....	$(NO_2)_2C_6H_3\cdot CHO$	VII-264	196.12
2601	benzaldehyde (2,6)	.....	$(NO_2)_2C_6H_3\cdot CHO$	*VII-144	196.12
2602	benzene (*o*)	.....	$(NO_2)_2C_6H_4$	V-257	168.11
2603	benzene (*m*)	.....	$(NO_2)_2C_6H_4$	V-258	168.11
2604	benzene (*p*)	.....	$(NO_2)_2C_6H_4$	V-261	168.11
2605	benzene sulfonic acid	(2,4;1)	$(NO_2)_2C_6H_3\cdot SO_3H\cdot 3H_2O$	XI-78	302.22
2606	benzene sulfonic	Na salt (2,4;1)	$C_6H_3O_7N_2SNa\cdot H_2O$	XI-78	288.17
2607	benzoic acid (2,4)	.....	$(NO_2)_2C_6H_3\cdot CO_2H$	IX-411	212.12
2608	benzoic acid (2,5)	.....	$(NO_2)_2C_6H_3\cdot CO_2H$	IX-412	212.12
2609	benzoic acid (2,6)	.....	$(NO_2)_2C_6H_3\cdot CO_2H$	IX-412	212.12
2610	benzoic acid (3,4)	.....	$(NO_2)_2C_6H_3\cdot CO_2H$	IX-413	212.12
2611	benzoic acid (3,5)	.....	$(NO_2)_2C_6H_3\cdot CO_2H$	IX-413	212.12
2612	benzophenone (4,4′)	.....	$(NO_2\cdot C_6H_4)_2CO$	VII-428	272.21
2613	benzoyl chloride	(3,5)	$(NO_2)_2C_6H_3\cdot COCl$	IX-414	230.57
2614	benzoylene urea	(6,8)	$C_8H_4O_6N_4$	*XXIV-344	252.14
2615	benzyl chloride (2,4)	.....	$(NO_2)_2C_6H_3\cdot CH_2Cl$	V-344	216.58
2616	*o*-cresol (4,6)	3,5-diNO_2-2-OH-toluene	$(NO_2)_2C_6H_2(CH_3)\cdot OH$	VI-368	198.13
2617	*m*-cresol (2,6)	2,4-diNO_2-3-OH-toluene	$(NO_2)_2C_6H_2(CH_3)\cdot OH$	VI-387	198.13
2618	diazo-aminobenzene (4,4′)	.....	$NO_2C_6H_4\cdot N{:}N\cdot NH\cdot C_6H_4NO_2$	XVI-700	287.23
2619	diethylaniline	(2,4)	$(NO_2)_2C_6H_3N(C_2H_5)_2$	XII-750	239.23
2620	diphenyl (2,2′)	.....	$(NO_2\cdot C_6H_4\cdot)_2$	V-583	244.20
2621	diphenyl (3,3′)	.....	$(NO_2\cdot C_6H_4\cdot)_2$	V-583	244.20
2622	diphenyl (4,4′)	.....	$(NO_2\cdot C_6H_4\cdot)_2$	V-584	244.20
2623	diphenyl (2,4′)	.....	$(NO_2\cdot C_6H_4\cdot)_2$	V-584	244.20

Dinitro-aminophenol 5303
Dinitro-bromobenzene 930-1
Dinitro-bromobenzoic acid 932
Dinitro-chlorobenzene 1364-9

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2586	nd./al.	.....	120	.....	i. c.	v. s. h.	s.
2587	or. yel./al.	.....	127	.....	.....	v. s.	s.
2588	yel. or gn. mn.	$1.615^{14°}$	187-8	.....	v. sl. s. h.	$0.76^{21°}$	sl. s. h. HCl
2589	or. yel./al.	.....	137	.....	.....	v. s.	.....
2590	yel. nd./al.	.....	138-40	.....	i.	s. h. bz.	i. lg.
2591	yel. nd./aq.	.....	154	.....	.....	v. s.	s.
2592	yel. nd./aq.	.....	159-60	.....	sl. s. bz.	s.	s.
2593	col. mn.	$1.341^{20°}$	94-5	.....	sl. s. h.	$1.5^{20°}$	.....
2594	yel. pl./al.	.....	268	.....	$0.02^{15°}$	sl. s.	.....
2595	yel. nd.	.....	>330	subl.	i.	v. sl. s.	v. sl. s.
2596	yel. pr.	.....	312	.....	s. Ac_2O	.....	.....
2597	nd./ac.	.....	262	subl.	i.	sl. s.	sl. s.
2598	yel. nd./ bz.	.....	192-3	.....	.....	.....	.....
2599	cr./Ac_2O	.....	237	.....	i.	i.	i
2600	yel. pr.	.....	69-70	$190\text{-}210^{10mm}$	i.	v. s.	v. s.
2601	lf.s/ac.	.....	123	.....	s. h.	s.; sl. s. CS_2	s.; v. sl. s. lg.
2602	col. mn.	$1.59^{18°}$	117-8	319^{774mm}	0.01 c.	$1.9^{21°}$	$5.7^{18°}$ bz.
2603	col. rhb.	$1.575^{\frac{20°}{4}}$	89.8	300-2	$0.3^{99°}$	$3.3^{20°}$ abs.	$39.5^{18°}$ bz.
2604	col. mn.	$1.625^{18°}$	173-4	299^{777mm}	$0.18^{100°}$	$0.18^{21°}$	$2.6^{18°}$ bz.
2605	pa. yel., hyg. pr.	.....	106-8	$-3H_2O$, >130	s.; s. ac.	s.; i. bz.; i. lg.	v. sl. s.
2606	cr./aq.	.....	.....	.....	v. s.	.....	.....
2607	cr./aq.	.....	179-80	.....	$1.85^{25°}$	s.	$0.71^{30°}$ bz.
2608	mn. pr.	.....	177-9	.....	s. h.	s.	s.
2609	nd./aq.	.....	202	.....	v. s. h.	.....	.....
2610	nd.	.....	163-4	.....	$0.67^{25°}$	s.	s.
2611	mn. pr.	.....	204-5	subl.	2 h.	v. s.	sl. s.
2612	col. nd./ac.	.....	189	.....	i.	.....	.....
2613	nd./bz.	.....	66-8	196^{12mm}	d.	d.	.....
2614	gn. yel. pr.	.....	274-5	.....	$0.016^{23°}$	sl. s. h.; s. h. ac.	s. NaOH; sl. s. act.
2615	pl./et.	.....	34	.....	i.	s.	s.
2616	yel. pr./al.	.....	86-7	.....	v. sl. s.; v. sl. s. lg.	$10^{15°}$; s. alk.	s.; s. act.
2617	or. red nd.	.....	99	.....	.....	.....	.....
2618	yel. nd./al.	.....	224-6 d.	.....	i.; v. sl. s. chl.	sl. s. h.; v. sl. s. bz.	s.
2619	yel. rhb./ act.	$1.374^{15°}$	80	.....	v. sl. s. lg.	v. s. h.	v. s. h.
2620	yel. nd.	1.45	124	.....	i.	s. h.	s.
2621	cr.	.....	198	.....	i.	.....	.....
2622	nd./al.	1.445	233	.....	i.	v. sl. s. c.	sl. s. bz.
2623	mn.	1.474	93.5	.....	.....	v. s. h.	.....

Dinitro-chlorobenzoic acid 1370-1
Dinitro-chlorophenol 1372
Dinitro-dihydroxyquinone 4586

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2624	**Dinitro** diphenylamine (2,4)	.....	$(NO_2)_2C_6H_3\cdot NH\cdot C_6H_4$	.....	259.22
2625	diphenylamine (2,4′)	.....	$(NO_2\cdot C_6H_4)_2NH$	XII-715	259.22
2626	diphenylamine (4,4′)	.....	$(NO_2\cdot C_6H_4)_2NH$	XII-716	259.22
2627	diphenyl ether (2,2′)	.....	$(NO_2\cdot C_6H_4)_2O$	VI-219	260.20
2628	diphenyl ether (4,4′)	.....	$(NO_2\cdot C_6H_4)_2O$	VI-232	260.20
2629	diphenylmethane	(4,4′)	$(NO_2\cdot C_6H_4)_2CH_2$	.....	258.23
2630	ethane (1,1)	.....	$CH_3\cdot CH(NO_2)_2$	I-102	120.07
2631	hexane (1,1)	.....	$C_5H_{11}\cdot CH(NO_2)_2$	I-147	176.17
2632	hydroquinone acetate (2,6)	(2,6;1,4)	$(NO_2)_2C_6H_2(OH)\cdot O_2C\cdot CH_3$	VI-858 †	242.14
2633	hydroquinone diacetate (2,6)	.....	$(NO_2)_2C_6H_2:(O_2C\cdot CH_3)_2$	*VI-419	284.18
2634	4′-hydroxydiphenylamine (2,4)	.....	$(NO_2)_2C_6H_3\cdot NH\cdot C_6H_4\cdot OH$	XIII-444	275.22
2635	mesitylene (2,4)	*eso*-dinitromesitylene	$(NO_2)_2C_6H(CH_3)_3$	V-411	210.19
2636	methane	.....	$(NO_2)_2CH_2$	I-77	106.04
2637	naphthalene (1,3)	γ-dinitronaphthalene	$(NO_2)_2C_{10}H_6$	V-557	218.16
2638	naphthalene (1,5)	α-dinitronaphthalene	$(NO_2)_2C_{10}H_6$	V-558	218.16
2639	naphthalene (1,6)	δ-dinitronaphthalene	$(NO_2)_2C_{10}H_6$	V-559	218.16
2640	naphthalene (1,8)	β-dinitronaphthalene	$(NO_2)_2C_{10}H_6$	V-559	218.16
2641	α-naphthol (2,4)	.....	$(NO_2)_2C_{10}H_5\cdot OH$	VI-617	234.16
2642	α-naphthol (2,4) Na	Martius yellow	$C_{10}H_5O_5N_2Na\cdot H_2O$	VI-618	274.17
2643	β-naphthol (1,6)	.....	$(NO_2)_2C_{10}H_5\cdot OH$	VI-655	234.16
2644	phenanthraquinone	(2,7)	$O:C_{14}H_6(NO_2)_2:O$	VII-807	298.20
2645	phenetole (2,4)	α-dinitrophenetole	$(NO_2)_2C_6H_3\cdot OC_2H_5$	VI-254	212.16
2646	phenol (2,3)	ε-dinitrophenol	$(NO_2)_2C_6H_3\cdot OH$	VI-251	184.11
2647	phenol (2,4)	α-dinitrophenol	$(NO_2)_2C_6H_3\cdot OH$	VI-251	184.11
2648	phenol (2,4) Na	.....	$C_6H_3O_5N_2Na\cdot H_2O$	*VI-126	224.11
2649	phenol (2,5)	γ-dinitrophenol	$(NO_2)_2C_6H_3\cdot OH$	VI-256	184.11
2650	phenol (2,6)	β-dinitrophenol	$(NO_2)_2C_6H_3\cdot OH$	VI-257	184.11
2651	phenol (3,4)	δ-dinitrophenol	$(NO_2)_2C_6H_3\cdot OH$	VI-257	184.11
2652	phenol (3,5)	θ-dinitrophenol	$(NO_2)_2C_6H_3\cdot OH$	VI-258	184.11
2653	phenylacetic acid (2,4)	.....	$(NO_2)_2C_6H_3\cdot CH_2\cdot CO_2H$	IX-459	226.14
2654	phenylcarbazide (4,4′)	.....	$(NO_2\cdot C_6H_4\cdot NH\cdot NH)_2:CO$	.....	332.27
2655	phenyl disulfide	(2,2′)	$(NO_2\cdot C_6H_4\cdot S\cdot)_2$	VI-338	308.32
2656	phenyl disulfide	(4,4′)	$(NO_2\cdot C_6H_4\cdot S\cdot)_2$	VI-340	308.32
2657	phenylhydrazine	(2,4)	$(NO_2)_2C_6H_3\cdot NHNH_2$	XV-489	198.14
2658	propane (1,1)	.....	$C_2H_5\cdot CH(NO_2)_2$	I-117	134.09
2659	propane (2,2)	.....	$(CH_3)_2C(NO_2)_2$	I-117	134.09
2660	resorcinol (2,4)	.....	$(NO_2)_2C_6H_2(OH)_2$	VI-827	200.11
2661	resorcinol (4,6)	.....	$(NO_2)_2C_6H_2(OH)_2$	VI-828	200.11
2662	salicylic acid (3,5)	3,5-diNO_2-2-OH-benzoic acid	$(NO_2)_2C_6H_2(OH)\cdot CO_2H\cdot H_2O$	X-122	246.13

† See also correction in *VI-419
Dinitro-diphenyl disulfide 2655-6
Dinitro-glycol 3462
Dinitro-hydroxybenzoic acid 2662

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2624	red nd./bz.	.....	157	.....	s. act.	s. h.	s. chl.
2625	red nd.	.....	220-2	.....	i.	sl. s.	$0.4^{22°}$ act.
2626	yel. nd.	.....	214-5	.....	i.	sl. s.	$5.66^{20°}$ act.
2627	nd./al.	.....	114.5	.....	i.	$0.7^{20°}$	.....
2628	nd./al.	.....	142-3	.....	i.	3 h.	sl. s.
2629	nd./bz.	.....	183-5	.....	s. h. ac.	i. c.	sl. s.
2630	lq.	$1.350^{\frac{2}{2}\frac{3}{3}\cdot\frac{5}{5}°}$	.....	185-6	v. sl. s.	s.	s.
2631	yel. oil	>1	.....	d.	v. sl. s.	v. s.	v. s.
2632	yel. nd./al.	.....	95-6	.....	s. chl.	s.	s.
2633	nd./al.	.....	135-6	.....	i.	s. h.	s. ac.
2634	red nd./ aq. al.	.....	195-6	.....	s. alk.	s.	v. sl. s. bz.
2635	rhb./al.	.....	86	.....	i.	s. h.	.....
2636	lq.	.....	<−15	100 d.	s.	.....	.....
2637	lt. yel. nd.	.....	144-5	subl.	i.	s.	.....
2638	nd./ac.	.....	216	subl.	i.	s. h. bz.	v. sl. s. CS_2
2639	cr./ac.	.....	166	.....	i.	.....	.....
2640	rhb. pl.	.....	170-2	d.	i.	$0.19^{19°}$, 88% al.	$0.72^{19°}$ bz.
2641	yel. nd./al.	.....	138	.....	v. sl. s. h.	sl. s.	sl. s.; s. ac.
2642	yel. red nd.	.....	.....	.....	v. s.	.....	.....
2643	yel. nd.	.....	195	.....	v. sl. s. h.	s.	v. s.
2644	yel. cr./ac.	.....	303-5	.....	.....	sl. s.	sl. s. ac.
2645	col. nd./al.	.....	86	d.	v. sl. s.	s.	.....
2646	yel. mn./al.	$1.681^{20°}$	144-5	.....	sl. s.	v. s. h.	v. s.
2647	yel. rhb.	$1.683^{24°}$	114-5	subl.	0.5 c.; 5 h.	$4^{20°}$; s. bz.	v. s. h.
2648	cr.	.....	.....	.....	$4^{25°}$	$2.7^{25°}$ abs.	$1^{25°}$ act.
2649	yel. mn./ aq.	.....	104	.....	sl. s.	v. s. h.	s.; s. alk.
2650	yel. rhb./ aq.	.....	63-4	.....	s. h.	s. h.	s.; s. chl.
2651	col. tri./aq.	1.672	134	.....	.....	v. s.	v. s.
2652	mn./HCl	1.702	123	.....	.....	v. s.	v. s.
2653	col. nd./ aq.	.....	160	d. 179-80	.....	.....	.....
2654	brn. pd.	.....	261-3	.....	i.	s.	i.
2655	yel. nd./bz.	.....	195	d.	v. sl. s. ac.	v. sl. s.	v. sl. s. act.
2656	pl./al.	.....	181	.....	.....	.....	.....
2657	vl. pr./al.	.....	197-8 d.	.....	i.	s. dil. a.	i.
2658	acidic oil	$1.258^{22°}$	.....	189	s. alk.	.....	.....
2659	cr.	.....	53	185.5	v. sl. s.	i. alk.	.....
2660	yel. lf.	.....	147-8	expl.	v. sl. s.	s.	s. alk.
2661	yel. pr.	.....	215	subl.	s. h.	s.	s.
2662	pl./aq.	.....	173 d.	.....	s. c.	v. s.	v. s.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2663	**Dinitro** stilbene (4,4′)	low m.p. form	$(NO_2{\cdot}C_6H_4{\cdot}CH{:})_2$	V-637	270.24
2664	stilbene (4,4′)	high m.p. form	$(NO_2{\cdot}C_6H_4{\cdot}CH{:})_2$	V-637	270.24
2665	thymol (2,4)	(2,4;3,1,6)	$(NO_2)_2C_6H(CH_3){\cdot}(OH)(C_3H_7)$	VI-543	240.21
2666	toluene (2,3)	.....	$(NO_2)_2C_6H_3{\cdot}CH_3$	V-339	182.13
2667	toluene (2,4)	.....	$(NO_2)_2C_6H_3{\cdot}CH_3$	V-339	182.13
2668	toluene (2,5)	.....	$(NO_2)_2C_6H_3{\cdot}CH_3$	V-341	182.13
2669	toluene (2,6)	.....	$(NO_2)_2C_6H_3{\cdot}CH_3$	V-341	182.13
2670	toluene (3,4)	.....	$(NO_2)_2C_6H_3{\cdot}CH_3$	V-341	182.13
2671	toluene (3,5)	.....	$(NO_2)_2C_6H_3{\cdot}CH_3$	V-341	182.13
2672	tyrosine (3,5)(*l*)	.....	$C_9H_9O_7N_3{\cdot}H_2O$	*XIV-668	289.20
2673	*o*-xylene (3,4)	.....	$(NO_2)_2C_6H_2(CH_3)_2$	V-369	196.16
2674	*o*-xylene (3,6)	.....	$(NO_2)_2C_6H_2(CH_3)_2$	V-369	196.16
2675	*o*-xylene (4,5)	.....	$(NO_2)_2C_6H_2(CH_3)_2$	V-369	196.16
2676	*o*-xylene (3,5)	.....	$(NO_2)_2C_6H_2(CH_3)_2$	V-369	196.16
2677	*m*-xylene (2,4)	.....	$(NO_2)_2C_6H_2(CH_3)_2$	V-379	196.16
2678	*m*-xylene (4,6)	.....	$(NO_2)_2C_6H_2(CH_3)_2$	V-380	196.16
2679	*p*-xylene (2,3)	β-dinitro-*p*-xylene	$(NO_2)_2C_6H_2(CH_3)_2$	V-387	196.16
2680	*p*-xylene (2,5)	γ-dinitro-*p*-xylene	$(NO_2)_2C_6H_2(CH_3)_2$	V-388	196.16
2681	*p*-xylene (2,6)	α-dinitro-*p*-xylene	$(NO_2)_2C_6H_2(CH_3)_2$	V-388	196.16
2682	**Dinonyl ketone** (*n*)	caprinone	$(C_9H_{19})_2CO$	I-718	282.49
2683	**Dioctyl** acetic acid (*n*)	.....	$[CH_3(CH_2)_7]_2CH{\cdot}CO_2H$	II-388	284.47
2684	ether (*n*)	.....	$[CH_3(CH_2)_7]_2O$	I-419	242.43
2685	ketone (*n*)	pelargone	$[CH_3(CH_2)_7]_2CO$	I-718	254.44
2686	**Dioxindole**	oxindole; hydrindic acid	$C_6H_4{\cdot}CHOH{\cdot}CO{\cdot}NH$ (ring)	XXI-578	149.14
2687	**Diphenetyl urea** (4,4′)	di-(*p*-EtO-phenyl)-urea	$(C_2H_5O{\cdot}C_6H_4{\cdot}NH)_2{:}CO$	XIII-481	300.35
2688	**Diphenic** acid (2,2′)	diphenic acid (1,10)	$(\cdot C_6H_4{\cdot}CO_2H)_2$	IX-922	242.22
2689	acid (3,3′)	diphenic acid (2,9)	$(\cdot C_6H_4{\cdot}CO_2H)_2$	IX-927	242.22
2690	acid (2,3′)	diphenic acid (1,9)	$(\cdot C_6H_4{\cdot}CO_2H)_2$	IX-926	242.22
2691	acid (2,4′)	diphenic acid (1,8)	$(\cdot C_6H_4{\cdot}CO_2H)_2$	IX-926	242.22
2692	**Diphenoxy**-diethyl ether (β,β′)	.....	$(C_6H_5OCH_2CH_2)_2O$	*VI-84	258.30
2693	ethane (1,2)	.....	$(C_6H_5O{\cdot}CH_2{\cdot})_2$	VI-146	214.25
2694	propane (1,3)	.....	$(C_6H_5O{\cdot}CH_2)_2CH_2$	VI-147	228.28
2695	**Diphenyl**	biphenyl; xenene	$C_6H_5{\cdot}C_6H_5$	V-576	154.20
2696	acetamidine (*N*,*N*′)	ethenyl-diPh-amidine	$CH_3C(NHC_6H_5){:}NC_6H_5$	XII-248	210.27
2697	acetic acid	.....	$(C_6H_5)_2CH{\cdot}CO_2H$	IX-673	212.24
2698	amine	.....	$(C_6H_5)_2NH$	XII-174	169.22
2699	amine HCl	.....	$(C_6H_5)_2NH{\cdot}HCl$	XII-180	205.68
2700	amine sulfate	.....	$(C_6H_5)_2NH{\cdot}H_2SO_4$	XII-180	267.29
2701	amine sulfonic acid	*N*-Ph-sulfanilic	$C_6H_5{\cdot}NH{\cdot}C_6H_4{\cdot}SO_3H$	XIV-699	249.28
2702	amine sulfonic	Ba salt	$(C_{12}H_{10}O_3NS)_2Ba$	XIV-699	633.90
2703	benzene (*o*)	diphenyl-phenylene	$C_6H_5{\cdot}C_6H_4{\cdot}C_6H_5$	.....	230.29
2704	benzene (*m*)	*iso*-diphenyl-benzene	$C_6H_5{\cdot}C_6H_4{\cdot}C_6H_5$	V-695	230.29
2705	benzene (*p*)	terphenyl	$C_6H_5{\cdot}C_6H_4{\cdot}C_6H_5$	V-696	230.29

Dioform 136
Diolene 5256
Dionin, cf. alkd.
Dioxane 2237, 6285

Dioxallene 1240
Dioxolane 3454
Dioxy-purine 6449

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2663	red yel./ chl.	.....	210-6	.....	s. bz., act.	v. sl. s.	v. sl. s.
2664	yel. lf./ac.	.....	288-92	.....	s. act.	sl. s.	sl. s.
2665	yel. pr./ pet.	.....	55	.....	v. sl. s.	v. s.	v. s.
2666	nd./pet.	$1.263^{111°}$	61-3	.....	.....	.....	.....
2667	nd./CS_2	$1.321^{71°}$	70	300 sl. d.	i.	v. sl. s. c.	v. sl. s. c.
2668	nd./al.	$1.282^{111°}$	52.5	.....	v. s. bz.	v. s.	v. s. CS_2
2669	rhb.	$1.283^{111°}$	60.5	.....	.....	s.	.....
2670	nd./CS_2	$1.259^{111°}$	60-1	.....	i.	$2.21^{7°}$ CS_2	.....
2671	mn. pr.	$1.277^{111°}$	92-3	subl.	sl. s.	s. h.	s.
2672	yel. pl.	.....	$-H_2O$, 140	d. >220	s. alk.	s. dil. a.	.....
2673	nd./al.	.....	82	expl. 413	sl. s. pet.	sl. s.	v. s.
2674	col. cr./al.	.....	56	.....	s. pet.	s.	s.
2675	col. nd./al.	.....	115-6	.....	sl. s. h.	sl. s. c.	sl. s. c. pet.
2676	yel. nd./al.	.....	75-6	expl. 438	v. s. bz.	v. s. act.	v. s. chl.
2677	cr./al.	.....	83-4	.....	.....	.....	.....
2678	col. pr./al.	.....	93-4	.....	i.	s. h.	.....
2679	mn. pr./al.	.....	90-3	.....	i.	v. s. h.	.....
2680	yel. nd./al.	.....	147-8	.....	i.	s. h.	s. h.
2681	nd./al.	.....	123.5	.....	.....	.....	.....
2682	lf./al.	.....	58	>350 sl. d.	.....	s.	s.
2683	lf./al.	.....	39	$270\text{-}5^{100mm}$	i.	s. abs.	.....
2684	lq.	$0.805^{17°}_{17°}$	.....	291.7	sl. s.	s.	s.
2685	pl./Me al.	.....	52-3	.....	.....	sl. s. c.	s. Me al.
2686	rhb./al.	.....	180 (violet)	195 d.	8.3 c.; 16.6 h.	6.6 c.; 10 h.	s. alk.
2687	nd./ac.; pr./al.	.....	225-6	.....	.....	.....	.....
2688	mn. pr.	.....	228-9	subl.	sl. s.	s.	s.
2689	lf./al.	.....	356-7	.....	v. sl. s. h.	s. h.	s.
2690	nd./aq.	.....	216	.....	sl. s. h.	s.	.....
2691	lf./al.	.....	251-2	.....	.....	.....	.....
2692	col. nd./ aq. al.	.....	66-7	.....	i.	s. h.	s.
2693	lf./abs. al.	.....	97-8	.....	i.; $27^{25°}$ bz.	s. h.; $23^{25°}$ act.	$9^{25°}$
2694	lf./al.	.....	61	$338\text{-}40^{762mm}$	i.	s.	s.
2695	col. mn.	$0.992^{\frac{25}{4}°}$	69-70	254.9	i.	$9.98^{19.5°}$	$6.57^{19.5°}$ Me al.
2696	nd./al.	.....	131-2	.....	s. a.	s. h.	s.
2697	nd./aq.	.....	148	.....	s. h.	s.	s.
2698	col. mn.	$1.160^{20°}_{20°}$	52.9	302	i.; $58^{19.5°}$ Me al.	$56^{19.5°}$; s. bz.	s.; s. CS_2; s. ac.
2699	col. nd./al.	.....	.....	.....	s.	s.	.....
2700	col. cr.	.....	123-5	.....	i.	s.	s. H_2SO_4
2701	col. lf.	.....	.....	.....	s.	s.	i.
2702	col. lf.	.....	.....	.....	v. sl. s.	.....	.....
2703	pr./Me al.	.....	56-7	332	i.	s.	s.
2704	nd./aq. al.	.....	86-7	363	i.; s. bz.	s. h.	s.; s. ac.
2705	lf. or nd.	.....	212-3	404-27	s. h. bz.	v. sl. s. h.	sl. s.

Dioxy-pyrimidine 6383
Diphenol 2340-3
Diphenyl-acetamide 84.1
Diphenyl-acetone 1787
Diphenyl-acetylene 5954
Diphenyl-amine orange 4996

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Diphenyl				
2706	benzidine (*N*)	.....	$(C_6H_5{\cdot}NH{\cdot}C_6H_4)_2$	XIII-223	336.42
2707	butyl-phenyl phosphate (*p-tert*)	phosphen I	$C_4H_9{\cdot}C_6H_4{\cdot}O{\cdot}PO:(O{\cdot}C_6H_5)_2$	.....	382.38
2708	carbamine chloride	diPh-carbamyl chloride	$(C_6H_5)_2N{\cdot}CO{\cdot}Cl$	XII-428	231.68
2709	carbazone (*sym*)	.....	$C_6H_5{\cdot}N:N{\cdot}CO{\cdot}NH{\cdot}NH{\cdot}C_6H_5$	XVI-24	240.26
2710	carbohydrazide (1,5)	diPh-carbazide	$(C_6H_5NH{\cdot}NH)_2CO$	XV-292	242.27
2711	carbonate	phenyl carbonate	$(C_6H_5O)_2CO$	VI-158	214.21
2712	chloroarsine	sneezing gas	$(C_6H_5)_2AsCl$	XVI-845	264.57
2713	*o*-chlorophenyl phosphate	phosphen 3	$(C_6H_5O)_2PO{\cdot}OC_6H_4Cl$	.....	360.73
2714	*iso*-cyanate	*p*-xenylcarbimide	$C_6H_5{\cdot}C_6H_4N:CO$	XII-1319	195.21
2715	disulfide	phenyl disulfide	$(C_6H_5S{\cdot})_2$	VI-323	218.32
2716	disulfoxide	phenyl oxydisulfide	$(C_6H_5{\cdot}SO)_2$	VI-324	250.32
2717	ethane (*sym*)	dibenzyl	$(C_6H_5{\cdot}CH_2{\cdot})_2$	V-598	182.25
2718	ethane (*uns*)	.....	$(C_6H_5)_2CH{\cdot}CH_3$	V-605	182.25
2719	ether	phenyl ether	$(C_6H_5)_2O$	VI-146	170.20
2720	ethylenediamine (*N*)(*sym*)	ethylene-diphenyl-diamine	$(C_6H_5{\cdot}NH{\cdot}CH_2{\cdot})_2$	XII-543	212.28
2721	formamidine (*N,N'*)	methenyl-diphenyl-amine	$HC(:NC_6H_5)NHC_6H_5$	XII-236	196.24
2722	glyoxalone (4,5)	4,5-diPh-imidazolone	$C_6H_5{\cdot}C:C(C_6H_5){\cdot}$ NH·CO·NH	XXIV-211	236.26
2723	guanidine	melaniline	$(C_6H_5NH)_2C:NH$	XII-369	211.26
2724	hydantoin (5,5)	dilantin	$CO{\cdot}NH{\cdot}CO{\cdot}NH{\cdot}C:(C_6H_5)_2$	XXIV-410	252.26
2725	hydrazine (α,α)†	.....	$(C_6H_5)_2N{\cdot}NH_2$	XV-122	184.23
2726	hydrazine HCl	(α,α), *uns*, or *N,N*	$(C_6H_5)_2N{\cdot}NH_2{\cdot}HCl$	XV-123	220.70
2727	hydrazine (*p*)	4-hydrazino-diPh	$C_6H_5{\cdot}C_6H_4{\cdot}NH{\cdot}NH_2$	XV-576	184.23
2728	iodonium hydroxide	known only in soln.	$(C_6H_5)_2I{\cdot}OH$	V-219	298.13
2729	iodonium iodide	.....	$(C_6H_5)_2I{\cdot}I$	V-219	408.04
2730	ketene	.....	$(C_6H_5)_2C:CO$	VII-471	194.22
2731	methane	ditane	$(C_6H_5)_2CH_2$	V-588	168.23
2732	α-naphthyl carbinol	.....	$(C_6H_5)_2C(OH){\cdot}C_{10}H_7$	VI-729	310.37
2733	nitrosamine	nitroso-diPh-amine	$(C_6H_5)_2N{\cdot}NO$	XII-580	198.22
2734	phenanthracene	(9,10)	$C_{14}H_8(C_6H_5)_2$	V-747	330.40
2735	phosphate	.....	$(C_6H_5O)_2PO{\cdot}OH$	VI-178	250.19
2736	phosphate	.....	$(C_6H_5)_2HPO_4{\cdot}2H_2O$	*VI-95	286.22
2737	phthalate	phenyl phthalate	$C_6H_4(CO_2C_6H_5)_2$	IX-801	318.31
2738	piperazine (*N,N'*)	.....	$(C_6H_5N)_2(CH_2)_4$	XXIII-8	238.32
2739	propionic acid (β,β)	β-Ph-hydrocinnamic acid	$(C_6H_5)_2CH{\cdot}CH_2{\cdot}CO_2H$	IX-680	226.26
2740	propiophenone	(β,β)	$(C_6H_5)_2CH{\cdot}CH_2{\cdot}CO{\cdot}C_6H_5$	VII-524	286.35

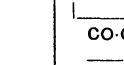
† See also No. 3685

Diphenyl-benzylamine 804
Diphenyl-black base-P 314
Diphenyl-carbamyl chloride 2708
Diphenyl-carbazide 2710
Diphenyl carbinol 691
Diphenyl-carbonimide 2714
Diphenyl-carboxylic acid 5160-2
Diphenyl-dichloromethane 726
Diphenyl-diimide 599
Diphenyl-ethyl carbamate 2761
Diphenyl-ethylene 5642-3

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2706	lf./PhMe	.....	242	.....	s. ac.	sl. s.	sl. s. bz.
2707	col. lq.	1.16^{25}_{25}°	<0	245-60^{5mm}	i.	v. s.; ∞ CCl_4	∞ bz.
2708	lf./al.	.....	85-6	.....	d. h.	d. alk.	.....
2709	or. red nd.	.....	157±, d.	.....	i.	s.; s. bz.	s. chl.
2710	cr./al.	.....	175	.....	v. sl. s. h.	s. h.	i.; s. act.
2711	nd./al.	$1.272^{14°}$	80	302-6	i.	v. s.	s.; s. CCl_4
2712	rhb.	$1.583^{40°}$	43-4	333, in CO_2	0.2, d.	20	s.; s. bz.
2713	col. lq.	1.30^{25}_{25}°	<0	256-60^{15mm}	i.	v. s.	∞ bz.; ∞ CCl_4
2714	nd./et.	.....	56	283 d.	.....	.....	v. s.
2715	nd./al.	.....	61	310	i.	s.	v. s.
2716	mn./al.	.....	45	d.	i.; i. alk.	s. h.	s.
2717	col. pr.	0.978^{50}_{50}°	51-2	284	i.	s.	v. s.
2718	col. oil	$1.004^{20°}$	−21.5	272	i.	∞	∞
2719	col. rhb.	$1.073^{20°}$	27	259	v. sl. s.; s. ac.	5$^{-10°}$, 87% al.	∞ ; s. bz.
2720	lf./aq. al.	.....	64-5	.....	.....	v. s.	v. s.
2721	nd./bz.	.....	139-43	sl. d.	v. s. chl.	0.05$^{9°}$ pet.	s.
2722	nd./al.	.....	324-5	.....	i.; s. h. ac.	s.; v. sl. s. bz.	v. sl. s.; v. sl. s. lg.
2723	mn./al.	.....	147-8	d. >170	v. sl. s. c.; s. dil. a.	$9.1^{20°}$ 90% al.	sl. s.; s. h. bz.
2724	cr./al.	.....	295-8	.....	i.; s. alk.; sl. s. bz.	2; s. ac.; sl. s. chl.	sl. s.; 3 act.
2725	tri.	$1.190^{16°}$	44 (36)	220^{50mm}	sl. s.	s.	s.
2726	nd./al.-HCl	.....	.....	.....	i.	v. s.	i. HCl
2727	lf./al.	.....	135-6 d.	.....	v. sl. s.	v. sl. s. lg.	.....
2728	.....	.....	.....	.....	.....	.....	.....
2729	yel. nd./al.	.....	182	.....	.....	v. sl. s. h.	.....
2730	red-yel. lq.	$1.104^{20°}_{4}$	.....	265-70	.....	.....	.....
2731	col. pr.	$1.001^{26°}_{4}$	26-7	265	i.	v. s.	v. s.
2732	cr./lg.	.....	137-8	d.	i.; s. bz.	s. h.	v. s.
2733	yel. mn.	.....	66-7	.....	v. s. h. bz.	s. h.	.....
2734	col. nd./al.	.....	240	subl.	s. bz.	sl. s.	s.
2735	nd./chl. lg.	.....	70	.....	3	s.; s. bz.	s.; s. chl.
2736	col. cr./aq.	$1.242^{60°}_{25°}$	51	−2H_2O, 100	$3^{25°}$	$4^{25°}$ CCl_4	$100^{25°}$
2737	col. pr./al.	$1.572^{74°}$	73	* 405^{759mm}	i.; s. act.	sl. s.	sl. s.
2738	nd./Me al.	.....	164	230-5^{12mm}	i.; $7^{25°}$ bz.	$4^{25°}$ act.	$2^{25°}$
2739	nd./aq. al.	.....	154-5	.....	v. sl. s.	s.	.....
2740	nd./al.	.....	96	.....	v. sl. s. lg.; s. bz.	s. h.; s. act.	sl. s.; s. chl.

* Heated rapidly; decomposed when heated slowly.

Diphenyl-glycolic acid 699
Diphenyl-imidazolone 2722
Diphenyl-ketone 724
Diphenyl-ketoxime 728
Diphenyl mercury 4047
Diphenyl-methylenediamine 4431
Diphenyl-oxide 2719
Diphenyl-phenoxy ethane 2853
Diphenyl-phenylene 2703-5
Diphenyl-phthalide 5292

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2741	**Diphenyl** quinomethane	fuchsone	$(C_6H_5)_2C{:}C_6H_4{:}O$	VII-520	258.30
2742	selenium	selenium diphenyl	$(C_6H_5)_2Se$	VI-345	233.16
2743	selenium dichloride	.....	$(C_6H_5)_2SeCl_2$	VI-346	304.07
2744	semicarbazide(1,1)	.....	$(C_6H_5)_2N{\cdot}NHCONH_2$	XV-304	227.26
2745	semicarbazide(1,4)	.....	$(C_6H_5NH)_2(\cdot NHCO\cdot)$	XV-288	227.26
2746	semicarbazide(2,4)	.....	$C_6H_5N(NH_2){\cdot}CO{\cdot}NH{\cdot}C_6H_5$	XV-277	227.26
2747	semicarbazide(4,4)	.....	$(C_6H_5)_2N{\cdot}CONHNH_2$	*XII-257	227.26
2748	succinate	phenyl succinate	$(CH_2{\cdot}CO_2C_6H_5)_2$	VI-155	270.27
2749	sulfide	phenyl sulfide	$(C_6H_5)_2S$	VI-299	186.26
2750	sulfone	sulfobenzide	$(C_6H_5)_2SO_2$	VI-300	218.26
2751	4-sulfonic acid	Na salt	$C_6H_5{\cdot}C_6H_4{\cdot}SO_3Na$	.....	256.25
2752	sulfoxide	.....	$(C_6H_5)_2SO$	VI-300	202.26
2753	thiocarbazone	dithizone	$C_6H_5N{:}N{\cdot}CS{\cdot}NH{\cdot}NH{\cdot}C_6H_5$	XVI-26	256.32
2754	thiocarbohydrazide (1,5)	diPh-thiocarbazide	$(C_6H_5NH{\cdot}NH)_2CS$	XV-299	258.33
2755	***iso*-thiocyanate**	*p*-xenyl mustard oil	$C_{12}H_9N{:}CS$	XII-1319	211.27
2756	tolyl methane (*m*)	3-methyl tritane	$CH_3{\cdot}C_6H_4{\cdot}CH(C_6H_5)_2$	V-710	258.34
2757	tolyl methane (*p*)	4-methyl tritane	$CH_3{\cdot}C_6H_4{\cdot}CH(C_6H_5)_2$	V-710	258.34
2758	triketone	.....	$(C_6H_5{\cdot}CO)_2CO$	VII-871	238.23
2759	urea (*sym*)	carbanilide	$(C_6H_5{\cdot}NH)_2CO$	XII-352	212.24
2760	urea (*uns*)	.....	$(C_6H_5)_2N{\cdot}CO{\cdot}NH_2$	XII-429	212.24
2761	urethane	*N*-diPh-ethyl carbamate	$(C_6H_5)_2N{\cdot}CO_2C_2H_5$	XII-427	241.28
2762	*o*-xenyl phosphate	phosphen 5	$C_6H_5{\cdot}C_6H_4O{\cdot}PO{:}(O{\cdot}C_6H_5)_2$	.....	402.37
2763	**Diphenylene** oxide	dibenzofurane	$(C_6H_4)_2O$	XVII-70	168.18
2764	**Dipicryl**-amine (2,4,6,2′,4′,6′)	hexaNO_2-diPh-amine	$[(NO_2)_3C_6H_2]_2NH$	XII-766	439.22
2765	sulfide	(2,4,6,2′,4′,6′)	$[(NO_2)_3C_6H_2]_2S$	VI-344	456.26
2766	**Dipiperonalacetone**	dipiperonylidene-acetone	$(CH_2O_2{:}C_6H_3{\cdot}CH{:}CH)_2CO$	XIX-446	322.30
2767	**Di-*iso*-propanolamine**	.....	$(C_3H_6{\cdot}OH)_2NH$	.....	133.19
2768	**Dipropargyl**	hexadiyne-1,5	$(CH{:}C{\cdot}CH_2{\cdot})_2$	I-266	78.11
2769	**Di-*iso*-propenyl**	2,3-dimethyl-butadiene-1,3	$[CH_2{:}C(CH_3)]_2$	I-256	82.14
2770	**Dipropyl** acetic acid (*n*)	.....	$(C_3H_7)_2CH{\cdot}CO_2H$	II-350	144.21
2771	adipate (*n*)	*n*-propyl adipate	$[(CH_2)_2CO_2C_3H_7]_2$	.....	230.30
2772	amine (*n*)	.....	$(C_2H_5{\cdot}CH_2)_2NH$	IV-138	101.19
2773	amine (*iso*)	.....	$(C_3H_7)_2NH$	IV-154	101.19
2774	aminobenzaldehyde	(*n*)(*p*)	$(C_3H_7)_2N{\cdot}C_6H_4{\cdot}CHO$	.....	205.29
2775	aniline (*n*)(*N*)	.....	$C_6H_5N(C_3H_7)_2$	XII-167	177.28
2776	barbituric acid (5,5)	proponal		XXIV-492	212.24
2777	benzene (*iso*)(*o*)	.....	$[(CH_3)_2CH]_2C_6H_4$	V-447	162.26
2778	benzene (*iso*)(*m*)	alkazene 12	$[(CH_3)_2CH]_2C_6H_4$	V-447	162.26

Diphenyl selenide 2742
Diphenyl-thiocarbazide 2754
Diphenyl-thiourea 5892
Diphenylene carbinol 3247
Diphenylene disulfide 5877
Diphenylene-imine 1231
Diphenylene ketone 3248
Diphenylene ketone oxide 6451

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2741	brn. yel. nd.	.....	168-9	.....	i.	v. s. act.	sl. s. h.
2742	oil	1.338^{16}_{4}°	2.5	301-2	.....	∞	∞
2743	pa. yel. pr.	.....	182-5	.....	i.	i.	i.
2744	nd./al.	.....	195	.....	.....	s.	s. bz.
2745	nd./al.	.....	179-80	.....	v. sl. s. h.	s.; s. bz.	i.
2746	col. lf./al.	.....	165.5 *	.....	v. s. ac.	s.; s. bz.	s.; s. chl.
2747	pr./al.	.....	154	.....	s. h.; s. bz.	s.; s. chl.	v. sl. s.
2748	lf./al.	.....	122-3	330	i.; s. bz.	s. CS_2	s.
2749	col. lq.	1.119^{15}_{15}°	<−40	296-7	i.; ∞ bz.	s. h.	∞ ; ∞ CS_2
2750	nd./aq.	.....	128-9	379	sl. s. h.	s. h.	s. bz.
2751	col. cr.	.....	.....	.....	$1.5^{25°}$	$0.03^{25°}$ CCl_4	$0.03^{25°}$
2752	pr./lg.	.....	70.5	340 sl. d.	sl. s. pet.	s.	s.; s. bz.
2753	b.-bl. cr.	.....	.....	.....	i.; s. alk.	v. sl. s.; s. H_2SO_4	v. sl. s.; sl. s. chl.
2754	pr./al.	.....	150 ±	d.	v. sl. s. bz.	v. sl. s.	v. sl. s. ac.
2755	nd./et.	.....	58	.....	.....	.....	v. s.
2756	pr./al.	$1.07^{16°}$	60.5-1.5	353-4^{774mm}	v. s. bz.	sl. s.	v. s.
2757	pr./Me al.	.....	72	>360	sl. s. pet.	v. s. h.	v. s. bz.
2758	yel. nd./lg.	.....	69-70	289^{175mm}	i.	sl. s.	s.
2759	rhb.	1.239	240	260-2	v. sl. s.	sl. s. h.	s.
2760	rhb.	1.276	189	.....	v. sl. s.	s.	s.; s. chl.
2761	pr./lg.	.....	72	>360	s.; s. pet.	v. s.; s. bz.	v. s.
2762	col. lq.	$1.20^{60°}_{4}$	<0	$250-85^{5mm}$	i.; ∞ bz.	v. s.	∞ CCl_4
2763	lf./al.	.....	86-7	287-8	i.; s. bz.	s. h.	v. s.
2764	yel. pr./ ac.	.....	244-6 d.	.....	i.; s. 93% HNO_3	v. sl. s. act.	i.
2765	yel. lf./ac.	.....	226-30	expl. 290	i.	v. sl. s.	v. sl. s.
2766	yel. nd./ bz.	.....	185	.....	i.; i. lg.	sl. s.	s. chl.; s. act.
2767	.....	.....	33-4	.....	.....	.....	.....
2768	lq.	$0.805^{20°}_{4}$°	−6	85.4	i.	s.	v. s.
2769	lq.	$0.727^{20°}_{20°}$	−65	69.5^{750mm}	.....	.....	.....
2770	col. lq.	$0.922^{0°}_{4}$	.....	221-2	v. sl. s.	.....	.....
2771	col. lq.	.....	−20.3	$143-5^{10mm}$	i.	s.	s.
2772	col. lq.	$0.739^{20°}_{4}$°	−39.6	110-1	s.	∞	∞
2773	col. lq.	$0.722^{22°}$	.....	83.5^{743mm}	s.	s.	.....
2774	lt. yel. lq.	.....	.....	$204-6^{20mm}$	.....	.....	.....
2775	yel. oil	$0.910^{20.4°}$	.....	245.4	i.	s.	s.
2776	cr.	.....	145	.....	v. sl. s. c.; $1.4^{100°}$	v. s.	v. s.
2777	col. lq.	$0.858^{25°}_{25°}$	.....	210^{760mm}	i.	∞	∞
2778	col. lq.	$0.860^{25°}_{25°}$	−105	202^{760mm}	i.	∞	∞

* Decomposes to form 1,4-derivative

Diphenyline 1711
Diphosgene 6159
Diphthalimido-ethane 3205
Dipicolinic acid 5500
Diplosal 5585
Dipropasin 2779
Dipropenyl 3573

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2779	**Dipropyl** carbanilid-4,4′-dicarboxylate (*n*)	dipropasin	$CO(NH{\cdot}C_6H_4{\cdot}CO_2{\cdot}CH_2{\cdot}C_2H_5)_2$	XIV-434	384.42
2780	carbonate (*n*)	*n*-propyl carbonate	$(C_2H_5{\cdot}CH_2{\cdot}O)_2CO$	III-6	146.18
2781	*α,α′*-dibromo-succinate (*n*)	.....	$(CHBr{\cdot}CO_2C_3H_7)_2$	.....	360.06
2782	disulfide (*n*)	.....	$(C_2H_5{\cdot}CH_2{\cdot}S{\cdot})_2$	I-350	150.29
2783	ether (*n*)	*n*-propyl ether	$(C_2H_5{\cdot}CH_2)_2O$	I-354	102.17
2784	ether (*iso*)	*iso*-propyl ether	$[(CH_3)_2CH]_2O$	I-362	102.17
2785	ether (*n-iso*)	.....	$C_2H_5CH_2{\cdot}O{\cdot}CH(CH_3)_2$	I-362	102.17
2786	ketone (*n*)	heptanone-4	$(C_2H_5{\cdot}CH_2)_2CO$	I-699	114.18
2787	ketone (*iso*)	2,4-diMe-pentanone-3	$[(CH_3)_2CH]_2CO$	I-703	114.18
2788	maleate (*n*)	propyl maleate	$(CH{\cdot}CO_2C_3H_7)_2$	II-752	200.23
2789	malonate (*n*)	.....	$CH_2(CO_2C_3H_7)_2$	II-581	188.22
2790	nitrosamine (*n*)	nitroso-diPr-amine	$(C_3H_7)_2N{\cdot}NO$	IV-146	130.19
2791	nitrosamine (*iso*)	.....	$[(CH_3)_2CH]_2N{\cdot}NO$	IV-156	130.19
2792	oxalate (*n*)	propyl oxalate	$(CO_2CH_2{\cdot}C_2H_5)_2$	II-539	174.19
2793	oxalate (*iso*)	.....	$(CO_2{\cdot}C_3H_7)_2$	II-539	174.19
2794	phthalate (*n*)	propyl phthalate	$C_6H_4(CO_2{\cdot}C_3H_7)_2$	.....	250.28
2795	phthalate (*iso*)	.....	$C_6H_4(CO_2{\cdot}C_3H_7)_2$	IX-798	250.28
2796	succinate (*n*)	propyl succinate	$(CH_2{\cdot}CO_2{\cdot}CH_2{\cdot}C_2H_5)_2$	II-611	202.24
2797	succinate (*iso*)	.....	$(CH_2{\cdot}CO_2{\cdot}C_3H_7)_2$	II-611	202.24
2798	sulfate (*n*)	*n*-propyl sulfate	$(C_2H_5{\cdot}CH_2O)_2SO_2$	I-354	182.23
2799	sulfide (*n*)	*n*-propyl sulfide	$(C_2H_5{\cdot}CH_2)_2S$	I-359	118.23
2800	sulfide (*iso*)	.....	$[(CH_3)_2CH]_2S$	I-367	118.23
2801	sulfite (*n*)	.....	$(C_2H_5{\cdot}CH_2{\cdot}O)_2SO$	I-354	166.23
2802	sulfone (*n*)	.....	$(C_2H_5{\cdot}CH_2)_2SO_2$	I-359	150.23
2803	sulfone (*iso*)	.....	$[(CH_3)_2CH]_2SO_2$	I-367	150.23
2804	tartrate (*n*)(*d*)	propyl tartrate	$(CHOH{\cdot}CO_2{\cdot}C_3H_7)_2$	III-516	234.24
2805	tartrate (*iso*)(*d*)	.....	$(CHOH{\cdot}CO_2{\cdot}C_3H_7)_2$	III-517	234.24
2806	urea (*n*)(*sym*)	.....	$(C_2H_5{\cdot}CH_2{\cdot}NH)_2CO$	IV-142	144.21
2807	urea (*n*)(*uns*)	.....	$(C_3H_7)_2N{\cdot}CO{\cdot}NH_2$	IV-143	144.21
2808	**Dipropylene glycol**	.....	$(CH_3CHOHCH_2)_2O$	.....	134.17
2809	**Dipyridine**	nicotyrine	$C_{10}H_{10}N_2$	XXIII-185	158.20
2810	**Dipyridyl** (2,2′)	(*α,α′*)	$(C_5H_4N)_2$	XXIII-199	156.18
2811	**Dipyridyl** (4,4′)	.....	$(C_5H_4N)_2$	XXIII-200	156.18
2812	**Dipyridyl** (2,3′)	.....	$C_{10}H_8N_2$	XXIII-200	156.18
2813	**Dipyridyl** (3,3′)	.....	$C_{10}H_8N_2$	XXIII-200	156.18
2814	**Diquinoyl** (2,3′)	.....	$(C_9H_6N)_2$	XXIII-293	256.29
2815	**Diquinoyl** (3,7′)(*β*)	.....	$(C_9H_6N)_2$	XXIII-295	256.29
2816	**Diquinoyl** (6,6′)(*γ*)	.....	$(C_9H_6N)_2$	XXIII-295	256.29
2817	**Diresorcinol** (5,5′)	.....	$[C_6H_3(OH)_2]_2{\cdot}2H_2O$	VI-1164	254.23
2818	**Dithio**-acetic acid	.....	$CH_3{\cdot}CS{\cdot}SH$	II-233	92.17
2819	carbamic acid	.....	$NH_2{\cdot}CS{\cdot}SH$	III-216	93.16
2820	hydroquinone (*p*)	.....	$HS{\cdot}C_6H_4{\cdot}SH$	VI-867	142.23
2821	oxamide	rubeanic acid	$(\cdot C{:}S{\cdot}NH_2)_2$	II-565	120.19
2822	resorcinol (*m*)	.....	$HS{\cdot}C_6H_4{\cdot}SH$	VI-834	142.23
2823	salicylic acid	(1,2)	$HO{\cdot}C_6H_4{\cdot}CS{\cdot}SH$	X-134	170.24
2824	**Ditolualacetone** (*p*)	dixylidene acetone	$(CH_3{\cdot}C_6H_4{\cdot}CH{:}CH)_2CO$	VII-508	262.33
2825	**Ditolyl** (2,2′)	.....	$(CH_3{\cdot}C_6H_4{\cdot})_2$	V-608	182.25
2826	**Ditolyl** (2,3′)	.....	$(CH_3{\cdot}C_6H_4{\cdot})_2$	V-609	182.25

Dipropyl carbinol (*n*) 3543
Dipropyl carbinol (*iso*) 3531
Dipropyl mercury 4046
Dipropyl zinc 6505-6
Di-*iso*-propylidene acetone 5268
Disalicylic acid 5525
Disalicylide 3747
Dispermin 2226

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2779	wh. pd.	.....	171-2	.....	i.	s.	.....
2780	col. lq.	$0.968^{22°}$	.....	168.2	.....	.....	.....
2781	lt. yel. lq.	.....	.....	147-50^{7mm}	i.	s.	s.
2782	col. lq.	$0.814^{17°}$	−102±	192-3	i.	s.	s.
2783	col. lq.	$0.744^{21.2°}_{0}$	−122	91	sl. s.	∞	∞
2784	col. lq.	$0.725^{20.8°}_{0}$	−60	68.5-9.0	0.2	∞	∞
2785	col. lq.	.....	.....	82-3	.....	.....	.....
2786	col. lq.	$0.822^{20°}_{4}$	−32.6	143.7	0.43	∞	∞
2787	col. lq.	$0.806^{20°}_{4}$	.....	123.7	v. sl. s.	∞	∞ ; s. bz.
2788	col. lq.	$1.030^{18.4°}_{4}$	.....	114-7^{6mm}	.....	.....	.....
2789	col lq.	$1.027^{9°}_{0}$	.....	228.3	.....	.....	.....
2790	yel. oil	$0.916^{20°}_{4}$	.....	205.9	v. sl. s.	.....	.....
2791	cr./et.	.....	46	194.5	v. sl. s.	s.	s.; s. bz.
2792	col. lq.	$1.038^{0°}_{0}$	.....	213.5	d. h.	.....	.....
2793	col. lq.	.....	.....	190±	.....	.....	.....
2794	col. lq.	.....	.....	129-32^{1mm}	i.	s.	s.
2795	col. lq.	.....	.....	160-1^{9mm}	i.	s.	s.
2796	col. lq.	$1.006^{15°}$	.....	250.8	.....	.....	.....
2797	col. lq.	$1.019^{0°}_{0}$	.....	247.1	.....	.....	.....
2798	oil	$1.11^{22.5°}$	d. 140-70	120^{20mm}	.....	.....	.....
2799	lq.	$0.814^{17°}$	.....	142-3^{772mm}	i.	s.	s.
2800	lq.	.....	.....	120.5^{763mm}	.....	.....	.....
2801	col. lq.	.....	.....	194	i.	s.	s.
2802	scales	.....	29-30	.....	.....	.....	.....
2803	cr.	.....	36	.....	v. s.	.....	.....
2804	lq.	$1.139^{20°}_{4}$	.....	303	sl. s.	s.	s.
2805	col. lq.	$1.130^{20°}$	.....	275	.....	.....	.....
2806	nd./aq.	.....	105	255	sl. s. c.	v. s.	v. s.
2807	nd.	.....	76	.....	v. s.	.....	.....
2808	col. lq.	$1.025^{20°}_{20}$	.....	231.8	∞	.....	.....
2809	lq.	$1.124^{13°}$	.....	280-1	v. sl. s. h.	s.	s.
2810	pr./pet.	.....	69.5	272.5	0.5	s.; s. bz.	s.; s. chl.
2811	pl.	.....	111-2	304.8	s. h.	v. s.	v. s.
2812	lq.	.....	.....	296	v. sl. s.	.....	s.
2813	hyg. nd.	$1.164^{20°}$	68	295.5-6.5	∞	∞	sl. s.
2814	yel. nd.	.....	175.5-6.0	>400 sl. d.	i. h.	s. h.	s.
2815	pl./al.	.....	192.5	subl.	i.	s. h.	sl. s.
2816	mn./al.	.....	178	.....	v. sl. s. h.	sl. s.	sl. s.; s. bz.
2817	pl. or nd.	.....	310 (anh.)	−2H_2O, 100	s. h.	sl. s.	i. ac.
2818	red-yel. oil	$1.24^{20°}$	.....	37^{15mm}	i. c.	v. s.	v. s.; s. bz.
2819	col. nd.	.....	.....	.....	v. s. d.	v. s.; d. h.	v. s.
2820	lf./aq. al.	.....	98	.....	s. bz.	s.; s. lg.	s. ac.
2821	or. red cr.	.....	41	subl.	v. sl. s. c.	s.; s. alk.	i.
2822	cr.	.....	27	243	.....	.....	.....
2823	yel. nd./ pet.	.....	48-50	.....	sl. s.	s.	s.; s. bz.
2824	yel. nd./al.	.....	175	.....	.....	.....	.....
2825	cr./al.	$0.955^{10°}$	17.8	258^{738mm}	v. s. bz.	v. s.	v. s.
2826	lq.	.....	.....	270	.....	v. s.	v. s.

Distyryl ketone 1775
Disulfo acid-C 4534
Disulfo acid-S 4533

Ditane 2731
Dithizone 2753
Dithymol-diiodide 5940

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2827	**Ditolyl** (3,3′)	.....	$(CH_3{\cdot}C_6H_4{\cdot})_2$	V-609	182.25
2828	**Ditolyl** (4,4′)	.....	$(CH_3{\cdot}C_6H_4{\cdot})_2$	V-610	182.25
2829	**Ditolyl** (2,4′)	.....	$(CH_3{\cdot}C_6H_4{\cdot})_2$	V-609	182.25
2830	amine (2,2′)	.....	$(CH_3{\cdot}C_6H_4)_2NH$	XII-787	197.27
2831	amine (3,3′)	.....	$(CH_3{\cdot}C_6H_4)_2NH$	XII-858	197.27
2832	amine (4,4′)	.....	$(CH_3{\cdot}C_6H_4)_2NH$	XII-907	197.27
2833	carbonate (*o*)	dicresyl carbonate	$(CH_3{\cdot}C_6H_4{\cdot}O)_2CO$	VI-356	242.26
2834	carbonate (*m*)	.....	$(CH_3{\cdot}C_6H_4{\cdot}O)_2CO$	VI-379	242.26
2835	carbonate (*p*)	.....	$(CH_3{\cdot}C_6H_4{\cdot}O)_2CO$	VI-398	242.26
2836	disulfide (*p*)	.....	$(CH_3{\cdot}C_6H_4{\cdot}S)_2$	VI-425	246.37
2837	guanidine (*o*)	.....	$(C_7H_7{\cdot}NH)_2C{:}NH$	XII-803	239.31
2838	ketone (*p*)	diMe-benzophenone	$(CH_3{\cdot}C_6H_4)_2CO$	VII-451	210.26
2839	*m*-phenylene-diamine (*p*)	.....	$(CH_3{\cdot}C_6H_4NH)_2C_6H_4$	XIII-42	288.38
2840	*p*-phenylene-diamine (*p*)	.....	$(CH_3{\cdot}C_6H_4NH)_2C_6H_4$	XIII-81	288.38
2841	phthalate (*o*)	*o*-cresyl phthalate	$C_6H_4(CO_2{\cdot}C_7H_7)_2$	.....	346.36
2842	sulfide (*p*)	diMe-diPh sulfide	$(CH_3{\cdot}C_6H_4)_2S$	VI-419	214.31
2843	sulfone (*p*)	.....	$(CH_3{\cdot}C_6H_4)_2SO_2$	VI-419	246.31
2844	thiourea (*o*)(*sym*)	.....	$(CH_3{\cdot}C_6H_4{\cdot}NH)_2CS$	XII-807	256.35
2845	thiourea (*m*)(*sym*)	.....	$(CH_3{\cdot}C_6H_4{\cdot}NH)_2CS$	XII-864	256.35
2846	thiourea (*p*)(*sym*)	.....	$(CH_3{\cdot}C_6H_4{\cdot}NH)_2CS$	XII-948	256.35
2847	urea (*o*)(*sym*)	.....	$(CH_3{\cdot}C_6H_4{\cdot}NH)_2CO$	XII-801	240.29
2848	urea (*m*)(*sym*)	.....	$(CH_3{\cdot}C_6H_4{\cdot}NH)_2CO$	XII-863	240.29
2849	urea (*p*)(*sym*)	.....	$(CH_3{\cdot}C_6H_4{\cdot}NH)_2CO$	XII-941	240.29
2850	**Diundecyl ketone**	laurone	$(C_{11}H_{23})_2CO$	I-719	338.60
2851	**Diurea**	*p*-urazine	$CO{:}(NH{\cdot}NH)_2{:}CO$	XXVI-204	116.08
2852	**Divinyl sulfide**	.....	$(CH_2{:}CH)_2S$	I-434	86.15
2853	**Dixenoxy ethane** (*o*)	diPh-phenoxy ethane	$(C_6H_5{\cdot}C_6H_4{\cdot}O{\cdot}CH_2)_2$	.....	366.44
2854	**Djenkolic acid** (*l*)(−)	cysteine thioform-acetal	$[HO_2C{\cdot}CH(NH_2){\cdot}CH_2S]_2CH_2$	.....	254.32
2855	**Docosane** (*n*)	.....	$CH_3(CH_2)_{20}CH_3$	I-174	310.59
2856	**Dodecane** (*n*)	dihexyl	$CH_3(CH_2)_{10}CH_3$	I-171	170.33
2857	**Dodecane**	2,4,5,7-tetra-methyl-octane	$C_{12}H_{26}$	I-171	170.33
2858	**Dodecyl** acetate (*n*)	.....	$CH_3{\cdot}CO_2{\cdot}C_{12}H_{25}$	II-136	228.36
2859	alcohol (*n*)	dodecanol-1	$CH_3(CH_2)_{10}CH_2OH$	I-428	186.33
2860	bromide (*n*)	lauryl bromide	$CH_3(CH_2)_{10}CH_2Br$	.....	249.24
2861	chloride (*n*)	lauryl chloride	$CH_3(CH_2)_{10}CH_2Cl$	.....	204.78
2862	cyanide (*n*)	.....	$CH_3(CH_2)_{10}CH_2CN$	II-364	195.34
2863	**Dodecylene** (*α*)	dodecene-1	$CH_3(CH_2)_9CH{:}CH_2$	I-225	168.31
2864	**Dodecyne-2**	.....	$CH_3(CH_2)_8C{:}C{\cdot}CH_3$	I-261	166.30
2865	**Doryl**	carbamylcholine chloride	$NH_2{\cdot}CO_2{\cdot}CH_2{\cdot}CH_2{\cdot}N(CH_3)_3Cl$	.....	182.65
2866	**Dotriacontane** (*n*)	dicetyl	$CH_3(CH_2)_{30}CH_3$	I-177	450.85
2867	**Echitin**	.....	$C_{32}H_{52}O_2$	.....	468.74
2868	**Eicosane** (*n*)	.....	$CH_3(CH_2)_{18}CH_3$	I-174	282.54
2869	**Eicosyl alcohol**	eicosanol-1	$CH_3(CH_2)_{18}CH_2OH$	I-431	298.54
2870	**Elaidic acid**	.....	$C_{17}H_{33}{\cdot}CO_2H$	II-469	282.45
2871	**Eleostearic acid**	.....	$C_{18}H_{32}O_2$	II-497	280.44

Ditolyl-hydrazine 3692-4
Ditolyl mercury 4048-50
Divinyl ether 6436
Dixylylidene acetone 2824
D. M. gas 2712
Docosanoic acid 623
Docosenoic acid 2892
Docosenol 2893
Docosinoic acid 624
Dodecahydro-diphenyl 2083
Dodecanal 3952
Dodecanoic acid 3950
Dodecanol 2859
Dodecene 2863
Dopa 2361
Double green 3594
Dulcin 5112
Dulcite (*iso*) 5558
Dulcitol 3608
Duotol 3484

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2827	oil	$0.999^{\frac{18}{4}°}$	5-7	287^{713mm}	i.; s. bz.	s.	s.
2828	mn./et.	.....	121-2	295	i.; s. bz.	s.	s.
2829	lq.	.....	.....	272-80	i.; s. bz.	s.	s.
2830	lq.	.....	.....	$312^{727.5mm}$	v. sl. s.	.....	.....
2831	lq.	.....	<−12	320-4	v. sl. s.	s.	s.
2832	nd.	.....	79	330.5	v. sl. s.	.....	.....
2833	nd./al.	.....	60	.....	s. ac.	.....	.....
2834	col. cr.	.....	47-9	.....	i.	s. h.	s.
2835	nd./al.	.....	111-3	.....	v. sl. s.	sl. s. c.	.....
2836	nd./al.	.....	46	$210\text{-}5^{20mm}$	.....	s.	v. s.
2837	cr./aq. al.	$1.10^{\frac{20}{4}°}$	178-9	.....	v. sl. s.	s. h.	s.
2838	rhb./al.	.....	95	333^{725mm}	l.; s. CS_2	v. s. abs.	v. s.
2839	nd./al.	.....	138-9	d.	sl. s. bz.; sl. s. ac.	sl. s. c.	sl. s.
2840	lf.	.....	182	.....	sl. s. bz.; sl. s. ac.	v. sl. s. c.	v. sl. s. pet.
2841	col. cr.	.....	110-2	.....	i.	s. h.	i.
2842	nd./al.	.....	56-7	>300	i.; s. bz.	v. s. h.	v. s.
2843	pr./bz.	.....	158-9	405^{714mm}	s. CS_2	s. h.	s. chl.
2844	nd./al.	.....	158	216-8	i.	v. s. h.	i.
2845	nd.	.....	122	.....	v. sl. s. h.	s.	s. bz.
2846	rhb.	.....	178	.....	i.	v. sl. s. h.	i.
2847	nd./ac.	.....	255-6	.....	i.	sl. s. h.	s. h. ac.
2848	nd./al.	.....	217	.....	i.	s. h.	.....
2849	cr./al.	.....	266-8	.....	i.	sl. s. c.	sl. s.
2850	pl.	$0.809^{\frac{68}{4}°}$	69-70	.....	.....	i. c.	.....
2851	mn./aq.	.....	267-70	.....	sl. s. c.	sl. s.	sl. s. h. ac.
2852	oil	0.913	.....	101	v. sl. s.	∞	∞
2853	col. cr.	.....	101-2	.....	$0.02^{25°}$	$19^{25°}$ act.	$55^{25°}$ bz.
2854	nd.	.....	300-50	.....	.....	.....	.....
2855	cr.	$0.778^{\frac{44}{4}°}$	44.5	224.5^{15mm}	i.	4 h.	v. s.
2856	lq.	$0.751^{\frac{20}{4}°}$	−9.6	214.5	i.	v. s.	v. s.
2857	oily lq.	.....	.....	208-10	s. lg.	.....	.....
2858	col. lq.	.....	.....	$151\text{-}2^{15mm}$	.....	.....	.....
2859	lf.	$0.831^{\frac{24}{4}°}$	24	255-9	i.	s.	s.
2860	col. lq.	.....	.....	$175\text{-}80^{45mm}$	i.	s.	s.
2861	col. lq.	.....	.....	$128\text{-}30^{11mm}$	i.	.....	s.
2862	col. lq.	.....	.....	275	.....	v. s.	v. s.
2863	col. lq.	$0.762^{\frac{15}{4}°}$	−31.5	96^{15mm}	i.	v. s.	v. s.
2864	lq.	$0.792^{\frac{15}{4}°}$	−9	105^{15mm}	.....	.....	.....
2865	col. cr.	.....	203-4 d.	.....	100	2	i.
2866	cr./chl.	$0.780^{70.1°}$	70-1	310^{15mm}	s. h. ac.	v. sl. s. c.	s. h.
2867	lf.	.....	170	.....	v. s. chl.	$0.07^{15°}$, 80% al.	sl. s.
2868	cr.	$0.778^{\frac{86.7}{4}°}$	36.5	205^{15mm}	i.	.....	∞
2869	col. wax	.....	71	220^{3mm}	s. h. pet.	v. s. c.	s. h. bz.
2870	lf./al.	$0.851^{\frac{79.4}{4}°}$	51-2	288^{100mm}	i.	v. s.	v. s.
2871	α lf./al. βnd./al.	.....	α48-9 β72	235^{12mm} ±, sl. d.	αv. s. et. βv. s. CS_2	β s. h. ac.	.....

Duratol 784
Durene 5828-9
Duridine 5819-20
Duroquinone 5831

Durylic acid 6256, 6259-61
Dutch liquid 1994
Ebert and Merz α acid 4464
Ebert and Merz β acid 4463

Ecgonine, cf. alkd.
Echtrot-D 3732
Eclipse red 733
Ehrlich's reagent 2436

Eicosanoic acid 574
Eicosanol 2869
Eikonogen 341
Elbon 1509

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2872	**Ellagic acid**	dilactone	$C_{14}H_2O_4(OH)_4 \cdot 2H_2O$	XIX-261	338.22
2873	**Embelin**	embelic acid	$C_{18}H_{26}O_2(OH)_2$	.....	308.40
2874	**Emodin**	4,5,7-triOH-2-Me-anthraquinone	$C_{15}H_7O_2(OH)_3$	VIII-520	270.23
2875	**Eosine**	tetraBr-fluorescein	$C_{20}H_8O_5Br_4$	XIX-228	647.93
2876	salt	soluble eosine	$C_{20}H_6O_5Br_4Na_2$	XIX-230	691.91
2877	**Ephedrine** (*l*) †	.....	$C_6H_5 \cdot CHOH \cdot CH \cdot (CH_3) \cdot NHCH_3$	XIII-636	165.23
2878	*pseudo*-**Ephedrine** (*d*) †	*d*-isoephedrine	$C_6H_5 \cdot CHOH \cdot CH \cdot (CH_3) \cdot NHCH_3$	XIII-637	165.23
2879	**Epichlorohydrin** (α)	chloropropylene oxide	$O \cdot CH_2 \cdot CH \cdot CH_2 \cdot Cl$ (epoxide)	XVII-6	92.53
2880	**Epicyanohydrin**	cyanopropylene oxide	$O \cdot CH_2 \cdot CH \cdot CH_2CN$ (epoxide)	XVIII-261	83.09
2881	**Epiiodohydrin** (α)	iodopropylene oxide	$O \cdot CH_2 \cdot CH \cdot CH_2I$ (epoxide)	XVII-10	183.99
2882	**Epinine**	3,4-diOH-Ph-EtMe-amine	$(HO)_2C_6H_3 \cdot CH_2 \cdot CH_2 \cdot NHCH_3$	.....	167.20
2883	**Equilenin** (*dl*)	(synthetic)	$C_{18}H_{18}O_2$	.....	266.32
2884	**Equilenin** (*d*)	(from mares)	$C_{18}H_{18}O_2$	.....	266.32
2885	benzoate	.....	$C_{18}H_{17}O \cdot O_2C \cdot C_6H_5$	.....	370.43
2886	**Equilenin** (*l*)	(synthetic)	$C_{18}H_{18}O_2$	.....	266.32
2887	*iso*-**Equilenin** (*dl*)	.....	$C_{18}H_{18}O_2$	.....	266.32
2888	*iso*-**Equilenin** (*d*)	14-epi-equilenin	$C_{18}H_{18}O_2$	.....	266.32
2889	**Ergosterol**	ergosterin	$C_{28}H_{44}O$	.....	396.63
2890	**Ergothioneine** (*d*)	thiohistidine betaine	$C_9H_{15}O_2N_3S \cdot 2H_2O$	XXV-521	265.33
2891	**Eriodictyol** §	5,7,3′,4′-tetraOH-flavanone	$(HO)_2C_7H_2O_2 \cdot C_6H_3(OH)$	VIII-543	244.19
2892	**Erucic acid**	docosenoic acid	$CH_3(CH_2)_7CH{:}CH \cdot (CH_2)_{11}CO_2H$	II-472	338.56
2893	**Erucyl alcohol**	docosene-9-ol-22	$C_{22}H_{44}O$	I-453	324.57
2894	**Erythritol** (*dl*)	butantetrol-1,2,3,4	$(CHOH \cdot CH_2OH)_2$	I-525	122.12
2895	tetranitrate	nitro-erythrite	$C_4H_6(ONO_2)_4$	I-527	302.12
2896	**Erythrosine**	tetraiodo-fluorescein	$C_{20}H_8O_5I_4$	XIX-231	835.94
2897	salt	.....	$C_{20}H_6O_5I_4Na_2$	.....	879.92
2898	**Esculetin**	6,7-diOH-coumarin	$C_9H_6O_4 \cdot H_2O$	XVIII-98	196.15
2899	**Esculin**	.....	$C_{15}H_{16}O_9 \cdot 1\frac{1}{2}H_2O$	.....	367.30
2900	**Estradiol** (β)	dihydroestrone	$CH_3 \cdot C_{17}H_{19}(OH)_2$	.....	272.37
2901	**Estragole**	*p*-methoxy-allyl-phenol	$CH_2{:}CH \cdot CH_2 \cdot C_6H_4 \cdot OCH_3$	VI-571	148.20
2902	**Estriol**	estrone hydrate	$C_{18}H_{24}O_3$	.....	288.37
2903	**Estrone**	ketohydroxy-estrin	$CH_3 \cdot C_{17}H_{18}O(OH)$	.....	270.36
2904	**Ethane**	.....	$CH_3 \cdot CH_3$	I-80	30.07
2905	sulfinic acid	ethyl sulfinic acid	$C_2H_5 \cdot SO \cdot OH$	IV-1	94.13
2906	sulfonic acid	ethyl sulfonic acid	$C_2H_5 \cdot SO_2 \cdot OH$	IV-5	110.13
2907	**Ethanolamine**	amino-ethyl alcohol	$NH_2 \cdot CH_2 \cdot CH_2OH$	IV-274	61.08

† See also Alkaloid Table.
§ Beilstein shows structure as a chalcone.

Elon 4117
Embelic acid 2873
Embutal 4583
Emerald green base 5762
Emetine, cf. alkd.
Empirin 115
Enanthaldehyde 3521
Enanthaldoxime 3522
Enanthic acid 3520
Endoiodin 3591
Ephedrine (iso) 2878
Epiallocholesterol 1481
Epicarin 3790

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2872	yel. pd.	$1.667^{18°}$	d.	$-2H_2O >$ 120	v. sl. s. h.	sl. s.	i.
2873	or. lf.	.....	143	subl.	i.; s. alk.	s.	sl. s. pet.
2874	red nd./ac.	.....	255-7	.....	i.; s. alk.	s.; s. bz.; s. chl.	s.; s. ac.
2875	col. cr./ac.	.....	.....	.....	i.	s.	sl. s. h. ac.
2876	red brn. pd.	.....	.....	.....	s.	s.	.....
2877	cr./et.	.....	40	255	5	500	s.; s. chl.
2878	rhb. pl.	.....	117	.....	sl. s. c.	s.	s.
2879	lq.	$1.183^{25}_{25°}$	-25.6	117^{756mm}	<5	∞	∞
2880	pr.	.....	162	.....	s. h.	s.	d. a.
2881	lq.	$2.031^{3°}$	.....	160-80	i.	.....	.....
2882	col. cr.	.....	188-9	.....	sl. s.	sl. s.	.....
2883	lf./act. al.	.....	288 (278)	.....	v. sl. s.	.....	.....
2884	nd./aq. al.	.....	251 (vac.)	.....	v. sl. s.	s.	s.
2885	cr.	.....	223 (vac.)	.....	.....	.....	.....
2886	col. cr.	.....	251 (vac.)	.....	v. sl. s.	s.	s.
2887	col. cr.	.....	223 (206)	.....	v. sl. s.	s.	s.
2888	col. cr.	.....	273 (258)	.....	v. sl. s.	s.	s.
2889	cr.	1.04	160-3	.....	i.; s. chl.	s.; s. bz.	s.
2890	col. mn./ aq.	.....	290 ±, d.	.....	$11.6^{20°}$	v. sl. s.	i.; i. chl.
2891	col. pl./al.	.....	267	.....	sl. s. h.	sl. s. h.	s. alk.
2892	nd./al.	$0.860^{5}_{4}{}^{5°}$	33-4	281^{30mm}	i.	v. s.	v. s.
2893	cr.	.....	34.5	$241\text{-}2^{10mm}$	v. s. ac.	v. s.	v. s. bz.
2894	tet. pr.	$1.451^{20°}_{4}$	126	329-31	60	sl. s. c.	i.
2895	lf./al.	.....	61	expl.	i. c.	s.; s. glyc.	s.
2896	or. cr./et.	.....	.....	.....	i.; i. bz.	sl. s.; i. chl.	i. abs.
2897	brn. pd.	.....	.....	.....	s.	s.	.....
2898	nd.	.....	>270 d. (anh.)	.....	s. h.	s.	v. sl. s.
2899	pr.	.....	160 d. (anh.)	$-H_2O$, 120-30	$0.151^{1°}$	4 h.; s. ac.	i. abs.
2900	nd./bz. act.	.....	223 (175)	d.	s. dioxane	s.	s.
2901	lq.	$0.965^{21°}$	.....	$214\text{-}6^{764mm}$	.....	.....	.....
2902	cr./al. EtOAc	.....	283 (275)	.....	0.003	s.	sl. s.
2903	col. cr./al.	.....	259-61 *	.....	i.; s. alk.	s.; s. bz.	s.; s. chl.
2904	col. gas	$0.546^{-88°}$ 1.049(A)	-172	-88.6	$4.7^{20°}$ cc.; $1.8^{80°}$cc.	150 cc., abs.	.....
2905	syrup	.....	.....	.....	s. alk.	.....	.....
2906	hyg. cr.	.....	.....	.....	s.	s.	s. alk.
2907	col. oil	$1.022^{20°}$	.....	171^{757mm}	∞ ; sl. s. bz.	∞ ; s. chl.	1

* Two other forms, m. p. 254° and 256°.

Epidibromohydrin 1869-70
Epidichlorohydrin 2060-1
Epihydrin alcohol 3436
Epinephrine 157
Equisetic acid 141
Ergosterin 2889
Ergotinine, cf. alkd.
Ergotoxine, cf. alkd.
Ericin 4078
Eriodictyol (homo) 3672
Eriodictyonone 3672
Erythrene 1019
Esculetin methyl ether 5604
Esculin, cf. glcde.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2908	**Ethenyl**-aminophenol	2-methyl-benzoxazole	$C_6H_4N{:}C(CH_3)O$	XXVII-46	133.14
2909	aminothiophenol	2-methyl-benzothiazole	$C_6H_4N{:}C(CH_3)S$	XXVII-46	149.20
2910	*p,p'*-diethoxy-diphenylamidine HCl	holocaine-HCl; phenacaine-HCl	$C_2H_5O{\cdot}C_6H_4{\cdot}NH{\cdot}C{:}(CH_3)N{\cdot}C_6H_4{\cdot}OC_2H_5{\cdot}HCl{\cdot}H_2O$	.....	352.85
2911	**Ether**	(di)ethyl ether	$(C_2H_5)_2O$	I-314	74.12
2912	**Ethoxy**-acetic acid	glycolic ethyl ether	$C_2H_5O{\cdot}CH_2{\cdot}CO_2H$	III-233	104.10
2913	acetoanil (*p*)	*N*-ethylidene-*p*-phenetidine	$C_2H_5O{\cdot}C_6H_4{\cdot}N{:}CH{\cdot}CH_3$	.....	163.21
2914	benzaldehyde (*o*)	.....	$C_2H_5O{\cdot}C_6H_4{\cdot}CHO$	VIII-43	150.17
2915	benzoic acid (*o*)	.....	$C_2H_5O{\cdot}C_6H_4{\cdot}CO_2H$	X-64	166.17
2916	benzoic acid (*m*)	.....	$C_2H_5O{\cdot}C_6H_4{\cdot}CO_2H$	X-138	166.17
2917	benzoic acid (*p*)	.....	$C_2H_5O{\cdot}C_6H_4{\cdot}CO_2H$	X-156	166.17
2918	diphenyl (*p*)	.....	$C_2H_5O{\cdot}C_6H_4{\cdot}C_6H_5$	.....	198.25
2919	diphenyl sulfide	(*p*)	$C_2H_5O{\cdot}C_6H_4{\cdot}S{\cdot}C_6H_5$	.....	230.31
2920	ethyl adipate (*β*)	.....	$(CH_2)_4(CO_2{\cdot}CH_2{\cdot}CH_2{\cdot}O{\cdot}C_2H_5)_2$	.....	290.35
2921	ethyl *o*-benzoyl-benzoate (*β*)	.....	$C_6H_5{\cdot}CO{\cdot}C_6H_4{\cdot}CO_2{\cdot}CH_2CH_2{\cdot}OC_2H_5$	.....	298.32
2922	ethyl carbamate	(*β*)	$NH_2{\cdot}CO_2CH_2CH_2{\cdot}OC_2H_5$	.....	133.15
2923	ethyl chloroformate (*β*)	*β*-EtO-ethyl chlorocarbonate	$Cl{\cdot}CO_2CH_2{\cdot}CH_2{\cdot}OC_2H_5$	.....	152.58
2924	ethyl glycolate	(*β*)	$HOCH_2CO_2{\cdot}(CH_2)_2OC_2H_5$	.....	148.16
2925	ethyl *α*-hydroxy-*iso*-butyrate	.....	$(CH_3)_2C(OH)CO_2{\cdot}CH_2CH_2{\cdot}OC_2H_5$	.....	176.21
2926	ethyl lactate (*β*)	.....	$CH_3{\cdot}CHOH{\cdot}CO_2CH_2{\cdot}CH_2{\cdot}OC_2H_5$	.....	162.18
2927	phenol (*o*)	guaethol	$C_2H_5O{\cdot}C_6H_4{\cdot}OH$	VI-771	138.16
2928	phenol (*m*)	resorcinol ethyl ether	$C_2H_5O{\cdot}C_6H_4{\cdot}OH$	VI-814	138.16
2929	phenol (*p*)	hydroquinone ethyl ether	$C_2H_5O{\cdot}C_6H_4{\cdot}OH$	VI-843	138.16
2930	**Ethoxyl**-aniline	*β*-anilino-ethanol	$C_6H_5{\cdot}NH(C_2H_4OH)$	XII-182	137.18
2931	piperidine	*γ*-pipecolyl carbinol	$C_5H_{10}N{\cdot}C_2H_4OH$	XXI-4	129.20
2932	**Ethyl** abietate	.....	$C_{19}H_{29}CO_2{\cdot}C_2H_5$	.....	330.49
2933	acetamide (*N*)	.....	$CH_3CO{\cdot}NH{\cdot}C_2H_5$	IV-109	87.12
2934	acetanilide	acetethylanilide	$CH_3CO{\cdot}N(C_2H_5)C_6H_5$	XII-246	163.21
2935	acetate	acetic ether	$CH_3CO_2{\cdot}C_2H_5$	II-125	88.10
2936	acetate, ortho	ethenyl triEt-ether	$CH_3C(OC_2H_5)_3$	II-129	162.22
2937	acetoacetate	acetoacetic ester	$CH_3CO{\cdot}CH_2{\cdot}CO_2{\cdot}C_2H_5$	III-632	130.14
2938	acetoacetic ester	.....	$CH_3CO{\cdot}CH(C_2H_5){\cdot}CO_2{\cdot}C_2H_5$	III-691	158.19
2939	acetopyruvate	oxalacetone	$CH_3CO{\cdot}CH_2{\cdot}CO{\cdot}CO_2{\cdot}C_2H_5$	III-747	158.15
2940	acetylglycolate	.....	$CH_3CO_2{\cdot}CH_2{\cdot}CO_2{\cdot}C_2H_5$	III-237	146.14
2941	acetylsalicylate	.....	$CH_3CO_2{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_2H_5$	X-75	208.21

Esculinic acid, cf. glcde.
Eserine, cf. alkd.
Esmodil 6264
Essence of bitter almonds 642
Essence of mirbane 4646
Estrone hydrate 2902
Ethanal 5
Ethanamide 14
Ethandial 3478
Ethandioic acid 5006-7
Ethandiol 3444
Ethandithiol 3209
Ethanoic acid 36
Ethanol 2946
Ethanolic acid 3468
Ethanolthiol 5904
Ethanoyl, cf. acetyl.
Ethanselenol 3071
Ethanthiol 3083
Ethene 3192
Ethenol 6429

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2908	col. lq.	$1.137^{0°}$	.....	200-1	i.	s.	∞
2909	lq.	.....	12-4	238	i.	s.	s. HCl
2910	col. cr./aq.	.....	189 (anh.)	.....	2	s.	i.; s. chl.
2911	col. lq.	$0.708^{25°}_{4°}$	α -116.3 β -123.3	34.6	$7.5^{20°}$	∞	∞ chl.
2912	col. lq.	$1.102^{20°}_{4°}$	.....	206-7 sl. d.	s.	s.	s.
2913	yel. lq.	.....	.....	$160\text{-}2^{7mm}$	.....	.....	.....
2914	col.	.....	20-2(6)	247-9	.....	∞	∞
2915	oil	.....	19-20	d. 300 ±	v. sl. s.	.....	.....
2916	nd./aq.	.....	135-7	subl.	v. sl. s. h.	s.	s.
2917	nd.	.....	195-6	.....	v. sl. s. h.	.....	.....
2918	col. fl.	.....	71-2	.....	i.	s. h.	s.
2919	yel. lq.	.....	.....	$186\text{-}9^{10mm}$	.....	.....	.....
2920	col. lq.	.....	.....	$164\text{-}6^{4mm}$	.....	.....	.....
2921	col. pl.	.....	51-3	.....	i.	s.	v. s.
2922	col. cr.	.....	61-2	.....	s.	s.	sl. s.
2923	lt. yel. lq.	.....	.....	$55\text{-}65^{15mm}$	.....	.....	.....
2924	col. lq.	.....	.....	$98\text{-}100^{7mm}$	.....	.....	.....
2925	col. lq.	.....	.....	204-6	.....	.....	.....
2926	col. lq.	.....	.....	$99\text{-}101^{10mm}$	.....	.....	.....
2927	oil	.....	28	216-7	sl. s.	∞	∞
2928	yel. lq.	.....	.....	246-7	v. sl. s.	s.	s.; s. bz.
2929	lf./aq.	.....	66-7	246-7	v. s. h.	v. s.	v. s.
2930	lq.	$1.097^{20°}_{20°}$	35 ±	286	$4.6^{20°}$	s.	s.; s. chl.
2931	lq.	$1.006^{25°}_{4°}$	.....	227-8	∞	∞	.....
2932	lq.	$1.020^{20°}_{20°}$	d. >280	200^{4mm}	.....	.....	.....
2933	oily lq.	$0.942^{4.5°}$	.....	205	∞	∞	i. aq. alk.
2934	rhb./aq.	$0.994^{60°}_{4°}$	53-4	258	i.	s.	v. s.
2935	col. lq.	$0.901^{20°}_{4°}$	−82.4	77.1	$8.5^{15°}$	∞	∞
2936	col. lq.	$0.94^{22°}$	.....	142	.....	.....	.....
2937	col. lq.	$1.025^{20°}_{4°}$	−45	180^{755mm}	$13^{17°}$; ∞	∞; ∞ chl.	∞
2938	oil	$0.986^{20°}_{4°}$	.....	198	sl. s.	∞	∞
2939	cr.	$1.125^{20°}_{4°}$	18	213-5	.....	.....	.....
2940	lq.	$1.099^{17°}$	.....	180	v. sl. s.	.....	.....
2941	col. lq.	$1.157^{15°}$	.....	272 sl. d.	i.	s.	s.

Ethenyl-diphenylamidine 2696
Ethenyl-triethyl ether 2936
Ethine 130
Ethobrom 6104
Ethocaine 4934
Ethovan 3188
Ethoxy-acetanilide 23-5
Ethoxy-benzoylamino-quinoline 508
Ethoxy-ethyl acetate 1266
Ethoxy-ethyl alcohol 1265
Ethoxy-methoxybenzaldehyde 6419
Ethoxy-phenylsuccinimide 5476
Ethoxyl-amine 2907
Ethyl, cf. also diethyl.
Ethyl acetone 4355
Ethyl-acetylene 1156

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
2942	**Ethyl** acrylate	(polymerizes readily)	$CH_2{:}CH{\cdot}CO_2{\cdot}C_2H_5$	II-399	100.11
2943	acrylic acid (*β*)	butenoic acid	$C_2H_5{\cdot}CH{:}CH{\cdot}CO_2H$	II-426	100.11
2944	adipate (mono)	Et hydrogen adipate	$C_2H_5O_2C{\cdot}(CH_2)_4{\cdot}CO_2H$	* II-277	174.19
2945	alaninate HCl (*dl*)	alanine ethyl ester HCl	$CH_3CH(NH_2)CO_2{\cdot}C_2H_5{\cdot}HCl$	IV-390	153.61
2946	alcohol	ethanol; alcohol	$CH_3{\cdot}CH_2OH$	I-292	46.07
2947	allophanate	.....	$NH_2CO{\cdot}NHCO_2C_2H_5$	III-69	132.12
2948	allylacetoacetate	.....	$CH_3CO{\cdot}CH(C_3H_5){\cdot}CO_2C_2H_5$	III-738	170.20
2949	allyl ether	.....	$CH_2{:}CH{\cdot}CH_2{\cdot}O{\cdot}C_2H_5$	I-438	86.13
2950	amine	amino-ethane	$C_2H_5{\cdot}NH_2$	IV-87	45.08
2951	amine hydrobromide	.....	$C_2H_5NH_2{\cdot}HBr$	IV-91	126.01
2952	amine hydrochloride	.....	$C_2H_5NH_2{\cdot}HCl$	IV-91	81.55
2953	aminobenzoate (*o*)	ethyl anthranilate	$NH_2{\cdot}C_6H_4{\cdot}CO_2C_2H_5$	XIV-319	165.19
2954	aminobenzoate (*m*)	.....	$NH_2{\cdot}C_6H_4{\cdot}CO_2C_2H_5$	XIV-389	165.19
2955	aminobenzoate (*p*)	anesthesine	$NH_2{\cdot}C_6H_4{\cdot}CO_2C_2H_5$	XIV-422	165.19
2956	aminocrotonate (*β*)	.....	$CH_3C(NH_2){:}CH{\cdot}CO_2C_2H_5$	III-654	129.16
2957	amino ethanol (*β*)	.....	$C_2H_5NH{\cdot}CH_2{\cdot}CH_2OH$	IV-282	89.14
2958	amino phenol (*o*)	.....	$C_2H_5NH{\cdot}C_6H_4{\cdot}OH$	XIII-364	137.18
2959	amino phenol (*m*)	.....	$C_2H_5NH{\cdot}C_6H_4{\cdot}OH$	XIII-408	137.18
2960	amino phenol (*p*)	.....	$C_2H_5NH{\cdot}C_6H_4{\cdot}OH$	XIII-443	137.18
2961	amyl ether (*act.*)	.....	$C_2H_5{\cdot}O{\cdot}C_5H_{11}$	I-387	116.20
2962	amyl ether (*iso*)	.....	$C_2H_5{\cdot}O{\cdot}C_5H_{11}$	I-401	116.20
2963	*n*-amyl ketone	octanone-3	$C_2H_5{\cdot}CO{\cdot}C_5H_{11}$	I-706	128.21
2964	*iso*-amyl ketone	.....	$C_2H_5{\cdot}CO{\cdot}C_5H_{11}$	I-706	128.21
2965	aniline †	Et-Ph-amine	$C_6H_5{\cdot}NH{\cdot}C_2H_5$	XII-159	121.18
2966	aniline sulfonic acid (*m*)	*N*-ethyl-metanilic acid	$C_2H_5NH{\cdot}C_6H_4{\cdot}SO_3H$	XIV-690	201.24
2967	aniline sulfonate	Na salt	$C_8H_{10}O_3NSNa{\cdot}2H_2O$	XIV-690	259.26
2968	anisate (*p*)	.....	$CH_3O{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_2H_5$	X-159	180.20
2969	anthracene (9)	.....	$(C_6H_4)_2C_2H{\cdot}C_2H_5$	V-678	206.27
2970	arsine	.....	$C_2H_5{\cdot}AsH_2$	IV-601	105.99
2971	arsonic acid	.....	$C_2H_5{\cdot}AsO(OH)_2$	IV-614	153.99
2972	benzamide (*N*)	.....	$C_6H_5CO{\cdot}NH{\cdot}C_2H_5$	IX-202	149.19
2973	benzene	phenylethane	$C_6H_5{\cdot}C_2H_5$	V-351	106.16
2974	benzene sulfonate	.....	$C_6H_5{\cdot}SO_3{\cdot}C_2H_5$	XI-30	186.22
2975	benzoate	.....	$C_6H_5{\cdot}CO_2{\cdot}C_2H_5$	IX-110	150.17
2976	benzoic acid (*o*)	.....	$C_2H_5{\cdot}C_6H_4{\cdot}CO_2H$	IX-526	150.17
2977	benzoic acid (*m*)	.....	$C_2H_5{\cdot}C_6H_4{\cdot}CO_2H$	IX-528	150.17
2978	benzoic acid (*p*)	.....	$C_2H_5{\cdot}C_6H_4{\cdot}CO_2H$	IX-529	150.17
2979	*o*-benzoylbenzoate	.....	$C_6H_5CO{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_2H_5$	X-749	254.27
2980	benzoylformate	.....	$C_6H_5CO{\cdot}CO_2C_2H_5$	X-657	178.18
2981	benzoylene urea (1)	.....	$C_{10}H_{10}O_2N_2$	.....	190.20
2982	benzoylene urea (3)	.....	$C_{10}H_{10}O_2N_2$	XXIV-375	190.20
2983	benzylacetoacetate	.....	$CH_3CO{\cdot}CH(C_7H_7){\cdot}CO_2C_2H_5$	X-710	220.26
2984	benzylaniline	benzyl-Et-aniline	$C_6H_5N(C_2H_5)C_7H_7$	XII-1026	211.29

† See also Nos. 319-21.

Ethyl adipate 2944
Ethyl aminobenzene sulfonic acid 2966
Ethyl anilinocrotonate 39
Ethyl anthranilate 2953

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2942	col. lq.	$0.925^{15°}$	.....	100-1	.....	.....	.....
2943	col. lq.	$0.992^{15°}$	9-10	197-200	$6.3^{20°}$	.....	.....
2944	hyg. cr./ et.-pet.	.....	29	180^{19mm}	.....	.....	.....
2945	col. hyg. cr.	.....	85-7	.....	v. s.	s.	i.
2946	col. lq.	$*0.789\frac{20°}{4°}$	−112	78.4	∞	∞ chl.	∞
2947	nd./aq.	.....	192-3	d.	s. h.	$0.5^{21°}$	$0.1^{20°}$
2948	lq.	$0.992\frac{17.6°}{4}$	.....	206 sl. d.	.....	.....	.....
2949	lq.	$0.765\frac{20°}{4°}$	.....	$66\text{-}77^{42.9mm}$	i.	∞	∞
2950	col. lq.	$0.689\frac{15°}{15°}$	−80.6	16.6	∞	∞	∞
2951	mn. nd./al.	1.741	.....	.....	s. act.	v. s.	i. chl.
2952	mn.	1.216	108-9	.....	$240^{17°}$	v. s.	i.
2953	cr.	$1.117\frac{20°}{4°}$	13	266-8	.....	s.	s.
2954	oil	.....	.....	294	sl. s. h.	∞	∞
2955	cr./al.	.....	91-2	.....	i.	s.	s.
2956	mn. pr.	$1.021\frac{20°}{4°}$	33.9(20)	210-5 d.	i.	s.	s.; s. bz.
2957	oil	$0.914\frac{20°}{4°}$	.....	$167\text{-}9^{751mm}$	v. s.	v. s.	v. s.
2958	pl.	.....	108-9	.....	i.; sl. s. CS_2	v. s.; s. h. bz.	sl. s.
2959	cr./bz. lg.	.....	62	176^{12mm}	s. h.	s.; sl. s. lg.	s.; v. s. chl.
2960	nd./aq.	.....	100	.....	s. h.	s.	s.
2961	lq.	$0.759\frac{18°}{4°}$	.....	$108\text{-}9^{736mm}$	i.	∞	∞
2962	lq.	$0.764^{18°}$	.....	112	i.	∞	∞
2963	lq.	$0.850^{0°}$	.....	$169\text{-}70^{738mm}$	i.	∞	∞
2964	lq.	.....	.....	163.5	i.	∞	∞
2965	lq.	$0.963\frac{20°}{4°}$	−63.5	204	i.	∞	∞
2966	nd./aq.	.....	d. 294	.....	$2.15^{15°}$	.....	.....
2967	lf./aq. al.	.....	.....	.....	.....	.....	.....
2968	lq.	$1.103\frac{25°}{25°}$	7-8	269-70	i.	s.	s.
2969	lf./al.	$1.041^{99°}$	59-60	.....	i.	s.	.....
2970	col. lq.	$1.217^{22°}$	.....	36	$0.01^{19°}$	.....	.....
2971	cr./al.	.....	99.5	.....	$70^{27°}$	$39.4^{25°}$	.....
2972	nd./aq.	.....	70-1	298-300	sl. s. h.	.....	.....
2973	col. lq.	$0.867\frac{20°}{4°}$	−94.4	136.2	$0.01^{15°}$	∞	∞
2974	col. lq.	$1.219\frac{17°}{4°}$	.....	156^{15mm}	d. h.	∞; ∞ bz.	∞; ∞ chl.
2975	col. lq.	$1.052\frac{15°}{15°}$	−34.6	211-2	i.; ∞ pet.	∞; ∞ chl.	∞
2976	nd./h. aq.	.....	68	259	v. sl. s.	s.	s.
2977	nd./aq. al.	$1.042\frac{100°}{4°}$	47	.....	i. c.	s.	.....
2978	pr./al.	.....	112-3	.....	s. h.	s.	s.
2979	col. rhb. pr.	$1.122\frac{64.4°}{4°}$	58	.....	.....	v. s.	v. s.
2980	lq.	$1.122\frac{25.1°}{4°}$	.....	265^{766mm}	.....	.....	.....
2981	cr.	.....	215-7	.....	i.; s. NaOH	sl. s.	s. H_2SO_4
2982	nd.	.....	197.5-8.5	.....	i.	s.	s. NaOH
2983	col. lq.	$1.036\frac{15.5°}{16.5°}$	.....	283-4	i.	∞	∞
2984	lt. yel. oil	$1.034^{18.5°}$	.....	285^{710} sl. d.	i.; ∞ chl.	18	∞

* See also special table of specific gravities.
Ethyl azelate 2123
"Ethyl" base 5762
Ethyl benzoylacetate 739

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Ethyl				
2985	benzylbenzene (*p*)	.....	$C_2H_5{\cdot}C_6H_4{\cdot}CH_2{\cdot}C_6H_5$	V-614	196.28
2986	benzyl ether	.....	$C_2H_5O{\cdot}CH_2{\cdot}C_6H_5$	VI-431	136.19
2987	benzyl ketone	.....	$C_2H_5{\cdot}CO{\cdot}CH_2{\cdot}C_6H_5$	VII-314	148.20
2988	benzyl-*o*-toluidine	Et *o*-tolyl-benzyl-amine	$CH_3{\cdot}C_6H_4{\cdot}N(C_2H_5){\cdot}CH_2{\cdot}C_6H_5$	XII-1033	225.32
2989	bromide	bromoethane	$C_2H_5{\cdot}Br$	I-88	109.98
2990	bromoacetate	.....	$Br{\cdot}CH_2{\cdot}CO_2{\cdot}C_2H_5$	II-214	167.01
2991	α-bromoaceto-acetate	.....	$CH_3CO{\cdot}CHBr{\cdot}CO_2{\cdot}C_2H_5$	III-664	209.05
2992	bromobutyrate	(α)(*n*)	$C_2H_5{\cdot}CHBr{\cdot}CO_2C_2H_5$	II-282	195.06
2993	bromo-*iso*-butyrate	(α)	$(CH_3)_2CBr{\cdot}CO_2C_2H_5$	II-296	195.06
2994	α-bromo-*n*-caproate	.....	$CH_3(CH_2)_3CHBr{\cdot}CO_2C_2H_5$	II-325	223.12
2995	α-bromopropionate	.....	$CH_3{\cdot}CHBr{\cdot}CO_2C_2H_5$	II-255	181.04
2996	β-bromopropionate	.....	$Br(CH_2)_2CO_2{\cdot}C_2H_5$	II-256	181.04
2997	α-bromovalerate (*n*)	.....	$CH_3(CH_2)_2CHBr{\cdot}CO_2C_2H_5$	II-302	209.09
2998	α-bromo-*iso*-valerate	.....	$(CH_3)_2CH{\cdot}CHBr{\cdot}CO_2C_2H_5$	II-317	209.09
2999	*n*-butyl-barbituric acid (5,5)	sonneryl; neonal	$(CONH)_2CO{\cdot}C(C_2H_5)(C_4H_9)$	.....	212.24
3000	*n*-butyl ether	.....	$C_2H_5{\cdot}O{\cdot}C_2H_4{\cdot}C_2H_5$	I-369	102.17
3001	*iso*-butyl ether	.....	$C_2H_5{\cdot}O{\cdot}CH_2{\cdot}CH(CH_3)_2$	I-376	102.17
3002	*tert*-butyl ether	.....	$C_2H_5{\cdot}O{\cdot}C(CH_3)_3$	I-381	102.17
3003	*n*-butyl ketone	heptanone-3	$C_2H_5{\cdot}CO{\cdot}C_4H_9$	I-699	114.18
3004	*iso*-butyl ketone	.....	$C_2H_5{\cdot}CO{\cdot}C_4H_9$	I-700	114.18
3005	*n*-butyl sulfide	.....	$C_2H_5{\cdot}S{\cdot}C_4H_9$	.....	118.23
3006	*n*-butyrate	.....	$C_2H_5{\cdot}CH_2{\cdot}CO_2{\cdot}C_2H_5$	II-270	116.16
3007	*iso*-butyrate	.....	$(CH_3)_2CH{\cdot}CO_2{\cdot}C_2H_5$	II-291	116.16
3008	*n*-caprate	.....	$CH_3(CH_2)_8{\cdot}CO_2C_2H_5$	II-356	200.31
3009	*n*-caproate	.....	$CH_3(CH_2)_4{\cdot}CO_2C_2H_5$	II-323	144.21
3010	*n*-caprylate	.....	$CH_3(CH_2)_6{\cdot}CO_2C_2H_5$	II-348	172.26
3011	carbazole (*N*)	.....	$C_{12}H_8N{\cdot}C_2H_5$	XX-436	195.25
3012	carbonate, ortho †	.....	$C(OC_2H_5)_4$	III-5	192.25
3013	carbostyril	.....	$C_6H_4CH{:}C(C_2H_5){\cdot}NH{\cdot}CO$	XXI-115	173.21
3014	chaulmoograte	chaulmestrol; moogrol	$C_5H_7(CH_2)_{12}CO_2C_2H_5$	IX-80	308.49
3015	chloride	chloroethane	$C_2H_5{\cdot}Cl$	I-82	64.52
3016	chloroacetate	.....	$Cl{\cdot}CH_2{\cdot}CO_2{\cdot}C_2H_5$	II-197	122.55
3017	chloroacetoacetate	.....	$Cl{\cdot}CH_2{\cdot}CO{\cdot}CH_2{\cdot}CO_2{\cdot}C_2H_5$	III-663	164.59
3018	α-chloroaceto-acetate	.....	$CH_3CO{\cdot}CHCl{\cdot}CO_2{\cdot}C_2H_5$	III-662	164.59
3019	chloroformate	ethyl chlorocarbonate	$Cl{\cdot}CO_2{\cdot}C_2H_5$	III-10	108.53
3020	α-chloropropionate	.....	$CH_3{\cdot}CHCl{\cdot}CO_2C_2H_5$	II-249	136.58

† See also No. 2138.

Ethyl borate 6186
Ethyl bromomalonate 2133
Ethyl-butyl-acetaldehyde 3062
Ethyl-butyl alcohol 3638
Ethyl-butylamine 3640
Ethyl-butyl carbamate 1140-1
Ethyl-butyl carbinol (*iso*) 3537
Ethyl-butyl carbinol (*sec*) 3541
Ethyl butylmalonate 2134-6

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
2985	lq.	$0.985^{19°}$	.....	294-5	s. chl.	s.	s.
2986	oil	$0.949^{20°}_{4°}$	.....	187-9 ^{732mm}	i.	∞	∞
2987	lq.	$0.998^{17°}$	.....	230 ^{755mm}	i.	s.	∞
2988	yel. oil	.....	.....	153-7 ^{10mm}	.....	.....	.....
2989	col. lq.	$1.431^{20°}_{4°}$	−117.8	38.4	$1.06^{00°}$; $0.9^{30°}$	∞	∞
2990	lq.	$1.506^{20°}_{20°}$	.....	168	i.	∞	∞
2991	lq.	$1.429^{14°}_{4°}$	.....	210-5 d.	.....	.....	.....
2992	col. lq.	$1.330^{20°}_{20°}$	.....	177.5 ^{765mm} sl. d.	i.	∞	∞
2993	col. lq.	$1.329^{20°}_{20°}$	.....	163.6 ^{762mm}	i.	∞	∞
2994	lq.	.....	.....	205-10	.....	.....	.....
2995	col. lq.	$1.394^{20°}_{4°}$	.....	160-5 sl. d.	i.	∞	∞
2996	lq.	$1.261^{15°}$	.....	72-5 ^{15mm}	.....	.....	.....
2997	lq.	$1.226^{18°}_{4°}$	.....	190-2	i.	∞	∞
2998	lq.	$1.278^{17°}_{18°}$	.....	186	.....	.....	.....
2999	col. cr./ aq. al.	.....	127-8	.....	sl. s.; s. dil. alk.	20	11
3000	col. lq.	$0.752^{20°}_{20°}$	.....	91.4	i.	∞	∞
3001	col. lq.	0.751	.....	78-80	i.	∞	∞
3002	col. lq.	$0.752^{20°}$	.....	70 ^{758mm}	i.	∞	∞
3003	lq.	.....	.....	149-50	i.	∞	∞
3004	lq.	$0.815^{17°}_{4°}$	.....	135 ^{735mm}	i.	∞	∞
3005	yel. lq.	.....	.....	143-5	.....	.....	.....
3006	col. lq.	$0.879^{20°}_{4°}$	−93.3	120-1	$0.68^{25°}$	∞	∞
3007	col. lq.	$0.871^{20°}_{4°}$	−88.2	110-1	sl. s.	∞	∞
3008	lq.	0.862	.....	244.6 ^{758mm}	i.; ∞ chl.	∞	∞
3009	col. lq.	$0.873^{20°}_{20°}$	.....	165-6 ^{736mm}	i.	∞	∞
3010	col. lq.	$0.878^{17°}$	−45	207-8 ^{753mm}	i.	∞	∞
3011	lf./et.	.....	67-8	.....	i.	v. s. h.	v. s.
3012	col. lq.	$0.919^{19°}_{4°}$	.....	158-9	.....	.....	.....
3013	cr./aq. HCl	.....	168	.....	.....	.....	.....
3014	pa. yel. lq.	$0.906^{15°}_{4°}$	.....	230 ^{20mm}	i.	∞	∞ chl.
3015	col. lq.	$0.917^{6°}_{6°}$	−139	13	0.6	∞	∞
3016	col. lq.	$1.159^{20°}_{4°}$	−26	144	i.	∞	∞
3017	lq.	$1.218^{17°}_{4°}$	.....	220 ^{756mm}	v. sl. s.	∞	∞
3018	lq.	$1.19^{14°}_{18°}$	.....	193 d.	v. sl. s.	s.	s.
3019	col. lq.	$1.138^{20°}_{4°}$	−80.6	94-5	d.	∞; ∞ bz.	∞; ∞ chl.
3020	col. lq.	$1.087^{20°}_{4°}$	.....	147-8	i.	∞	∞

Ethyl-butyraldehyde 2099
Ethyl-butyric acid 2101
Ethyl-cacodyl 579
Ethyl-caproic acid 1221
Ethyl carbamate 6392
Ethyl carbonate 2138
Ethyl-carbylamine 3029
Ethyl chlorocarbonate 3019

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Ethyl				
3021	β-chloropropionate	.....	$Cl{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2C_2H_5$	II-250	136.58
3022	chlorosulfate	ethyl chlorosulfonate	$C_2H_5O{\cdot}SO_2Cl$	I-327	144.58
3023	cinnamate (*trans*)	.....	$C_6H_5{\cdot}C_2H_2{\cdot}CO_2C_2H_5$	IX-581	176.21
3024	crotonate (α)	.....	$C_3H_5{\cdot}CO_2{\cdot}C_2H_5$	II-411	114.14
3025	crotonic acid (α)	.....	$CH_3{\cdot}CH{:}C(C_2H_5){\cdot}CO_2H$	II-440	114.14
3026	crotonic acid (α)	.....	$CH_3{\cdot}CH{:}C(C_2H_5){\cdot}CO_2H$	II-440	114.14
3027	cyanate	.....	$NCO(C_2H_5)$	.....	71.08
3028	*iso*-cyanate	.....	$C_2H_5{\cdot}N{:}CO$	IV-122	71.08
3029	*iso*-cyanide	ethyl carbylamine	$C_2H_5{\cdot}NC$	IV-107	55.08
3030	cyanoacetate	cyanacetic ester	$NC{\cdot}CH_2{\cdot}CO_2{\cdot}C_2H_5$	II-585	113.11
3031	α-cyanocinnamate	Et β-Ph-α-cyanoacrylate	$C_6H_5{\cdot}CH{:}C(CN){\cdot}CO_2{\cdot}C_2H_5$	IX-894	201.22
3032	cyanoformate	cyanethyl carbonate	$NC{\cdot}CO_2{\cdot}C_2H_5$	II-547	99.09
3033	cyclopentan-1-one-2-carboxylate	.....	$CO(CH_2)_3CH{\cdot}CO_2{\cdot}C_2H_5$	X-597	156.18
3034	diacetoacetate	diacetoethyl acetate	$(C_2H_3O)_2CH{\cdot}CO_2C_2H_5$	III-751	172.18
3035	diazoacetate	diazoethyl acetate	$N_2CH{\cdot}CO_2{\cdot}C_2H_5$	* III-211	114.10
3036	dibromoacetate	.....	$Br_2CH{\cdot}CO_2{\cdot}C_2H_5$	II-219	245.92
3037	α,β-dibromobutyrate	.....	$CH_3(CHBr)_2CO_2C_2H_5$	II-284	273.97
3038	di-*n*-butylcarbamate	(*N*,*N*)	$(C_4H_9)_2N{\cdot}CO_2C_2H_5$	.....	201.30
3039	dichloroacetate	.....	$Cl_2CH{\cdot}CO_2{\cdot}C_2H_5$	II-203	157.00
3040	dichloroarsine	.....	$C_2H_5{\cdot}AsCl_2$	IV-603	174.88
3041	3,5-diiodosalicylate	(3,5;2,1)	$I_2C_6H_2(OH)CO_2C_2H_5$	X-114	417.99
3042	β,β-dimethylacrylate	.....	$(CH_3)_2C{:}CHCO_2C_2H_5$	II-433	128.17
3043	3,5-dinitrobenzoate	.....	$(NO_2)_2C_6H_3{\cdot}CO_2C_2H_5$	IX-414	240.17
3044	diphenylamine	.....	$C_2H_5{\cdot}N{:}(C_6H_5)_2$	XII-181	197.27
3045	diphenylphosphine	.....	$C_2H_5{\cdot}P{:}(C_6H_5)_2$	XVI-759	214.24
3046	fluoride	fluoroethane	$CH_3{\cdot}CH_2F$	I-82	48.06
3047	formamide (*N*)	.....	$H{\cdot}CO{\cdot}NHC_2H_5$	IV-108	73.09
3048	formate	.....	$H{\cdot}CO_2{\cdot}C_2H_5$	II-19	74.08
3049	formate, ortho	aethon	$H{\cdot}C(OC_2H_5)_3$	II-20	148.20
3050	furoate (α)	ethyl pyromucate	$C_4H_3O{\cdot}CO_2{\cdot}C_2H_5$	XVIII-275	140.13
3051	furoate (β)	.....	$C_4H_3O{\cdot}CO_2{\cdot}C_2H_5$	.....	140.13
3052	furoylacetate (α)	.....	$C_4H_3O{\cdot}CO{\cdot}CH_2{\cdot}CO_2{\cdot}C_2H_5$	XVIII-408	182.17
3053	β-furylacrylate	.....	$C_4H_3O{\cdot}CH{:}CH{\cdot}CO_2{\cdot}C_2H_5$	XVIII-300	166.17
3054	glutaric acid (α)	.....	$C_2H_5{\cdot}C_3H_5(CO_2H)_2$	II-676	160.17
3055	glutaric acid (β)	.....	$C_2H_5{\cdot}CH(CH_2CO_2H)_2$	II-676	160.17
3056	glycerate	.....	$(HO)_2C_2H_3{\cdot}CO_2C_2H_5$	III-397	134.13
3057	glycinate	.....	$H_2N{\cdot}CH_2{\cdot}CO_2{\cdot}C_2H_5$	IV-340	103.12
3058	glycinate HCl	.....	$C_4H_9O_2N{\cdot}HCl$	IV-342	139.59
3059	glycine (*N*)	.....	$C_2H_5NH{\cdot}CH_2{\cdot}CO_2H$	IV-349	103.12
3060	glycolate	.....	$HO{\cdot}CH_2{\cdot}CO_2{\cdot}C_2H_5$	III-236	104.10

Ethyl-cinnamic acid 5151
Ethyl citrate 6187
Ethyl cresyl ether 3173-5
Ethyl cresyl sulfide 3176
Ethyl cyanide 5363
Ethyl-cyclohexenyl-barbituric acid 5091
Ethyl decylate (*n*) 3008
Ethyl dibenzyl-malonate 2153
Ethyl dibromo-malonate 2155
Ethyl dibromo-succinate 2156
Ethyl dibutyl-malonate 2157
Ethyl diethyl-malonate 2158
Ethyl diphenyl-carbamate 2761
Ethyl-dipropyl carbinol 4923
Ethyl diselenide 2208

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3021	col. lq.	$1.109^{20°}_{4°}$	.....	162-3^{765mm}	.....	.....	.....
3022	lq.	$1.263^{18°}$	.....	58^{20mm}	s. chl.	s. bz.	s.
3023	col. lq.	$1.049^{20°}_{4°}$	12	271	i.	∞	∞
3024	col. lq.	$0.924^{15°}_{4°}$	.....	138^{748mm}	i.	s.	s.
3025	col. pr.	.....	41.5	209	v. sl. s.	v. s.	v. s.
3026	oily lq.*	.....	−35	199.5^{750mm}	i.	∞	∞
3027	lq.	$1.127^{15°}$	.....	d.	i.	∞	∞
3028	lq.	0.898	.....	60	d.	.....	.....
3029	col. lq.	$0.744^{25°}$	<−66	78-9	sl. s.	.....	s.
3030	col. lq.	$1.062^{20°}_{4°}$	−22.5	208^{753mm}	$22^{5°}$; $9^{80°}$	∞	∞
3031	nd./al.**	.....	50-1	360 sl. d.	s. chl.; s. ac.	12 c.	s.; s. bz.
3032	lq.	$1.003^{20°}_{4°}$	.....	115-6	.....	.....	.....
3033	col. lq.	$1.098^{0°}$	.....	218 sl. d.	.....	.....	.....
3034	col. lq.	$1.089^{25°}_{25°}$	.....	209-11 sl. d.	sl. s.	v. s.	v. s.
3035	yel. oil	$1.085^{18°}_{4°}$	−22	140-1^{720mm}	sl. s.	∞	∞
3036	oil	$1.903^{20°}_{20°}$	.....	192-4	i.	∞	∞
3037	lq.	.....[1]	.....	123-4^{30mm}	.....	.....	.....
3038	col. lq.	.....	.....	101-3^{6mm}	.....	.....	.....
3039	col. lq.	$1.282^{20°}_{4°}$	.....	158	i.	∞	∞
3040	col. lq.	.....	.....	156	sl. s.	∞	∞
3041	col. lf./al.	.....	133	d. >200°	i. c.	s. h.	sl. s.
3042	lq.	$0.922^{21°}_{21°}$	.....	154-5	v. s. CS_2; v. s. lg.	v. s.; v. s. chl.	v. s.; v. s. bz.
3043	nd./al.	$1.295^{111°}$	91-2	.....	.....	$0.6^{13°}$	s. h. al.
3044	lq.	.....	.....	295-7	i.	s.	.....
3045	oil	.....	.....	293	.....	s.	s. bz.
3046	gas	1.7(A)	.....	−32	$198^{14°}$cc.	v. s.	.....
3047	lq.	$0.952^{21°}$	<−30	197-9	∞	∞	∞
3048	col. lq.	$0.906^{20°}_{4°}$	−79	54^{760mm}	$11^{18°}$	∞	∞
3049	lq.	$0.897^{15°}_{4°}$	<−18	145-6	v. sl. s.	∞	∞
3050	lf.	$1.117^{20.8°}_{4°}$	34	195^{766mm}	i.	∞	∞
3051	lq.	$1.038^{20°}_{20°}$	.....	65-7^{14mm}	.....	.....	.....
3052	lt. yel. oil	$1.165^{17°}$	.....	143-5^{10mm}	i.; v. s. NH_4OH	s.	s.
3053	yel. cr.	$1.09^{20°}_{4°}$	24.5	232-3	i.	∞	∞
3054	col. cr.	.....	60.5	250-60 sl. d.	v. s.	v. s.	v. s.
3055	pr./chl.	.....	73	.....	v. s.	v. s.	v. s.
3056	lq.	$1.191^{15°}_{15°}$	.....	121^{14mm}	s.	s.	.....
3057	col. oil	$1.028^{20°}_{4°}$	<−20	148^{748mm} sl. d.	∞	∞	∞
3058	nd.	.....	144	subl.	v. s.	v. s.	d. alk.
3059	lf./al.	.....	>160 d.	.....	s.	s.	.....
3060	col. lq.	$1.087^{15°}_{4°}$	.....	160	.....	v. s.	v. s.

* Easily converted to solid modification.
** Also a liquid form, d. on boiling & forms some solid modification.
Ethyl dithiooxalate 2165
Ethyl ether 2911
Ethyl ethyl-acetoacetate 2938
Ethyl ethyl-amyl-malonate 2167
Ethyl ethyl-butyl-malonate 2168
Ethyl *N*-ethyl-carbamate 3184
Ethyl-ethylene 1147

No.	Name	Synonym	Formula	Bell. Ref.	Formula Weight
3061	**Ethyl** glycol ether	.....	$HO{\cdot}CH_2{\cdot}CH_2{\cdot}O{\cdot}C_2H_5$	I-467	90.12
3062	hexaldehyde (2)	Et-Bu-acetaldehyde	$C_4H_9{\cdot}CH(C_2H_5){\cdot}CHO$	I-707	128.21
3063	hydracrylate	.....	$HOCH{:}CHCO_2C_2H_5$	III-297	118.13
3064	hydrazine	.....	$C_2H_5{\cdot}NH{\cdot}NH_2$	IV-550	60.10
3065	hydrocinnamate	.....	$C_6H_5(CH_2)_2CO_2C_2H_5$	IX-511	178.22
3066	hydrogen oxalate	ethyl oxalic acid	$HO_2C{\cdot}CO_2{\cdot}C_2H_5$	II-535	118.09
3067	hydrogen phthalate (*o*)	.....	$C_6H_4(CO_2C_2H_5){\cdot}CO_2H$	IX-797	194.18
3068	hydrogen tetrachlorophthalate	.....	$HO_2C{\cdot}C_6Cl_4{\cdot}CO_2{\cdot}C_2H_5$	IX-820	331.98
3069	hydrogen sulfate	ethyl sulfuric acid	$C_2H_5O{\cdot}SO_2{\cdot}OH$	I-325	126.13
3070	hydrogen tartrate (*d*)	.....	$HO_2C{\cdot}(CHOH)_2{\cdot}CO_2C_2H_5$	III-512	178.14
3071	hydroselenide	.....	$C_2H_5{\cdot}SeH$	I-349	109.03
3072	*p*-hydroxybenzoate †	.....	$HO{\cdot}C_6H_4{\cdot}CO_2C_2H_5$	X-159	166.17
3073	α-hydroxy-*iso*-butyrate	.....	$(CH_3)_2C(OH)CO_2{\cdot}C_2H_5$	III-315	132.16
3074	hydroxylamine (α)	.....	$C_2H_5O{\cdot}NH_2$	I-336	61.08
3075	hydroxylamine (β)	.....	$C_2H_5{\cdot}NH{\cdot}OH$	IV-535	61.08
3076	hypochlorite	.....	$C_2H_5{\cdot}O{\cdot}Cl$	I-324	80.52
3077	iodide	iodoethane	$CH_3{\cdot}CH_2I$	I-96	155.98
3078	iodoacetate	.....	$ICH_2{\cdot}CO_2{\cdot}C_2H_5$	II-222	214.02
3079	lactate	.....	$CH_3{\cdot}CHOH{\cdot}CO_2C_2H_5$	III-280	118.13
3080	laurate	.....	$CH_3(CH_2)_{10}CO_2C_2H_5$	II-361	228.36
3081	levulinate	.....	$CH_3{\cdot}CO(CH_2)_2{\cdot}CO_2{\cdot}C_2H_5$	III-675	144.17
3082	malonic acid	.....	$C_2H_5{\cdot}CH(CO_2H)_2$	II-643	132.11
3083	mercaptan	ethanthiol	$C_2H_5{\cdot}SH$	I-340	62.13
3084	mesoxalate	.....	$CO(CO_2C_2H_5)_2$	III-769	174.15
3085	methylaceto-acetate	Me-acetoacetic ester	$CH_3CO{\cdot}CH(CH_3){\cdot}CO_2{\cdot}C_2H_5$	III-679	144.17
3086	methyl acrylate	.....	$C_3H_5{\cdot}CO_2{\cdot}C_2H_5$	II-423	114.14
3087	*S*-methylxanthate	.....	$C_2H_5O{\cdot}CS{\cdot}SCH_3$	III-210	136.22
3088	myristate	.....	$C_{13}H_{27}CO_2{\cdot}C_2H_5$	II-365	256.42
3089	naphthalene (α)	.....	$C_2H_5{\cdot}C_{10}H_7$	V-569	156.22
3090	naphthalene (β)	.....	$C_2H_5{\cdot}C_{10}H_7$	V-569	156.22
3091	α-naphthylamine	.....	$C_2H_5{\cdot}NH{\cdot}C_{10}H_7$	XII-1222	171.23
3092	β-naphthylamine	.....	$C_2H_5{\cdot}NH{\cdot}C_{10}H_7$	XII-1274	171.23
3093	α-naphthyl ether	.....	$C_{10}H_7{\cdot}O{\cdot}C_2H_5$	VI-606	172.22
3094	β-naphthyl ether	neroline; bromelia	$C_{10}H_7{\cdot}O{\cdot}C_2H_5$	VI-641	172.22
3095	nicotinate	.....	$C_5H_4N{\cdot}CO_2C_2H_5$	XXII-39	151.16
3096	nitrate	nitric ether	$C_2H_5{\cdot}O{\cdot}NO_2$	I-329	91.07
3097	nitrite	nitrous ether	$C_2H_5{\cdot}O{\cdot}NO$	I-329	75.07
3098	nitroacetate	.....	$NO_2{\cdot}CH_2{\cdot}CO_2{\cdot}C_2H_5$	II-225	133.10
3099	nitrobenzoate (*o*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CO_2C_2H_5$	IX-372	195.17
3100	nitrobenzoate (*m*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CO_2C_2H_5$	IX-378	195.17
3101	nitrobenzoate (*p*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CO_2C_2H_5$	IX-390	195.17
3102	nitrocinnamate (*o*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH{:}CH{\cdot}CO_2{\cdot}C_2H_5$	IX-605	221.21
3103	nitrocinnamate (*m*) (*trans*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH{:}CH{\cdot}CO_2{\cdot}C_2H_5$	IX-606	221.21
3104	nitrocinnamate (*p*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH{:}CH{\cdot}CO_2{\cdot}C_2H_5$	IX-607	221.21

† See also ethyl salicylate.

Ethyl ethyl-malonate 2169
Ethyl ethyl-phenyl-malonate 2170
Ethyl ethyl-propyl-malonate 2171
Ethyl S-ethylxanthate 2164
Ethyl fumarate 2174
Ethyl glutaconate 2175
Ethyl glutarate 2176
Ethyl glycolic acid 2912
Ethyl *n*-heptylate 3108
Ethyl heptyl-malonate 2177
Ethyl hexenal 3141
Ethyl-hexyl carbinol 4920
Ethyl itaconate 2179
Ethyl malate 2182

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3061	lq.	$0.935^{15°}_{15°}$	.....	134-5^{748mm}	.....	.....	.....
3062	col. lq.	$0.820^{20°}_{20°}$	<−100	163-4	0.07$^{20°}$	.....	.....
3063	col. lq.	1.064$^{25°}$	.....	185-90	∞	∞	∞
3064	hyg. lq.	.....	.....	99.5^{709mm}	v. s.	v. s.	v. s.
3065	lq.	$1.015^{20°}_{4°}$	.....	249	i.	s.	s.
3066	col. lq.	$1.218^{20°}_{4°}$	.....	117^{15mm}	.....	.....	.....
3067	oil	.....	2	d.	sl. s.	s.	s.
3068	cr.	.....	94-5	d. 150	i.; s. aq. alk. carb.	s.	s.
3069	syrup	1.316$^{17°}$	.....	d.	∞; d. h.	∞; d. h.	∞
3070	col. hyg. pr.	.....	90±	.....	s.; d. h.	s.	i.
3071	lq.	$1.395^{24°}_{4°}$	.....	53.5	i.	.....	.....
3072	col. cr.	.....	115-6	297-8	180°	72$^{25°}$ act.	45$^{25°}$
3073	col. lq.	.....	.....	149-50	d. h.	.....	.....
3074	col. lq.	0.883$^{7.5°}$	.....	68	∞	∞	∞
3075	nd./lg.	$0.908^{20°}_{4°}$	59 d.	.....	v. s.	v. s.	sl. s.
3076	yel. lq.	.....	expl.	36^{752mm}	∞ bz.	∞ chl.	∞
3077	col. lq.	$1.933^{20°}_{4°}$	−105	72.4	0.4$^{20°}$	∞	∞
3078	col. oil	$1.817^{12.7°}_{4°}$	.....	178-80	.....	.....	.....
3079	oil	$1.030^{25°}_{4°}$	.....	155	∞	∞	∞
3080	oil	$0.868^{3°}_{4°}$	−10.7	269	i.	s.	∞
3081	col. lq.	$1.016^{20°}_{20°}$	.....	205.2^{756mm}	v. s.	∞	.....
3082	col. pr.	.....	111.5	d. 160	v. s.	v. s.	v. s.
3083	lq.	$0.839^{20°}_{4°}$	−121	36-7	1.5; s. alk.	s.	s.
3084	yel. gn. lq.	$1.119^{20°}_{20°}$	−30±	220±	.....	s.	s.
3085	col. lq.	$1.019^{20°}_{4°}$	.....	186.8	i.	s.	s.
3086	col. lq.	.....	.....	115-20	i.	s.	s.
3087	lq.	$1.119^{25°}_{4°}$	.....	183-4	i.	s.	s.
3088	col. cr.	$0.856^{20°}_{4°}$	10.5-1.5	295	i.	sl. s.	sl. s.
3089	lq.	$0.990^{25°}_{25°}$	−27	258^{758mm} sl. d.	i.	∞	∞
3090	lq.	1.008$^{0°}$	−19	251	i.	∞	∞
3091	oil	$1.060^{20°}_{4°}$	.....	303^{723mm}	i.	s.	s.
3092	oil	$1.057^{20°}_{4°}$	.....	316-7	i.	s.	s.
3093	cr.	$1.061^{20°}_{20°}$	5.5	276.4	i.	s.	s.
3094	pl.	$1.064^{20°}_{20°}$	37.5	282	i.; s. chl.	s.; s. bz.	s.; s. pet.
3095	col. oil	.....	8-9	225	sl. s.	s.	s.; s. bz.
3096	col. lq.	$1.100^{20°}_{4°}$	−102	87-8	1.3$^{55°}$	∞	∞
3097	lq.	0.900$^{15.5°}$	.....	17	v. sl. s.	∞	∞
3098	col. lq.	$1.199^{20°}_{4°}$	.....	105-7^{25mm}	v. sl. s.	∞	.....
3099	tri.	.....	30	149^{10mm}	i.	s.	s.
3100	mn. pr.	.....	47	298±	i.	s.	s.
3101	tri./al.	.....	57	.....	i.	s.	s.
3102	yel. rhb.	.....	44	.....	v. s. bz.	v. s. h.	v. s.
3103	col. mn./al.	.....	78-9	.....	i.	sl. s.	sl. s.
3104	wh. tri.	.....	141-2	.....	i.	v. sl. s. c.	s. ac.

Ethyl maleate 2183
Ethyl malonate 2184
Ethyl mesaconate 2186
Ethyl-metanilic acid 2966
Ethyl *N*-methylcarbamate 4416 [1]
Ethyl-morphine HCl, cf. alkd.
Ethyl muconate 2188
Ethyl mustard oil 3159

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3105	**Ethyl** nitrolic acid	.....	$CH_3 \cdot C(NOH) \cdot NO_2$	II-189	104.07
3106	octyl ether (*n*)	.....	$C_2H_5 \cdot O \cdot C_8H_{17}$	I-419	158.28
3107	octyl ketone (*n*)	undecanone-3	$C_2H_5 \cdot CO \cdot C_8H_{17}$	I-713	170.29
3108	oenanthylate	ethyl *n*-heptylate	$C_6H_{13}CO_2 \cdot C_2H_5$	II-340	158.23
3109	oleate	.....	$C_{17}H_{33}CO_2 \cdot C_2H_5$	II-467	310.50
3110	oxanilate	.....	$C_6H_5 \cdot NH \cdot CO \cdot CO_2 \cdot C_2H_5$	XII-282	193.20
3111	oxindole (1)	*N*-Et-oxindole	$C_8H_6ON \cdot C_2H_5$	XXI-283	161.20
3112	palmitate	.....	$C_{15}H_{31}CO_2 \cdot C_2H_5$	II-372	284.47
3113	pelargonate	.....	$C_8H_{17}CO_2 \cdot C_2H_5$	II-353	186.29
3114	phenol (*o*)	phlorol	$C_2H_5 \cdot C_6H_4 \cdot OH$	VI-470	122.16
3115	phenol (*m*)	.....	$C_2H_5 \cdot C_6H_4 \cdot OH$	VI-471	122.16
3116	phenol (*p*)	.....	$C_2H_5 \cdot C_6H_4 \cdot OH$	VI-472	122.16
3117	γ-phenoxybutyrate	.....	$C_6H_5O \cdot CH_2(CH_2)_2 \cdot CO_2 \cdot C_2H_5$	.....	208.25
3118	phenylacetate	.....	$C_6H_5 \cdot CH_2 \cdot CO_2 \cdot C_2H_5$	IX-434	164.20
3119	phenylacetic acid	.....	$C_6H_5 \cdot CH(C_2H_5)CO_2H$	IX-541	164.20
3120	phenylacetylene	1-phenyl-butyne-1	$C_6H_5 \cdot C \equiv C \cdot C_2H_5$	V-517	130.18
3121	phenylbromo-acetate	(*dl*)	$C_6H_5 \cdot CHBrCO_2C_2H_5$	IX-452	243.10
3122	phenyl carbinol (*dl*)	sec-Ph-Pr-alcohol	$C_6H_5 \cdot CHOH \cdot C_2H_5$	VI-502	136.19
3123	phenyl carbinol (*l*)	.....	$C_6H_5 \cdot CHOH \cdot C_2H_5$	VI-502	136.19
3124	phenyl-ethanol-amine	β-ethylanilino-ethyl alcohol	$C_6H_5N(C_2H_5)CH_2 \cdot CH_2OH$	XII-183	165.23
3125	phenylglycinate	*N*-Ph-glycine Et ester	$C_6H_5NH \cdot CH_2CO_2 \cdot C_2H_5$	XII-470	179.21
3126	phenylhydantoin (*dl*) (5,5)	nirvanol	$CO \cdot NH \cdot CO \cdot NH \cdot C(C_2H_5)(C_6H_5)$	*XXIV-348	204.22
3127	phenylhydrazine	(α,α)	$C_6H_5N(C_2H_5) \cdot NH_2$	XV-119	136.19
3128	phenylhydrazine	(α,β)	$C_6H_5 \cdot NH \cdot NH \cdot C_2H_5$	XV-120	136.19
3129	phenyl ketone	propiophenone	$C_2H_5 \cdot CO \cdot C_6H_5$	VII-300	134.17
3130	2-phenyl-6-methyl-cinchoninate	neocincophen; neo-quinophan; novatophan	$CH_3 \cdot C_9H_4N(C_6H_5) \cdot CO_2 \cdot C_2H_5$	*XXII-520	291.33
3131	phenylpropiolate	.....	$C_6H_5 \cdot C \equiv C \cdot CO_2 \cdot C_2H_5$	IX-634	174.19
3132	phenyl sulfide	thiophenetole	$C_6H_5 \cdot S \cdot C_2H_5$	VI-297	138.22
3133	phenylsulfone	.....	$C_6H_5 \cdot SO_2 \cdot C_2H_5$	VI-297	170.22
3134	phenyl urea (*N,N'*)	.....	$C_2H_5NH \cdot CO \cdot NHC_6H_5$	XII-348	164.20
3135	phosphine	.....	$C_2H_5 \cdot PH_2$	IV-581	62.06
3136	propargyl ether	.....	$CH \equiv C \cdot CH_2 \cdot O \cdot C_2H_5$	I-454	84.11
3137	propiolate	.....	$CH \equiv C \cdot CO_2 \cdot C_2H_5$	II-477	98.10
3138	propionate	.....	$C_2H_5 \cdot CO_2 \cdot C_2H_5$	II-240	102.13
3139	*n*-propylaceto-acetate	.....	$CH_3CO \cdot CH(C_3H_7) \cdot CO_2 \cdot C_2H_5$	III-700	172.22
3140	*iso*-propylaceto-acetate	.....	$CH_3CO \cdot CH(C_3H_7) \cdot CO_2 \cdot C_2H_5$	III-702	172.22
3141	β-*n*-propyl-acrolein (α)	2-Et-hexenal	$C_3H_7 \cdot CH : C(C_2H_5) \cdot CHO$	I-744	126.19
3142	*n*-propyl ether	.....	$C_2H_5 \cdot O \cdot CH_2 \cdot C_2H_5$	I-354	88.15
3143	*iso*-propyl ether	.....	$C_2H_5 \cdot O \cdot CH(CH_3)_2$	I-362	88.15
3144	*n*-propyl ketone	hexanone-3	$C_2H_5 \cdot CO \cdot CH_2 \cdot C_2H_5$	I-690	100.16
3145	*iso*-propyl ketone	2-Me-pentanone-3	$C_2H_5 \cdot CO \cdot CH(CH_3)_2$	I-691	100.16
3146	pyridine (2)	.....	$C_2H_5 \cdot C_5H_4N$	XX-241	107.15

Ethyl nitrophthalate 2190
Ethyl nitroso-ethylcarbamate 4886
Ethyl nitroso-methylcarbamate 4891
Ethyl orthoformate 3049
Ethyl orthopropionate 6193
Ethyl oxalate 2193
Ethyl oxalic acid 3066
Ethyl oxamate 5015
Ethyl-phenylamine 2965
Ethyl-phenyl-barbituric acid 5113

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3105	rhb.	.....	88 d.	.....	s.	s.	s.
3106	lq.	$0.801^{0°}$	.....	189	i.	s.	s.
3107	lq.	.....	4.5	227	i.	s.	s.
3108	col. lq.	$0.872^{20°}_{20}$	−66.1	187-8	$0.029^{20°}$	∞	∞ ; ∞ chl.
3109	oil	$0.867^{25°}$	.....	216-8^{15mm}	i.	∞	∞
3110	pl. or pr./al.	.....	66-7	260-300 (sl. d.)	sl. s. h.	s.	s.
3111	nd./act.	.....	97	.....	sl. s. h.	.....	.....
3112	col. nd.	.....	24-5	191^{10mm}	i.	s.	s.
3113	col. lq.	$0.866^{17.5°}$	−44.5	227-8^{757mm}	i.	∞	∞
3114	col. lq.	$1.018^{25°}_{25}$	−45	207-8^{756mm}	v. sl. s.	∞ ; s. bz.	∞
3115	col. lq.	$1.001^{25°}_{25}$	−4	214^{752mm}	v. sl. s.	∞	∞
3116	nd.	.....	46-7	218.5-9.5	v. sl. s.	$1200^{25°}$	$710^{25°}$
3117	lq.	$1.048^{23°}_{25}$	.....	156-62^{20mm}	.....	.....	.....
3118	col. lq.	$1.033^{20°}_{4}$	.....	227	i.	∞	∞
3119	pl./et.	.....	42	270	.....	.....	.....
3120	lq.	$0.923^{21°}$	.....	201-3	i.	s.	s.
3121	oil	$1.415^{20°}_{4}$	.....	145^{15mm}	.....	.....	.....
3122	col. q.	$0.994^{23°}_{0}$	.....	219-20 sl. d.	i.	s.	s.
3123	col. lq.	$0.998^{1.3\cdot8°}_{4}$	.....	.....	i.	s.	s.
3124	lq.	$1.043^{20°}_{20}$	.....	268^{740mm}	$0.5^{20°}$	.....	.....
3125	lf.	.....	57-8	273 sl. d.	v. sl. s. h.	v. s. h.	v. s.
3126	col. nd./al.	.....	199-200	.....	0.06 c.; 0.9 h.	6; i. bz.; s. alk.	0.6; s. ac.
3127	oil	$1.018^{15°}$	.....	237	.....	.....	.....
3128	oil	$1.004^{16°}_{15}$	.....	*237-40	sl. s.	v. s.	v. s.
3129	pl.	$1.012^{20°}_{20}$	21	218	i.	s.	s.
3130	yel. cr./al.	.....	75-6	.....	i.; s. a.	s. h.	s.; s. chl.
3131	oil	$1.063^{1.3°}_{4}$	.....	260-70 sl. d.	.....	.....	.....
3132	lq.	$1.024^{15°}_{4}$	.....	205-6	.....	.....	.....
3133	mn.	$1.010^{22°}$	42	>300	s. h.	s.	s.; s. a.
3134	nd./aq. al.	.....	99	.....	.....	s.	.....
3135	col. lq.	<1	.....	25	.....	.....	.....
3136	lq.	$0.833^{20°}_{4}$	.....	80-2	sl. s.	∞	.....
3137	col. lq.	$0.968^{15°}_{15}$	.....	119^{745mm}	i.; v. s. chl.	v. s.	v. s.
3138	col. lq.	$0.891^{20°}_{4}$	−72.6	99.1	$2.4^{20°}$	∞	∞
3139	lq.	$0.948^{25°}_{4}$	.....	223.6	.....	.....	.....
3140	lq.	$0.960^{25°}_{25}$	.....	205 d.	v. sl. s.	∞	∞
3141	col. lq.	$0.848^{20°}_{4}$	.....	174.5^{748mm}	$0.07^{20°}$	s.	∞ ; ∞ bz.
3142	col. lq.	$0.739^{20°}_{4}$	<−79	62-3	sl. s.	∞	∞
3143	col. lq.	$0.745^{0°}$	.....	54	sl. s.	∞	∞
3144	col. lq.	$0.813^{21\cdot8°}_{4}$	.....	123-4	v. sl. s.	∞	∞
3145	col. lq.	$0.814^{18°}_{0}$	.....	114^{745mm}	v. sl. s.	v. s.	∞
3146	lq.	$0.950^{0°}$	.....	148.5^{753mm}	sl. s.	∞	v. s.

* In nitrogen.

Ethyl phenyl-benzyl-carbamate 5165
Ethyl phenyl-carbamate 5254
Ethyl phenyl-cyanoacrylate 3031
Ethyl-phenyl ether 5111
Ethyl-phenylnitrosoamine 4885
Ethyl phosphate 6188
Ethyl phosphite 6192
Ethyl phthalate 2199, 3067
Ethyl pimelate 2202
Ethyl-propyl carbinol (*n*) 3626
Ethyl-propyl carbinol (*iso*) 3632
Ethyl propyl-malonate 2203-4

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3147	**Ethyl** pyridine (3)	*β*-lutidine	$C_2H_5 \cdot C_5H_4N$	XX-242	107.15
3148	pyridine (4)	.....	$C_2H_5 \cdot C_5H_4N$	XX-243	107.15
3149	pyrrole (*N*)	Et-pyrrolylamine	$C_4H_4N \cdot C_2H_5$	XX-163	95.14
3150	pyruvate	.....	$CH_3CO \cdot CO_2 \cdot C_2H_5$	III-616	116.11
3151	salicylate (*o*)	Et hydroxybenzoic †	$HO \cdot C_6H_4 \cdot CO_2 \cdot C_2H_5$	X-73	166.17
3152	silicate, ortho	.....	$Si(OC_2H_5)_4$	I-334	208.30
3153	stearate	.....	$C_{17}H_{35}CO_2 \cdot C_2H_5$	II-379	312.52
3154	succinic acid	.....	$HO_2C \cdot CH(C_2H_5) \cdot CH_2 \cdot CO_2H$	II-660	146.14
3155	sulfone chloride	Et-sulfonyl chloride	$C_2H_5 \cdot SO_2 \cdot Cl$	IV-6	128.58
3156	thioacetate (*S*)	.....	$CH_3CO \cdot S \cdot C_2H_5$	II-232	104.16
3157	thiocarbamate	dithiourethane	$NH_2 \cdot CS \cdot S \cdot C_2H_5$	III-218	121.21
3158	thiocyanate	.....	$C_2H_5 \cdot S \cdot CN$	III-175	87.14
3159	*iso*-thiocyanate	ethyl mustard oil	$C_2H_5 \cdot N{:}C{:}S$	IV-123	87.14
3160	thioglycolate	.....	$HS \cdot CH_2CO_2 \cdot C_2H_5$	III-255	120.16
3161	thioglycolic acid	(*S*)	$C_2H_5S \cdot CH_2 \cdot CO_2H$	III-248	120.16
3162	thiourea	.....	$C_2H_5 \cdot NH \cdot CS \cdot NH_2$	IV-117	104.17
3163	toluate (*o*)	.....	$CH_3 \cdot C_6H_4 \cdot CO_2 \cdot C_2H_5$	IX-463	164.20
3164	toluate (*m*)	.....	$CH_3 \cdot C_6H_4 \cdot CO_2 \cdot C_2H_5$	IX-476	164.20
3165	toluate (*p*)	.....	$CH_3 \cdot C_6H_4 \cdot CO_2 \cdot C_2H_5$	IX-484	164.20
3166	toluene (*o*)	methyl-ethyl-benzene	$C_2H_5 \cdot C_6H_4 \cdot CH_3$	V-396	120.19
3167	toluene (*m*)	.....	$C_2H_5 \cdot C_6H_4 \cdot CH_3$	V-396	120.19
3168	toluene (*p*)	.....	$C_2H_5 \cdot C_6H_4 \cdot CH_3$	V-397	120.19
3169	*p*-toluene sulfonate	.....	$CH_3 \cdot C_6H_4 \cdot SO_3 \cdot C_2H_5$	XI-99	200.25
3170	*o*-toluidine	.....	$CH_3 \cdot C_6H_4 \cdot NHC_2H_5$	XII-786	135.20
3171	*m*-toluidine	.....	$CH_3 \cdot C_6H_4 \cdot NHC_2H_5$	XII-857	135.20
3172	*p*-toluidine	.....	$CH_3 \cdot C_6H_4 \cdot NHC_2H_5$	XII-904	135.20
3173	*o*-tolyl ether	Et *o*-cresyl ether	$CH_3 \cdot C_6H_4 \cdot O \cdot C_2H_5$	VI-352	136.19
3174	*m*-tolyl ether	.....	$CH_3 \cdot C_6H_4 \cdot O \cdot C_2H_5$	VI-376	136.19
3175	*p*-tolyl ether	.....	$CH_3 \cdot C_6H_4 \cdot O \cdot C_2H_5$	VI-393	136.19
3176	*p*-tolyl sulfide	Et *p*-cresyl sulfide	$CH_3 \cdot C_6H_4 \cdot S \cdot C_2H_5$	VI-417	152.25
3177	triazoacetate	.....	$N_3CH_2 \cdot CO_2 \cdot C_2H_5$	II-229	129.12
3178	tribromoacetate	.....	$Br_3C \cdot CO_2 \cdot C_2H_5$	II-221	324.83
3179	trichloroacetate	.....	$Cl_3C \cdot CO_2 \cdot C_2H_5$	II-209	191.45
3180	tripropylbenzene	(*iso*)	$C_2H_5 \cdot C_6H_2(C_3H_7)_3$	.....	232.39
3181	undecylate (*n*)	.....	$C_{10}H_{21}CO_2 \cdot C_2H_5$	II-358	214.34
3182	*n*-undecyl ketone	tetradecanone-3	$C_2H_5 \cdot CO \cdot C_{11}H_{23}$	I-716	212.36
3183	urea	.....	$C_2H_5 \cdot NH \cdot CO \cdot NH_2$	IV-115	88.11
3184	urethane	Et *N*-Et carbamate	$C_2H_5 \cdot NHCO_2C_2H_5$	IV-114	117.15
3185	valerate (*n*)	.....	$CH_3(CH_2)_3CO_2C_2H_5$	II-301	130.18
3186	*iso*-valerate	.....	$(CH_3)_2CH \cdot CH_2 \cdot CO_2 \cdot C_2H_5$	II-312	130.18
3187	vanillate (4,3;1)	.....	$HO(CH_3O)C_6H_3 \cdot CO_2 \cdot C_2H_5$	X-397	196.20
3188	vanillin	3-EtO-4-OH-benzaldehyde; ethovan	$HO(C_2H_5O)C_6H_3 \cdot CHO$	VIII-256	166.17
3189	vinyl carbinol	pentene-1-ol-3	$CH_2{:}CH \cdot CHOH \cdot C_2H_5$	I-443	86.13
3190	vinyl sulfide	.....	$CH_2{:}CH \cdot S \cdot C_2H_5$	I-434	86.16
3191	violet base	hexaEt-4,4′,4″-tri-NH_2-triPh-carbinol	$[(C_2H_5)_2N \cdot C_6H_4]_3C \cdot OH$	XIII-759	473.68

† See also No. 3072.

Ethyl pyromucate 3050
Ethyl-pyrrolylamine 3149
Ethyl red 2144
Ethyl sebacate 2206
Ethyl selenemercaptan 3071
Ethyl suberate 2210
Ethyl succinate 2211-2
Ethyl sulfate 2213
Ethyl sulfinic acid 2905
Ethyl sulfonic acid 2906
Ethyl sulfonyl chloride 3155
Ethyl sulfuric acid 3069
Ethyl tartrate 2218, 3070
Ethyl thioncarbamate 6450

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3147	lq.	$0.959^{\frac{9}{4}°}$	.....	165.3	sl. s. c.; v. sl. s. h.	s.	s.
3148	lq.	$0.936^{20°}$	.....	166	s. aq. a.	.....	.....
3149	lq.	$0.888^{16°}$	.....	130-1	i. c.; s. a.	∞	∞
3150	col. lq.	$1.060^{\frac{1}{4}\frac{8}{4}°}$	.....	155	l.	∞	∞
3151	col. lq.	$1.133^{\frac{2}{3}\frac{5}{5}°}$	1.3	233-4	i.	∞	∞
3152	lq.	$0.936^{\frac{2}{2}\frac{0}{0}°}$	.....	168.1	sl. d.	∞	.....
3153	col. cr.	.....	34.7-5.0	199-201^{10mm}	i.	s.	s.
3154	col. pr.	.....	98	.....	v. s.	v. s.	v. s.
3155	lq.	$1.357^{22.5°}$	.....	177.5	sl. d.	sl. d.	v. s.
3156	lq.	$0.976^{\frac{4}{4}\frac{8}{4}°}$	.....	116-7	i.	v. s.	v. s.
3157	lf./et.	.....	41-2	d.	i.	v. s.	v. s.
3158	lq.	$0.996^{\frac{2}{4}\frac{5}{4}°}$	−85.5	145^{765mm}	i.	∞	∞
3159	col. lq.	$1.004^{\frac{1}{4}\frac{5}{4}°}$	−5.9	131-2	i.	∞	∞
3160	lq.	$1.096^{15°}$	.....	156-8	.....	.....	.....
3161	oil	$1.150^{\frac{2}{4}\frac{0}{4}°}$	−8.7	123-4^{15mm}	∞	s.	s.
3162	nd.	.....	113	.....	v. s.	v. s.	.....
3163	lq.	$1.032^{\frac{2}{2}\frac{5}{5}°}$	<−10	227	i.	∞	∞
3164	lq.	$1.030^{\frac{2}{2}\frac{0}{0}°}$	.....	231^{750mm}	i.	∞	∞
3165	lq.	$1.024^{\frac{2}{2}\frac{5}{5}°}$	.....	235.5	i.	∞	∞
3166	lq.	$0.882^{\frac{2}{4}\frac{0}{4}°}$	<−17	164.9	i.	∞	∞
3167	lq.	$0.869^{20°}$	.....	158-9	i.	∞	∞
3168	lq.	$0.862^{\frac{2}{4}\frac{0}{4}°}$	<−20	162.5	i.	∞	∞
3169	mn. pr./al.	$1.166^{\frac{1}{4}\frac{8}{4}°}$	33-4	221.3	i.	s.	s.
3170	lq.	$0.948^{\frac{3}{4}\frac{6}{4}°}$	<−15	215-6	i.	.....	.....
3171	lq.	.....	.....	221-2	.....	.....	.....
3172	lq.	$0.942^{\frac{2}{4}\frac{5}{4}°}$	.....	217	i.	.....	.....
3173	lq.	$0.959^{\frac{1}{4}\frac{3}{4}\cdot\frac{3}{4}°}$	.....	184	.....	.....	.....
3174	lq.	$0.956^{\frac{0}{0}°}$	.....	192	.....	.....	.....
3175	lq.	$0.966^{\frac{0}{0}°}$	.....	188-9	.....	.....	.....
3176	lq.	$1.002^{17.5°}$	.....	220-1	.....	.....	.....
3177	col. oil	$1.127^{\frac{2}{2}\frac{0}{0}°}$	.....	70^{20mm}	.....	.....	.....
3178	col. lq.	$2.230^{\frac{2}{2}\frac{0}{0}°}$	.....	225	i.	∞	∞
3179	col. lq.	$1.383^{\frac{2}{4}\frac{0}{4}°}$	.....	167-8	i.	∞	∞
3180	col. cr.	.....	106.9	260	i.	$1.5^{25°}$	$105^{25°}$
3181	lq.	.....	.....	140^{20mm}	i.	.....	.....
3182	cr./Me al.	.....	34	152^{16mm}	.....	.....	.....
3183	nd.	$1.213^{18°}$	92	.....	v. s.	v. s.	i.
3184	col. lq.	$0.981^{\frac{3}{4}\frac{0}{4}°}$	.....	174-6	$63^{15°}$	d. h. alk.	.....
3185	col. lq.	$0.877^{20°}$	.....	144.6^{737mm}	i.	∞	∞
3186	col. lq.	$0.867^{\frac{2}{4}\frac{0}{4}°}$	−99.3	135	0.3	∞; ∞ bz.	∞
3187	nd.	.....	44	291-3	i.; s. alk.	v. s.	v. s.
3188	col. pl./aq.	.....	77-8	.....	v. sl. s.	s.	s.
3189	lq.	$0.840^{\frac{1}{0}\frac{9}{0}\cdot\frac{5}{0}°}$	.....	114.5-4.7	.....	.....	.....
3190	col. lq.	$0.887^{14°}$	.....	90.5-1.5	.....	.....	.....
3191	cr./lg.	.....	.....	.....	.....	sl. d.	.....

Ethyl thionurethane 6450
Ethyl thiourethane 5921
Ethyl-tolyl-benzylamine 2988
Ethyl vinyl ether 6438
Ethyl xylene 2483-6

Ethylal 2172
Ethylene acetate 3445
Ethylene benzoate 3447
Ethylene bromide 1837
Ethylene chloride 1994

Ethylene chlorobromide 1343
Ethylene diacetate 3445
Ethylene dibenzoate 3447
Ethylene dibutyrate 3450
Ethylene dicaprate 3451

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3192	**Ethylene**	ethene	$CH_2:CH_2$	I-180	28.05
3193	bromohydrin	glycol bromohydrin	$Br{\cdot}CH_2{\cdot}CH_2OH$	I-338	124.98
3194	chlorohydrin	2-chloro-ethanol-1	$ClCH_2{\cdot}CH_2OH$	I-337	80.52
3195	cyanohydrin	β-OH-propionitrile	$HO{\cdot}CH_2{\cdot}CH_2{\cdot}CN$	III-298	71.08
3196	diamine	.....	$NH_2{\cdot}CH_2{\cdot}CH_2{\cdot}NH_2$	IV-230	60.10
3197	diamine HBr	.....	$(CH_2NH_2)_2{\cdot}2HBr$	IV-232	221.95
3198	diamine HCl	.....	$(CH_2NH_2)_2{\cdot}2HCl$	IV-232	133.03
3199	diamine hydrate	.....	$(CH_2NH_2)_2{\cdot}H_2O$	IV-230	78.12
3200	diamine *iso*-valerate	*iso*-valeryl-ethylene-diamine	$C_{12}H_{28}O_4N_2$	.....	264.36
3201	dicaprate	.....	$(C_9H_{19}CO_2)_2C_2H_4$	.....	370.56
3202	diphenyl ether	.....	$(C_6H_5{\cdot}O{\cdot}CH_2)_2$	VI-146	214.25
3203	diphenylsulfone	.....	$(C_6H_5{\cdot}SO_2{\cdot}CH_2)_2$	VI-302	310.37
3204	diphenylthioether	.....	$(C_6H_5{\cdot}S{\cdot}CH_2)_2$	VI-301	246.37
3205	diphthalimide (*N*,*N'*)	.....	$[C_6H_4(CO)_2:N{\cdot}CH_2]_2$	XXI-492	320.29
3206	disulfonic acid	.....	$(HO_3S{\cdot}CH_2)_2$	IV-11	190.19
3207	ethylidene oxide	glycol-ethylidene-diacetal	$CH_3{\cdot}CH:(OCH_2{\cdot})_2$	XIX-8	88.10
3208	iodohydrin	2-iodo-ethanol-1	$ICH_2{\cdot}CH_2OH$	I-339	171.98
3209	mercaptan	ethandithiol-1,2	$HS{\cdot}CH_2{\cdot}CH_2{\cdot}SH$	I-471	94.19
3210	oxide	.....	$CH_2{\cdot}CH_2{\cdot}O$ (ring)	XVII-4	44.05
3211	thiocyanate	.....	$(CH_2{\cdot}SCN)_2$	III-178	144.21
3212	urea	.....	$(CH_2NH)_2CO$	XXIV-2	86.09
3213	**Ethylidene** acetone	Me-propenyl ketone	$CH_3{\cdot}CH:CH{\cdot}CO{\cdot}CH_3$	I-732	84.11
3214	diacetate	diacetoxyethane (1,1)	$CH_3{\cdot}CH(O_2C{\cdot}CH_3)_2$	II-152	146.14
3215	diurethane	.....	$CH_3{\cdot}CH:(NH{\cdot}CO_2{\cdot}C_2H_5)_2$	III-24	204.22
3216	urea	.....	$CH_3{\cdot}CH:(NHCONH)$	III-60	86.09
3217	**Eucalyptole**	cineole	$C_{10}H_{18}O$	XVII-24	154.24
3218	**Eugenol** (1,3,4)	allyl guaiacol	$C_6H_3(C_3H_5)(OCH_3){\cdot}OH$	VI-961	164.20
3219	acetate	.....	$CH_3{\cdot}CO_2{\cdot}C_{10}H_{11}O$	VI-965	206.23
3220	benzoate	benzoyl eugenol	$C_6H_5CO_2C_{10}H_{11}O$	.....	268.30
3221	cinnamate	.....	$C_8H_7CO_2C_{10}H_{11}O$	IX-586	294.33
3222	methyl ether	.....	$C_3H_5{\cdot}C_6H_3:(OCH_3)_2$	VI-963	178.22
3223	***iso*-Eugenol** (1,3,4)	propenyl guaiacol	$C_6H_3(C_3H_5)(OCH_3){\cdot}OH$	VI-955	164.20
3224	methyl ether	Me isoeugenol	$C_3H_5{\cdot}C_6H_3:(OCH_3)_2$	VI-956	178.22
3225	**Eugetinic acid**	(5;6,3,1)	$CH_3O{\cdot}C_6H_2(OH){\cdot}(C_3H_5)CO_2H$	X-441	208.21
3226	**Eupittonic acid**	.....	$C_{19}H_8(OCH_3)_6O_3$	VIII-574	470.46
3227	**Euxanthone**	1,7-diOH-xanthone	$CO:(C_6H_3OH)_2O$	XVIII-113	228.19
3228	**Evans blue**	.....	$C_{34}H_{26}O_{14}N_6S_4Na_4$	.....	962.82
3229	**Evernic acid**	.....	$C_{16}H_{13}O_6{\cdot}OCH_3$	X-416	332.30
3230	**Everninic acid**	(6,4;2,1)	$HO(CH_3O)C_6H_2{\cdot}(CH_3)CO_2H$	X-413	182.17
3231	**Evipan** (1,5;5)	*N*-Me-cyclohexenyl-methylbarbituric	$C_4HO_3N_2(CH_3)_2{\cdot}C_6H_9$	.....	236.26
3232	**Fenchene** (*dl*)	.....	$C_{10}H_{16}$	V-163	136.23
3233	**Fenchone** (*d*)	.....	$C_{10}H_{16}O$	VII-96	152.23

Ethylene dicaprylate 3452
Ethylene dicyanide 5661
Ethylene dilaurate 3458
Ethylene dimyristate 3461
Ethylene dipalmitate 3464
Ethylene diphenyldiamine 2720
Ethylene dipropionate 3465
Ethylene distearate 3467
Ethylene fluoride 2249
Ethylene formate 3455
Ethylene glycol-, cf. glycol.
Ethylene glycol 3444
Ethylene glycol diethyl ether 2139
Ethylene imine 6430
Ethylene iodide 2391
Ethylene lactic acid 3682
Ethylene malonic acid 6425
Ethylene nitrate 3462
Ethylene nitrite 3463
Ethylene periodide 5812
Ethylene phenyl sulfide 3204
Ethylene tetrabromide 5721
Ethylene tetrachloride 5741
Ethylene tetraiodide 5812

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3192	col. gas	0.975(A) $0.566^{-\frac{1}{0}\frac{0}{2}2^{\circ}}$	−169	−103.9	25.6^{00} cc.	360 cc.	s.
3193	col. lq.	$1.772^{\frac{20}{4}0^{\circ}}$	.....	150 sl. d.	s.	s.	.....
3194	col. lq.	$1.213^{\frac{20}{4}0^{\circ}}$	−69	128.8*	∞	∞	∞
3195	lq.	1.059^{00}	.....	220-27^{54mm}	∞	∞	$2.3^{15^{\circ}}$
3196	col. lq.	$0.900^{\frac{20}{20}0^{\circ}}$	8.5	117.2	∞	∞ ; i. bz.	0.3
3197	col. pr.	.....	.....	.....	s.	i.	i.
3198	mn. pr.	.....	subl.	.....	s.	i.	i.
3199	col. lq.	$0.963^{\frac{21}{4}0^{\circ}}$	10	118	∞	.....	.....
3200	wh. pd.	.....	129	.....	s.	s.	.....
3201	col. pl.	.....	37-8	.....	i.	s.	v. s.
3202	lf./abs. al.	.....	97-8	.....	i.	s. h.	s.; s. chl.
3203	nd./al.	.....	179-80	.....	v. sl. s. h.	s. h.; s. bz.	v. s. h. ac.
3204	nd.	.....	70.0-0.5	.....	i.	.....	.....
3205	nd./ac.	.....	233-4	.....	i.	s. h.	i.; s. bz.
3206	nd.	.....	104	.....	v. s.	v. s.	.....
3207	lq.	$0.987^{\frac{18}{4}0^{\circ}}$	.....	82.5^{766mm}	66.6; i. aq. $CaCl_2$	∞	∞
3208	col. lq.	$2.197^{\frac{20}{4}0^{\circ}}$	.....	85^{25mm}	s.	s.	.....
3209	lq.	$1.123^{23.5^{\circ}}$	.....	146	v. s. alk.	v. s.	s. NH_4OH
3210	lq.	$0.887^{\frac{7}{4}0^{\circ}}$	−111.3	13.5^{747mm}	∞	∞	v. s.
3211	pl. or nd.	.....	90	d.	sl. s.	s.	s.
3212	nd.	.....	131	.....	s.	s. h.	v. sl. s.
3213	col. lq.	$0.856^{20^{\circ}}$	.....	$122-4^{745mm}$	s.	.....	.....
3214	col. lq.	$1.061^{12^{\circ}}$	.....	168^{740mm}	sl. s.	∞	d. alk.
3215	nd.	.....	125-6	$170-80^{20mm}$	s. h.	s.	s.
3216	nd.	.....	154	d. 160	i.	sl. s.	i.
3217	col. oil	$0.927^{20^{\circ}}$	1.5	176-7	$1.9^{15^{\circ}}$	∞ ; s. oils	∞ ; s. ac.
3218	oil	$1.070^{\frac{15}{15}0^{\circ}}$	.....	253.5	v. sl. s.	∞ ; ∞ chl.	∞
3219	pl./al.	$1.087^{\frac{15}{15}0^{\circ}}$	29-30	$281-2^{752mm}$	i.	s.	s.
3220	col. cr.	.....	70.5	360	i.; s. act.	s. h.	s.; s. chl.
3221	col. nd.	.....	90-1	.....	i.; s. act.	s. h.	s.; s. chl.
3222	lq.	$1.055^{15^{\circ}}$	.....	248-9	i.	25, 60% al.	∞
3223	oil	$1.091^{\frac{15}{15}0^{\circ}}$	−10	267.5	v. sl. s.	∞	∞
3224	col. lq.	$1.055^{22^{\circ}}$	.....	263-4	i.	s.	s.
3225	pr./aq.	.....	124	d.	v. sl. s. c.	s.; s. $(NH_4)_2CO_3$	s.
3226	or. nd./al.	.....	200 d.	.....	s. alk.	sl. s. h. abs.	s. ac.
3227	yel. nd.	.....	240	subl. sl. d.	i.; s. alk.	s. h.	sl. s.
3228	b. pd.	.....	.....	.....	s.	i.	i.
3229	pr./al.	.....	168-9 d.	.....	v. sl. s. h.	s. h.	v. sl. s.
3230	cr./aq.	.....	170-1 d.	.....	v. sl. s. h.; s. EtOAc	s. h.; s. dil. NaOH	v. sl. s.
3231	col. cr. pd.	.....	143-5	.....	sl. s.	s. h.	sl. s.
3232	lq.	$0.868^{19^{\circ}}$	.....	155-6	.....	.....	.....
3233	oil	$0.948^{18^{\circ}}$	5-6	193-5	i.	v. s.	v. s.

* Constant b. p. mixt., 42.5% aq. 95.8°.

Ethylene tribromide 6105
Ethylene trichloride 6155
Ethylidene chlorobromide 1342
Ethylidene dibromide 1836
Ethylidene dichloride 1993
Ethylidene diiodide 2390
Ethylidene dimethyl ether 2415
Ethylidene phenetidine 2913
Ethyne 130
Eubornyl 863
Eudermol, cf. alkd.
Eupyrin 6420
Euresol 114
Eurisol 114
Euxanthic acid, cf. glcde.
Evipal 3231
Evodiamine, cf. alkd.
Ewer and Pick's acid 4462
Exalgin 4086
F acid 4510
Fantan 5171
Fast green-J base 5672
Fast red-D 3732

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3234	**Fenchyl** alcohol (*dl*)	.....	$C_{10}H_{17}OH$	VI-71	154.24
3235	alcohol (*d*)(α)	fenchol	$C_{10}H_{17}OH$	VI-70	154.24
3236	**Ferulic acid** (3;4,1)	MeO-OH-cinnamic acid	$CH_3O{\cdot}C_6H_3(OH){\cdot}CH{:}CHCO_2H$	X-436	194.18
3237	***iso*-Ferulic acid** (4;3,1)	hesperetinic acid	$CH_3O{\cdot}C_6H_3(OH){\cdot}CH{:}CHCO_2H$	X-437	194.18
3238	**Filicic acid**	filicin (1,1;2,4,6)	$(CH_3)_2C_6H_4(:O)_3$	VII-856	154.16
3239	**Filixic acid**	.....	$C_{35}H_{40}O_{12}$	VIII-576	652.67
3240	**Flavianic** acid	2,4-diNO_2-1-naphthol-7-sulfonic	$(NO_2)_2C_{10}H_4(OH){\cdot}SO_3H{\cdot}3H_2O$	XI-275	368.27
3241	sodium salt	naphthol yellow S	$C_{10}H_4O_8N_2SNa_2{\cdot}3H_2O$	XI-275	412.25
3242	**Flavaniline** (α)	*p*-aminophenyl-lepidine	$NH_2{\cdot}C_6H_4{\cdot}C_9H_5N{\cdot}CH_3$	XXII-469	234.29
3243	**Flavone**	3-phenyl-benzo-4-pyrone	$C_6H_4{\cdot}OC(C_6H_5){:}$ 	XVII-373	222.23
3244	**Fluoran**	.....	$C_{20}H_{12}O_3$	XIX-146	300.30
3245	**Fluoranthene**	idryl	$C_{15}H_{10}$	V-685	190.23
3246	**Fluorene**	.....	$C_6H_4{\cdot}CH_2{\cdot}C_6H_4$ 	V-625	166.21
3247	**Fluorenol**	diphenylene carbinol	$C_6H_4{\cdot}C_6H_4{\cdot}CHOH$ 	VI-691	182.21
3248	**Fluorenone**	diphenylene ketone	$C_6H_4{\cdot}CO{\cdot}C_6H_4$ 	VII-465	180.19
3249	oxime	.....	$C_{12}H_8{:}C{:}NOH$	VII-467	195.21
3250	**Fluorescein**	resorcinol phthalein	$C_{20}H_{12}O_5$	XIX-222	332.30
3251	sodium salt	uranin	$C_{20}H_{10}O_5Na_2$	XIX-225	376.27
3252	chloride	3,6-diCl-fluoran	$C_{20}H_{10}O_3Cl_2$	XIX-147	369.19
3253	diacetate	3,6-diAcO-fluoran	$C_{24}H_{16}O_7$	XIX-227	416.37
3254	**Fluorescin**	resorcinol phthalin	$C_{20}H_{14}O_5$	XVIII-358	334.31
3255	**Fluoro**-acetic acid	.....	$FCH_2{\cdot}CO_2H$	II-193	78.04
3256	aniline (*p*)	.....	$F{\cdot}C_6H_4{\cdot}NH_2$	XII-597	111.12
3257	anisole (*p*)	.....	$F{\cdot}C_6H_4{\cdot}OCH_3$	*VI-98	126.13
3258	benzene	phenyl fluoride	$C_6H_5{\cdot}F$	V-198	96.10
3259	benzoic acid (*o*)	.....	$F{\cdot}C_6H_4{\cdot}CO_2H$	IX-333	140.11
3260	benzoic acid (*m*)	.....	$F{\cdot}C_6H_4{\cdot}CO_2H$	IX-333	140.11
3261	benzoic acid (*p*)	.....	$F{\cdot}C_6H_4{\cdot}CO_2H$	IX-333	140.11
3262	bromobenzene (*p*)	.....	$F{\cdot}C_6H_4{\cdot}Br$	V-209	175.01
3263	chlorobenzene (*o*)	.....	$F{\cdot}C_6H_4{\cdot}Cl$	*V-110	130.55
3264	chlorobenzene (*m*)	.....	$F{\cdot}C_6H_4{\cdot}Cl$	.....	130.55
3265	chlorobenzene (*p*)	.....	$F{\cdot}C_6H_4{\cdot}Cl$	.....	130.55
3266	chlorobromo-methane	.....	$CHClBrF$	I-67	147.39
3267	chloromethane	.....	CH_2ClF	I-60	68.48
3268	dibromomethane	(2;1,1)	$FCH_2{\cdot}CHBr_2$	I-92	205.88
3269	dibromoethane	(2;1,2)	$FCHBr{\cdot}CH_2Br$	I-92	205.88
3270	1,1-dichloro-1,2-di-bromoethane (2)	.....	$Cl_2CBr{\cdot}CHFBr$	I-93	274.77
3271	dichloromethane	.....	$FCHCl_2$	I-61	102.93
3272	iodobenzene (*p*)	.....	$F{\cdot}C_6H_4{\cdot}I$	V-220	222.01
3273	naphthalene (α)	naphthyl fluoride	$C_{10}HX_7F$	V-540	146.16
3274	nitrobenzene (*p*)	.....	$NO_2{\cdot}C_6H_4{\cdot}F$	V-241	141.10

Fast scarlet 733
Fast yellow 4996
Fenchol 3235
Feraconitine, cf. alkd.
Ferron 3888
Ferulic methyl ketone 6416
Filicin 3238
Filicinic acid 3238
Fire damp 4061
Fisetin 5805
Flavin 5807
Flavopurpurin 6214

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3234	col. cr.	$0.935^{40°}$	33-5*	201	sl. s.	.....	.....
3235	col. pr.	$0.964^{20°}_{4°}$	45-7	201-2	sl. s.	s.	s.; s. pet.
3236	pr./aq.	.....	169-70	d.	s. h.	s.; sl. s. bz.	sl. s.
3237	nd. or pr.	.....	225-8	.....	sl. s. h.	s.	s.; i. lg.
3238	col. cr./al.	.....	213-5 d.	subl. sl. d.	1.4 h.	10 h.	sl. s.
3239	cr.	.....	184 d.	.....	i.; s. chl.	i. abs.	sl. s.; s. bz.
3240	pa. yel. nd./HCl	.....	100; 140-50(anh.)	d. >175	v. s.	v. s.	.....
3241	yel. pd.	.....	.....	.....	s.	.....	.....
3242	yel. nd./al.	.....	83-4	.....	i.	s.	s.; s. bz.
3243	col./lg.	.....	97	.....	i.	s.	s.
3244	nd.	.....	180	.....	s. H_2SO_4	s. HNO_3	.....
3245	nd./al.	.....	109-10	$250\text{-}1^{60mm}$	i.	v. s. h.	v. s.
3246	col. cr./al.	.....	115-6	293-5	i.	s. h.	s.
3247	nd./aq.	.....	153	.....	.....	s.	s.
3248	yel. rhb.	.....	83-4	341.5	i.	v. s.	v. s.
3249	nd.	.....	192-3	.....	s. chl.	i. pet.	.....
3250	yel. red pd.	.....	d. >290	.....	v. sl. s. h.	s. h.; s. alk.	s. h. ac.
3251	or. red pd.	.....	.....	.....	s.	sl. s.	.....
3252	col. cr.	.....	252	.....	i.; s. chl.	v. sl. s.	s. h. bz.
3253	col. cr./et. bz.	.....	201-5	.....	i. c. alk.	v. sl. s.	s. ac.
3254	col. nd./ac.	.....	125-7**	.....	i.; s. alk.	s.	s.
3255	cr.	.....	33	165	.....	.....	.....
3256	oil	$1.173^{20°}_{4°}$	-0.8	187^{753mm}	v. sl. s.	.....	.....
3257	col. lq.	.....	-43.5	156-7	.....	.....	.....
3258	col. lq.	$1.024^{20°}_{4°}$	-41.2	85-6	i.	∞	∞
3259	nd./aq.	.....	120-2	.....	s. h.	s.	s.
3260	lf./aq.	.....	124	.....	sl. s. h.	.....	.....
3261	mn./aq.	.....	182-4	.....	sl. s. h.	s.	s.
3262	col. lq.	$1.597^{20°}_{4°}$	-8	152^{755mm}	i.	v. s.	v. s.
3263	lq.	.....	-42.5	138^{774mm}	.....	.....	.....
3264	col. lq.	.....	.....	123-5	.....	.....	.....
3265	col. lq.	$1.226^{20.5°}_{4°}$	-26.9	130^{756mm}	.....	.....	.....
3266	col. lq.	$1.906^{16°}$	<-65	38	.....	.....	.....
3267	gas	.....	.....	.....	d.	.....	.....
3268	lq.	.....	.....	117.5	.....	.....	.....
3269	col. lq.	$2.257^{17°}$	-54	122.5^{761mm}	.....	.....	.....
3270	col. lq.	$2.130^{23°}$	.....	163.5	.....	.....	.....
3271	gas	$1.426^{0°}$	-127	14.5	i.	s.	s.
3272	col. lq.	.....	-18 (-27)	183.2^{760mm}	i.	s.	s.
3273	lq.	$1.133^{19.5°}_{4°}$	-8	212-6	s. bz.	s.; s. ac.	s. chl.
3274	pa. yel. cr.	$1.320^{3°}_{4°}$	27(21.6)	205	.....	.....	.....

* Rapid heating, m. p. 37-8°.
** Solvent free crysts. m. p. 253-4°.
Fluoro-ethane 3046
Fluoro-ethylene 6439
Fluoro-methane 4240
Fluoro-octane 4978

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Fluoro				
3275	pentabromoethane	.....	$Br_3C{\cdot}CBr_2F$	I-95	442.60
3276	pentachloroethane	.....	$Cl_3C{\cdot}CCl_2F$	.....	220.31
3277	tetrabromoethane	.....	$Br_3C{\cdot}CHBrF$	I-95	363.69
3278	tetrachloroethane	.....	$Cl_3C{\cdot}CHClF$	I-86	185.86
3279	toluene (*o*)	.....	$CH_3{\cdot}C_6H_4{\cdot}F$	V-290	110.13
3280	toluene (*m*)	.....	$CH_3{\cdot}C_6H_4{\cdot}F$	V-290	110.13
3281	toluene (*p*)	.....	$CH_3{\cdot}C_6H_4{\cdot}F$	V-290	110.13
3282	tribromoethane	.....	$BrCH_2{\cdot}CFBr_2$	I-93	284.78
3283	tribromoethane	.....	$Br_2CH{\cdot}CHBrF$	I-93	284.78
3284	trichloroethane	.....	$Cl_2CH{\cdot}CHClF$	I-85	151.41
3285	trichloroethylene	.....	$FClC{:}CCl_2$	.....	149.39
3286	trichloromethane	.....	Cl_3CF	I-64	137.38
3287	**Fluoroform**	trifluoromethane	CHF_3	I-59	70.02
3288	**Formaldehyde**	methanal	$H{\cdot}CH{:}O$	I-558	30.03
3289	**Formaldehyde** (meta)	α-trioxymethylene	$(CH_2O)_3$	XIX-381	90.08
3290	**Formaldehyde** (para)	.....	$(CH_2O)_x{\cdot}xH_2O$	I-566	(30.03)
3291	acetamide	formicin †	$CH_3CONH{\cdot}CH_2OH$	II-178	89.09
3292	bisulfite Na	.....	$CH_2OH{\cdot}SO_3Na{\cdot}H_2O$	I-578	152.11
3293	hydrosulfite	hydrosulfite N. F.	$CH_2O{\cdot}Na_2S_2O_4{\cdot}H_2O$	I-578	222.16
3294	oxime	formaldoxime	$H_2C{:}NOH$	I-590	45.04
3295	sulfoxalate Na	formosul	$CH_2OH{\cdot}SO_2Na{\cdot}2H_2O$	I-577	154.12
3296	**Formamide**	.....	$H{\cdot}CO{\cdot}NH_2$	II-26	45.04
3297	**Formamidine**	salts only known	$HN{:}CH{\cdot}NH_2$	II-90	44.06
3298	**Formamidoxime**	isuretin	$H_2N{\cdot}CH{:}NOH$	II-91	60.06
3299	**Formanilide**	formylaniline	$C_6H_4{\cdot}NH{\cdot}CHO$	XII-230	121.13
3300	*sodium salt*	.....	$C_6H_5{\cdot}N(Na){\cdot}CHO$	XII-233	143.12
3301	**Formic acid**	methanoic acid	$H{\cdot}CO_2H$	II-8	46.03
3302	sodium salt	sodium formate	$H{\cdot}CO_2Na$	II-14	68.02
3303	thallium salt	thallous formate	$H{\cdot}CO_2Tl$	II-16	249.41
3304	**Formyl** acetone	.....	$HO{\cdot}CH{:}CH{\cdot}CO{\cdot}CH_3$	I-767	86.09
3305	amino-1,3-dimethylbenzene (2)	form-*m*-xylidide (*vis*)	$(CH_3)_2C_6H_3NH{\cdot}OCH$	XII-1109	149.19
3306	diphenylamine	*N*-Ph-formanilide	$H{\cdot}CO{\cdot}N(C_6H_5)_2$	XII-235	197.23
3307	hydrazine	formhydrazide	$H_2N{\cdot}NH{\cdot}CHO$	II-93	60.06
3308	phenylhydrazine (β)	.....	$C_6H_5NH{\cdot}NH{\cdot}CHO$	XV-233	136.15
3309	thioaldehyde	.....	$CH_2{\cdot}(S{\cdot}CH_2)_2{\cdot}S$ (ring)	XIX-382	138.26
3310	**Fraxin** ‡	.....	$C_{16}H_{18}O_{10}$ + aq.	.....	370.30
3311	**Fructosamine** (*d*)	*iso*-glucosamine	$C_6H_{11}O_5(NH_2)$	IV-332	179.17
3312	**Fucose**	.....	$C_5H_{11}O_4{\cdot}CHO$	I-876	164.16
3313	**Fulminuric acid**	*iso*-cyanuric acid	$NC{\cdot}CH(NO_2){\cdot}CONH_2$	II-598	129.08
3314	**Fumaric** acid (*trans*)	butendioic acid	$(:CH{\cdot}CO_2H)_2$	II-737	116.07
3315	amide	.....	$(:CH{\cdot}CO{\cdot}NH_2)_2$	II-743	114.10
3316	chloride	fumaryl chloride	$(:CH{\cdot}CO{\cdot}Cl)_2$	II-743	152.97
3317	**Furfural** (3)	.....	$C_4H_3O{\cdot}CHO$	.....	96.08
3318	**Furfural** (2)	furfurol	$C_4H_3O{\cdot}CHO$	XVII-272	96.08

† Formicin is a commercial syrupy product. ‡ See also Glucoside table.

Fluoro-propane 5406-7
Folliculin 2903
Formaldehyde diacetate 4430
Formaldehyde diethylacetal 2172
Formaldehyde dimethylacetal 4424
Formaldehyde dipropylacetal 5458
Formaldehyde trimethyleneacetal 6285
Formaldoxime 3294
Formamine 3599
Formhydrazide 3307
Formicin 3291
Formin 3599
Formonitrile 3714
Formopan 3295
Formosul 3295
Formyl-aniline 3299
Formyl-diethylamine 2173
Formyl-salicylic acid 168
Formyl-xylidine 3305
Form-xylidide 3305
Forsling's acid-I 4551

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3275	col. cr.	.....	176 d.	subl. 120	s. bz., chl.	sl. s. c.	s.
3276	col. cr.	$1.74^{25°}$	100	136.8	i.	.....	.....
3277	lq.	$1.939^{16°}$	.....	103.5^{23mm}	.....	.....	.....
3278	col. lq.	$1.631^{16.7°}$	.....	116.5	.....	.....	.....
3279	col. lq.	$1.004^{13.2°}$	−80 ±	115-6	i.	s.	s.
3280	col. lq.	$0.997^{13.4°}$	−110.8	115-6	i.	s.	s.
3281	col. lq.	$1.001^{\frac{1}{4}6°}$	.....	116-7	i.	s.	s.
3282	col. lq.	$2.605^{17.5°}$	.....	162.7^{757mm}	.....	.....	.....
3283	col. lq.	$2.674^{18°}$	.....	178	.....	.....	.....
3284	col. lq.	$1.550^{17°}$	.....	103	i.	∞	∞
3285	col. lq.	$1.530^{25°}$	−82	71.0	d.	.....	.....
3286	col. lq.	$1.494^{17.2°}$	.....	24.9	i.	∞	∞
3287	gas	.....	.....	$20^{40atm.}$	75 cc.	500 cc.	sl. s. chl.
3288	gas	$0.815^{-200°}$	−92 ±	−21	v. s.	v. s.	v. s.
3289	wh. solid	$1.17^{65°}$	64; subl. 46	114.5^{759mm}	$21^{25°}$; ∞ h.	s.	s.; sl. s. pet.
3290	wh. amor.	.....	150-60	subl. 120 ±	$20\text{-}30^{18°}$	i.	i.
3291	hyg. cr.	1.2	50-2 ±	d.	v. s.	v. s.	i.
3292	nd./aq.	.....	.....	.....	s.; d. alk.	sl. s.; d. a.	s. Me al.
3293	nd.	.....	.....	.....	s.	.....	.....
3294	col. lq.	.....	.....	84	10-20	.....	.....
3295	hyg. nd./aq.	.....	63-4	d. >125	50-60	i. abs.	i.; i. bz.
3296	lq.	$1.139^{\frac{20°}{4}}$	2	193	∞	∞	v. sl. s.
3297	.....	.....	.....	.....	.....	.....	.....
3298	rhb.	.....	104-5	.....	v. s.; i. bz.	v. sl. s.	v. sl. s.
3299	mn.	$1.147^{\frac{15°}{15}}$	47	216^{120mm}	sl. s.	v. s.	s.
3300	.....	.....	.....	.....	d.	v. sl. s.	.....
3301	col. lq.	$1.220^{\frac{20°}{4}}$	8.6	100.8	∞	∞	.....
3302	mn.	1.919	124	d.	70	sl. s.	i.; s. gly.
3303	cr.	.....	95	.....	$500^{100°}$	.....	.....
3304	exists only as salts	.....	.....	.....	.....	.....	.....
3305	nd./al.	.....	164-5*	.....	.....	s.	.....
3306	rhb./al.	$1.230^{\frac{20°}{4}}$	73-4	$189\text{-}90^{13mm}$	i.	s.	s.; s. bz.
3307	pl. or nd.	.....	54	.....	v. s. chl.	v. s.; s. bz.	v. s.
3308	lf./al.	.....	145-6	.....	s. h.	s.	sl. s. bz.
3309	pr./chl.	.....	247(218)	subl. 150	sl. s. h.	sl. s.	sl. s.; s. bz.
3310	nd./al.	.....	$-H_2O$, 110	.....	s. h.	s. h.	i.
3311	syrup	.....	.....	.....	.....	s.	i.
3312	nd.	.....	145	.....	v. s.	v. sl. s.	.....
3313	pr./al.	.....	145 d.	.....	v. s.; i. bz.	v. s.	v. sl. s.
3314	col. pr.	$1.635^{\frac{20°}{4}}$	286-7**; subl. 7^{200}	290	$0.71^{17°}$; $9.8^{100°}$	$5.75^{29.7°}$	0.725^{0}
3315	pr./aq.	.....	d. 265-70	.....	s. h.	sl. s. h.	i. ac.; i. chl.
3316	col. lq.	$1.415^{\frac{20°}{20}}$	.....	161-4	d.	d.	.....
3317	lq.	$1.111^{\frac{20°}{20}}$	.....	144^{732mm}	.....	.....	.....
3318	lq.	$1.159^{\frac{20°}{4}}$	−38.7	161.7^{760mm}	$9.1^{13°}$	∞	∞

* When heated rapidly, m. p. 176-7°. ** In sealed tube.

Forsling's acid-II 4550
Frangulin, cf. glcde.
Frangulinic acid 2874
Franguloside, cf. glcde.
Fraxin, cf. glcde.
Fraxinin, cf. glcde.
Freon 2246
Fructose 3616
Fructosone 3368
Fruit sugar 3616
Fuchsine 5571
Fuchsine (para) 5039
Fuchsine carbinol base 5570
Fuchsone 2741
Fumarine, cf. alkd.
Fumaryl chloride 3316
Furacrolein 3347
Furan 3327
Furan carboxylic acid 3339-40
Furan tetrahydride 5773
Furfuracrolein 3347
Furfuraldehyde 3246

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3319	**Furfural** acetone	.....	$C_4H_3O{\cdot}CH{:}CH{\cdot}CO{\cdot}CH_3$	XVII-306	136.14
3320	acetophenone (ω)	.....	$C_4H_3O{\cdot}CH{:}CH{\cdot}CO{\cdot}C_6H_5$	XVII-353	198.21
3321	diacetate	.....	$C_4H_3O{\cdot}CH(O_2C{\cdot}CH_3)_2$	XVII-278	198.17
3322	oxime (α)(*syn*)	furfuraldoxime	$C_4H_3O{\cdot}CH{:}NOH$	XVII-281	111.10
3323	oxime (β)(*anti*)	.....	$C_4H_3O{\cdot}CH{:}NOH$	XVII-281	111.10
3324	phenylhydrazone	.....	$C_4H_3O{\cdot}CH{:}N{\cdot}NH{\cdot}C_6H_5$	XVII-282	186.21
3325	2-thiohydantoin (5)	.....	$CO{\cdot}NH{\cdot}CS{\cdot}NH{\cdot}C(CH{\cdot}C_4H_3O)$	.....	194.20
3326	**Furfuramide**	.....	$(C_5H_4O)_3N_2$	XVII-281	268.26
3327	**Furfuran**	furan	$CH{:}CH{\cdot}CH{:}CH{\cdot}O$	XVII-27	68.07
3328	**Furil** (α,α)	difurfuroyl	$(C_4H_3O{\cdot}CO)_2$	XIX-166	190.15
3329	dioxime (*syn*)(α)	.....	$(C_4H_3O{\cdot}C{:}NOH)_2{\cdot}H_2O$	XIX-166	238.20
3330	dioxime (β)	.....	$(C_4H_3O{\cdot}C{:}NOH)_2$	XIX-166	220.18
3331	**Furfuryl** acetate	.....	$C_4H_3O{\cdot}CH_2{\cdot}O_2C{\cdot}CH_3$	XVII-112	140.13
3332	alcohol	α-furyl carbinol	$C_4H_3O{\cdot}CH_2OH$	XVII-112	98.10
3333	amine	.....	$C_4H_3O{\cdot}CH_2NH_2$	XVIII-584	97.11
3334	butyrate (α)	.....	$C_3H_7CO_2{\cdot}CH_2{\cdot}C_4H_3O$	.....	168.19
3335	chloride (α)	.....	$C_4H_3O{\cdot}CH_2Cl$	.....	116.55
3336	furoate (α)	furfuryl pyromucate	$C_4H_3O{\cdot}CO_2{\cdot}CH_2{\cdot}C_4H_3O$	.....	192.16
3337	mercaptan (α)	.....	$C_4H_3O{\cdot}CH_2{\cdot}SH$	.....	114.16
3338	propionate (α)	.....	$C_2H_5CO_2{\cdot}CH_2{\cdot}C_4H_3O$	.....	154.16
3339	**Furoic** acid (β)(3)	.....	$C_4H_3O{\cdot}CO_2H$	*XVIII-439	112.08
3340	acid (α)(2)	pyromucic acid	$C_4H_3O{\cdot}CO_2H$	XVIII-272	112.08
3341	amide (α)	pyromucamide	$C_4H_3O{\cdot}CO{\cdot}NH_2$	XVIII-276	111.10
3342	amide (β)	.....	$C_4H_3O{\cdot}CO{\cdot}NH_2$	.....	111.10
3343	anhydride (α)	pyromucic anhydride	$(C_4H_3O{\cdot}CO)_2O$	XVIII-276	206.15
3344	chloride (α)	furoyl chloride	$C_4H_3O{\cdot}COCl$	XVIII-276	130.53
3345	nitrile (α)	2-cyanofuran	$C_4H_3O{\cdot}CN$	XVIII-278	93.08
3346	**Furoin** (α,α)	.....	$C_4H_3O{\cdot}CHOH{\cdot}CO{\cdot}C_4H_3O$	XIX-204	192.16
3347	**Furyl**-acrolein	fur (fur)acrolein	$C_4H_3O{\cdot}CH{:}CH{\cdot}CHO$	XVII-305	122.12
3348	acrolein oxime	.....	$C_4H_3O{\cdot}(CH)_3NOH$	.....	137.13
3349	acrylamide	.....	$C_4H_3O{\cdot}CH{:}CH{\cdot}CO{\cdot}NH_2$	XVIII-300	137.13
3350	acrylic acid	(stable form)	$C_4H_3O{\cdot}CH{:}CH{\cdot}CO_2H$	XVIII-300	138.12
3351	acrylic acid	(labile form)	$C_6H_5O{\cdot}CO_2H$	XVIII-301	138.12
3352	**Gallamide** (3,4,5;1)	gallamic acid	$(HO)_3C_6H_2{\cdot}CONH_2{\cdot}1\frac{1}{2}H_2O$	X-487	196.16
3353	**Gallocyanine**	solid violet	$C_{15}H_{12}O_5N_2$	XXVII-438	300.26
3354	**Geranyl** acetate	geraniol acetate	$CH_3CO_2{\cdot}C_{10}H_{17}$	II-140	196.28
3355	*n*-butyrate	.....	$C_3H_7{\cdot}CO_2{\cdot}C_{10}H_{17}$	II-272	224.33
3356	formate	.....	$H{\cdot}CO_2{\cdot}C_{10}H_{17}$	II-23	182.25
3357	**Germanium tetra-ethyl**	tetraEt germanium	$(C_2H_5)_4Ge$	IV-631	188.84

Furfuraldoxime 3322-3
Furfurol 3318
Furfuryl pyromucate 3336
Furfurylidene, cf. furfural.
Furoyl chloride 3344
Furyl, cf. also furfuryl.
Furyl carbinol 3332
Furyl cyanide 3345
Furylidene acetic acid 3350-1
Fustic 5806
Fustin, cf. glode.
G acid 4495-6
Galactonic acid 3946
Galactose 3617
Gallacetophenone 6211
Gallamic acid 3352
Gallic acid 6223
Gallic acid dimethyl ether 5686
Gallic acid trimethyl ether 6242
Gallicin 4249
Gallobromol 1841
Gamma acid 338
Garantose 5579
Gardenal 5113

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3319	col. nd.	.....	39-40	135-7^{33mm}	i.	s.	s.; s. chl.
3320	oil	1.114$^{20°}$	.....	317	.....	.....	.....
3321	col. cr./pet.	.....	52-3	220	i.; s. bz.	s.	v. s.
3322	nd./lg.	.....	90-1	201-8 sl. d.	v. sl. s. c.	s.; s. bz.	s.; s. ac.
3323	nd./lg.	.....	74-5	.....	sl. s.	v. s.; s. bz.	v. s.
3324	yel. lf./al.	.....	97-8	.....	i.; i. lg.	s.	s.
3325	gn. cr.	.....	250-2	.....	i.	sl. s.	i.
3326	nd./al.	.....	117-21	250 d.	i.; d. a.	s.	s.
3327	col. lq.	0.937$^{\frac{20°}{4°}}$	.....	31-2^{756mm}	i.	s.	s.
3328	yel. nd./bz.	.....	165-6	.....	i.; s. chl.	sl. s.	sl. s.
3329	col. nd./aq.	.....	166-8	.....	v. sl. s. bz.	v. s.	v. s.
3330	cr./lg.-et.	.....	188-90 d.	.....	.....	.....	v. sl. s.
3331	col. oil	1.118$^{\frac{20°}{4°}}$	.....	175-7	i.	s.	s.
3332	oil	1.129$^{\frac{25°}{4°}}$	.....	169.5^{752mm}	∞; slow d.	s.	s.
3333	lq.	<1	.....	145^{754mm}	∞	s.	s.
3334	col. lq.	1.053$^{\frac{20°}{4°}}$	.....	212-3	v. sl. s.	s.	∞
3335	col. lq.	1.178$^{\frac{20°}{4°}}$	.....	49^{26mm}	i.	s.	s.
3336	col. lq.	α1.33 β1.40	α19.5 β27.5	>350^{760} d.	i.; i. pet.	∞; ∞ bz.	∞; ∞ chl.
3337	col. oil	1.132$^{\frac{20°}{4°}}$	.....	84^{65mm}	i.	.....	.....
3338	col. lq.	1.109$^{\frac{20°}{4°}}$	.....	195-6	v. sl. s.	s.	∞
3339	col. nd./aq.	.....	121-2	105-10^{12mm}	s. h.	s.	v. s.
3340	mn. pr.	.....	133-4 subl.>100	230-2 d. >250	3.6$^{15°}$; 25 h.	s.	s.
3341	cr.	.....	142-3	subl. >100	.....	.....	.....
3342	cr.	.....	169	.....	.....	.....	.....
3343	nd./al.	.....	73	325 d.	.....	s.	s.
3344	col. lq.	.....	−2 to 0	173-6	sl. d. h.	sl. d. h.	s.
3345	col. lq.	.....	.....	146-8	v. sl. s.	∞	∞
3346	pa. brn. nd./Me al.	.....	138-9	d.	v. sl. s. h.	sl. s. h.; s. h. toluene	sl. s.
3347	yel. nd./lg.	.....	54	>200 d.	i.	s.	s.
3348	yel. nd.	.....	103-5	.....	i.	s.	s.
3349	sc./aq.	.....	168-9	.....	v. sl. s. c.	.....	.....
3350	nd./aq.	.....	141	286 d.; in vac. subl.	0.2 c.; s. h.	s.; v. s. ac.; 1.5$^{19°}$ bz.	v. s.; i. lg.; i. CS_2
3351	pr. or pl.	.....	103-4	.....	s. h.	7.5$^{19°}$ bz.	.....
3352	lf./aq.	.....	.....	244 d. (anh.)	s. h.	s.	.....
3353	gn. cr.	.....	.....	.....	v. sl. s. h.	s.; s. act.	s. alk.
3354	col. lq.	0.917$^{15°}$	.....	242-5^{764} d.	v. sl. s.	s.	∞
3355	col. lq.	0.901$^{\frac{17°}{4°}}$	.....	151-3^{18mm}	i.	s.	s.
3356	col. lq.	0.927$^{\frac{20°}{4°}}$	.....	113-4^{15mm}	i.	s.	s.
3357	col. lq.	0.991$^{\frac{24.5°}{24.5°}}$	.....	160	i.	.....	.....

Gardenidin 1555
Gardenin 1555
Garlic oil 1684
Gas (for war) 1247; 1303; 1473; 1985; 4697
Gaultherin, cf. glcde.
GC solvent 3446
Gelsemine, cf. alkd.
Gelseminic acid 5604
Gelseminine, cf. alkd.
Genol 4117
Gentian violet base 3592
Gentian violet dye salt 3593
Gentisic acid 2317
Geoffroyine 4405
Geranial 1512
Geraniol 2517
Geraniol acetate 3354
Geraniol butyrate 3355
Geraniol formate 3356
Geraniol tetrahydride 2520
Geraniolene 2492
Glaucine, cf. alkd.
Glaurin 2234

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3358	**Gluco-α-heptose** (*d*)	.....	$C_7H_{14}O_7$	I-934	210.18
3359	**Gluconic** acid	.....	$CH_2OH(CHOH)_4 \cdot CO_2H$	III-542	196.16
3360	Ca salt	Ca gluconate	$C_{12}H_{22}O_{14}Ca \cdot H_2O$	III-544	448.39
3361	δ-lactone	glucono-δ-lactone	$C_6H_{10}O_6$	*XVIII-405	178.14
3362	**Glucose** (α) penta-acetate (*d*)	penta-acetyl glucose	$C_6H_7O_6(COCH_3)_5$	II-159	390.34
3363	(β)pentacetate (*d*)	.....	$C_6H_7O_6(COCH_3)_5$	II-159	390.34
3364	pentabutyrate	.....	$C_6H_7O_6(COC_3H_7)_5$	.....	530.60
3365	pentapropionate	.....	$C_6H_7O_6(COC_2H_5)_5$	.....	460.47
3366	phenylhydrazone	(*d*)(α)	$C_6H_5NH \cdot N : C_6H_{12}O_5$	XV-221	270.28
3367	phenylhydrazone (β)	.....	$C_6H_5NH \cdot N : C_6H_{12}O_5$	XV-221	270.28
3368	**Glucosone** (*d*)	fructosone	$C_4H_9O_4 \cdot CO \cdot CHO$	I-932	178.14
3369	**Glucosoxime** (*d*)	.....	$C_6H_{12}O_5 : NOH$	I-902	195.17
3370	**Glutaconic acid**	pentendioic acid	$HO_2C \cdot CH_2 \cdot CH : CH \cdot CO_2H$	II-758	130.10
3371	**Glutamic** acid (*dl*)	glutaminic acid	$HO_2C \cdot CHNH_2 \cdot (CH_2)_2 \cdot CO_2H$	IV-493	147.13
3372	acid (*l*)(+)	α-NH_2-glutaric	$C_5H_9O_4N$	IV-488	147.13
3373	acid HCl (*d*)	acidulin	$C_5H_9O_4N \cdot HCl$	IV-491	183.60
3374	amide (*dl*)	glutamine	$HO_2C \cdot C_3H_5NH_2 \cdot CO \cdot NH_2$	IV-491	146.15
3375	amide (*l*)(+)	*l*-glutamine	$C_5H_{10}O_3N_2$	IV-491	146.15
3376	**Glutaric** acid	pentandioic acid	$CH_2(CH_2 \cdot CO_2H)_2$	II-631	132.11
3377	nitrile	.....	$CH_2(CH_2 \cdot CN)_2$	II-635	94.11
3378	**Glutathione**	.....	$C_{10}H_{17}O_6N_3S$	.....	307.32
3379	**Glyceric** acid (*dl*)	dihydroxy-propionic	$HOCH_2CHOH \cdot CO_2H$	III-392	106.08
3380	aldehyde (*dl*)	.....	$HOCH_2CHOH \cdot CHO$	I-845	90.08
3381	**Glycerol**	glycerin	$CHOH(CH_2OH)_2$	I-502	92.09
3382	acetate, mono	monacetin †	$C_5H_{10}O_4$	II-146	134.13
3383	acetate, di	diacetin	$HO \cdot C_3H_5(O_2C \cdot CH_3)_2$	II-147	176.17
3384	amine, di (αγ)	1,3-diNH_2-2-propanol	$CHOH(CH_2NH_2)_2$	IV-290	90.13
3385	amine, mono (α)	1-NH_2-2,3-propandiol	$CH_2OH \cdot CHOH \cdot CH_2 \cdot NH_2$	IV-301	91.11
3386	*iso*-amyl ether	(di)(αγ)	$(C_5H_{11}OCH_2)_2 : CHOH$	I-513	232.35
3387	*iso*-amyl ether	(mono)(α)	$CH_2OH \cdot CHOH \cdot CH_2 \cdot O \cdot C_5H_{11}$	I-513	162.22
3388	bromohydrin, di (α)	1,3-dibromo-2-propanol	$(CH_2Br)_2 : CHOH$	I-365	217.91
3389	bromohydrin, di (β)	2,3-dibromo-1-propanol	$Br \cdot CH_2 \cdot CHBr \cdot CH_2OH$	I-357	217.91
3390	*n*-butyl ether	(di)(αγ)	$(C_4H_9OCH_2)_2 : CHOH$	.....	204.30
3391	*n*-butyl ether	(mono)(α)	$CH_2OH \cdot CHOH \cdot CH_2 \cdot O \cdot C_4H_9$	.....	148.20
3392	*n*-butyrate, mono	α-monobutyrin	$C_3H_7CO_2 \cdot CH_2 \cdot CHOH \cdot CH_2OH$	II-273	162.18
3393	chlorohydrin, di (α)	1,3-dichloro-2-propanol	$(CH_2Cl)_2 : CHOH$	I-364	128.99
3394	chlorohydrin, di (β)	2,3-dichloro-1-propanol	$Cl \cdot CH_2 \cdot CHCl \cdot CH_2OH$	I-356	128.99

† Mixture of both isomers.

Gluco-chloral 1289
Gluco-gallin, cf. glcde.
Glucosamine (*iso*) 3311
Glucose 3618
Glucose dimethyl-ketal 60
Glucosido-methyl salicylate, cf. glcde.
Glucosido-salicylaldehyde, cf. glcde.
Gluside 5579
Glutamine 3374-5

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3358	rhb.	.....	180-90 d.	.....	$10^{14°}$; v. s. h.	v. sl. s. abs. al.	.....
3359	syrup	.....	.....	.....	s.	i. abs. al.	i.
3360	col. nd./aq.	.....	.....	.....	$3.8^{16.5°}$	i.	20 h. aq.
3361	nd./al.	.....	153	.....	d.	.....	.....
3362	mn. nd./al.	.....	112-3	.....	$0.15^{18.5°}$; i. pet.	$1.3^{19°}$ abs. al.	$2.8^{15°}$
3363	mn. nd./al.	.....	131-2	subl. vac.	$0.1^{18°}$; i. pet.	$0.8^{19°}$ abs. al.	$2.1^{15°}$
3364	pa. yel. lq.	$1.094^{25°}$	.....	$228^{1.5mm}$	i.	s.	s.; s. chl.
3365	pa. yel. lq.	$1.151^{25°}$	.....	.....	i.	s.	s.; s. chl.
3366	col. cr.	.....	159-60	.....	s.	sl. s. c.	sl. s. c.
3367	col. cr.	.....	140-1	.....	sl. s.	sl. s. c.	v. sl. s. c.
3368	amor.	.....	.....	.....	s.	s. h.	i.
3369	nd./Me al.	.....	137-8	.....	v. s.	v. sl. s.	i.
3370	pr./et.	.....	137-8	.....	v. s.	v. s.	v. s.
3371	cr./aq.	1.460	199 d.	.....	$1.5^{20°}$	v. sl. s.	v. sl. s.
3372	rhb.	$1.538^{20°}_{4}$	224-5 d.	.....	$0.7^{20°}$	i. abs.	i.
3373	rhb.	.....	202-4*	.....	33.3 c.*	i. HCl	.....
3374	nd./aq.	.....	256	.....	$3.6^{18°}$	v. sl. s.	.....
3375	nd./aq. al.	.....	186	.....	$3.6^{18°}$	$0.0005^{25°}$	v. sl. s.
3376	col. cr.	$1.429^{15°}$	97.5	200^{20mm}	$63.9^{20°}$	v. s. abs.	v. s.; s. bz.
3377	col. lq.	$0.989^{25°}$	−29	285-7	s.	s.	i.
3378	col. pr.	.....	190-2 d.	.....	s. c.; d. h.	i. abs.	i.; i. ac.
3379	syrup	.....	.....	.....	∞	∞	i.
3380	nd. or pr.	.....	142	.....	s.	sl. s.	sl. s.
3381	col. lq.	$1.260^{20°}_{4}$	17.9**	290	∞; i. bz.	∞; i. pet.	i.; i. chl.
3382	col. oil	$1.20^{20°}_{4}$	.....	158^{165mm}	v. s.	v. s.	sl. s.; i. bz.
3383	col. lq.	$1.178^{15°}_{15}$	40	$175\text{-}6^{40mm}$	s.	s.	sl. s.
3384	col. hyg.	$1.096^{25°}_{25}$	42	130^{10mm} ±	∞; d. act.	∞; i. bz.	i.; i. CCl_4
3385	oil	$1.185^{25°}_{25}$	.....	264 sl. d.	s.	s.	i.; i. bz.
3386	col. lq.	$0.903^{25°}_{25}$	.....	270-2	i.	∞	∞
3387	col. lq.	$0.987^{25°}_{25}$	.....	260-2	s.	∞	∞
3388	col. lq.	$2.11^{18°}$	.....	219	i.	.....	.....
3389	col. lq.	$2.168^{0°}$	.....	219 sl. d.	.....	.....	.....
3390	col. lq.	.....	.....	$121\text{-}5^{13mm}$	i.	∞	∞
3391	col. lq.	$0.945^{25°}_{25}$	.....	$133\text{-}7^{18mm}$	s.	∞	∞
3392	col. lq.	1.09	.....	269-71	∞	.....	.....
3393	col. lq.	$1.367^{20°}_{4}$	<−20	174.3^{760mm}	$12^{20°}$, $19^{70°}$	∞	∞
3394	col. lq.	$1.362^{20°}_{4}$	.....	182-3	14.5	.....	.....

* Heated rapidly, m. p. 213°; d. − HCl, in aq.
** Solidifies at much lower temp.
Glutaminic acid 3371
Glycerin(e) 3381
Glycerol, cf. also glyceryl.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Glycerol				
3395	chlorohydrin, mono	α-chlorohydrin	$CH_2Cl{\cdot}CHOH{\cdot}CH_2OH$	I-473	110.54
3396	chlorohydrin, mono	β-chlorohydrin	$CHCl(CH_2OH)_2$	I-476	110.54
3397	formal *	.....	$H_2C{:}C_3H_6O_3$	.....	104.10
3398	formate, di *	.....	$(HCO_2)_2C_3H_6O$	II-24	148.11
3399	furfural *	.....	$C_5H_4O{:}C_3H_6O_3$	.....	170.16
3400	guaiacol ether, mono	guaiamar; aresol; oreson	$CH_3O{\cdot}C_6H_4{\cdot}O{\cdot}C_3H_5(OH)_2$	.....	198.21
3401	iodohydrin, di (α)	1,3-diiodo-2-propanol; iotone	$(CH_2I)_2{:}CHOH$	I-366	311.92
3402	iodohydrin, mono (α)	3-iodo-1,2-propandiol; alival	$CH_2I{\cdot}CHOH{\cdot}CH_2OH$	I-475	202.01
3403	methyl ether, di	(αγ)	$(CH_3OCH_2)_2CHOH$	I-512	120.15
3404	methyl ether, mono	(α)	$CH_3O{\cdot}C_3H_5(OH)_2$	I-512	106.12
3405	nitrate, di (1,2)	.....	$C_3H_3(OH)(O{\cdot}NO_2)_2$	I-515	182.09
3406	nitrate, di (1,3)	.....	$CHOH(CH_2NO_3)_2$	I-515	182.09
3407	nitrate, mono (α)	.....	$(HO)_2C_3H_5{\cdot}O{\cdot}NO_2$	I-514	137.09
3408	nitrate, mono (β)	.....	$(CH_2OH)_2CH_2O{\cdot}NO_2$	I-515	137.09
3409	phenyl ether, di	(αγ)	$(C_6H_5OCH_2)_2CHOH$	VI-149	244.28
3410	phenyl ether, mono (α)	antodyne	$C_6H_5{\cdot}O{\cdot}CH_2{\cdot}CHOH{\cdot}CH_2OH$	VI-149	168.19
3411	phosphoric acid	.....	$(HO)_2C_3H_5{\cdot}OPO_3H_2$	I-517	172.08
3412	phosphate, sodium	(β)	$(HOCH_2)_2CH{\cdot}O{\cdot}PO(ONa)_2{\cdot}5H_2O$	*I-517	306.14
3413	propionate, mono	α-monopropionin	$C_2H_5CO_2{\cdot}CH_2{\cdot}CHOH{\cdot}CH_2OH$	*II-107	148.16
3414	salicylate, mono (α or β)	monosalicylin	$HO{\cdot}C_6H_4CO_2{\cdot}C_3H_5(OH)_2$	X-82	212.20
3415	stearate, mono	α-monostearin	$C_{17}H_{35}CO_2{\cdot}CH_2{\cdot}CHOH{\cdot}CH_2OH$	II-380	358.55
3416	stearate, mono	β-monostearin	$C_{17}H_{35}CO_2{\cdot}CH{:}(CH_2OH)_2$	II-380	358.55
3417	**Glyceryl** ether	.....	$C_3H_5O_3{:}C_3H_5$	XIX-393	130.14
3418	triacetate	triacetin	$(CH_3CO_2)_3C_3H_5$	II-147	218.20
3419	triarachidate	triarachin	$(C_{19}H_{39}CO_2)_3C_3H_5$	II-390	975.61
3420	tribenzoate	tribenzoin	$(C_6H_5CO_2)_3C_3H_5$	IX-140	404.40
3421	tributyrate	tributyrin	$(C_3H_7CO_2)_3C_3H_5$	II-273	302.36
3422	tricaprate	tricaprin	$(C_9H_{19}CO_2)_3C_3H_5$	II-356	554.83
3423	tricaproate	tricaproin	$(C_5H_{11}CO_2)_3C_3H_5$	II-324	386.51
3424	tricaprylate	tricaprylin	$(C_7H_{15}CO_2)_3C_3H_5$	II-348	470.67
3425	triheptylate	triheptylin	$(C_6H_{13}CO_2)_3C_3H_5$	.....	428.59
3426	trilaurate	trilaurin	$(C_{11}H_{23}CO_2)_3C_3H_5$	II-362	638.98
3427	trimyristate	trimyristin	$(C_{13}H_{27}CO_2)_3C_3H_5$	II-367	723.14
3428	trinitrate	nitroglycerin	$(O_2N{\cdot}O)_3C_3H_5$	I-516	227.09
3429	trinitrite	.....	$(ON{\cdot}O)_3C_3H_5$	I-514	179.09
3430	trioleate	triolein	$(C_{17}H_{33}CO_2)_3C_3H_5$	II-468	885.40
3431	tripalmitate	tripalmitin	$(C_{15}H_{31}CO_2)_3C_3H_5$	II-373	807.29
3432	tripropionate	tripropionin	$(C_2H_5CO_2)_3C_3H_5$	*II-107	260.28
3433	tristearate	tristearin	$(C_{17}H_{35}CO_2)_3C_3H_5$	II-383	891.45
3434	trivalerate	trivalerin	$(C_4H_9CO_2)_3C_3H_5$	.....	344.44

* Mixture of both isomers.
Glyceryl, cf. also glycerol.

Glyceryl-amine 3384-5
Glyceryl diacetate 3383

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3395	col. lq.	1.318^{25}_{25}°	.....	213	∞	∞	s.
3396	col. lq.	1.321^{20}_{4}°	.....	146^{18mm}	.....	.....	.....
3397	col. lq.	1.220^{25}_{25}°	.....	192-5	∞	∞	∞
3398	col. lq.	1.304^{15}°	.....	$163\text{-}6^{30mm}$	i. CS_2	.....	.....
3399	yel. lq.	1.267^{25}_{25}°	.....	$163\text{-}7^{22mm}$	s.	∞	sl. s.
3400	col. cr. pd.	.....	78-9	.....	5	s.	s.; s. chl.
3401	yel. oil	2.41^{15}°	freezes −16 to −20	d.	1.3; d. alk.	∞; ∞ bz.	∞; ∞ chl.
3402	col. cr.	2.03^{13}°	49 ±	.....	v. s.	v. s.	.....
3403	col. lq.	1.004^{25}_{4}°	.....	169	∞	∞	∞
3404	col. lq.	1.111^{25}_{4}°	.....	220	∞	∞	s.
3405	oil	.....	expl.	.....	d. by a.	d. by alk.	.....
3406	oil	1.47^{15}°	<−30; expl.	$146\text{-}8^{15mm}$ sl. d.	d. by a., alk.	v. s.	v. s.
3407	col. pr.	1.40	58-9	155-60*	70^{15}°	v. s.	v. sl. s.
3408	lf.	1.40	54	155-60	.....	v. s.	sl. s.
3409	col. hex.	1.179^{2}_{4}°	80-1	$200\text{-}10^{10mm}$	i.; s. bz.	s. h.	s.; s. chl.
3410	col. nd./ abs. et.	1.225^{30}_{4}°	69-70 (53-4)	200^{22mm}	∞; v. sl. s. lg.	∞; v. s. bz.	∞
3411	syrup	1.59^{14}°	−20	.....	∞	∞ abs.	.....
3412	pl./aq.	.....	98-100	d. >130	66 c.	.....	.....
3413	col. lq.	1.154^{20}_{4}°	.....	$141\text{-}4^{6mm}$	.....	.....	.....
3414	col. nd./ et.	.....	76	.....	1 c.; v. s. h.	s.; ∞ gly.	sl. s.; s. h. bz.
3415	col. nd./ Me al.	0.984^{20}_{4}°	82(57)	.....	i.	s. h.	s.
3416	nd. or wax	.....	.....	.....	i.	s. h.	s.
3417	lq.	1.091^{18}°	.....	171-2	∞	∞	∞
3418	col. lq.	1.161^{17}_{4}°	−78	258-9	7	∞; ∞ chl.	∞; ∞ bz.
3419	col. cr.	.....	72.2	.....	i.	s. h.	s. h.
3420	nd./Me al.	1.228^{12}°	75-6	d.	i.; s. bz.	s. h.	s.; s. chl.
3421	col. lq.	1.032^{20}_{4}°	<−75	287-8	i.	s.	s.
3422	col. cr.	0.921^{40}_{4}°	31	.....	i.; s. bz.	s. h.	v. s.
3423	col. lq.	0.987^{20}_{4}°	−25	.....	i.	s. 85% al.	s.
3424	col. lq.	0.954^{20}_{4}°	9	.....	i.	s. 85% al.	s.
3425	col. lq.	0.969^{20}°	.....	$223\text{-}5^{3mm}$	i.	s.	s.
3426	col. nd.	0.894^{60}_{4}°	45-6	.....	v. s. bz.	sl. s. c.	v. s.
3427	lf.	0.885^{60}_{4}°	56.5(49)**	.....	i.; v. s. bz.	v. s.	v. s. chl.
3428	col. or yel. oil	1.601^{15}°	13.3(2.0)	160^{15mm}; expl. 270	0.18^{20}°	54^{20}° abs.	∞
3429	yel. lq.	1.291^{10}_{15}°	.....	150 sl. d.	d.; i. CS_2	d.; s. chl.	s.; s. bz.
3430	col. oil	0.915^{15}°	−4	240^{18mm} sl. d.	i.	sl. s.	v. s.
3431	col. nd.	0.866^{80}_{4}°	65.1(46)	$310\text{-}20^{0.1mm}$	i.	0.004^{21}° abs. al.	v. s.
3432	lq.	1.100^{20}_{15}°	.....	$177\text{-}82^{20mm}$	.....	.....	.....
3433	col. pr.	0.862^{80}_{4}°	70.8(54.5; 64.5)	.....	i.; s. bz.	s. h.	s. h.; sl. s. pet.
3434	pa. yel. lq.	1.030^{20}°	.....	$152\text{-}5^{1mm}$	i.	s.	s.

* Not explosive.
** Probably several other modifications.

Glyceryl tribromohydrin 6112
Glyceryl trichlorohydrin 6166

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Glyceryl				
3435	trivalerate (*iso*)	tri-*iso*-valerin	$(C_4H_9CO_2)_3C_3H_5$	II-314	344.44
3436	**Glycide**	glycidol; epihydrin alcohol	$CH_2{\cdot}O{\cdot}CH{\cdot}CH_2OH$ (epoxy)	XVII-104	74.08
3437	**Glycine**	amino-acetic acid	$NH_2{\cdot}CH_2{\cdot}CO_2H$	IV-333	75.07
3438	amide	.....	$NH_2{\cdot}CH_2{\cdot}CO{\cdot}NH_2$	IV-343	74.08
3439	anhydride	diketopiperazine	$C_4H_6O_2N_2$	XXIV-264	114.10
3440	**Glycocholic** acid	cholylglycine; "cholic acid"	$C_{24}H_{39}O_4{\cdot}NH{\cdot}CH_2{\cdot}CO_2H$	.....	465.61
3441	sodium salt	Na glycocholate	$C_{26}H_{42}O_6NNa$	.....	487.60
3442	**Glycocyamine**	guanyl glycine	$HN{:}C(NH_2){\cdot}NH{\cdot}CH_2CO_2H$	IV-359	117.11
3443	**Glycogen**	animal starch	$(C_6H_{10}O_5)_x$	.....	(162.14)
3444	**Glycol**	ethandiol-1,2	$HOCH_2{\cdot}CH_2OH$	I-465	62.07
3445	acetate, di	ethylene acetate	$(CH_3CO_2{\cdot}CH_2{\cdot})_2$	II-142	146.14
3446	acetate, mono	.....	$CH_3CO_2{\cdot}CH_2CH_2OH$	II-141	104.10
3447	benzoate, di	ethylene benzoate	$(C_6H_5CO_2{\cdot}CH_2)_2$	IX-129	270.27
3448	benzyl ether, di	.....	$(C_6H_5CH_2{\cdot}O{\cdot}CH_2)_2$	.....	242.30
3449	benzyl ether, mono	benzyl cellosolve	$C_7H_7O{\cdot}C_2H_4OH$	.....	152.19
3450	butyrate, di	ethylene dibutyrate	$(C_3H_7CO_2{\cdot}CH_2)_2$	II-272	202.24
3451	capr(o)ate, di	ethylene dicaprate	$(C_5H_{11}CO_2{\cdot}CH_2)_2$	.....	258.35
3452	caprylate, di	ethylene dicaprylate	$(C_7H_{15}CO_2{\cdot}CH_2)_2$	.....	314.45
3453	ether	diethylene glycol	$(HO{\cdot}CH_2{\cdot}CH_2)_2O$	I-468	106.12
3454	formal	dioxolane; glycol-methylene ether	$O{\cdot}CH_2{\cdot}CH_2{\cdot}O{\cdot}CH_2$ (cyclic)	XIX-2	74.08
3455	formate, di	ethylene formate	$(HCO_2{\cdot}CH_2)_2$	II-23	118.09
3456	formate, mono	.....	$HCO_2{\cdot}CH_2{\cdot}CH_2OH$	II-23	90.08
3457	guaiacyl ether, di	.....	$(CH_3OC_6H_4O{\cdot}CH_2)_2$	.....	274.30
3458	laurate, di	ethylene dilaurate	$(C_{11}H_{23}CO_2{\cdot}CH_2)_2$	II-361	426.66
3459	methyl ether, di	diMeO-ethane	$(CH_3{\cdot}O{\cdot}CH_2)_2$	I-467	90.12
3460	methyl ether, mono	methyl cellosolve	$CH_3O(CH_2)_2OH$	I-467	76.09
3461	myristate, di	ethylene dimyristate	$(C_{13}H_{27}CO_2{\cdot}CH_2)_2$	II-366	482.76
3462	nitrate, di	dinitroglycol	$(O_2N{\cdot}O{\cdot}CH_2)_2$	I-469	152.07
3463	nitrite, di	ethylene nitrite	$(ON{\cdot}O{\cdot}CH_2)_2$	I-469	120.07
3464	palmitate, di	ethylene dipalmitate	$(C_{15}H_{31}CO_2{\cdot}CH_2)_2$	II-373	538.87
3465	propionate, di	ethylene dipropionate	$(C_2H_5CO_2{\cdot}CH_2)_2$	II-242	174.19
3466	salicylate, mono	glysal; spirosal	$C_7H_5O_3{\cdot}C_2H_4OH$	X-81	182.17
3467	stearate, di	ethylene distearate	$(C_{17}H_{35}CO_2{\cdot}CH_2)_2$	II-380	594.97
3468	**Glycolic** acid	hydroxy-acetic acid	$HO{\cdot}CH_2{\cdot}CO_2H$	III-228	76.05
3469	Ca salt	calcium glycolate	$C_4H_6O_6Ca{\cdot}4H_2O$	III-232	262.23
3470	aldehyde	hydroxy-acetaldehyde	$HO{\cdot}CH_2{\cdot}CHO$	I-817	60.05
3471	aldehyde-diethyl-acetal	.....	$HO{\cdot}CH_2{\cdot}CH{:}(OC_2H_5)_2$	I-818	134.17
3472	amide	hydroxy-acetamide	$HO{\cdot}CH_2{\cdot}CO{\cdot}NH_2$	III-240	75.07
3473	anhydride	.....	$(HO{\cdot}CH_2{\cdot}CO)_2O$	III-239	134.09
3474	nitrile	.....	$HO{\cdot}CH_2{\cdot}CN$	III-242	57.05
3475	**Glycolide**	glycolid	$CH_2{\cdot}CO_2{\cdot}CH_2{\cdot}CO{\cdot}O$ (cyclic)	XIX-153	116.07
3476	**Glycyl** glycine	.....	$H_2N{\cdot}CH_2{\cdot}CO{\cdot}NH{\cdot}CH_2{\cdot}CO_2H$	IV-371	132.12
3477	glycine ester	.....	$C_3H_7ON_2{\cdot}CO_2C_2H_5$	IV-373	160.17
3478	**Glyoxal**	ethandial	$O{:}CH{\cdot}CH{:}O$	I-759	58.04

Glycidol 3436
Glycin (photo) 3800
Glycine ethyl ester 3057
Glycine phenetidide 5115
Glycocol 3437
Glycol acetal 3207
Glycol amide 3472
Glycol bromohydrin 3193
Glycol chlorohydrin 3194
Glycol cyanohydrin 3195
Glycol dibromide 1837
Glycol dichloride 1994
Glycol diiodide 2391
Glycol ethyl ether 1265
Glycol ethylidene-diacetal 3207

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3435	oil	$0.998^{20°}$	.....	$153\text{-}6^{2mm}$	.....	.....	.....
3436	col. lq.	$1.114^{16}_{16}°$	.....	166-7 sl. d.	∞; sl. s. pet.	∞; sl. s. xylene	∞; s. bz.
3437	mn.	1.161	232-6 d.	.....	23 c.	0.1 c.	i.
3438	hyg. nd.	.....	65-7	.....	v. s.	v. s.	v. sl. s.
3439	pl./aq.	.....	275 d.	subl. 260	s. h.	s.; d. a.	d. alk.
3440	nd.	.....	154-5 d.	.....	$3.3^{20°}$; $8.5^{100°}$	v. s.; v. sl. s. bz.	$0.09^{20°}$; v. sl. s. chl.
3441	hyg. pd.	.....	.....	.....	s.	s.	.....
3442	nd./aq.	.....	d.	.....	$0.45^{15°}$	v. sl. s.	v. sl. s.
3443	wh. pd.	.....	240	.....	s.	i.	i.
3444	col. lq.	$1.113^{19}_{4}°$	−15.6	197.4	∞	∞	1.0
3445	col. lq.	$1.109^{11}_{4}°$	−31	190.5	$14.3^{22°}$	∞	∞
3446	col. lq.	1.108	.....	182	∞	∞	.....
3447	rhb./et.	.....	73-4	>360	i.	.....	s.
3448	col. lq.	.....	.....	$131\text{-}6^{2mm}$	.....	.....	.....
3449	col. lq.	1.07	<−75	256	0.4	.....	.....
3450	col. lq.	$1.024^{0°}$	.....	240	i.	v. s.	v. s.
3451	.....	.....	37-8	.....	.....	.....	.....
3452	pa. yel. lq.	.....	22	.....	i.	.....	.....
3453	lq.	$1.118^{20}_{20}°$	.....	244.8	∞; i. bz.	∞; i. chl.	i.
3454	lq.	$1.060^{20}_{4}°$	.....	75-6	∞	.....	.....
3455	lq.	.....	.....	174	.....	s.	s.
3456	lq.	$1.199^{15}_{4}°$	.....	180	.....	.....	.....
3457	col. nd.	.....	138-9	.....	v. sl. s.	s. h.	.....
3458	col. amor.	.....	52-4	188^{20mm}	i.	v. s.	v. s.
3459	lq.	$0.863^{20}_{4}°$	−58	84-5	∞	.....	.....
3460	col. lq.	$0.965^{20}_{4}°$	.....	124-5	∞	∞	∞; ∞ bz.
3461	.....	.....	63-4	$208^{0.1mm}$	.....	.....	.....
3462	yel. lq.	$1.482^{21}_{D}°$	−20	expl. 114	i.	s.	d. alk.
3463	lq.	$1.216^{0°}$	<−15	96-8	i.; d. alk.	s. d.	s.
3464	nd./al. chl.	.....	71-2	$226^{0.1mm}$	i.	s.	s.
3465	lq.	$1.045^{25°}$	.....	211-2	sl. s.	∞	∞
3466	col. cr.	.....	37	$169\text{-}70^{12mm}$	$0.97^{22°}$	v. s.; s. bz.	v. s.
3467	lf.	.....	76-7	$241^{0.1mm}$	i.	$0.12^{40°}$	v. s.
3468	nd./aq.	.....	79(63)	d.	v. s.	$90^{25°}$	v. s.
3469	nd.	.....	.....	.....	$1.3^{15°}$	$5^{100°}$ aq.	.....
3470	col. pl.	$1.366^{100°}$	95-7	.....	v. s.	v. s. h.	v. sl. s.
3471	lq.	$0.888^{24°}$	.....	167	d. h.	.....	.....
3472	rhb.	.....	120	.....	v. s.	sl. s.	.....
3473	cr. pd.	.....	128-30	.....	i. c.; d. h.	i.	i.
3474	col. oil	$1.104^{19°}$	<−72	183 sl. d.	v. s.	v. s.	v. s.; i. bz.
3475	lf./al.	.....	86-7	.....	s. h.; s. ac.	s. h.	sl. s. c.; s. h. chl.
3476	lf./aq.	.....	d. 215-20	.....	v. s. h.	sl. s.	i.
3477	nd.	.....	88-9	.....	v. s.	v. s.	sl. s.
3478	yel. cr.	$1.14^{20°}$	15	51^{776mm}	.....	v. s. abs.	v. s. abs.

Glycol iodohydrin 3208
Glycol methylene ether 3454
Glycol phenyl ether 5136
Glycolic ethyl ether 2912
Glycolic methyl ether 4063

Glycoline 2533
Glycoluril 139
Glycolyl thiourea 5907
Glycolyl urea 3679

Glycovanillin, cf. glcde.
Glycophillin, cf. glcde.
Glyoxalic acid 3480
Glyoxalin 3851

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3479	**Glyoxime**	.....	$HON{:}CH{\cdot}CH{:}NOH$	I-761	88.07
3480	**Glyoxylic acid**	glyoxalic acid	$HO_2C{\cdot}CH{:}O{\cdot}H_2O$	III-594	92.05
3481	**Guaiacol** acetate	.....	$CH_3OC_6H_4{\cdot}O_2CCH_3$	VI-774	166.17
3482	benzoate	benzosol	$CH_3OC_6H_4O_2C_7H_5$	IX-130	228.24
3483	*n*-caproate	.....	$CH_3OC_6H_4O_2C_6H_{11}$	.....	222.27
3484	carbonate	duotal	$(CH_3O{\cdot}C_6H_4O)_2CO$	VI-776	274.26
3485	cinnamate	styracol	$CH_3OC_6H_4O_2C_9H_7$	IX-585	254.27
3486	salicylate	guaiacol salol	$C_{14}H_{12}O_4$	X-81	244.24
3487	valerate	.....	$CH_3OC_6H_4O_2C_5H_9$	.....	208.25
3488	**Guanidine**	imino-urea	$(H_2N)_2C{:}NH$	III-82	59.07
3489	acetate	.....	$CH_5N_3{\cdot}HC_2H_3O_2$	III-86	119.13
3490	carbonate	.....	$(CH_5N_3)_2{\cdot}H_2CO_3$	III-86	180.17
3491	hydrochloride	.....	$CH_5N_3{\cdot}HCl$	III-86	95.54
3492	nitrate	.....	$CH_5N_3{\cdot}HNO_3$	III-86	122.09
3493	sulfate	.....	$(CH_5N_3)_2{\cdot}H_2SO_4{\cdot}\frac{1}{2}H_2O$	III-86	225.23
3494	thiocyanate	.....	$CH_5N_3{\cdot}HCNS$	III-169	118.16
3495	**Gynocardic acid**	.....	$C_{17}H_{33}CO_2H$	.....	282.45
3496	**Hedonal**	Me-*n*-Pr-carbinol-urethane	$H_2N{\cdot}CO_2{\cdot}CH(CH_3){\cdot}(CH_2CH_2CH_3)$	III-29	131.17
3497	**Helenin**	alantolactone	$C_{15}H_{20}O_2$	XVII-327	232.31
3498	**Hematein**	.....	$C_{16}H_{12}O_6$	XVIII-227	300.26
3499	**Hematin**	phenodin	$C_{34}H_{33}O_5N_4Fe$	.....	633.49
3500	**Hematoxylin**	hydroxybrasilin	$C_{16}H_{14}O_6{\cdot}3H_2O$	XVII-219	356.32
3501	**Hemin**	.....	$C_{34}H_{32}O_4N_4ClFe$	.....	651.94
3502	**Hemipinic acid** (3,4;1,2)	3,4-diMeO-phthalic acid	$(CH_3O)_2C_6H_2{:}(CO_2H)_2$ + aq.	X-543	226.18
3503	**Heneicosane** (*n*)	.....	$CH_3(CH_2)_{19}CH_3$	I-174	296.56
3504	**Heneicosene-9**	.....	$CH_3(CH_2)_7CH{:}CH(CH_2)_{10}CH_3$	I-227	294.55
3505	**Hentriacontane** (*n*)	.....	$CH_3(CH_2)_{29}CH_3$	I-177	436.82
3506	**Hepta**-chloropropane	(1,1,1,2,2,3,3)	$Cl_3C{\cdot}CCl_2{\cdot}CHCl_2$	I-108	285.24
3507	cosane (*n*)	.....	$CH_3(CH_2)_{25}CH_3$	I-176	380.72
3508	decane (*n*)	.....	$CH_3(CH_2)_{15}CH_3$	I-173	240.46
3509	decyl alcohol	heptadecanol-9	$[CH_3(CH_2)_7]_2CHOH$	I-430	256.46
3510	diene-2,4	.....	$CH_3{\cdot}(CH{:}CH)_2{\cdot}C_2H_5$	I-257	96.17
3511	**Heptandiol**-1,7	.....	$HO{\cdot}(CH_2)_7{\cdot}OH$	I-489	132.20
3512	**Heptane** (*n*)	.....	$CH_3{\cdot}(CH_2)_5{\cdot}CH_3$	I-154	100.20
3513	**Heptane** (*iso*)	2-methyl-hexane	$(CH_3)_2CH{\cdot}C_4H_9$	I-156	100.20
3514	**Heptane**	3-methyl-hexane	$C_3H_7{\cdot}CH(CH_3){\cdot}C_2H_5$	I-157	100.20
3515	**Heptane**	2,2-dimethyl-pentane	$(CH_3)_3C{\cdot}CH_2{\cdot}C_2H_5$	I-157	100.20
3516	**Heptane**	2,4-dimethyl-pentane	$[(CH_3)_2CH]_2CH_2$	I-158	100.20
3517	**Heptane**	3,3-dimethyl-pentane	$(CH_3)_2C(C_2H_5)_2$	I-158	100.20
3518	**Heptane**	3-ethyl-pentane	$(C_2H_5)_3CH$	I-157	100.20
3519	**Heptane**	2,2,3-triMe-butane	$(CH_3)_3C{\cdot}CH(CH_3)_2$	.....	100.20
3520	**Heptanoic** acid	oenanthylic acid	$CH_3(CH_2)_5CO_2H$	II-338	130.18
3521	aldehyde	oenanthole	$CH_3(CH_2)_5{\cdot}CHO$	I-695	114.18
3522	aldehyde oxime	enanthaldoxime	$CH_3(CH_2)_5{\cdot}CH{:}NOH$	I-698	129.20
3523	amide	*n*-heptamide	$CH_3(CH_2)_5CO{\cdot}NH_2$	II-340	129.20

Glyoxyl diureide 181
Glyoxylic nitrile 756
Glysal 3466
Gnoscopine, cf. alkd.
Gold orange 4328
Grain alcohol 2946
Grape sugar 3618
Gratiolin, cf. glcde.
Gratus strophanthin, cf. glcde.
Guaethol 2927
Guaiacof 4079
Guaiacol ethylene ether 3457
Guaiacol glyceryl ether 3400
Guaiacol salol 3486
Guaiamar 3400
Guajen 2508
Guanicaine 1760
Guanidine aminovaleric acid 575
Guanine, cf. alkd.
Guanyl glycine 3442
Guanyl hydrazine 322
Guanyl urea 2081
Guaranine, cf. alkd.
Guojol 2427

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3479	pr./aq.	.....	178	.....	v. s. h.	v. s.	v. s.
3480	cr.	.....	d.	.....	v. s.	.....	.....
3481	col. lq.	1.156^{0}	.....	240-1	.....	∞	∞
3482	col. cr. pd.	.....	57-8	.....	v. sl. s.	s. h.	s.; s. chl.
3483	col. lq.	.....	.....	$168\text{-}70^{15^\circ}$	i.	s.	s.
3484	cr.	.....	85-6	.....	i.	2; s. h.	7; s. bz.
3485	nd./al.	.....	130	.....	i.	s.; s. bz.	s.; s. chl.
3486	col. cr./al.	.....	65	.....	i.	s.	s.; s. chl.
3487	yel. lq.	1.05	.....	265	i.	s.; s. bz.	s.; s. chl.
3488	col. cr.	.....	.....	.....	v. s.	s.	.....
3489	nd.	.....	229-30	.....	v. s.	v. s.	i.
3490	col. cr.	1.25	197 d.	.....	50^{24°	0.2^{24°	.....
3491	col. cr.	.....	.....	.....	v. s.	s.	.....
3492	col. cr.	.....	214	.....	25.6^{20°	4.1^{20°	.....
3493	col. cr.	.....	.....	.....	v. s.	i.	.....
3494	col. lf.	.....	118	.....	73^{0°	135^{15° aq.	.....
3495	col. lf./al.	.....	67.5	.....	i.	s.	s.
3496	col. nd.	.....	74-6	215 ±	0.8^{35°	s.	s.; s. chl.
3497	nd./aq. al.	.....	76	275	v. sl. s. h.	s.; s. bz.	s.; s. chl.
3498	silv. nd.	.....	250 d.	.....	0.06^{20°; s. NH_4OH	sl. s.; i. chl.	0.013^{20°; i. bz.
3499	brn. pd.	.....	>200	.....	i.; s. alk.	i.; i. chl.	i.
3500	cr./aq. $(NH_4)_2SO_3$	.....	140(anh.)	$-H_2O$, 100-20	s. h.	s.; s. aq. borax	s.
3501	b. bl. rhb.	.....	.....	.....	i.; s. ac.	i.	i.; i. chl.
3502	mn.	.....	182-6 d.	.....	sl. s. c.	s.	0.09
3503	col. cr.	$0.778^{40.4^\circ}_{4^\circ}$	40.4	215^{5mm}	i.	.....	.....
3504	col. lq.	0.802^{20°	3	$201\text{-}2^{11mm}$	i.	.....	.....
3505	col. cr.	$0.781^{68.1^\circ}_{4}$	68.1	302^{15mm}	i.	.....	sl. s.
3506	col. cr.	$1.805^{34^\circ}_{4}$	30	247-8	.....	.....	.....
3507	col. cr.	$0.780^{59.5^\circ}_{4}$	59.5	270^{15mm}	i.	.....	.....
3508	col. cr.	$0.775^{20^\circ}_{4}$	22.5	303	i.	sl. s.	s.
3509	col. pl.	.....	61	.....	.....	sl. s. aq. al.	.....
3510	col. lq.	$0.733^{21.5^\circ}_{4}$	.....	104-6	.....	.....	.....
3511	col. cr.	.....	22.5	262	v. s.	v. s.	i.
3512	col. lq.	$0.684^{20^\circ}_{4}$	−90.6	98.4^{760mm}	i.	sl. s.	∞; ∞ chl.
3513	col. lq.	$0.679^{20^\circ}_{4}$	−118.2	90.0	i.	s.	∞
3514	col. lq.	$0.687^{20^\circ}_{4}$	−119.4	91.8	i.	s.	∞
3515	col. lq.	$0.674^{20^\circ}_{4}$	−125	79.1	i.	s.	∞
3516	col. lq.	$0.675^{20^\circ}_{4}$	−119.4	80.8	i.	s.	∞
3517	col. lq.	$0.693^{20^\circ}_{4}$	−135.0	86.0	i.	s.	∞
3518	col. lq.	$0.698^{20^\circ}_{4}$	−118.7	93.5	i.	s.	∞
3519	col. lq.	$0.690^{20^\circ}_{4}$	−25	80.8	i.	s.	∞
3520	col. lq.	0.918^{20°	−10	221-2	0.25^{15°	s.	s.
3521	col. lq.	$0.850^{20^\circ d}_{4}$	−42	155	sl. s.	∞	∞
3522	pl./al.	$0.858^{54.7^\circ}$	54-5	195	sl. s. c.	s.	s.
3523	nd./al.	$0.849^{112^\circ}_{4}$	95-6	250-8	v. s.	v. s.	v. s.

Guvacine, cf. alkd.
Gynesin, cf. alkd.
Gynoval 869
H acid 342
Harmaline, cf. alkd.
Harmine, cf. alkd.
Hasting's naphtha 4100
Hederin (α), cf. glcde.
Helianthin-B 4328
Helicin, cf. glcde.
Helicon 115
Heliotropine 5323
Helixin, cf. glcde.
Helleborein, cf. glcde.
Helleborin, cf. glcde.
Hemellitic acid 2458
Hemimellitic acid 683
Hemimellitene 6253
Hemisine 157
Hendecenoic acid 6376
Hepta-decanal 4015
Hepta-decanoic acid 4014
Hepta-decanol 3509
Hepta-decyl cyanide 5638
Hepta-methylene 1596
Hepta-methylene dicyanide 597
Heptamide 3523
Heptandioic acid 5309

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Heptanoic				
3524	anhydride (*n*)	heptylic anhydride	$(C_6H_{13}CO)_2O$	II-340	242.35
3525	**Heptanthiol-2**	heptyl mercaptan	$CH_3{\cdot}CH(SH){\cdot}C_5H_{11}$	I-415	132.26
3526	**Heptyl** acetate (*n*)	.....	$CH_3CO_2{\cdot}C_7H_{15}$	II-134	158.23
3527	alcohol (*n*)	heptanol-1	$CH_3(CH_2)_5CH_2OH$	I-414	116.20
3528	alcohol	2,2,3-trimethyl-butanol-3	$(CH_3)_3C{\cdot}C(CH_3)_2{\cdot}OH$	I-418	116.20
3529	alcohol	2,3-dimethyl-pentanol-3	$(CH_3)_2CH{\cdot}C(OH){\cdot}(CH_3){\cdot}C_2H_5$	I-417	116.20
3530	alcohol	2,4-dimethyl-pentanol-2	$(CH_3)_2C(OH){\cdot}CH_2{\cdot}CH(CH_3)_2$	I-417	116.20
3531	alcohol	2,4-diMe-pentanol-3	$[(CH_3)_2CH]_2CHOH$	I-417	116.20
3532	alcohol	3-ethyl-pentanol-2	$(C_2H_5)_2CH{\cdot}CHOH{\cdot}CH_3$	I-416	116.20
3533	alcohol	3-ethyl-pentanol-3	$(C_2H_5)_3COH$	I-417	116.20
3534	alcohol	2-methyl-hexanol-1	$CH_3(CH_2)_3CH(CH_3){\cdot}CH_2OH$	I-415	116.20
3535	alcohol	2-methyl-hexanol-2	$(CH_3)_2C(OH)(CH_2)_3{\cdot}CH_3$	I-415	116.20
3536	alcohol	2-methyl-hexanol-3	$(CH_3)_2CH{\cdot}CHOH{\cdot}(CH_2)_2CH_3$	I-416	116.20
3537	alcohol	2-methyl-hexanol-4	$(CH_3)_2CH{\cdot}CH_2{\cdot}CHOH{\cdot}C_2H_5$	I-416	116.20
3538	alcohol	2-methyl-hexanol-5	$(CH_3)_2CH(CH_2)_2{\cdot}CHOH{\cdot}CH_3$	I-416	116.20
3539	alcohol (*iso*)	2-methyl-hexanol-6	$(CH_3)_2CH(CH_2)_3{\cdot}CH_2OH$	I-416	116.20
3540	alcohol	3-methyl-hexanol-3	$C_2H_5{\cdot}CH_2{\cdot}C(CH_3){\cdot}(OH){\cdot}C_2H_5$	I-416	116.20
3541	alcohol	3-methyl-hexanol-4	$C_2H_5{\cdot}CH(CH_3){\cdot}CHOH{\cdot}C_2H_5$	I-416	116.20
3542	alcohol	heptanol-2	$CH_3(CH_2)_4{\cdot}CHOH{\cdot}CH_3$	I-415	116.20
3543	alcohol	heptanol-4	$(CH_3{\cdot}CH_2{\cdot}CH_2)_2{:}CHOH$	I-415	116.20
3544	amine (*n*)	.....	$C_7H_{15}{\cdot}NH_2$	IV-193	115.21
3545	bromide (*n*)	1-bromoheptane	$CH_3(CH_2)_5{\cdot}CH_2Br$	I-115	179.11
3546	chloride (*n*)	1-chloroheptane	$CH_3(CH_2)_5{\cdot}CH_2Cl$	I-154	134.65
3547	chloride	3-chloro-2,3-di-methyl-petane	$(CH_3)_2CH{\cdot}CCl(CH_3){\cdot}C_2H_5$	I-157	134.65
3548	formate (*n*)	.....	$HCO_2{\cdot}C_7H_{15}$	II-22	144.21
3549	iodide	1-iodo-2-methyl-hexane	$ICH_2{\cdot}CH(CH_3){\cdot}(CH_2)_3{\cdot}CH_3$	I-157	226.11
3550	malonic acid (*n*)	.....	$C_7H_{15}CH(CO_2H)_2$	II-721	202.24
3551	nitrite (*n*)	.....	$CH_3(CH_2)_6{\cdot}O{\cdot}NO$	I-415	145.20
3552	oenanthylate	*n*-heptyl *n*-heptylate	$C_6H_{13}CO_2{\cdot}C_7H_{15}$	II-340	228.36
3553	propionate (*n*)	.....	$C_2H_5CO_2{\cdot}C_7H_{15}$	II-241	172.26
3554	**Heptylene** (α)	heptene-1	$CH_3(CH_2)_4{\cdot}CH{:}CH_2$	I-219	98.18
3555	**Heptylene**	2,4-dimethyl-pentene-2	$(CH_3)_2C{:}CH{\cdot}CH{:}(CH_3)_2$	I-220	98.18
3556	**Heptylene**	2,3,3-triMe-butene-1	$(CH_3)_3C{\cdot}C(CH_3){:}CH_2$	.....	98.18
3557	alcohol	2-Me-penten-4-ol-2	$C_2H_5{\cdot}CH_2{\cdot}C(CH_3)_2{\cdot}OH$	I-445	114.18
3558	**Heptyne-1**	oenanthylidene	$CH_3(CH_2)_4{\cdot}C{:}CH$	I-256	96.17

Heptanol 3527-43
Heptanone 2786, 3003, 4122
Heptene 3554-6
Heptyl, cf. also diheptyl.
Heptyl aldehyde 3521
Heptyl carbinol 4961
Heptyl cyanide 1226
Heptyl ether 2264
Heptyl heptylate 3552
Heptyl mercaptan 3525

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3524	lq.	$0.932^{21°}$	17	258-68	.....	.....	.....
3525	lq.	$0.835^{20°}$	.....	174-5^{765mm}	i.	.....	.....
3526	col. lq.	$0.874\frac{16}{16}°$	.....	191.5^{759mm}	i.	s.	s.
3527	col. lq.	$0.824\frac{20}{4}°$	34.6	175^{756mm}	v. sl. s.	∞	∞
3528	col. lq.	.....	15-7	131-2	hydrate $+1H_2O$	∞	∞
3529	lq.	$0.833^{21°}$	<−30	138-40^{750mm}	.....	∞	∞
3530	lq.	$0.816\frac{20}{4}°$	<−20	132-3^{760mm}	i.	∞	∞
3531	col. lq.	$0.829\frac{20}{4}°$	.....	140	v. sl. s.	∞	∞
3532	lq.	$0.853^{0°}$	.....	148-52	.....	∞	∞
3533	col. oil	$0.839\frac{20}{4}°$	.....	142^{764mm}	sl. s.	∞	∞
3534	lq.	$0.831\frac{13}{4}°$	.....	162-4^{750mm}	.....	∞	∞
3535	col. lq.	0.816	.....	141-2^{755mm}	i.	∞	∞
3536	col. oil	$0.827\frac{16.7}{4}°$	.....	145-6	i.	∞	∞
3537	lq.	.....	.....	147-8^{756mm}	.....	∞	∞
3538	lq.	$0.819^{17.5°}$	.....	148-50	.....	∞	∞
3539	lq.	$0.825\frac{11.5}{4}°$	.....	170.5^{755mm}	v. sl. s.	∞	∞
3540	lq.	$0.828\frac{18}{4}°$	.....	140.3^{745mm}	.....	∞	∞
3541	lq.	$0.852^{0°}$	.....	149-50	i.	s.	s.
3542	lq.	$0.819\frac{20}{4}°$	.....	160.4	$0.4^{20°}$	s.	s.
3543	lq.	$0.820\frac{20}{4}°$	.....	154-5	i.	s.	s.
3544	col. lq.	$0.777^{20°}$	−23	155	v. sl. s.	∞	∞
3545	lq.	$1.133^{16°}$	.....	178.5^{751mm}	i.	∞	∞
3546	lq.	$0.881^{16°}$	.....	159.2^{750mm}	i.	∞	∞
3547	lq.	$0.884^{22°}$	<−15	135-8^{757mm}	i.	∞	∞
3548	lq.	$0.894^{0°}$	.....	176.7	i.	s.	s.
3549	lq.	$1.366\frac{21}{4}°$	.....	78-9^{19mm}	i.	s.	s.
3550	cr./bz.	.....	95 d.	.....	i.	s.	s.; v. s. act.
3551	lq.	$0.894^{0°}$	.....	155	i.	.....	s.
3552	col. lq.	$0.865\frac{19}{4}°$	.....	273-4^{754mm}	i.	s.	s.
3553	lq.	$0.885^{0°}$	.....	208	i.	s.	s.
3554	col. lq.	$0.703^{19°}$	.....	95-100	i.	s.	s.
3555	col. lq.	$0.696\frac{22}{4}°$	.....	82-3	i.	s.	s.
3556	lq.	$0.705^{20°}$	−111.4	77.9	.....	.....	.....
3557	lq.	$0.831\frac{18}{0}°$	.....	119.5	.....	.....	.....
3558	lq.	$0.738\frac{12.6}{4}°$	<−70	99	.....	.....	.....

Heptyl sulfide 2266
Heptylic acid 3520
Heptylic anhydride 3524
Herapathite, cf. alkd.
Heroin, cf. alkd.
Hesperetinic acid 3237
Hesperetole 6441
Hesperidin, cf. glcde.
Heteroauxin 3865
Hexabromo-cyclohexane 666
Hexachloro-cyclohexane 668-9
Hexadecanoic acid 5022
Hexadecanol 1275
Hexadecene 3570
Hexadecyl, cf. cetyl.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3559	**Hesperetin**†	5,7,3′-triOH-4′-MeO-flavanone	$C_{16}H_{14}O_6$	VIII-544	302.27
3560	**Hesperidin**	.....	$C_{28}H_{34}O_{15}$	.....	610.55
3561	**Hexabromo**-benzene	perbromobenzene	C_6Br_6	V-215	551.56
3562	ethane	perbromoethane	$Br_3C{\cdot}CBr_3$	I-96	503.52
3563	**Hexachloro**-benzene	perchlorobenzene	C_6Cl_6	V-205	284.80
3564	ethane	carbon hexachloride	$Cl_3C{\cdot}CCl_3$	I-87	236.76
3565	chlorophenol	(low melting)	C_6OCl_6	VI-194	300.80
3566	chlorophenol	(high melting)	C_6OCl_6	VII-144	300.80
3567	**Hexacosane** (*n*)	.....	$CH_3(CH_2)_{24}{\cdot}CH_3$	I-175	366.69
3568	**Hexacosane** (*iso*)	cerane	$(CH_3)_2CH{\cdot}(CH_2)_{22}{\cdot}CH_3$	*I-70	366.69
3569	**Hexadecane** (*n*)	cetane	$CH_3(CH_2)_{14}{\cdot}CH_3$	I-172	226.43
3570	**Hexadecylene** (α)	hexadecene-1	$CH_3(CH_2)_{13}{\cdot}CH{:}CH_2$	I-226	224.42
3571	**Hexadecyne-1**	.....	$CH_3(CH_2)_{13}{\cdot}C{:}CH$	I-262	222.40
3572	**Hexadecyne-2**	cetylene	$CH_3(CH_2)_{12}{\cdot}C{:}C{\cdot}CH_3$	I-262	222.40
3573	**Hexadiene**-2,4	dipropenyl	$(CH_3{\cdot}CH{:}CH{\cdot})_2$	I-254	82.14
3574	**Hexadiene**-1,5	diallyl	$(CH_2{:}CH{\cdot}CH_2{\cdot})_2$	I-253	82.14
3575	**Hexaethylbenzene**	"alkazene 6"	$(C_2H_5)_6C_6$	V-471	246.42
3576	**Hexahydro**-anthracene	anthracene hexahydride	$C_{14}H_{16}$	V-573	184.27
3577	benzoic acid	cyclohexane-carboxylic acid	$CH_2(CH_2)_4{\cdot}CH{\cdot}CO_2H$ |_____|	IX-7	128.17
3578	cumene	.....	$C_3H_7{\cdot}C_6H_{11}$	V-41	126.23
3579	cymene (*p*)	menthane; terpane	$CH_3{\cdot}C_6H_{10}{\cdot}C_3H_7$	V-47	140.26
3580	mellitic acid	.....	$C_6H_6(CO_2H)_6$	IX-1007	348.22
3581	mesitylene	(1,3,5)	$C_6H_9(CH_3)_3$	V-45	126.23
3582	naphthalene	.....	$C_{10}H_{14}$	V-433	134.21
3583	*o*-phthalic acid (*cis*)	.....	$C_6H_{10}(CO_2H)_2$	IX-730	172.18
3584	*o*-phthalic acid (*dl*)	(*trans*)	$C_6H_{10}(CO_2H)_2$	IX-730	172.18
3585	*p*-phthalic acid	(*cis*)	$C_6H_{10}(CO_2H)_2$	IX-733	172.18
3586	*p*-phthalic acid	(*trans*)	$C_6H_{10}(CO_2H)_2$	IX-733	172.18
3587	salicylic acid (*o*)	.....	$HO{\cdot}C_6H_{10}{\cdot}CO_2H$	X-5	144.17
3588	**Hexahydroxy-benzene**	.....	$C_6(OH)_6$	VI-1198	174.11
3589	**Hexaiodobenzene**	periodobenzene	C_6I_6	V-230	833.58
3590	**Hexamethyl**-benzene	.....	$C_6(CH_3)_6$	V-450	162.26
3591	diamino-*iso*-propanol-diiodide	endoiodin	$[I(CH_3)_3N{\cdot}CH_2]_2{:}CHOH$	.....	430.14
3592	pararosaniline base	4,4′,4″-tris-diMe-amino-triPh-carbinol	$[(CH_3)_2N{\cdot}C_6H_4]_3C{\cdot}OH$	XIII-755	389.52
3593	pararosaniline chloride	(dye salt) ‡	$C_{25}H_{30}N_3Cl{\cdot}9H_2O$	XIII-756	570.12
3594	pararosaniline-hydroxymethyl-ate	(dye salt) §	$C_{26}H_{33}N_3Cl_2$	XIII-758	458.46
3595	4,4′,4″-triamino-triphenyl-methane	(leuco base)	$[(CH_3)_2N{\cdot}C_6H_4]_3CH$	XIII-315	373.52

† Beilstein lists this compound as a chalkone.
‡ Commercial product usually mixed with pentamethyl deriv.
§ Base not isolated; comes into commerce as $ZnCl_2$ double salt.

Hexadecyl acetylene 4942
Hexadecyl bromide 1276
Hexadienoic acid 5625
Hexadiyne 2768
Hexaethyl-pararosaniline 3191
Hexahydro-aniline 326
Hexahydro-benzene 1601
Hexahydro-cresol 4200-1
Hexahydro-diethylaniline 2145

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3559	yel. wh. cr./ EtOAc	.....	226-7 d.	.....	i.; v. sl. s. alk.	s.; sl. s. bz.	s.; sl. s. chl.
3560	hyg. nd.	.....	251 ±, d.	.....	0.02 h.	sl. s.	i.; i. bz.
3561	nd./bz.	.....	316	.....	i.	v. sl. s.	v. sl. s.
3562	rhb.	3.823	170 d.	.....	v. s. CS_2	v. sl. s. h.*	v. sl. s.
3563	mn.	$2.044^{24°}$	228-31	309^{742mm}	i.; s. bz.	v. sl. s. h.	s. h.
3564	rhb.	2.09	186.9-7.4*	185.5^{777mm}	i.	v. s.	v. s.
3565	yel. cr.	.....	46	.....	.....	.....	.....
3566	yel. cr.	.....	106	d. 210	i.	s.; s. chl.	s. pet.
3567	cr.	$0.779^{57}_{4}°$	56.6	262^{15mm}	s. bz.	v. sl. s.	.....
3568	pl./et.	.....	61	$207^{0.7mm}$	i.	s.	s.
3569	lf.	$0.774^{20}_{4}°$	18.5(16.2)	287.5	i.	∞	∞
3570	lq.	$0.784^{15}_{4}°$	4	274	i.	.....	.....
3571	cr.	$0.797^{20°}$	15	155^{15mm}	i.	.....	.....
3572	pl.	$0.804^{20}_{4}°$	20	160^{15mm}	i.	.....	.....
3573	oil	$0.718^{20}_{4}°$	.....	82	i.	.....	.....
3574	lq.	$0.688^{20}_{4}°$	.....	59.5	i.	.....	.....
3575	pr./al.	$0.831^{15}_{4}°$	130	298.3	i.; v. s. bz.	$0.75^{25°}$	$8^{25°}$
3576	lf.	.....	63	290	i.; v. s. bz.	v. s.	v. s.
3577	pr.	$1.034^{22}_{4}°$	30-1	232-4	sl. s.	v. s.; s. chl.	v. s.; s. pet.
3578	lq.	$0.787^{20°}$	.....	150-3	i.	v. s.	v. s.
3579	lq.	$0.793^{20}_{0}°$	.....	169-70	i.	v. s.	v. s.
3580	syrup	.....	d., $-H_2O$	.....	v. s.	v. s.	sl. s.
3581	lq.	$0.787^{4°}$	.....	135-8	.....	.....	.....
3582	lq.	$0.934^{23}_{0}°$	.....	200	.....	.....	.....
3583	tri./aq.	.....	192	d., $-H_2O$ >192	$>0.2^{20°}$	s.	.....
3584	mn./aq.	.....	215-21	.....	$0.2^{20°}$	s. act.	.....
3585	lf./aq.	.....	.....	.....	$>0.08^{17°}$	s.	s.; s. chl.
3586	mn./aq.	.....	300 ±	subl.	$0.08^{17°}$; 1.3 h.	s.; s. act.	sl. s.; i. chl.
3587	cr./aq.	.....	111	.....	s.	s.	s.; sl. s. bz.
3588	nd./aq. HCl	.....	d. 200	.....	sl. s. c.	sl. s.	sl. s.; sl. s. bz.
3589	red nd./bz.	.....	340-50 d.	.....	i.	i.	i.
3590	pl./al.	.....	166	265	i.	$0.2^{20°}$	v. s. bz.
3591	col. cr. pd.	.....	275 d.	.....	s.	sl. s.	i.; i. act.
3592	col. cr./bz.	.....	219	.....	i.; s. bz.; s. pet.	sl. s.; s. CS_2	s.; s. chl.
3593	gn. brn. met. cr./aq.	.....	$-8H_2O$, 70-80°	.....	s.	s.	v. s. chl.
3594	gn. pd.	.....	.....	.....	s.	sl. s.	.....
3595	lf./al.	.....	178-9	.....	i. c.; s. bz.	s. h.; s. ac.	s.; s. chl.

* Sealed tube.

Hexahydro-phenol 1605
Hexahydro-pyridine 5322
Hexahydro-toluene 4199
Hexahydro-triphenyltriazine 512
Hexahydro-xylene 2471-3
Hexahydroxy-anthraquinone 5575
Hexahydroxy-hexahydrobenzene 1602-3
Hexalin 1601
Hexamethyl-ethane 4945

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3596	**Hexamethylene-** diamine	.....	$NH_2{\cdot}(CH_2)_6{\cdot}NH_2$	IV-269	116.20
3597	dicyanide	.....	$NC{\cdot}(CH_2)_6{\cdot}CN$	II-694	136.19
3598	glycol	hexandiol-1,6	$HO{\cdot}(CH_2)_6{\cdot}OH$	I-484	118.17
3599	tetramine	urotropine; formin; methenamine	$(CH_2)_6N_4$	I-583	140.19
3600	tetramine-alliodide	allyliodourotropine	$C_6H_{12}N_4{\cdot}C_3H_5I$	I-588	308.18
3601	camphorate	amphotropin	$C_{12}H_{24}N_8{\cdot}C_{10}H_{16}O_4$	.....	480.60
3602	salicylate	saliformin	$C_6H_{12}N_4{\cdot}C_7H_6O_3$	.....	278.31
3603	**Hexane** (*n*)	.....	$CH_3{\cdot}(CH_2)_4{\cdot}CH_3$	I-142	86.17
3604	**Hexane** (*iso*)	2-methyl-pentane	$(CH_3)_2CH{\cdot}(CH_2)_2{\cdot}CH_3$	I-148	86.17
3605	**Hexane**	2,2-dimethyl-butane	$(CH_3)_3C{\cdot}C_2H_5$	I-150	86.17
3606	**Hexane**	2,3-dimethyl-butane	$[(CH_3)_2CH]_2$	I-151	86.17
3607	**Hexane**	3-methyl-pentane	$(C_2H_5)_2CH{\cdot}CH_3$	I-149	86.17
3608	**Hexanhexol**	dulcitol	$HOCH_2(CHOH)_4{\cdot}CH_2OH$	I-544	182.17
3609	**Hexanhexol**	*d*-mannitol; mannite	$HOCH_2(CHOH)_4{\cdot}CH_2OH$	I-534	182.17
3610	hexaacetate	mannitol hexa-acetate	$C_6H_8O_6(COCH_3)_6$	II-150	434.39
3611	**Hexanhexol**	*d*-sorbitol; sorbite	$HOCH_2(CHOH)_4{\cdot}CH_2OH$	I-533	182.17
3612	hexaacetate	sorbitol hexaacetate	$C_6H_8O_6(COCH_3)_6$	II-150	434.39
3613	**Hexatriacontane**	.....	$C_{36}H_{74}$	I-178	506.95
3614	**Hexenyl** alcohol	.....	$C_6H_{11}OH$	I-446	100.16
3615	alcohol	1-hexen-5-ol	$CH_2{:}CH(CH_2)_2{\cdot}CHOH{\cdot}CH_3$	I-444	100.16
3616	**Hexose**	*d*-fructose; levulose	$C_5H_{12}O_5{:}CO$	I-918	180.16
3617	**Hexose**	*d*-galactose	$C_5H_{11}O_5{\cdot}CHO$	I-911	180.16
3618	**Hexose**	*d*-glucose; dextrose	$C_5H_{11}O_5{\cdot}CHO$	I-879	180.16
3619	**Hexose**	*d*-mannose; semi-nose	$C_5H_{11}O_5{\cdot}CHO$	I-905	180.16
3620	**Hexose**	*d*-sorbose; sorbinose	$C_6H_{12}O_6$	I-927	180.16
3621	**Hexyl** acetate (*n*)	.....	$CH_3CO_2{\cdot}C_6H_{13}$	II-132	144.21
3622	acetate	Me-*iso*-Bu carbinol acetate	$CH_3CO_2{\cdot}CH(CH_3){\cdot}CH_2CH(CH_3)_2$	II-133	144.21
3623	acetate (*iso*)	.....	$CH_3CO_2{\cdot}C_4H_7(CH_3)_2$	II-133	144.21
3624	alcohol (*n*)	hexanol-1	$CH_3(CH_2)_4CH_2OH$	I-407	102.17
3625	alcohol (*n*)	hexanol-2	$CH_3{\cdot}CHOH{\cdot}C_4H_9$	I-408	102.17
3626	alcohol (*n*)	hexanol-3	$C_2H_5{\cdot}CHOH{\cdot}C_3H_7$	I-408	102.17
3627	alcohol	2,2-di Me-butanol-3	$(CH_3)_3C{\cdot}CHOH{\cdot}CH_3$	I-412	102.17
3628	alcohol	2,2-di Me-butanol-4	$(CH_3)_3CCH_2CH_2OH$	I-412	102.17
3629	alcohol	2,3-di Me-butanol-2	$(CH_3)_2CH{\cdot}C(CH_3)_2{\cdot}OH$	I-413	102.17
3630	alcohol	2-Me-pentanol-1	$C_2H_5{\cdot}CH_2{\cdot}CH(CH_3){\cdot}CH_2OH$	I-409	102.17
3631	alcohol	2-Me-pentanol-2	$(CH_3)_2COH{\cdot}CH_2{\cdot}C_2H_5$	I-409	102.17
3632	alcohol	2-Me-pentanol-3	$(CH_3)_2CH{\cdot}CHOH{\cdot}C_2H_5$	I-410	102.17
3633	alcohol	2-Me-pentanol-4	$CH_3{\cdot}CHOH{\cdot}CH_2{\cdot}CH(CH_3)_2$	I-410	102.17

Hexamethylene-dibromide 1844
Hexamethylene-diiodide 2393
Hexamin 2764
Hexamine 3599
Hexanal 1212
Hexandecanal 5023
Hexandioic acid 153
Hexandiol 2346, 3598, 3662
Hexanoic acid 1208
Hexanol 3624-38
Hexanone 3144, 4163
Hexanthiol 3652
Hexanitro-diphenylamine 2764
Hexanitro-diphenyl sulfide 2765
Hexazane 5322

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3596	lf.	.....	42	204-5	v. s.	s.	.....
3597	col. lq.	$0.954^{18°}$	−3.5	185^{15mm}	.....	.....	.....
3598	nd./aq.	.....	42	250	s.	s.	sl. s. h.
3599	col. rhb.	.....	.....	subl. vac. 230-70	$81^{12°}$	$3^{12°}$ abs.	v. sl. s.
3600	col. cr.	.....	148±, d.	.....	v. s.	i. chl.	i.
3601	col. cr.	.....	.....	.....	10	s.; s. chl.	i.; i. bz.
3602	col. cr.	.....	.....	.....	s.	s.	.....
3603	col. lq.	$0.659^{20°}_{4°}$	−94	69	i.; ∞ chl.	$50^{33°}$	∞
3604	lq.	$0.654^{20°}_{4°}$	−153.7	60.2	i.	.....	s.
3605	lq.	$0.649^{20°}_{20°}$	−98.2	49.7	i.	.....	s.
3606	lq.	$0.662^{20°}_{4°}$	−129.8	58.0^{760mm}	i.	.....	s.
3607	lq.	$0.664^{20°}_{4°}$	−118	63.2	i.	.....	s.
3608	mn.	$1.466^{15°}$	189	$290-5^{3mm}$	$3.2^{15°}$; v. sl. s. h.	v. sl. s.	i.
3609	col. rhb.	$1.489^{20°}_{4°}$	166	$290-5^{3mm}$	$13^{14°}$	$0.07^{14°}$ abs. al.	i.
3610	col. cr.	.....	119-20	.....	i.	sl. s. h.	i.; s. ac.
3611	cr. + ½ or $1H_2O$	.....	100-10 (anh.)*	.....	v. s.	v. s. h.	.....
3612	col. cr./al.	.....	99-100	.....	sl. s.	sl. s.	i.
3613	cr.	$0.782^{76°}$	75.8	$265^{1.0mm}$	sl. s. chl.	v. sl. s.	sl. s.
3614	lq.	$0.891^{100°}$	.....	137^{765mm}	$10^{100°}$	∞	∞
3615	lq.	$0.842^{16}_{17.2°}$	.....	140^{759mm}	v. sl. s.	.....	.....
3616	nd./aq.	$1.669^{17.5°}$	95-105	.....	v. s.	$8.5^{18°}$ abs. al.	s. act.
3617	pr.	.....	165.5 (anh.)**	.....	v. s. h.	$0.6^{38.5°}$ 85% al.	s. pyr.
3618	rhb.***	$1.544^{25°}$	146(anh.)	.....	$82^{17.5°}$	sl. s.	i.
3619	rhb.	$1.539^{20°}_{4°}$	132	.....	$248^{17°}$	v. sl. s. abs.	i.
3620	rhb.	$1.654^{15°}$	165	.....	$55^{17°}$	v. sl. s. abs.	sl. s. Me al.
3621	col. lq.	$0.890^{0°}_{0°}$	.....	169.2	i.	v. s.	v. s.
3622	col. lq.	$0.860^{20°}_{20°}$	.....	146-7	$0.13^{20°}$	.....	.....
3623	col. lq.	.....	.....	159^{755mm}	i.	v. s.	v. s.
3624	col. lq.	$0.820^{20°}_{20°}$	−51.6	157.2	$0.6^{20°}$	∞	∞
3625	col. lq.	$0.818^{16}_{4}{}^{.8°}$	.....	137-8	sl. s.	∞	∞
3626	col. lq.	$0.818^{20°}_{4°}$	.....	135	sl. s.	∞	∞
3627	lq. or nd.	$0.812^{25°}$	5.5	120-1	v. sl. s.	∞	∞
3628	oily lq.	.....	−60	.....	v. sl. s.	∞	∞
3629	lq.	$0.821^{20°}_{0°}$	−14	120-1	v. sl. s.	∞	∞
3630	lq.	$0.826^{20°}_{4°}$	.....	148^{762mm}	v. sl. s.	∞	∞
3631	lq.	.....	<−38	$122.5-3.5^{762mm}$	v. sl. s.	∞	∞
3632	lq.	$0.826^{18°}_{4°}$	.....	127.5^{721mm}	v. sl. s.	∞	∞
3633	lq.	$0.813^{20°}_{4°}$	.....	131.8	$1.6^{20°}$	∞	∞

* Crysts./al., m. 87-95°.
** Crysts. + $1H_2O$, m. 118-20°.
*** Crysts. + $1H_2O$, mn. pl.
Hexene 3655-61
Hexophan 3801
Hexone 4164
Hexyl, cf. also dihexyl.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3634	**Hexyl** alcohol	2-Me-pentanol-5	$(CH_3)_2CH{\cdot}CH_2{\cdot}CH_2{\cdot}CH_2OH$	I-411	102.17
3635	alcohol (*act.*)	3-Me-pentanol-1	$C_2H_5{\cdot}CH(CH_3){\cdot}CH_2{\cdot}CH_2OH$	I-411	102.17
3636	alcohol (*act.*)	3-Me-pentanol-2	$CH_3{\cdot}CHOH{\cdot}CH{\cdot}(CH_3){\cdot}C_2H_5$	I-411	102.17
3637	alcohol	3-Me-pentanol-3	$C_2H_5{\cdot}C(CH_3){\cdot}(OH){\cdot}C_2H_5$	I-411	102.17
3638	alcohol	3-methylol-pentane	$(C_2H_5)_2CH{\cdot}CH_2OH$	I-412	102.17
3639	amine (*n*)	.....	$CH_3(CH_2)_5{\cdot}NH_2$	IV-188	101.19
3640	amine	2-Et Bu-amine	$(C_2H_5)_2CHCH_2{\cdot}NH_2$	IV-192	101.19
3641	bromide (*n*)	1-bromohexane	$CH_3(CH_2)_4CH_2Br$	I-144	165.08
3642	bromide (*iso*)	5-bromo-2-methyl-pentane	$(CH_3)_2CH{\cdot}(CH_2)_2{\cdot}CH_2Br$	I-148	165.08
3643	bromide	2-bromo-2,3-diMe-butane	$(CH_3)_2CH{\cdot}CBr{:}(CH_3)_2$	I-152	165.08
3644	chloride (*n*)	1-chlorohexane	$CH_3{\cdot}(CH_2)_4{\cdot}CH_2Cl$	I-143	120.62
3645	chloride	2-chlorohexane	$CH_3(CH_2)_3CHCl{\cdot}CH_3$	I-144	120.62
3646	chloride	1-chloro-2,3-diMe-butane	$(CH_3)_2CH{\cdot}CH{:}(CH_2Cl)CH_3$	I-151	120.62
3647	chloride	2-chloro-2,3-diMe-butane	$(CH_3)_2CH{\cdot}CCl(CH_3)_2$	I-151	120.62
3648	cyanide (*n*)	oenanthylic nitrile	$CH_3(CH_2)_5{\cdot}CN$	II-341	111.18
3649	formate (*n*)	.....	$HCO_2{\cdot}C_6H_{13}$	II-22	130.18
3650	iodide (*n*)	1-iodohexane	$CH_3{\cdot}(CH_2)_4{\cdot}CH_2I$	I-146	212.08
3651	iodide	2-iodo-2,3-dimethyl-butane	$(CH_3)_2CI{\cdot}CH(CH_3)_2$	I-153	212.08
3652	mercaptan (*n*)	hexanthiol-1	$CH_3(CH_2)_4{\cdot}CH_2{\cdot}SH$	I-408	118.23
3653	nitrite (*n*)	.....	$C_6H_{13}{\cdot}O{\cdot}NO$	I-407	131.17
3654	resorcinol (*n*)	(1;2,4)	$C_6H_{13}{\cdot}C_6H_3(OH)_2$	.....	194.26
3655	**Hexylene** (α)	1-hexene	$CH_3(CH_2)_3CH{:}CH_2$	I-215	84.16
3656	**Hexylene**	2,3-diMe-butene-1	$(CH_3)_2CH{\cdot}C(CH_3){:}CH_2$	I-218	84.16
3657	**Hexylene**	3,3-diMe-butene-1	$(CH_3)_3C{\cdot}CH{:}CH_2$	.....	84.16
3658	**Hexylene**	2,3-diMe-butene-2	$(CH_3)_2C{:}C(CH_3)_2$	I-218	84.16
3659	**Hexylene**	2-methyl-pentene-2	$(CH_3)_2C{:}CH{\cdot}C_2H_5$	I-217	84.16
3660	**Hexylene** (*isomer No.* 1)	3-methyl-pentene-2	$(C_2H_5)(CH_3)C{:}CH{\cdot}CH_3$	I-217	84.16
3661	*isomer No.* 2	3-methyl-pentene-2	C_6H_{12}	I-217	84.16
3662	glycol (2,3)	hexandiol-2,3	$C_3H_7{\cdot}(CHOH)_2{\cdot}CH_3$	I-484	118.17
3663	**Hexylphenyl-carbinol** (*n*)	α-Ph-*n*-heptyl alcohol	$C_6H_{13}{\cdot}CHOH{\cdot}C_6H_5$	*VI-272	192.29
3664	**Hippuric** acid	benzoyl glycine	$C_6H_5CO{\cdot}NHCH_2{\cdot}CO_2H$	IX-225	179.17
3665	calcium salt	Ca hippurate	$(C_9H_8O_3N)_2Ca{\cdot}3H_2O$	IX-229	450.45
3666	sodium salt	Na hippurate	$C_9H_8O_3NNa$	IX-229	201.16
3667	**Histamine**	β-imidazolyl-4-ethylamine	$C_3H_3N_2{\cdot}C_2H_4{\cdot}NH_2$	*XXV-629	111.15
3668	hydrochloride, di	.....	$C_5H_9N_3{\cdot}2HCl$	*XXV-630	184.08
3669	**Histidine** (*l*)(−)	β-imidazolyl-α-alanine	$C_3H_3N_2{\cdot}CH_2{\cdot}CH{\cdot}(NH_2){\cdot}CO_2H$	XXV-513	155.16
3670	hydrochloride, di	.....	$C_6H_9O_2N_3{\cdot}2HCl$	XXV-515	228.09

Hexylene bromide 1842
Hexylene iodide 2393
Holocaine HCl 2910

Homoatropine, cf. alkd.
Homocatechol 2374
Homogentisic acid 3673

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3634	lq.	$0.816^{20°}_{4}$	.....	151-2^{747mm}	v. sl. s.	∞	∞
3635	lq.	$0.826^{20°}$	.....	152-3	i.	s.	s.
3636	oil	$0.831^{18°}_{4}$	.....	135^{762mm}	.....	.....	.....
3637	lq.	$0.824^{20°}_{0}$	<−38	122.5^{758mm}	.....	.....	.....
3638	lq.	$0.833^{20°}_{20°}$	<−15	148.9	0.43	.....	.....
3639	col. lq.	$0.763^{25°}_{4}$	−19	129-30^{742mm}	v. sl. s.	∞	∞
3640	col. lq.	.....	.....	125.3	s.	∞	∞
3641	lq.	$1.173^{20°}$	.....	155.5^{744mm}	.....	.....	.....
3642	col. lq.	$1.168^{20°}$	.....	146-7	.....	.....	.....
3643	col. cr.	$1.177^{20°}_{0}$	24-5	132-3^{742mm}	.....	.....	.....
3644	lq.	$0.876^{20°}_{4}$	.....	132.9^{765mm}	i.	.....	.....
3645	lq.	$0.869^{21°}_{4}$	.....	122.5^{754mm}	.....	.....	.....
3646	lq.	$0.887^{22°}$	.....	122	.....	.....	.....
3647	lq.	$0.878^{19°}$	−10.4	112	.....	.....	.....
3648	col. lq.	$0.811^{20°}_{0}$	.....	183-4^{765mm}	i.	.....	.....
3649	lq.	$0.898^{0°}$	.....	153.6	.....	∞	∞
3650	lq.	$1.439^{20°}_{4}$	.....	180^{763mm}	.....	.....	.....
3651	nd.	$1.446^{20°}_{0}$	.....	140^{749mm}	.....	.....	.....
3652	col. lq.	$0.849^{20°}$	.....	149-50^{768mm}	i.	.....	.....
3653	yel. lq.	$0.885^{20°}$	.....	129-30^{774mm}	i.	s.	s.
3654	col. nd.	.....	68-70	179^{7mm}	0.05	v. s.; s. bz.	s.; s. act.
3655	col. lq.	$0.673^{20°}_{4}$	−98.5	63.4-3.7	i.	∞	∞
3656	col. lq.	$0.678^{20°}$	−140.1	55.6	i.; ∞ CS_2	∞	∞
3657	col. lq.	$0.653^{20°}$	−115.5	41.2	i.	.....	.....
3658	lq.	$0.712^{20°}$	−75.4	73.2^{760mm}	.....	s. act.	s.
3659	lq.	$0.690^{20°}_{4}$	.....	67.2-7.5	s. 2 vol. H_2SO_4 + 1 aq.	.....	.....
3660	lq.	$0.722^{15°}$	.....	65.7	.....	.....	.....
3661	lq.	$0.693^{20°}_{20°}$	.....	70-1	.....	.....	.....
3662	cr.	$0.967^{0°}$	60	206-7	∞	s.	.....
3663	lq.	0.946	.....	275	.....	.....	.....
3664	rhb.	$1.371^{20°}_{4}$	187-8	d.	0.4$^{20°}$; i. pet.	s. h.; i. bz.	0.25$^{18°}$
3665	col. pr.	1.32	.....	.....	5 c.; 16 h.	.....	.....
3666	wh. pd.	.....	.....	.....	s.	s.	.....
3667	col. hyg. cr./aq.	.....	86*	209-10^{18mm}	v. s.; s. h. chl.	s.	i.
3668	pr./aq. al.	.....	239-46 (d.)	.....	s.	sl. s.	i.
3669	lf./aq.	.....	d. 287-8	.....	s.	v. sl. s.	i.
3670	rhb.	.....	245	.....	s. d.	i.	i.

* Sealed tube.

Homohydroquinone 2372
Homopyrocatechin 2374
Homosalicylaldehyde 4379
Homosalicylic acid 3833, 3836, 3839, 3841
Hot stuff gas 1985

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3671	**Histidine** hydrochloride, mono	.....	$C_6H_9O_2N_3 \cdot HCl \cdot H_2O$	XXV-515	209.64
3672	**Homo**-eriodictyol	5,7,4'-triOH-3'-methoxy-flavanone	$C_{16}H_{14}O_6$†	.....	.....
3673	gentisinic acid	2,5-diOH-phenyl-acetic acid	$(HO)_2C_6H_3CH_2 \cdot CO_2H \cdot H_2O$	X-407	186.16
3674	phthalic acid (*o*)	.....	$HO_2C \cdot C_6H_4 \cdot CH_2 \cdot CO_2H$	IX-857	180.15
3675	**Hordenine** (*p*)‡	.....	$HO \cdot C_6H_4 \cdot CH_2 \cdot CH_2 \cdot N(CH_3)_2$	XIII-626	165.23
3676	sulfate	.....	$(C_{10}H_{15}ON)_2 \cdot H_2SO_4 \cdot H_2O$	XIII-626	446.55
3677	sulfate	.....	$(C_{10}H_{15}ON)_2 \cdot H_2SO_4 \cdot 2H_2O$	*XIII-236	464.56
3678	**Hydantoic acid**	.....	$H_2N \cdot CO \cdot NH \cdot CH_2 \cdot CO_2H$	IV-359	118.09
3679	**Hydantoin**	glycolyl urea	$HN \cdot CH_2 \cdot CO \cdot NH \cdot CO$ (ring)	XXIV-242	100.08
3680	**Hydnocarpic acid**	.....	$C_5H_7(CH_2)_{10}CO_2H$	IX-79	252.38
3681	**Hydracetamide**	.....	$(CH_3 \cdot CH)_3N_2$	I-608	112.17
3682	**Hydracrylic acid**	ethylene lactic acid	$HO \cdot CH_2CH_2 \cdot CO_2H$	III-295	90.08
3683	**Hydratropic acid**	α-Ph-propionic acid	$C_6H_5CH(CH_3)CO_2H$	IX-524	150.17
3684	**Hydrazinobenzoic acid** (*p*)	.....	$H_2N \cdot NH \cdot C_6H_4 \cdot CO_2H$	XV-631	152.15
3685	**Hydrazo**-benzene	*N,N'*-diphenyl-hydrazine	$C_6H_5NH \cdot NHC_6H_5$	XV-123	184.23
3686	benzoic acid (*o*)	.....	$(HO_2C \cdot C_6H_4 \cdot NH \cdot)_2$	XV-626	272.25
3687	benzoic acid (*m*)	.....	$(HO_2C \cdot C_6H_4 \cdot NH \cdot)_2$	XV-629	272.25
3688	benzoic acid (*p*)	.....	$(HO_2C \cdot C_6H_4 \cdot NH \cdot)_2$	XV-632	272.25
3689	dicarbonamide	.....	$(H_2N \cdot CO \cdot NH \cdot)_2$	III-116	118.10
3690	naphthalene (α,α')	.....	$C_{10}H_7NH \cdot NHC_{10}H_7$	XV-562	284.34
3691	naphthalene (β,β')	.....	$C_{10}H_7NH \cdot NHC_{10}H_7$	XV-569	284.34
3692	toluene (*o*)	.....	$(CH_3 \cdot C_6H_4 \cdot NH \cdot)_2$	XV-497	212.28
3693	toluene (*m*)	.....	$(CH_3 \cdot C_6H_4 \cdot NH \cdot)_2$	XV-506	212.28
3694	toluene (*p*)	.....	$(CH_3 \cdot C_6H_4 \cdot NH \cdot)_2$	XV-511	212.28
3695	**Hydrindene** (1,2)	indane	$C_6H_4 \cdot CH_2 \cdot CH_2 \cdot CH_2$ (ring)	V-486	118.17
3696	dicarboxylic acid	(β,β)	$C_9H_8(CO_2H)_2$	IX-904	206.19
3697	dicarboxylic acid	(α,β)	$C_9H_8(CO_2H)_2$	*IX-391	206.19
3698	**Hydrindone** (α)	indanone-1	$C_6H_4 \cdot CH_2 \cdot CH_2 \cdot CO$ (ring)	VII-360	132.15
3699	**Hydrindone** (β)	indanone-2	$C_6H_4 \cdot CH_2 \cdot CO \cdot CH_2$ (ring)	VII-363	132.15
3700	**Hydro**-benzamide	tribenzaldiamine	$C_6H_5CH:(N:CHC_6H_5)_2$	VII-215	298.37
3701	benzoin	.....	$(C_6H_5 \cdot CHOH \cdot)_2$	VI-1003	214.25
3702	benzoin (*iso*)	.....	$C_{14}H_{12}(OH)_2$	VI-1004	214.25
3703	carbostyril	.....	C_9H_9ON	XXI-288	147.17
3704	cinnamic acid	β-Ph-propionic acid	$C_6H_5CH_2CH_2CO_2H$	IX-508	150.17
3705	cinnamic alcohol	γ-Ph-Pr-alcohol	$C_6H_5(CH_2)_3OH$	VI-503	136.19
3706	cinnamic aldehyde	.....	$C_6H_5CH_2CH_2 \cdot CHO$	VII-304	134.17

† Beilstein gives structure as a chalcone.
‡ See also Alkaloid table.
HS (hot stuff) gas 1985
Hydracetin 111
Hydraergotocin, cf. alkd.
Hydramine, mixt. of 2314 and 5260
Hydrastine, cf. alkd.
Hydrastinine, cf. alkd.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3671	col. rhb./ aq.	.....	250-5	$-H_2O$, 100	s.	i.	i.
3672	col. nd./ ac.	.....	224-5	.....	i.; i. chl.	s.; i. bz.	sl. s. EtOAc
3673	pr./aq.	.....	152(anh.)	.....	v. s.	v. s.	v. s.; i. bz.
3674	cr./aq.	.....	175-80	.....	s. h.	v. s.	sl. s.
3675	col. rhb.	.....	117.8 subl. > 140	173-4^{11mm}	s.; i. pet.; s. chl.	v. s.; s. dil. a.	v. s.; s. alk.
3676	pr. nd.	.....	205(anh.)	.....	s.	v. sl. s.	.....
3677	col. cr.	.....	197	.....	s.	sl. s.	i.
3678	mn.	.....	d. 173-9	.....	$3^{20°}$; s. h.	$0.5^{20°}$; s. h.	.....
3679	nd.	.....	220-1	.....	s. h.; s. alk.	1.7 h.	i.
3680	lf./al.	.....	59-60	.....	i.	v. sl. s.	v. sl. s.
3681	yel. pd.	.....	.....	.....	v. s. d.	v. s.	.....
3682	syrup	.....	.....	d.	.....	.....	.....
3683	col. lq.	$1.1^{0°}$	<-20	266-7	v. sl. s.	.....	.....
3684	nd. or pl./ aq.	.....	220-5 d.	.....	sl. s. h.	.....	.....
3685	lt. yel./al.	$1.158^{16°}$	131	d.	v. sl. s.	$5^{16°}$	i. ac.
3686	lf./al.	.....	205	.....	i.	s. h.	s. alk.
3687	lt. yel./al.	.....	.....	.....	i.	sl. s. h.	.....
3688	nd./al.	.....	.....	.....	v. sl. s.	sl. s. h.	.....
3689	pl./aq.	.....	245-6 d.	.....	$0.02^{16°}$; sl. s. h.	i.	i.
3690	lf./bz.	.....	274(271)	.....	s. bz.	s.	s.
3691	lt. red lf.	.....	140-1	.....	i.	v. s.	v. s.
3692	lf./al.	.....	165	.....	s. bz.	v. sl. s. aq. al.	s.
3693	col. oil	.....	.....	.....	.....	v. s.	.....
3694	mn.	0.957	133-4(126)	d.	v. s. bz.	v. s.	v. s.
3695	col. lq.	$0.963^{\frac{18}{4}°}$	.....	177	i.	∞	∞
3696	lf./aq.	.....	199	$-CO_2$ > 200	.....	.....	.....
3697	cr.	.....	222	.....	v. sl. s. bz.	s.; s. act.	sl. s.
3698	nd./aq.	$1.099^{42°}$	41-2	243-5	sl. s.	v. s.	v. s.
3699	nd./al.	$1.071^{67°}$	58-61	250-5 sl. d.	i.	v. s.	v. s.
3700	cr./al.	.....	101-2	.....	i.	v. s.	v. s.
3701	mn.	$0.927^{134°}$	138-9	>300	$0.25^{15°}$	v. s. h.	.....
3702	mn./al.	.....	121-2	$133^{0.02mm}$	$0.19^{15°}$; 1.25 h.	s.	s.
3703	rhb./al.	.....	163	.....	i.; s. h. HCl	s.	s.
3704	mn.	$1.071^{\frac{48}{4}\cdot 7°}$	48.5	279.8	$0.6^{20°}$	s.; s. chl.	s.; s. bz.
3705	oil	$1.008^{\frac{20}{4}°}$	<-18	235-7	s.	∞	∞
3706	lq.	.....	.....	$221-4^{744mm}$	i.	16.7	.....

Hydrazine yellow 5694
Hydrazino-benzene 5196
Hydrazino-diphenyl 2727
Hydrazino-toluene 6022-7
Hydrazino-xylene 6500-2
Hydrazo-methane 2494
Hydrazo-phenylene 2279
Hydrindic acid 2686
Hydro-berberine, cf. alkd.
Hydro-cinchonine, cf. alkd.
Hydro-cinnamyl alcohol 3705

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Hydro				
3707	cinnamic amide	β-Ph-propionamide	$C_6H_5CH_2CH_2CONH_2$	IX-511	149.19
3708	cinnamic chloride	.....	$C_6H_5CH_2CH_2COCl$	IX-511	168.62
3709	cinnamic nitrile	β-Ph-propionitrile	$C_6H_5CH_2CH_2CN$	IX-512	131.17
3710	corulignone (4;3,5)	.....	$[HOC_6H_2(OCH_3)]_2$	VI-1200	306.30
3711	coumaric acid (*o*)	melilotic acid	$HOC_6H_4(CH_2)_2CO_2H$	X-241	166.17
3712	coumaric acid (*m*)	phenol propionic acid	$HOC_6H_4(CH_2)_2CO_2H$	X-244	166.17
3713	coumaric acid (*p*)	phlorentinic acid	$HOC_6H_4(CH_2)_2CO_2H$	X-244	166.17
3714	cyanic acid	formonitrile	HCN	II-29	27.03
3715	cyanic acid (dimolecular)	prussic acid	HN:CH·NC	II-28	54.05
3716	**Hydroquinone** acetate, di	diacetyl-hydroquinone (*p*)	$(CH_3CO_2)_2:C_6H_4$	VI-846	194.18
3717	benzyl ether, di	.....	$(C_6H_5CH_2O)_2C_6H_4$	VI-845	290.34
3718	benzyl ether, mono	.....	$C_6H_5CH_2O·C_6H_4OH$	VI-845	200.23
3719	dicarboxylic acid	(2,5;1,4)	$(HO)_2C_6H_2(CO_2H)_2$	X-554	198.13
3720	**Hydroquinophthalein**	2,7-dihydroxyfluorane	$C_{20}H_{12}O_5$	XIX-219	332.30
3721	**Hydroxy**-acetophenone (*o*)†	.....	$HO·C_6H_4·CO·CH_3$	VIII-85	136.14
3722	acetophenone (*m*)	.....	$HO·C_6H_4·CO·CH_3$	VIII-86	136.14
3723	acetophenone (*p*)	.....	$HO·C_6H_4·CO·CH_3$	VIII-87	136.14
3724	anthraquinone (1)	.....	$C_6H_4(CO)_2C_6H_3·OH$	VIII-338	224.20
3725	anthraquinone (2)	.....	$C_6H_4(CO)_2C_6H_3·OH$	VIII-342	224.20
3726	anthraquinone (2)	2-hydroxyanthraquinone-1,4	$C_{10}H_6(CO)_2CH:COH$	VIII-337	224.20
3727	azobenzene (*o*)	.....	$HO·C_6H_4·N:N·C_6H_5$	XVI-90	198.22
3728	azobenzene (*m*)	.....	$HO·C_6H_4·N:N·C_6H_5$	XVI-94	198.22
3729	azobenzene (*p*)	.....	$HO·C_6H_4·N:N·C_6H_5$	XVI-96	198.22
3730	azobenzene sulfonic acid (4,4′)	.....	$HO·C_6H_4·N:N·C_6H_4·SO_3H$	XVI-272	278.28
3731	azobenzene sulfonic Na	(4,4′)	$HO·C_6H_4·N:N·C_6H_4·SO_3Na·2H_2O$	XVI-272	336.30
3732	1,1′-azonaphthalene-3,6,4′-trisulfonic acid (2) Na	bordeaux S; fast red D	$NaO_3S·C_{10}H_6N:N·C_{10}H_4(OH)(SO_3Na)_2$	*XVI-305	604.48
3733	benzaldehyde (*o*)	salicylaldehyde	$HO·C_6H_4·CHO$	VIII-31	122.12
3734	benzaldehyde (*m*)	.....	$HO·C_6H_4·CHO$	VIII-58	122.12
3735	benzaldehyde (*p*)	.....	$HO·C_6H_4·CHO$	VIII-64	122.12
3736	benzaldehyde oxime (*o*)	salicylaldoxime	$HO·C_6H_4·CH:NOH$	VIII-49	137.13
3737	benzaldehyde phenylhydrazone	(*o*)	$HO·C_6H_4·CH:N·NH·C_6H_5$	XV-188	212.24
3738	benzamide (*o*)	salicylamide	$HO·C_6H_4·CO·NH_2$	X-87	137.13
3739	benzamide (*m*)	.....	$HO·C_6H_4·CO·NH_2$	X-140	137.13
3740	benzamide (*p*)	.....	$HOC_6H_4CONH_2·H_2O$	X-164	155.15
3741	benzanilide (*o*)	salicylanilide	$HO·C_6H_4CO·NHC_6H_5$	XII-500	213.23
3742	benzoic acid (*o*)	salicylic acid	$HO·C_6H_4·CO_2H$	X-43	138.12

† See also No. 754.

Hydro-cotarnine, cf. alkd.
Hydro-naphthoquinone 2348, 2350
Hydro-phloron 2379
Hydro-quinine, cf. alkd.
Hydro-quinone 2314
Hydro-quinone diethyl ether 2093
Hydro-quinone dimethyl ether 2408
Hydro-quinone ethyl ether 2929
Hydro-quinone methyl ether 4081
Hydro-resorcin 2285
Hydro-sulfite N.F. 3293
Hydrol 4435
Hydrolit 3295
Hydropyrin 119

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3707	nd./aq.	.....	104-5	.....	.....	s.	s.
3708	lq.	$1.135^{21°}$	<−60	225 d.	.....	.....	.....
3709	lq.	$1.001^{18°}$	.....	261	.....	.....	.....
3710	mn./al.	.....	190±	d.	v. sl. s.	i. CS_2	v. sl. s.
3711	cr./aq.	.....	82-3	.....	$5^{18°}$; $108^{400°}$	v. s.	v. s.
3712	mn./bz. lg.	.....	111	.....	i. lg.	s.; s. bz.	s.
3713	mn./et.	.....	128-30	.....	v. s. h.	v. s.	v. s.; i. CS_2
3714	poison. lq.	$0.697^{18°}$	−12	25-6	∞	∞	∞
3715	rhb.	.....	87	120-5	v. s.	sl. s.	sl. s.
3716	pl./al.	.....	123-4	.....	sl. s. h.	s.	s.; s. chl.
3717	pl./al.	.....	128	.....	v. sl. s. ac.	2.5 h.	v. sl. s.
3718	pl./aq.	.....	122-3	.....	s. h.	s.; s. alk.	s.; s. bz.
3719	yel. cr./al.	.....	d.	.....	sl. s. h.	sl. s. h.	sl. s.
3720	nd./et.	.....	227-32	.....	v. sl. s. h.	s.; s. alk.	s.; i. lg.
3721	oil	$1.131^{\frac{21}{4}°}$	.....	213^{717mm}	sl. s.	∞	∞; ∞ ac.
3722	nd. or lf.	$1.099^{109°}$	95-6	296^{756mm}	s. h.	s.	s.; s. bz.
3723	nd./aq. al.	1.109	109	$147\text{-}8^{3mm}$	$1^{22°}$; $7.1^{100°}$	s.	s.
3724	or. red/al.	.....	194-5	subl.	.....	s.	v. s.
3725	yel. nd./al.	.....	302-6	subl.	v. sl. s. c.	s.	s.
3726	yel. nd./al.	.....	d. 235	subl.	s. alk.	s. alk. carb.	.....
3727	or. nd./et.	.....	82.5-3	.....	sl. s.	s.	s.
3728	yel. pr./bz.	.....	114-6	.....	0.08 h.	s.	s.
3729	or. rhb./al.	.....	155-6	220-30 ^{20mm} sl. d.	$0.002^{25°}$; 0.08 h.	$31^{25°}$; $0.6^{25°}$ CCl_4	v. s.; $2^{25°}$ bz.
3730	yel. red pr./aq.	.....	d. > 200	.....	sl. s.; i. HCl	s.	i.
3731	red yel. pl.	.....	.....	.....	$0.7^{15°}$; v. s. h.	.....	.....
3732	red brn. pd.	.....	.....	.....	s.	sl. s.	.....
3733	col. oil	$1.153^{\frac{25}{4}°}$	−7	196.5	sl. s.	∞	∞
3734	nd./aq.	.....	106-8	240±	s. h.	s.	s.
3735	nd./aq.	$1.129^{130°}$	116-7	subl.	s. h.	$70^{25°}$ act.	$4^{25°}$ bz.
3736	col. pr./bz.-pet.	.....	57-9	d.	v. sl. s. c.	s.; s. dil. HCl	s.; i. lg.; s. bz.
3737	col. nd.	.....	142-3	234^{28mm}	sl. s. h.	s. h.	s.
3738	lf./aq.	.....	140	d. 270	sl. s.	s.; s. chl.	s.
3739	lf./aq.	.....	170.5	.....	s. h.	s.; i. chl.	s.; i. CS_2
3740	nd./aq.	.....	162(anh.)	$-H_2O$, 100	s. h.	s.; i. chl.	s.; i. CS_2
3741	pr./al.	.....	135	d.	v. sl. s. h.	s.; s. bz.; s. chl.	s.; sl. s. CS_2
3742	mn.	$1.443^{\frac{20}{4}°}$	159; subl. 76	211^{20mm} ±	$0.16^{4°}$; $2.67^{75°}$	$49.6^{15°}$ abs. al.	$50.5^{15°}$

Hydroxy-acetaldehyde 3470
Hydroxy-acetamide 3472
Hydroxy-acetanilide 33-5
Hydroxy-acetic acid 3468
Hydroxy-acetonaphthone 48
Hydroxy-aniline 345-52
Hydroxy-anthracene 545, 561-2
Hydroxy-benzalacetophenone 3763
Hydroxy-benzene 5118

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Hydroxy				
3743	benzoic Ca (*o*)	calcium salicylate	$(C_7H_5O_3)_2Ca \cdot H_2O$†	X-60	332.32
3744	benzoic Na (*o*)	sodium salicylate	$HO \cdot C_6H_4 \cdot CO_2Na$	X-59	160.11
3745	benzoic acid (*m*)	.....	$HO \cdot C_6H_4 \cdot CO_2H$	X-134	138.12
3746	benzoic acid (*p*)	.....	$HO \cdot C_6H_4 \cdot CO_2H$	X-149	138.12
3747	benzoic anhydride (*o*)	salicylide; *β*-disalicylide	$(C_6H_4)_2O_2(CO)_2$	XIX-171	240.20
3748	benzonitrile (*o*)	salicylic nitrile	$HO \cdot C_6H_4 \cdot CN$	X-96	119.12
3749	benzophenone (*p*)	.....	$C_6H_5 \cdot CO \cdot C_6H_4 \cdot OH$	VIII-158	198.21
3750	benzyl alcohol (*o*)	salicyl alcohol	$HO \cdot C_6H_4 \cdot CH_2OH$	VI-891	124.13
3751	benzyl alcohol (*m*)	.....	$HO \cdot C_6H_4 \cdot CH_2OH$	VI-896	124.13
3752	benzyl alcohol (*p*)	.....	$HO \cdot C_6H_4 \cdot CH_2OH$	VI-897	124.13
3753	butyric acid (*α*) (*dl*)	.....	$C_2H_5 \cdot CHOH \cdot CO_2H$	III-303	104.10
3754	butyric acid (*β*)(*l*)	.....	$CH_3 \cdot CHOH \cdot CH_2 \cdot CO_2H$	III-307	104.10
3755	butyric acid (*β*)(*dl*)	.....	$HO \cdot C_3H_6 \cdot CO_2H$	III-308	104.10
3756	butyric acid (*γ*)	.....	$HO(CH_2)_3CO_2H$	III-311	104.10
3757	butyric acid (*iso*)(*α*)	acetonic acid	$(CH_3)_2COH \cdot CO_2H$	III-313	104.10
3758	butyric nitrile (*γ*)	(*dl*)	$HO \cdot (CH_2)_3 \cdot CN$	III-311	85.10
3759	caproic acid (*α*)(*dl*)	oxycaproic acid	$CH_3(CH_2)_3CHOH \cdot CO_2H$	III-332	132.16
3760	caproic acid(*iso*)(*α*)	leucic acid (*dl*)	$HO \cdot C_5H_{10} \cdot CO_2H$	III-336	132.16
3761	caprylic acid (*α*)	.....	$C_6H_{13} \cdot CHOH \cdot CO_2H$	III-348	160.21
3762	caprylic acid (*iso*) (*α*)	tetramethyl-hydracrylic acid	$[(CH_3)_2CH]_2 : C(OH) \cdot CO_2H$	III-348	160.21
3763	chalcone (2)‡	*o*-OH-benzalacetophenone	$C_6H_5 \cdot CO \cdot CH : CH \cdot C_6H_4 \cdot OH$	III-191	224.25
3764	*γ*-chloro-*n*-butyronitrile (*β*)(*dl*)	.....	$ClCH_2 \cdot CHOH \cdot CH_2 \cdot CN$	III-310	119.55
3765	*β*,*β*-dimethyl-*γ*-butyrolactone (*α*)	(*dl*)§		XVIII-3	130.14
3766	*β*,*β*-dimethyl-*γ*-butyrolactone (*α*)	(*l*)§	$C_6H_{10}O_3$	.....	130.14
3767	diphenylamine (*o*)	anilino-phenol	$HO \cdot C_6H_4 \cdot NH \cdot C_6H_5$	XIII-365	185.22
3768	diphenylamine (*m*)	anilino-phenol	$HO \cdot C_6H_4 \cdot NH \cdot C_6H_5$	XIII-410	185.22
3769	diphenylamine (*p*)	anilino-phenol	$HO \cdot C_6H_4 \cdot NH \cdot C_6H_5$	XIII-444	185.22
3770	diphenyl ether (*o*)	phenoxy-phenol	$HO \cdot C_6H_4 \cdot O \cdot C_6H_5$	VI-772	186.20
3771	ethyl ethylenediamine	.....	$HO \cdot CH_2 \cdot CH_2 \cdot NH \cdot CH_2 \cdot CH_2 \cdot NH_2$	IV-286	104.15
3772	glutamic acid (*β*)	(*l*+)	$HO_2C \cdot CH_2 \cdot CHOH \cdot CH(NH_2) \cdot CO_2H$	*IV-550	163.13
3773	glutaric acid (*α*) (*dl*)	.....	$HO_2C \cdot CHOH \cdot CH_2 \cdot CH_2 \cdot CO_2H$	III-442	148.11
3774	glutaric acid (*β*)	.....	$HOCH : (CH_2CO_2H)_2$	III-443	148.11

† Crysts. + $2H_2O$, 2.8$^{16°}$ aq., − H_2O 100°; + $3H_2O$, 2.3$^{15°}$, 35.8$^{100°}$ aq.
‡ See also No. 1781.
§ Lactone portion of pantothenic acid is the *l*-form.

Hydroxy-benzoquinone-oxime 4900
Hydroxy-brasilin 3500
Hydroxy-butene 4422
Hydroxy-butyraldehyde 169
Hydroxy-chlorobenzaldehyde 1461
Hydroxy-cinchonine, cf. alkd.
Hydroxy-cinnamic acid 1531-3, 1537
Hydroxy-coniine, cf. alkd.
Hydroxy-coumarin 6369
Hydroxy-cumene 5433-5
Hydroxy-deguelin 5699

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3743	col. nd.	.....	.....	.....	1.4 c.; 4 h.	s.	s.
3744	col. pl./al.	.....	.....	.....	$125^{25°}$	$17^{15°}$	25 gly.
3745	rhb./aq.	1.473	201	.....	$0.8^{19°}$; s. h.	s. h.	10^{100}
3746	mn./aq. al.	$1.468^{4°}$	214.5-5.5	.....	$0.17^{0°}$; $2.75^{55°}$	v. s.	$23^{25°}$; i. CS_2
3747	nd./chl.	.....	200-1	d.	i.	s. h.	.....
3748	pr./bz.	.....	97-8	149^{14mm}	v. sl. s.	v. s.	v. s.
3749	rhb.	.....	134-5	.....	s. h.	$25^{25°}$ act.	$8^{25°}$
3750	rhb./aq.	$1.161^{25°}$	86-7	subl.	$6.6^{15°}$	v. s.	v. s.; s. bz.
3751	cr./bz.	.....	67	300 ±, d.	v. s. h.	v. s.	v. s.
3752	pr./aq.	.....	125	252	v. s.	v. s.	v. s.
3753	hyg. cr.	.....	43-4	subl. > 60; 225-60 d.	s.	s.	s.
3754	mn.	.....	48-50	.....	v. s.	v. s.	v. s.; i. bz.
3755	hyg. syrup	.....	.....	130^{12mm} ±	.....	.....	.....
3756	lq.	.....	<-17	d. slowly room temp.	.....	.....	.....
3757	hyg. pr.	.....	79; subl. 50	212	v. s.	v. s.	v. s.; v. sl. s. bz.
3758	lq.	$1.029^{8°}$	.....	238-40	s.	s.; i. CS_2	s.; s. chl.
3759	nd.	.....	60-2	subl. 100 sl. d.	v. s.	v. s.	v. s.
3760	pl./et. + pet.	.....	76-7	.....	s.	s.	s.
3761	pl.	.....	69.5	.....	v. sl. s.	v. s.	v. s.
3762	cr./et.	.....	152-3 d.	192-3 d.	v. s.	v. s.	v. s.
3763	yel. lf./aq. al.	.....	154-5 d.	.....	v. sl. s. CS_2	v. s.	sl. s. chl.
3764	yel. lq.	.....	.....	250 ±, d.	s.	s.	s.
3765	col. hyg. nd.	.....	56-8	$119\text{-}21^{15mm}$	s.; s. bz.	s.; s. chl.; s. CS_2	s.; sl. s. pet.
3766	cr./bz. pet.	.....	91-2	.....	s.; sl. s. pet.	s.	s.
3767	pr./aq.	.....	69-70	$180\text{-}9^{20mm}$	sl. s. h.	s.	s.; sl. s. bz.
3768	lf./aq.	.....	81.5-2.0	340	sl. s. h.; s. alk.	s.; s. dil. a.	s.; sl. s. lg.
3769	lf.	.....	70	330	v. sl. s. c.; s. alk.	s.; s. dil. a.	s.; s. chl.
3770	nd./aq.	.....	106-7	$151\text{-}5^{11mm}$	sl. s. h.	v. s. h.	v. s. h.
3771	lq.	.....	.....	238-40	v. s.	v. s.	i.
3772	pr./aq.	.....	softens 100	d. > 100	v. s.	i.	i.; v. s. ac.
3773	col. cr.	.....	72	.....	s.	.....	.....
3774	nd./aq.	.....	95	.....	v. s.	v. s.	sl. s.

Hydroxy-diethylaniline 2116
Hydroxy-dimethylbenzene 6465-70
Hydroxy-diphenyl 5216-8
Hydroxy-diphenylmethane 823
Hydroxy-ditane 824
Hydroxy-ethyl acetate 3446
Hydroxy-ethylamine 2907
Hydroxy-ethylaniline 2930
Hydroxy-ethyl formate 3456
Hydroxy-hydroquinone 6217
Hydroxy-isophenoxazone 5554
Hydroxy-lepidine 4179
Hydroxy-malonic acid 5695
Hydroxy-methoxybenzaldehyde 6418, 6421
Hydroxy-methoxybenzoic acid 6417
Hydroxy-methoxybenzyl alcohol 6422

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Hydroxy				
3775	hydroquinone triacetate (1,2,4)	triacetyl-hydroxyhydroquinone	$(CH_3CO_2)_3C_6H_3$	VI-1089	252.22
3776	3-methoxyacetophenone (4)	acetovanillone; apocynin	$CH_3CO{\cdot}C_6H_3(OH){\cdot}OCH_3$	VIII-272	166.17
3777	methyl benzoic acid	(*o*)	$HO{\cdot}CH_2{\cdot}C_6H_4{\cdot}CO_2H$	X-218	152.14
3778	α-naphthoic acid	(2,1)	$HO{\cdot}C_{10}H_6{\cdot}CO_2H$	X-328	188.17
3779	α-naphthoic acid	(5,1)	$HO{\cdot}C_{10}H_6{\cdot}CO_2H$	X-330	188.17
3780	α-naphthoic acid	(6,1)	$HO{\cdot}C_{10}H_6{\cdot}CO_2H$	X-330	188.17
3781	α-naphthoic acid	(7,1)	$HO{\cdot}C_{10}H_6{\cdot}CO_2H$	X-330	188.17
3782	β-naphthoic acid	(1,2)	$HO{\cdot}C_{10}H_6{\cdot}CO_2H$	X-331	188.17
3783	β-naphthoic acid	(3,2)	$HO{\cdot}C_{10}H_6{\cdot}CO_2H$	X-333	188.17
3784	β-naphthoic acid	(5,2)	$HO{\cdot}C_{10}H_6{\cdot}CO_2H$	X-337	188.17
3785	β-naphthoic acid	(7,2)	$HO{\cdot}C_{10}H_6{\cdot}CO_2H$	X-337	188.17
3786	α-naphthoquinone	(2)	$C_{10}H_5O_2{\cdot}OH$	VIII-300	174.15
3787	α-naphthoquinone	(5); juglon; nucin	$C_{10}H_5O_2{\cdot}OH$	VIII-308	174.15
3788	β-naphthoquinone	(7)	$C_{10}H_5O_2{\cdot}OH$	VIII-299	174.15
3789	β-naphthoquinone	(6)	$C_{10}H_5O_2{\cdot}OH$	*VIII-638	174.15
3790	naphthyl-*o*-hydroxy-*m*-toluic acid (β)	epicarin	$HO{\cdot}C_{10}H_6{\cdot}CH_2{\cdot}C_6H_3(OH){\cdot}CO_2H$	.....	294.29
3791	nicotinic acid (α)	.....	$HO{\cdot}C_5H_3N{\cdot}CO_2H$	XXII-214	139.11
3792	nicotinic acid (*p*)	.....	$HO{\cdot}C_5H_3N{\cdot}CO_2H$	XXII-215	139.11
3793	oenanthylic acid (α)	.....	$C_5H_{11}{\cdot}CHOH{\cdot}CO_2H$	III-342	146.18
3794	phenylacetic acid (*o*)	.....	$HO{\cdot}C_6H_4{\cdot}CH_2{\cdot}CO_2H$	X-187	152.14
3795	phenylacetic acid	(*m*)	$HO{\cdot}C_6H_4{\cdot}CH_2{\cdot}CO_2H$	X-189	152.14
3796	phenylacetic acid (*p*)	.....	$HO{\cdot}C_6H_4{\cdot}CH_2{\cdot}CO_2H$	X-190	152.14
3797	phenylarsonic acid	(*p*)	$HO{\cdot}C_6H_4{\cdot}AsO(OH)_2$	XVI-874	218.03
3798	phenylarsonate Na	(*p*)	$HO{\cdot}C_6H_4{\cdot}As{:}O(OH)ONa{\cdot}2\frac{1}{2}H_2O$	XVI-874	285.06
3799	phenylethylamine (*p*)	tyramine	$HO{\cdot}C_6H_4{\cdot}CH_2{\cdot}CH_2{\cdot}NH_2$	XIII-625	137.18
3800	phenylglycine (*p*)	photo-glycin	$HO{\cdot}C_6H_4{\cdot}NH{\cdot}CH_2{\cdot}CO_2H$	XIII-488	167.16
3801	phenyl-quinoline-dicarboxylic acid	2-(4-OH-3-CO_2H-Ph)cinchoninic acid	$HO_2C{\cdot}C_9H_5N{\cdot}C_6H_3(OH)CO_2H$	*XXII-567	309.27
3802	*o*-phthalic acid	(3;1,2)	$HO{\cdot}C_6H_3(CO_2H)_2$	X-498	182.13
3803	*o*-phthalic acid	(4;1,2)	$HO{\cdot}C_6H_3(CO_2H)_2$	X-499	182.13
3804	*m*-phthalic acid	(2;1,3)	$HO{\cdot}C_6H_3(CO_2H)_2{\cdot}H_2O$	X-501	200.14
3805	*m*-phthalic acid	(4;1,3)	$HO{\cdot}C_6H_3(CO_2H)_2$	X-502	182.13
3806	*m*-phthalic acid	(5;1,3)	$HO{\cdot}C_6H_3(CO_2H)_2{\cdot}2H_2O$	X-504	218.16
3807	*p*-phthalic acid	(2;1,4)	$HO{\cdot}C_6H_3(CO_2H)_2$	X-505	182.13
3808	proline (4)(*dl*)	4-OH-pyrrolidine-2-carboxylic acid	$HN{:}C_4H_6(OH)CO_2H$	XXII-190	131.13
3809	proline (4)(*l* −)	.....	$C_5H_9O_3N$	XXII-191	131.13
3810	propiophenone (*o*)	*o*-propionyl-phenol	$HOC_6H_4COC_2H_5$	VIII-102	150.17

Hydroxy-methoxycoumarin 5604
Hydroxy-methyl-azobenzene 657-8
Hydroxy-methylbenzaldehyde 4379
Hydroxy-methylcoumarin 4406
Hydroxy-methylene acetone 3304
Hydroxy-naphthalene 4489-90
Hydroxy-phenetole 5136
Hydroxy-phenylalanine 6367
Hydroxy-phenyl-mercurichloride 4034-5
Hydroxy-propionitrile 3195
Hydroxy-purine, cf. alkd.
Hydroxy-quinol 6217
Hydroxy-quinoline carboxylic acid 3937
Hydroxy-stachydrine, cf. alkd.
Hydroxy-styrene 6443-4
Hydroxy-succinic acid 3997-8

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3775	nd./abs. al.	.....	96-7	>300 sl. d.	d. a.	d. alk.	.....
3776	col. pr./ aq.	.....	115	295-300	v. s. h.; i. pet.	$7.7^{9°}$	s.; s. bz.
3777	nd.	.....	128 d.	.....	$0.4^{20°}$	s.	s.
3778	nd./aq. al.	.....	156-7 d.	.....	v. sl. s.	v. s. abs.	s.; s. bz.
3779	nd./h. aq.	.....	234-7	subl.	s. h.	v. s.	s.; s. ac.
3780	nd./aq.	.....	208-9	.....	sl. s. h.	v. s.	.....
3781	nd./aq.	.....	253-4	.....	s. h.	s.	.....
3782	nd./al.	.....	188-91	.....	v. sl. s. h.	s.; s. alk.	s.; s. bz.
3783	yel. lf./aq.	.....	216	.....	sl. s. h.	s.; s. bz.	s.; s. chl.
3784	nd./al.	.....	211-2	.....	sl. s. h.	s.	.....
3785	lf.	.....	262	.....	s.	s.	s.
3786	red cr./ac.	.....	190d.	subl.	sl. s. h.	s.	s.
3787	yel. red/ bz.	.....	153-4	d.	i.; s. h. ac.	sl. s. c.	sl. s.
3788	brn. nd.	.....	194	.....	i. bz.	s.; s. ac.	i.
3789	lt. yel./aq. al.	.....	>200	d. > 220	s. h.	s.	.....
3790	wh. pd.	.....	90±, d.	.....	i.	s.; i. chl.	s.; s. act.
3791	nd./aq.	.....	256	.....	v. sl. s.	.....	.....
3792	nd./aq.	.....	301-2 d.	subl.	sl. s. h.	v. sl. s.	v. sl. s.
3793	pr.	.....	65	d.	v. sl. s. c.	.....	.....
3794	nd./et.	.....	145-7	240-3 d.	s.	sl. s. c. chl.	s.
3795	nd./bz. lg.	.....	129	190^{11mm}	v. s.	v. s.	v. s.
3796	nd./aq.	.....	148	.....	v. s. h.	v. s.	v. s.
3797	wh. pd.	.....	170±, d.	.....	v. s.	s.	.....
3798	nd./aq. al.	.....	$-2\frac{1}{2}H_2O$, 100	.....	s.	.....	.....
3799	lf./bz.	.....	161	$175\text{-}81^{8mm}$	<10 h.	10± h.; s. bz.	sl. s. h. xylene
3800	lf./aq.	.....	240-1 d.	.....	sl. s.; s. alk.	sl. s.	i.
3801	yel. pd.	.....	283-4 d.	.....	i.; s. alk.	sl. s.; sl. s. EtOAc	i. lg.
3802	nd./aq.	.....	150±, d.	.....	s.	s.	s.
3803	cr./aq.	.....	204-5 d.	.....	v. sl. s. bz.	s.	s.; sl. s. pet.
3804	nd./aq.	.....	243-4 (anh.)	$-H_2O$, 100	$0.14^{24°}$; $2.6^{100°}$	s.	s.; sl. s. chl.
3805	nd./aq.	.....	310	.....	$0.02^{100°}$; $0.7^{100°}$	s.; s. h. ac.	s.; i. chl.
3806	nd./aq.	.....	288(anh.)	$-2H_2O$, 100	$0.03^{5°}$; $18^{99°}$	s.	s.; s. bz.
3807	pd./aq.	.....	>330	subl. sl. d.	v. sl. s.	s.; s. Me al.	sl. s.
3808	col. pl./ Me al.	.....	261-2 d.	.....	v. s.	v. sl. s.	.....
3809	lf./aq. al.	.....	270	.....	v. s.	v. sl. s.	.....
3810	lq.	.....	.....	115^{15mm}	v. sl. s.	s.; s. alk.	s.

Hydroxy-toluene 1545-7
Hydroxy-tyrosine 2361
Hydroxy-xanthene 6453
Hyoscine, cf. alkd.
Hyoscyamine, cf. alkd.
Hypaphorine, cf. alkd.
Hypnal 567
Hypnone 51
Hypotonin 3200
Hypoxanthine, cf. alkd.
Hystazarin 2302
Hystazin 2302
I acid 337
Idryl 3245
Ignotine 1251
Imidazolyl-alanine 3669
Imidazolyl-ethylamine 3667
Imino-ethyl alcohol 2090
Imino-urea 3488
Indane 3695
Indanone 3698-9
Indican, cf. glcde.
Indigo-disulfonic acid 3858
Indigo red 3862

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Hydroxy				
3811	propiophenone (*p*)	*p*-propionyl-phenol	$HOC_6H_4COC_2H_5$	VIII-102	150.17
3812	pyridine (2)(α)	α-pyridone	$HO{\cdot}C_5H_4N$	XXI-43	95.10
3813	pyridine (3)	β-pyridone	$HO{\cdot}C_5H_4N$	XXI-46	95.10
3814	pyridine (γ)	γ-pyridone	$HO{\cdot}C_5H_4N{\cdot}H_2O$	XXI-48	113.11
3815	pyrotartaric acid (α)	.....	$HO_2C{\cdot}CH(CH_3){\cdot}CHOH{\cdot}CO_2H$	III-445	148.11
3816	quinaldine (3)	.....	$C_{10}H_9ON$	XXI-103	159.18
3817	quinaldine (4)	.....	$C_{10}H_9ON$	XXI-104	159.18
3818	quinaldine (5)	.....	$C_{10}H_9ON$	XXI-106	159.18
3819	quinaldine (6)	.....	$C_{10}H_9ON$	XXI-106	159.18
3820	quinoline (2)(α)	carbostyril	$HO{\cdot}C_9H_6N$	XXI-77	145.15
3821	quinoline (4)(γ)	kyanurin	$HO{\cdot}C_9H_6N{\cdot}3H_2O$	XXI-83	199.20
3822	quinoline (5)(*ana*)	.....	$HO{\cdot}C_9H_6N$	XXI-84	145.15
3823	quinoline (6)(*p*)	.....	$HO{\cdot}C_9H_6N$	XXI-85	145.15
3824	quinoline (7)(*m*)	.....	$HO{\cdot}C_9H_6N$	XXI-91	145.15
3825	quinoline (8)(*o*)	oxine	$HO{\cdot}C_9H_6N$	XXI-91	145.15
3826	*iso*-quinoline (1)	*iso*-carbostyril	$C_6H_4CO{\cdot}NH{\cdot}CH{:}CH$ (ring)	XXI-100	145.15
3827	quinoline (8) sulfate	chinosol; quinosol	$(HO{\cdot}C_9H_6N)_2{\cdot}H_2SO_4$	XXI-92	388.38
3828	quinoline-5-sulfonic acid (8)	.....	$HOC_9H_5N{\cdot}SO_3H{\cdot}2H_2O$	XXII-407	261.25
3829	stearic acid (α)	.....	$C_{16}H_{33}CHOH{\cdot}CO_2H$	III-364	300.47
3830	stearic acid (10)	.....	$CH_3(CH_2)_7{\cdot}CHOH{\cdot}(CH_2)_8CO_2H$	III-365	300.47
3831	stearic acid (λ)	.....	$CH_3(CH_2)_5{\cdot}CHOH{\cdot}(CH_2)_{10}CO_2H$	III-366	300.47
3832	*o*-toluic acid (1;2,6)	.....	$CH_3C_6H_3(OH)CO_2H$	X-214	152.14
3833	*o*-toluic acid (1;3,2)	Me-salicylic acid (6)	$CH_3C_6H_3(OH)CO_2H$	X-217	152.14
3834	*o*-toluic acid (1;3,6)	.....	$CH_3C_6H_3(OH)CO_2H{\cdot}\frac{1}{2}H_2O$	X-214	161.15
3835	*o*-toluic acid (1;4,2)	.....	$CH_3C_6H_3(OH)CO_2H$	X-215	152.14
3836	*m*-toluic acid (1;2,3)	β-cresotinic acid	$CH_3C_6H_3(OH)CO_2H$	X-220	152.14
3837	*m*-toluic acid (1;2,5)	.....	$CH_3C_6H_3(OH)CO_2H{\cdot}\frac{1}{2}H_2O$	X-225	161.15
3838	*m*-toluic acid (1;3,5)	.....	$CH_3C_6H_3(OH)CO_2H$	X-227	152.14
3839	*m*-toluic acid (1;4,3)	α-cresotinic acid	$CH_3C_6H_3(OH)CO_2H$	X-227	152.14
3840	*p*-toluic acid (1;2,4)	.....	$CH_3C_6H_3(OH)CO_2H$	X-237	152.14
3841	*p*-toluic acid (1;3,4)	γ-cresotinic acid	$CH_3C_6H_3(OH)CO_2H$	X-233	152.14
3842	urea	.....	$NH_2{\cdot}CO{\cdot}NHOH$	III-95	76.06
3843	valeric acid (α)(*n*)	.....	$C_3H_7{\cdot}CHOH{\cdot}CO_2H$	III-320	118.13
3844	*iso*-valeric acid (α)	(*dl*)	$(CH_3)_2CH{\cdot}CHOH{\cdot}CO_2H$	III-328	118.13
3845	*iso*-valeric acid (β)	.....	$(CH_3)_2COH{\cdot}CH_2{\cdot}CO_2H$	III-327	118.13

Indigotin 3857
Indirubin 3862
Indolyl-alanine 6365
Indoxyl-glucoside 3856
Indoxyl-β-glucoside, cf. glcde.
Inositol 1602-3
Iodal 5817
Iodeikon 5814
Iodeosin 2896
Iodistol 5940
Iodo-acetol 2398
Iodo-acetonitrile 3890
Iodo-allylene 5344
Iodo-aspirin 93-4
Iodo-butane 1095-8
Iodo-butene 1568
Iodo-cyanogen 1592
Iodo-cyclohexane 1614
Iodo-decane 1647
Iodo-dimethylbenzene 3909
Iodo-ethane 3077
Iodo-ethanol 3208
Iodo-ethyl allophanate 179
Iodo-ethylene 6442

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3811	nd./aq.	.....	149-50	.....	$0.04^{15°}$	$3.3^{100°}$ aq.	$4^{25°}$
3812	nd./bz.	.....	106-7	280-1	v. s.	v. s.	s.; sl. s. lg.
3813	nd./bz.	.....	129	subl.	s.	s.	sl. s. bz.
3814	mn.	.....	92; 148.5 (anh.)	>350	$100^{15°}$	s.; v. sl. s. chl.	i.; i. bz.
3815	mn.	.....	123	d.	.....	.....	.....
3816	nd./al.	.....	265 d.	.....	sl. s.	s.	.....
3817	cr.	.....	230-1	>360 d.	1 c.; 10 h.	s.; v. sl. s. bz.	v. sl. s.
3818	lf./al.	.....	232-4	sl. d.	i.	sl. s. c.	s.
3819	cr./aq.	.....	213	sl. d.	sl. s.	s.	s.
3820	pr./al.	.....	199-200	subl.	s. h.	v. s.	v. s.
3821	nd./aq.	.....	52*	>300 d.	$0.47^{15°}$	v. s. h.	v. sl. s.
3822	nd./al.	.....	224 d.	subl.	v. s. h. Na_2CO_3	s.	sl. s.; i. lg.
3823	pr./abs. al.	.....	193	>360	v. sl. s. c.	sl. s.; s. alk.	v. sl. s.; s. a.
3824	pr./abs. al.	.....	235-8 d.	.....	v. sl. s.	v. s.	s. alk.
3825	pr./aq. al.	.....	75-6	266.6^{752mm}	v. sl. s. c.	s.; s. dil. alk.	sl. s.
3826	mn./bz.	.....	208-9	subl.	sl. s.	s.; s. chl.	sl. s.; sl. s. bz.
3827	yel. cr. pd.	.....	177-8	.....	v. s.	sl. s.	i.; s. gly.
3828	pa. yel. cr./HCl	.....	275±, d.	.....	sl. s. h.	sl. s.	v. sl. s.
3829	nd./chl.	.....	92-3	.....	v. s. h. bz.	$0.6^{20°}$	s.
3830	tab./al.	.....	83-5	.....	.....	$9.7^{20°}$	$2.4^{20°}$
3831	cr./al.	.....	78	.....	s. chl.; i. lg.	$13^{20°}$	$5.4^{19°}$
3832	cr./aq.	.....	142-5	.....	.....	.....	.....
3833	nd./aq.	.....	167-8	.....	$0.14^{25°}$	v. s.	v. s.
3834	cr./aq.	.....	178(anh.)	$-H_2O$, 100	s. h.	v. s.	v. s.; i. chl.
3835	nd./aq.	.....	180-2	subl.	s.	v. s.	v. s.
3836	nd./h. aq.	.....	163-4	.....	s. h.	s.	s.; s. chl.
3837	nd./aq.	.....	173-4 (anh.)	$-H_2O$, 100	s. h.	s.	s.; i. CS_2
3838	nd./aq.	.....	208-10	subl.	s.	.....	.....
3839	nd./aq.	.....	152-3	subl. sl. d.	s. h.	s.	s.; s. chl.
3840	nd./aq.	.....	206-7	subl.	s. h.	s.	s.; i. chl.
3841	nd./aq.	.....	177-8	subl.	s.	s.	s. chl.
3842	nd./al.	.....	139-40	d.	v. s.	s. h.	.....
3843	hyg. pl.	.....	34	subl.	v. s.	v. s.	v. s.
3844	rhb.	.....	86	.....	v. s.	v. s.	v. s.
3845	syrup	.....	.....	.....	v. s.	v. s.	v. s.

* Losses $3H_2O$, 110°; m. p. anh. 201°.

Iodo-gorgonic acid 2401-2
Iodo-heptane 3549
Iodo-hexadecane 1277
Iodo-hexahydrobenzene 1614
Iodo-hexane 3650-1
Iodo-hydrin 3208, 6287
Iodo-methane 4287
Iodo-nonane 4929
Iodo-octadecane 4940
Iodo-octane 4980
Iodo-pentane 459-63
Iodo-propene 208
Iodo-phthalein 5813
Iodo-propane 5417-8
Iodo-propyl alcohol 6287
Iodo-propylene 208
Iodo-propylene glycol 3402
Iodo-propylene oxide 2881
Iodo-quinine sulfate, cf. alkd.
Iodo-thymol 5940
Iodo-toluene (ω) 813
Iodol 5817
Iodophen 5813

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3846	**Hydroxy** valeric lactone (γ)	.....	$CH_3 \cdot CHCH_2CH_2CO \cdot O$ (ring)	XVII-235	100.11
3847	**Hyenic acid**	.....	$CH_3(CH_2)_{23} \cdot CO_2H$	II-394	382.65
3848	**Hypnoacetin**	.....	$C_{16}H_{15}O_3N$	XIII-464	269.29
3849	**Hypogaeic acid**	.....	$C_{15}H_{29} \cdot CO_2H$	II-461	254.40
3850	**Imesatin**	.....	$C_6H_4 \cdot C(NH)CO \cdot NH$ (ring)	XXI-440	146.14
3851	**Imidazol**	glyoxalin	$C_3H_4N_2$	XXIII-45	68.08
3852	**Imino**-diacetic acid	.....	$HN:(CH_2 \cdot CO_2H)_2$	IV-365	133.10
3853	diaceto-dinitrile	.....	$HN:(CH_2 \cdot CN)_2$	IV-367	95.10
3854	**Indandione** (1,3)	α,γ-diketo-hydrindene	$C_6H_4 \cdot CO \cdot CH_2 \cdot CO$ (ring)	VII-694	146.14
3855	**Indene**	.....	$C_6H_4 \cdot CH_2 \cdot CH:CH$ (ring)	V-515	116.15
3856	**Indican** (β)	indoxyl-β-glucoside	$C_{14}H_{17}O_6N \cdot 3H_2O$	.....	349.33
3857	**Indigo**	indigotin	$C_{16}H_{10}O_2N_2$	XXIV-417	262.26
3858	carmine	soluble indigo	$C_{16}H_8O_2N_2(SO_3Na)_2$	XXV-304	466.35
3859	dicarboxylic acid	.....	$C_{18}H_{10}O_6N_2$	XXV-273	350.28
3860	disulfonic acid	.....	$C_{16}H_8O_2N_2(SO_3H)_2$	XXV-304	422.38
3861	monosulfonic acid	.....	$C_{16}H_9O_2N_2(SO_3H)$	XXV-303	342.32
3862	purpurin	indirubin	$(NH \cdot C_6H_4CO \cdot C:)_2$	XXIV-430	262.26
3863	white	.....	$(C_6H_4C(OH):C \cdot NH)_2$ (ring)	XXIII-538	264.27
3864	**Indole**	benzopyrrole	C_8H_7N	XX-304	117.14
3865	**Indolyl**-acetic acid (3)	skatole carboxylic acid (ω)	$C_8H_6N \cdot CH_2CO_2H$	XXII-66	175.18
3866	butyric acid (3)(γ)	.....	$C_8H_6N \cdot (CH_2)_3CO_2H$	.....	203.23
3867	propionic acid (3)(β)	skatole-ω-acetic	$C_8H_6N \cdot (CH_2)_2CO_2H$	XXII-69	189.21
3868	**Indophenin**	.....	$(C_{12}H_7NOS)_2$	XXI-438	426.49
3869	**Indophenol**	.....	$HO \cdot C_6H_4 \cdot N:C_6H_4:O$	.....	199.20
3870	**Indoxyl**	.....	$HN \cdot CH:C(OH) \cdot C_6H_4$ (ring)	XXI-69	133.14
3871	**Indoxylic acid**	.....	$C_6H_4 \cdot COH \cdot C(CO_2H):$ (ring) NH	XXII-226	177.15
3872	**Inulin**	dahlin; alantin; alant starch	$(C_6H_{10}O_5)_6 \cdot H_2O$	.....	990.86
3873	**Iodo**-acetanilide (p)	.....	$I \cdot C_6H_4 \cdot NH \cdot COCH_3$	XII-671	261.07
3874	acetic acid	.....	$I \cdot CH_2 \cdot CO_2H$	II-222	185.96
3875	aniline (o)	.....	$I \cdot C_6H_4 \cdot NH_2$	XII-669	219.04
3876	aniline (m)	.....	$I \cdot C_6H_4 \cdot NH_2$	XII-670	219.04
3877	aniline (p)	.....	$I \cdot C_6H_4 \cdot NH_2$	XII-670	219.04
3878	anisole (o)	.....	$CH_3O \cdot C_6H_4 \cdot I$	VI-207	234.05
3879	benzene	phenyl iodide	$C_6H_5 \cdot I$	V-215	204.02
3880	benzoic acid (o)	.....	$I \cdot C_6H_4 \cdot CO_2H$	IX-363	248.03
3881	benzoic acid (m)	.....	$I \cdot C_6H_4 \cdot CO_2H$	IX-365	248.03
3882	benzoic acid (p)	.....	$I \cdot C_6H_4 \cdot CO_2H$	IX-366	248.03
3883	benzoyl chloride (o)	.....	$I \cdot C_6H_4 \cdot CO \cdot Cl$	IX-364	266.48

Iodosol 5940
Iopropane 3401
Iothion 3401
Iothymol 5940
Iotone 3401
Iridin, cf. glcde.
Isacen 1675
Iso-γ-acid 337
Isoamyl, isobutyl, etc., cf. amyl, butyl, etc.
Isodibutylene 1923
Isobutylene chloride 4060
Isoephedrine 2878
Isoequilenin 2887-8
Isonitroso-amyl ketone 79
"Isooctane" 4947
Isophthalic, cf. also phthalic.
Isophthalic acid 5276
Isophthalyl dichloride 5285
Isopral 6168
Isoprene 4154
Isopropanol 5369
Isopropenyl-benzene 5224
Isopurpurin 6215
Istazin 2301

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3846	lq.	$1.050^{\frac{22}{4}°}$	<−18	207-8	∞; i. aq. K_2CO_3	.....	.....
3847	cr./et.	.....	77-8	.....	.....	v. sl. s. c.	v. s.
3848	lf./al.	.....	160±	.....	i.	$0.3^{23°}$	i.
3849	col. nd.	.....	33	236^{15mm}	i.	v. s.	.....
3850	yel. pr.	.....	175-6	.....	i.	s. h.	sl. s.
3851	pr.	.....	89-90	255-6	s.	v. s.	sl. s.
3852	rhb.	.....	d. 225-36	.....	$2.4^{5°}$	i.	i.
3853	lf./et.	.....	75-7	.....	s.	s.	sl. s.
3854	cr./lg.	.....	129-31 d.	.....	v. sl. s. c.	s. h.	s. bz.
3855	col. lq.	$0.991^{\frac{25}{25}°}$	−2	181-2	i.	s.	∞
3856	brn. rhb.	.....	57; 176-8 (anh.)	.....	v. s.	v. s.; sl. s. bz.	sl. s.
3857	b. cr./ aniline	1.35	390-2	subl.	i.	i.	i.; s. h. act.
3858	b. amor.	.....	.....	.....	sl. s. c.	i.	i. aq. NaCl
3859	b. bl. ppt.	.....	.....	.....	s. H_2SO_4	i.	i.; i. chl.
3860	b. amor.	.....	.....	.....	v. s.	v. s.	.....
3861	b. amor.	.....	d. 200	.....	v. s.	v. s.	.....
3862	brn. nd.	.....	.....	subl.	i.	sl. s.	s. ac.
3863	col.-gray	.....	.....	.....	i.; s. alk.	s.	s.
3864	lf./aq.	.....	52	253-4	s. h.	s. h.	s.; s. bz.
3865	col. lf./bz.	.....	164-5	.....	v. sl. s. c.	s.; s. act.	s.; i. chl.
3866	rhb./bz. pet.	.....	124-5	.....	i.	s.; s. act.	s.; i. chl.
3867	cr./aq.	.....	133-4	.....	v. sl. s. c.	s.; s. ac.	s.
3868	b. pd.	.....	d.	.....	i.; s. H_2SO_4	v. sl. s.	v. sl. s.; i. bz.
3869	pl./act. pet.	.....	160	.....	s.; i. pet.	s.; s. bz.	s.; s. chl.
3870	yel. pr.	.....	85	110	s.; s. act.	s.	s.; v. sl. s. pet.
3871	cr.	.....	subl. 122-3	d.	v. sl. s; d. h.	.....	.....
3872	hyg. pd.	1.4(anh.)	d. 160	.....	$0.01^{0°}$; $37^{100°}$	$0.02^{16°}$	.....
3873	mn.	$1.989^{15-20°}$	183-4	.....	s. h.	$6.4^{21°}$	v. s. ac.
3874	col. pl.	.....	82-3	.....	s.	s.	sl. s.
3875	nd.	.....	60-1	.....	v. sl. s.	v. s.	v. s.
3876	lf. or nd.	.....	33	.....	i.	s.	.....
3877	nd./aq.	.....	67-8	.....	sl. s.	s.; s. chl.	s.
3878	yel. lq.	$1.8^{20°}$	.....	240-1	i.; s. bz.	∞; ∞ chl.	∞
3879	col. lq.	$1.824^{\frac{25}{4}°}$	−28.5	188.6	i.; ∞ chl.	s.	∞
3880	nd./aq.	2.25	162	.....	sl. s. h.	v. s.	v. s.
3881	cr./act.	.....	187-8	subl.	sl. s.	s.	.....
3882	lf.	.....	269-70	subl.	sl. s. h.	s.	.....
3883	cr.	.....	30-1	159^{27mm}	d.	d.	.....

Isuretin 3298
J acid 337
Jalapin, cf. glcde.
Japaconitine, cf. alkd.
Jervine, cf. alkd.
Juglon 3787
Kachin 2312
Kalmin, cf. glcde.
Kalmopyrin 116
Kalsetal 116
Kelene 3015
Ketine 2533
Keto-glutaric acid (β) 59
Keto-heptanone 1597
Keto-hexahydrotoluene 4204-6
Keto-hydroxyestrin 2903
Keto-pentamethylene 1620
Ketone 4436
Ketone base 4436
Koch acid 4555
Kodelon 350
Kryofine 4064
Kryogenin 1569
K. S. K. gas 3078

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3884	**Iodo** diphenyl (*o*)	.....	$I{\cdot}C_6H_4{\cdot}C_6H_5$	.....	280.11
3885	diphenyl (*p*)	.....	$I{\cdot}C_6H_4{\cdot}C_6H_5$	V-581	280.11
3886	ethylacetate (*β*)	.....	$CH_3CO_2{\cdot}CH_2{\cdot}CH_2I$	II-129	214.02
3887	form	triiodomethane	HCI_3	I-73	393.78
3888	8-hydroxyquinoline-5 sulfonic acid (7)	loretin; ferron	$IC_9H_4N(OH){\cdot}SO_3H$	XXII-408	351.13
3889	lepidine (2)	2-I-4-Me-quinoline	$C_{10}H_8NI$	XX-397	269.09
3890	methyl cyanide	iodoacetonitrile	$I{\cdot}CH_2{\cdot}CN$	II-223	166.96
3891	naphthalene (*α*)	*α*-naphthyl iodide	$C_{10}H_7I$	V-550	254.08
3892	naphthalene (*β*)	*β*-naphthyl iodide	$C_{10}H_7I$	V-552	254.08
3893	nitrobenzene (*o*)	.....	$I{\cdot}C_6H_4{\cdot}NO_2$	V-252	249.02
3894	nitrobenzene (*m*)	.....	$I{\cdot}C_6H_4{\cdot}NO_2$	V-253	249.02
3895	nitrobenzene (*p*)	.....	$I{\cdot}C_6H_4{\cdot}NO_2$	V-253	249.02
3896	phenetole (*o*)	.....	$I{\cdot}C_6H_4{\cdot}O{\cdot}C_2H_5$	VI-207	248.07
3897	phenetole (*p*)	.....	$I{\cdot}C_6H_4{\cdot}O{\cdot}C_2H_5$	VI-208	248.07
3898	phenol (*o*)	.....	$I{\cdot}C_6H_4{\cdot}OH$	VI-207	220.02
3899	phenol (*m*)	.....	$I{\cdot}C_6H_4{\cdot}OH$	VI-207	220.02
3900	phenol (*p*)	.....	$I{\cdot}C_6H_4{\cdot}OH$	VI-209	220.02
3901	propionic acid (*α*)	.....	$CH_3{\cdot}CHI{\cdot}CO_2H$	II-261	199.99
3902	propionic acid (*β*)	.....	$ICH_2{\cdot}CH_2{\cdot}CO_2H$	II-261	199.99
3903	propyne-1 (1)†	.....	$CH_3{\cdot}C{\vdots}CI$	I-248	165.97
3904	salicylic acid (3)	*m*-I-salicylic acid	$I{\cdot}C_6H_3(OH)CO_2H$	X-112	264.03
3905	toluene (*o*)	*o*-tolyl iodide	$I{\cdot}C_6H_4{\cdot}CH_3$	V-310	218.05
3906	toluene (*m*)	*m*-tolyl iodide	$I{\cdot}C_6H_4{\cdot}CH_3$	V-311	218.05
3907	toluene (*p*)	*p*-tolyl iodide	$I{\cdot}C_6H_4{\cdot}CH_3$	V-312	218.05
3908	trinitromethane	.....	$IC(NO_2)_3$	I-79	276.95
3909	*m*-xylene (2)	2-I-1,3-diMe-benzene	$I{\cdot}C_6H_3(CH_3)_2$	V-375	232.07
3910	**Iodoso**-benzene	.....	C_6H_5IO	V-217	220.02
3911	benzoic acid (*o*)	.....	$OI{\cdot}C_6H_4{\cdot}CO_2H$	IX-363	264.03
3912	**Iodoxybenzene**	.....	$C_6H_5IO_2$	V-218	236.02
3913	**Ionone** (*α*)	.....	$C_{10}H_{16}{:}CH{\cdot}CO{\cdot}CH_3$	VII-168	192.29
3914	**Ionone** (*β*)	.....	$C_{10}H_{16}{:}CH{\cdot}CO{\cdot}CH_3$	VII-167	192.29
3915	**Ionone** (*pseudo*)	citrylidene acetone	$C_{13}H_{20}O$	I-757	192.29
3916	semicarbazone (*α*)	.....	$C_{13}H_{20}{:}NNHCONH_2$	VII-169	249.35
3917	semicarbazone (*β*)	.....	$C_{13}H_{20}{:}NNHCONH_2$	VII-168	249.35
3918	**Irone** (*β*)	irone	$C_{14}H_{22}O$	VII-169	206.32
3919	**Isatin**	.....	$C_6H_4{\cdot}CO{\cdot}COH{:}N$ (ring)	XXI-432	147.13
3920	chloride	.....	$C_6H_4{\cdot}CO{\cdot}CCl{:}N$ (ring)	XXI-302	165.58
3921	**Isatinic acid**	anilino-glyoxylic acid	$NH_2{\cdot}C_6H_4{\cdot}CO{\cdot}CO_2H$	XIV-648	165.14
3922	**Isatoic anhydride**	.....	$C_6H_4{\cdot}CO_2{\cdot}CO{\cdot}NH$ (ring)	XXVII-264	163.13
3923	**Isatoxime**	nitroso-oxindol	$C_6H_4{\cdot}N{:}C(OH)C{:}NOH$ (ring)	XXI-443	162.14
3924	**Isatropic acid** (*α*)	1-Ph-1,2,3,4-tetrahydronaphthalene-1,4-dicarboxylic acid	$(C_9H_8O_2)_2$	IX-957	296.31

† See also No. 5344.

Kyanol 513
Kyanurin 3821
L acid 4503
Laburnine, cf. alkd.
Lactic anhydride 3948
Lactophenin 3949
Lactyl urea 4268
Lambda acid 4544
Lantanuric acid 182

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3884	lq.	$1.604^{\frac{25}{25}°}$	.....	$189\text{-}92^{36mm}$	.....	.....	.....
3885	col. cr./al.	.....	112-3	320 sl. d.	i.; s. bz.	s. h.	s.; s. ac.
3886	col. lq.	$2.441^{20°}$	.....	184^{743mm}	.....	.....	.....
3887	yel. hex.	$4.008^{17°}$	119	subl.	$0.01^{25°}$	$1.5^{17°}$; 11 h.	$13.6^{25°}$
3888	yel. lf.	.....	d. 260±	.....	0.2 c.; 0.6 h.	sl. s.; s. H_2SO_4	i.; i. bz.; i. chl.
3889	nd., lg.	.....	90	.....	.....	s.	s.; s. lg.
3890	oil	2.307	.....	182-4^{720} d.	s. d.	.....	.....
3891	oil	$1.734^{15°}$	.....	305	i.	∞	∞
3892	lf.	.....	54-5	308-10	i.	v. s.	v. s.
3893	yel. nd.	$1.883^{\frac{100°}{4}}$	52-4	288-9^{729mm}	i.	s. h.	v. s.
3894	mn.	$1.878^{\frac{100°}{4}}$	37-8	280±	.....	.....	.....
3895	yel. nd./al.	2.273 (solid)	171.5	287^{726mm}	.....	.....	.....
3896	lq.	.....	.....	245^{736mm}	i.	s.	s.
3897	cr.	.....	29	249^{729mm}	i.	s.	s.; s. chl.
3898	nd. or pl.	$1.876^{80°}$	40.4	$186\text{-}7^{160mm}$	s. h.	v. s.	v. s.
3899	nd./lg.	.....	40	d.	.....	.....	s.
3900	nd./aq.	$1.857^{112°}$	93-4	d.	sl. s.	v. s.	v. s.
3901	nd.	.....	44.5-5.5	$105^{0.3mm}$	v. sl. s.	s.	s.
3902	lf.	.....	82	.....	s. h.	v. s.	v. s.
3903	col. oil	$2.08^{22°}$	.....	110.2^{757mm}	.....	.....	.....
3904	col. nd./aq.	.....	199	.....	s. h.	s.	s. alk.
3905	lq.	$1.698^{20°}$	.....	211-2	i.	∞	∞
3906	lq.	$1.698^{20°}$	.....	204	i.	∞	∞
3907	lf.	.....	35-6	211.5	i.	v. s.	v. s.
3908	unstable, yel. pr.	.....	55-6	48^{13mm}	i.	s. h.	s. bz., lg.
3909	lq.	.....	.....	228-30	.....	.....	.....
3910	yel. amor.	.....	expl. 210	.....	s. h.	s. h.	v. sl. s.
3911	col. lf./aq.	.....	>200 d.	.....	s. h.	s. h.	v. sl. s.
3912	nd./aq.	.....	expl. 236-7	.....	s. h.	i.; i. bz.	s. h. ac.
3913	col. oil	$0.930^{20°}$	.....	136.1^{17mm}	sl. s.	∞	∞
3914	col. oil	$0.944^{20°}$	.....	140^{18mm}	sl. s.	∞	∞
3915	oil	$0.898^{20°}$	.....	$143\text{-}5^{12mm}$	.....	.....	.....
3916	cr./bz. lg.	.....	107-8 (137-8)	.....	.....	s.	.....
3917	nd./al.	.....	148-9	.....	i.	s.	s.; s. bz.
3918	col. oil	$0.939^{20°}$	.....	144^{16mm}	v. sl. s.	v. s.	v. s.
3919	yel. red mn.	.....	200-1	.....	s. h.	v. s. h.	sl. s.; s. alk.
3920	brn. nd.	.....	180±, d.	.....	i.	s.	s.; blue
3921	wh. pd.	.....	d.	.....	s.	.....	.....
3922	mn./act.	.....	240 d.	.....	d. h.	$38°$	sl. s.; 1.3 h. act.
3923	yel. nd.	.....	202 d.	.....	v. sl. s; s. a.	sl. s.	s. KOH; i. bz.
3924	cr.	.....	237	.....	sl. s. h.	sl. s.; i. CS_2	i.; i. bz.

Laricin, cf. glcde.
Larocaine 276
Laudanine, cf. alkd.
Laudanosine, cf. alkd.
Laurane 1017
Laurent's acid 4548
Laurone 2850
Lauroyl chloride 3955
Lauryl alcohol 2859
Lauryl bromide 2860

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3925	**Isatropic acid** (β)	.....	$(C_9H_8O_2)_2$	IX-957	296.31
3926	**Isomannide**	.....	$C_6H_{10}O_4$	I-540	146.14
3927	**Isonitrosoacetone**	.....	$CH_3{\cdot}CO{\cdot}CH{:}NOH$	I-763	87.08
3928	**Itaconic acid**	methylene succinic acid	$CH_2{:}C(CO_2H){\cdot}CH_2{\cdot}CO_2H$	II-760	130.10
3929	**Itamalic acid**	free acid non-existant	$CH_2OH{\cdot}CH(CO_2H){\cdot}CH_2{\cdot}CO_2H$	III-446	148.11
3930	**Kairoline**	*N*-methyl-tetrahydroquinoline	$C_9H_{10}N{\cdot}CH_3$	XX-264	147.21
3931	**Kawain**	.....	$CH_3O{\cdot}C_{13}H_{11}O_2$	.....	230.25
3932	**Ketazine**	acetone azine	$[(CH_3)_2C{:}N{\cdot}]_2$	I-651	112.17
3933	**Ketene**	.....	$H_2C{:}C{:}O$	I-724	42.04
3934	**Keto**-butyric acid (α)	.....	$CH_3{\cdot}CH_2{\cdot}CO{\cdot}CO_2H$	III-629	102.09
3935	dihydroquinazoline (4)	.....	$C_6H_4{\cdot}N{:}CH{\cdot}NH{\cdot}CO$	XXIV-143	146.14
3936	pyrrolidine	α,γ-butyrolactam	$NH{\cdot}(CH_2)_3{\cdot}CO{\cdot}H_2O$	XXI-236	103.12
3937	**Kynurenic acid**	4-hydroxyquinoline-3-carboxylic acid	$C_9H_5N(OH)CO_2H{\cdot}H_2O$	XXII-230	207.18
3938	**Lacmoid**	resorcinol blue	†	*VI-399	.....
3939	**Lactic** acid (*d*)	paralactic acid	$CH_3{\cdot}CHOH{\cdot}CO_2H$	III-261	90.08
3940	acid (*dl*)	.....	$CH_3{\cdot}CHOH{\cdot}CO_2H$	III-268	90.08
3941	Ca salt	calcium lactate	$(C_3H_5O_3)_2Ca{\cdot}5H_2O$	III-277	308.30
3942	aldehyde	.....	$CH_3{\cdot}CHOH{\cdot}CHO$	I-819	74.08
3943	amide	.....	$CH_3{\cdot}CHOH{\cdot}CO{\cdot}NH_2$	III-283	89.09
3944	nitrile	aldehyde-cyanohydrin	$CH_3{\cdot}CHOH{\cdot}CN$	III-284	71.08
3945	**Lactide** (*dl*)	dilactide	$C_6H_8O_4$	XIX-154	144.12
3946	**Lactoic acid** (*d*)	*d*-galactonic acid	$CH_2OH{\cdot}(CHOH)_4{\cdot}CO_2H$	III-549	196.16
3947	**Lactose**	milk sugar	$C_{12}H_{22}O_{11}{\cdot}H_2O$	.....	360.31
3948	**Lactyl lactic acid**	"lactic anhydride"	$C_2H_5O{\cdot}CO_2{\cdot}C_2H_4{\cdot}CO_2H$	III-282	162.14
3949	phenetidine (*p*)	lactophenin	$C_2H_5O{\cdot}C_6H_4{\cdot}NH{\cdot}CO{\cdot}CHOH{\cdot}CH_3$	XIII-491	209.24
3950	**Lauric** acid	dodecanoic acid	$CH_3(CH_2)_{10}{\cdot}CO_2H$	II-359	200.31
3951	ammonium salt	ammonium laurate	$C_{11}H_{23}CO_2NH_4$	*II-156	217.34
3952	aldehyde	dodecanal	$CH_3(CH_2)_{10}{\cdot}CHO$	I-714	184.31
3953	amide	.....	$C_{11}H_{23}{\cdot}CO{\cdot}NH_2$	II-363	199.33
3954	anhydride	.....	$(C_{11}H_{23}CO)_2O$	II-362	382.61
3955	chloride	lauroyl chloride	$CH_3(CH_2)_{10}{\cdot}CO{\cdot}Cl$	II-363	218.76
3956	nitrile	undecyl cyanide	$C_{11}H_{23}{\cdot}CN$	II-363	181.31
3957	**Lead** tetraethyl	tetraethyl lead	$(C_2H_5)_4Pb$	IV-639	323.45
3958	tetramethyl	tetramethyl lead	$(CH_3)_4Pb$	IV-639	267.35
3959	tetraphenyl	tetraphenyl lead	$(C_6H_5)_4Pb$	XVI-917	515.61
3960	**Lecithin**	protagon	$C_{42}H_{84}O_9PN$	.....	778.08
3961	**Lepamine**	.....	$C_{20}H_{32}N_2$	.....	300.47
3962	**Leuco**-aniline	3-Me; NH_2,4,4′,4″	$CH_3{\cdot}C_6H_3(NH_2)CH{:}(C_6H_4{\cdot}NH_2)_2$	XIII-321	303.39
3963	aurine (4,4′,4″)	.....	$(HO{\cdot}C_6H_4)_3CH$	VI-1143	292.32
3964	malachite green	Me_2N, 4,4′	$[(CH_3)_2N{\cdot}C_6H_4]_2{:}CH{\cdot}C_6H_5$	XIII-275	330.45

† Mixed dye; no formula.
Lauryl chloride 2861
Lauth's violet 5922
Lemonflavin, of. quercitrin, glcde.
Lenigallol 5516
Lepidine 4370
Lepidine ethiodide 4371
Lepidone 4179

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3925	pl./aq.	.....	206	d. to α, 220	.....	.....	.....
3926	hyg., mn.	.....	87	176^{30mm}	v. s.	s.; sl. s. chl.	i.; i. bz.
3927	lf./et.	$1.074^{67.5°}$	69	subl.	v. s.	v. sl. s. pet.	v. s.
3928	rhb.	1.63	165-6 sl. d.	.....	$8.3^{20°}$; v. sl. s. bz.	$25^{15°}$, 88% al.	v. sl. s.; v. sl. s. chl.
3929	.....	.....	.....	.....	.....	.....	.....
3930	lq.	$1.022^{\frac{20}{4}°}$	.....	$247\text{-}50^{758mm}$	.....	v. s.	sl. s.
3931	col. cr.	.....	105-6	$195\text{-}7^{0.1mm}$	i.	s.	s.; s. act.
3932	lq.	$0.843^{\frac{20}{4}°}$	.....	131	∞	∞	∞
3933	col. gas	.....	−151	−56	d.	d.	s.; s. act.
3934	hyg. pl.	.....	31.5-2.0	85^{21mm}	v. s.	v. s.	v. sl. s.
3935	col. nd.	.....	213-4	.....	s. h.	s.	s. NaOH
3936	cr.	$1.120^{\frac{20}{4}°}$	35	251*	v. s.	.....	.....
3937	nd.	.....	290(anh.)	$-H_2O$, 140-5	$0.09^{100°}$	s. h.	i.
3938	vl. pd.	.....	.....	.....	sl. s.	s.	i.; s. act.
3939	delq. pr.	.....	52.8	.....	∞	∞	∞
3940	$1.249^{\frac{15}{4}°}$	.....	16.8	122^{14mm}	∞	∞	∞
3941	col. cr.	.....	$-5H_2O$, 100	.....	10 c.	3	∞ h. aq.
3942	nd.	.....	101-5	.....	s.; v. s. ac.	s.; s. act.	i.; i. bz.
3943	cr.	$1.138^{\frac{80}{4}°}$	74	.....	v. s.	v. s.	.....
3944	col. lq.	$0.992^{\frac{15}{4}°}$	−40	182-4 sl. d.	∞	∞	i. pet.
3945	tri./al.	$0.862^{\frac{10}{4}°}$	124.5	255^{757mm}	v. sl. s. c.; d. h.	v. sl. s. c. abs. al.	.....
3946	nd./aq.	.....	d. 140-1	.....	s.	.....	.....
3947	col. rhb.	$1.525^{20°}$	202(anh.)	d.	17 c.; 40 h.	i.	i.
3948	lt. yel.	.....	.....	d. 250-60	v. sl. s.	s.	s.
3949	col. nd./aq.	.....	118	.....	0.3 c.; 1.8 h.	13; sl. s. lg.	sl. s.; s. h. bz.
3950	col. nd.	$0.869^{\frac{50}{4}°}$	48 (44)	225^{100mm}	i.; s. bz.	s.	s.; s.pet.
3951	waxy	0.88	48-55	$-NH_3 > 50$	s. h.	s.; i. chl.	i.; i. bz.
3952	col. lf.	.....	44.5	$184\text{-}5^{100mm}$	i.	s.	s.
3953	col. nd.	.....	102	$200^{12.5mm}$	i.	v. s.	.....
3954	col. cr.	.....	41	$166^{0.1mm}$	.....	.....	.....
3955	col. lq.	.....	−17	145^{18mm}	d.	d.	s.
3956	oil	0.827[15°]	4	198^{100mm}	.....	.....	.....
3957	col. lq.	$1.659^{\frac{18}{4}°}$	−136	152^{291mm}	i.; s. bz.	sl. s.	∞
3958	col. lq.	$1.995^{\frac{20}{4}°}$	−27.5	110^{760mm}	i.	∞	∞
3959	tet./bz.	$1.530^{20°}$	228-9	d. 270	i.	$0.1^{30°}$	$1.7^{30°}$ bz.
3960	waxy	.....	150-200 d.	.....	i.; s. chl.	s. h.	s. h.
3961	lq.	.....	.....	275	.....	.....	.....
3962	cr./aq.	.....	100	.....	sl. s. h.	v. s.	sl. s.
3963	col. pr./ac.	.....	.....	.....	sl. s.	s.; s. alk.	s. ac.
3964	nd./bz.	.....	102(94)	d.	i.	s.; s. bz.	s.; sl. s. lg.

* B. p. of anh. compound.

Leucic acid 3760
Leuco-aniline 6071-3
Leuco-alizarin 2295
Leuco-crystal violet 3595
Leuco-dimethylphenylene green 5833
Leucoline 5538

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
3965	**Leucyl glycine** (*dl*)	.....	$C_5H_{12}NCO{\cdot}NHCH_2{\cdot}CO_2H$	IV-448	188.22
3966	**Levulin**	.....	$C_6H_{10}O_5$	I-925	162.14
3967	**Levulinic** acid	acetopropionic acid	$CH_3CO(CH_2)_2CO_2H$	III-671	116.11
3968	aldehyde	.....	$CH_3CO(CH_2)_2CHO$	I-774	100.11
3969	**Lichenin**	moss starch	$(C_6H_{10}O_5)_x$	.....	(162.14)
3970	**Lignoceric acid**	.....	$C_{24}H_{48}O_2$	II-393	368.62
3971	**Limettin**	5,7-diMeO-coumarin	$(CH_3O)_2C_9H_4O_2$	XVIII-97	206.19
3972	**Limonene** (*dl*)	dipentene	$C_{10}H_{16}$	V-137	136.23
3973	**Limonene** (*d* or *l*)	*p*-menthadiene-1,8(9)	$C_{10}H_{16}$	V-133	136.23
3974	**Linalool** (*d*)†	coriandrol	$C_{10}H_{18}O$	I-461	154.24
3975	**Linalyl acetate**	bergamol	$CH_3CO_2{\cdot}C_{10}H_{17}$	II-141	196.28
3976	**Linoleic acid**	octadecadienoic acid	$C_{18}H_{32}O_2$	II-496	280.44
3977	**Linolenic acid**	octadecatrienoic acid	$C_{18}H_{30}O_2$	II-499	278.42
3978	**Lophine**	triphenyl-imidazole	$(C_6H_5)_3C{:}C{\cdot}N{:}C{\cdot}NH$ (ring)	XXIII-318	296.35
3979	**Lumisterol**	.....	$C_{28}H_{43}OH$	.....	396.63
3980	**Luteol**	oxychloro-diphenyl-quinoxaline	$C_{19}H_{14}ONCl$	.....	307.77
3981	**Lutidine** (2,5)‡	dimethyl-pyridine	$(CH_3)_2C_5H_3N$	XX-244	107.15
3982	**Lutidine** (2,4)(α,α')	dimethyl-pyridine	$(CH_3)_2C_5H_3N$	XX-244	107.15
3983	**Lutidine** (2,6)	dimethyl-pyridine	$(CH_3)_2C_5H_3N$	XX-244	107.15
3984	**Lutidine** (3,4)	dimethyl-pyridine	$(CH_3)_2C_5H_3N$	XX-246	107.15
3985	**Lycopene**	lycopin	$C_{40}H_{56}$	XXX-81	536.85
3986	**Lysine** (*dl*)	α,ϵ-diaminocaproic acid	$NH_2{\cdot}(CH_2)_4{\cdot}CHNH_2{\cdot}CO_2H$	IV-436	146.19
3987	dihydrochloride	.....	$C_6H_{14}O_2N_2{\cdot}2HCl$	IV-437	219.12
3988	**Lysine** (*l*+)	.....	$(NH_2)_2C_5H_9{\cdot}CO_2H$	IV-435	146.19
3989	hydrochloride (*d*)	.....	$C_6H_{14}O_2N_2{\cdot}2HCl$	IV-436	219.12
3990	monohydrochloride	(*d*)	$C_6H_{14}O_2N_2{\cdot}HCl$	.....	219.12
3991	**Lyxose** (α)(*d*)	.....	$CH_2(CHOH)_4{\cdot}O$ (ring)	.....	150.13
3992	**Lyxose** (β)(*d*)	.....	$CH_2(CHOH)_4{\cdot}O$ (ring)	.....	150.13
3993	**Malachite** green§	benzaldehyde green; (zinc salt)	$3C_{23}H_{25}N_2Cl{\cdot}2ZnCl_2{\cdot}2H_2O$	XIII-745	1403.33
3994	green	(oxalate salt)	$2C_{23}H_{25}N_2{\cdot}C_2HO_4{\cdot}H_2C_2O_4$	XIII-745	926.98
3995	**Maleic** acid (*cis*)	butendioic acid; toxilic acid	$(:CH{\cdot}CO_2H)_2$	II-748	116.07
3996	anhydride	.....	$(:CH{\cdot}CO)_2O$	XVII-432	98.06
3997	**Malic** acid (*dl*)	hydroxysuccinic acid	$HO_2C{\cdot}CHOH{\cdot}CH_2{\cdot}CO_2H$	III-435	134.09
3998	acid (*d* or *l*)	.....	$HO{\cdot}C_2H_3(CO_2H)_2$	III-417	134.09
3999	Ca acid salt (*l*)	Ca bimalate	$Ca(HC_4H_4O_5)_2{\cdot}6H_2O$	.....	414.34
4000	acid (α), *iso*-	methyl tartronic acid	$CH_3{\cdot}C(OH)(CO_2H)_2$	III-440	134.09
4001	amide (*l*)	*l*-malamide	$HO{\cdot}C_2H_3(CO{\cdot}NH_2)_2$	III-435	132.12
4002	**Malonic** acid	propandioic acid	$CH_2{:}(CO_2H)_2$	II-566	104.06
4003	Ca salt	calcium malonate	$CaC_3H_2O_4{\cdot}4H_2O$	II-570	214.19
4004	amide	malonamide	$CH_2{:}(CO{\cdot}NH_2)_2$	II-582	102.09

† See also No. 2518.
‡ See also No. 3147.
§ In medicinal use without $ZnCl_2$
Levulose 3616
Lewisite 1473
Light green 3594
Lilacin, cf. glcde.
Linalool tetrahydride 2519
Linaloolene 2515
Linamarin, cf. glcde.
Lindol 6351
Litmopyrin 117
Lobeline, cf. alkd.
Lodal 2413
Loretin 3888
Luminal 5113
Luminol 359
Lupanine, cf. alkd.
Lupinidine, cf. alkd.
Lupinine, cf. alkd.
Lutein 6452
Luteosterone 5334
Lutidinic acid 5498

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
3965	cr./aq.	.....	243 d.	.....	6.6 h.	v. sl. s.	v. sl. s.
3966	delq. amor.	.....	d. 140-5	.....	v. s.	v. sl. s.	i.
3967	lf.	$1.140^{20°}_{4°}$	33.5	245-6 sl. d.	v. s.	v. s.	v. s.
3968	col. lq.	$1.018^{20°}_{4°}$	<−21	186-8 sl. d.	∞	∞	s.
3969	col. amor.	.....	.....	.....	s. h.	s. HCl	i.
3970	col. nd.	.....	81-2	.....	s. bz.	s.; s. ac.	s.; s. CS_2
3971	col. cr./al.	.....	147.5	200 sl. d.	i.; s. chl.	s. h.	v. sl. s.
3972	col. lq.	$0.844^{20°}$	.....	178	i.	∞	∞
3973	lq.	$0.842^{20°}_{4°}$	−96.9	177	i.	∞	∞
3974	col. oil	$0.868^{20°}$	.....	198-200	v. sl. s.	10, 50% al.	∞
3975	col. lq.	$0.895^{20°}$	.....	220^{762} ±, d.	v. sl. s.	∞	∞
3976	lt. yel. oil	$0.903^{18°}_{4°}$	−11	$229\text{-}30^{16mm}$	i.	∞	∞
3977	oil	$0.914^{18°}_{4°}$	.....	$230\text{-}2^{17mm}$	i.	s.	v. s.
3978	nd.	.....	275	.....	i.	2.8 h., abs.	$0.3^{20°}$
3979	col. nd.	.....	118	.....	i.; s. act.	s.; s. chl.	v. s.
3980	yel. nd.	.....	246	.....	i.	s.	s.
3981	lq.	$0.938^{0°}$	.....	156.5	25 c.; sl. s. h.	∞	∞
3982	lq.	$0.949^{0°}_{4°}$	.....	157-9	20 c.; sl. s. h.	s.	s.
3983	lq.	$0.942^{0°}$	.....	142-3	sl. s. h.	20 c. aq.	.....
3984	lq.	.....	.....	163.5-4.5	.....	.....	.....
3985	red pr./pet.	.....	174-5	.....	i.; s. h. bz.	v. sl. s. h.	0.03 h.
3986	syrup	.....	.....	.....	s.	.....	i.
3987	cr.	.....	186-9	.....	v. s.	.....	.....
3988	nd./aq.	.....	224-5 d.	.....	v. s.	i.	.....
3989	cr./HCl	.....	193	.....	.....	.....	.....
3990	wh. pd.	.....	235-6	.....	s.	i.	i.
3991	cr./al. et.	.....	106-7	.....	v. s.	$2.5^{17°}$	.....
3992	nd./al.	.....	117-8	.....	v. s.	sl. s.	.....
3993	gn. pr./ aq. al.	.....	130 ±	.....	v. s.	v. s.	.....
3994	gn. pr.	.....	.....	.....	v. s. h.	s.	.....
3995	mn.	1.609	130.5	135 d.	$79^{25°}$; $393^{98°}$	$70^{30°}$	$8^{25°}$
3996	cr./chl.	1.5	57-60	202; subl.	$16.3^{30°}$	v. sl. s. GCl_4	.....
3997	col. cr.	$1.601^{20°}_{4°}$	128-9	150 d.	$144^{26°}$; $411^{79°}$	v. s.	v. s.
3998	col. cr.	$1.595^{20°}_{4°}$	99-100	140 ±, d.	v. s.	v. s.	$8.4^{15°}$
3999	col. rhb.	.....	.....	.....	sl. s. c.	sl. s. ac.	s. a.
4000	col. cr.	.....	142 d.	d. 170 ±	v. s.	v. s.	v. s.
4001	pr./aq.	.....	156-8	.....	s.	.....	.....
4002	col. tri.	$1.631^{15°}$	130-5 d.	.....	$138^{16°}$	$42^{25°}$	$8^{15°}$ abs.
4003	col. nd.	.....	$-4H_2O$, 180	$-3H_2O$, 100	$0.4^{0°}$	$0.7^{100°}$ aq.	.....
4004	tet. or mn.	.....	170	.....	$8.3^{8°}$	i. abs.	i.

Lycine 846-7
Lycopin 3985
Lycorin, cf. alkd.
Lysidine 4256
Maclayin, cf. glcde.
Macleyin, cf. glcde.
Macleyine, cf. alkd.
Maclurin 5070
Magisal 118
Magnespirin 118
Malachite green leuco base 3964
Malachite green-G (base) 5762
Malakin 5588
Malamide 4001
Malonamide 4004
Malonanilide 4005
Malonic amide nitrile 1581
Malonic ester 2184

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4005	**Malonic** anilide	malonanilide	$CH_2(CONH{\cdot}C_6H_5)_2$	XII-293	254.28
4006	nitrile	methylene dicyanide	$CH_2(CN)_2$	II-589	66.06
4007	**Maltose**	malt sugar	$C_{12}H_{22}O_{11}{\cdot}H_2O$	.....	360.31
4008	**Mandelic** acid (*dl*)	.....	$C_6H_5{\cdot}CHOH{\cdot}CO_2H$	X-197	152.14
4009	sodium salt	sodium mandelate	$C_6H_5{\cdot}CHOH{\cdot}CO_2Na$	.....	174.13
4010	nitrile (*dl*)	.....	$C_6H_5{\cdot}CHOH{\cdot}CN$	X-206	133.14
4011	**Mannitol hexanitrate**	.....	$C_6H_8(O{\cdot}NO_2)_6$	I-543	452.17
4012	**Mannoheptose** (*d*)	.....	$C_7H_{14}O_7$	I-935	210.18
4013	**Mapharsen**	3-NH_2-4-OH-phenyl-arsinoxide HCl	O:As·C_6H_3(OH)NH_2·HCl·$\frac{1}{2}C_2H_5OH$	*XVI-447	258.53
4014	**Margaric** acid	heptadecanoic acid	$CH_3{\cdot}(CH_2)_{15}{\cdot}CO_2H$	II-376	270.44
4015	aldehyde	heptadecanal	$CH_3{\cdot}(CH_2)_{15}{\cdot}CHO$	I-717	254.44
4016	**Meconic** acid	.....	$C_7H_4O_7{\cdot}3H_2O$	XVIII-503	254.15
4017	lactone	6,7-diMeO-phthalide; meconine; opianyl	CO·O·CH_2·C_6H_2: (OCH$_3$)$_2$	XVIII-89	194.18
4018	**Melam**	.....	$C_6H_9N_{11}$	III-169	235.22
4019	**Melamine**	cyanuramide	$C_3N_3(NH_2)_3$	XXVI-245	126.13
4020	hydrochloride	.....	$C_3H_6N_6{\cdot}HCl{\cdot}\frac{1}{2}H_2O$	XXVI-246	171.60
4021	**Melene**	.....	$C_{30}H_{60}$	I-227	420.78
4022	**Melissic acid**	.....	$C_{30}H_{61}{\cdot}CO_2H$	II-396	466.81
4023	**Menthene** (*d*)	.....	$C_{10}H_{18}$	V-87	138.24
4024	**Menthol** (*α*)(*l*)	hexahydrothymol	$C_{10}H_{19}OH$	VI-28	156.26
4025	**Menthol** (*d*)(*neo*)	*p*-menthanol-3	$C_{10}H_{19}OH$	VI-28	156.26
4026	**Menthone** (*l*)	.....	$C_{10}H_{18}O$	VII-38	154.24
4027	**Menthyl** acetate (*l*)	.....	$CH_3{\cdot}CO_2{\cdot}C_{10}H_{19}$	VI-32	198.30
4028	acetate (*d*)(*neo*)	.....	$CH_3{\cdot}CO_2{\cdot}C_{10}H_{19}$	.....	198.30
4029	amine (*l*)	aminomenthane	$C_{10}H_{19}{\cdot}NH_2$	XII-26	155.28
4030	benzoate (*α*)	.....	$C_6H_5{\cdot}CO_2{\cdot}C_{10}H_{19}$	IX-115	260.36
4031	salicylate	salimenthol	$HO{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_{10}H_{19}$	X-76	276.36
4032	*iso*-valerate (*l*)	validol	$C_4H_9{\cdot}CO_2{\cdot}C_{10}H_{19}$	VI-33	240.37
4033	**Mercaptobenzothiazole** (2)	.....	$C_6H_4{\cdot}N{:}C(SH){\cdot}S$	XXVII-185	167.24
4034	**Mercuri**-hydroxyphenyl chloride (*o*)	*o*-Cl-mercuriphenol	$HO{\cdot}C_6H_4{\cdot}HgCl$	XVI-959	329.17
4035	hydroxyphenyl chloride (*p*)	*p*-Cl-mercuriphenol	$HO{\cdot}C_6H_4{\cdot}HgCl$	XVI-961	329.17
4036	phenyl acetate	Ph-mercuric acetate	$C_6H_5{\cdot}Hg{\cdot}O_2CCH_3$	XVI-954	336.75
4037	phenyl chloride	Ph-mercuric chloride	$C_6H_5{\cdot}HgCl$	XVI-953	313.17
4038	phenyl nitrate	Ph-mercuric nitrate	$C_6H_5{\cdot}Hg{\cdot}O{\cdot}NO_2$	XVI-953	339.72
4039	tolyl chloride (*p*)	.....	$CH_3{\cdot}C_6H_4{\cdot}HgCl$	XVI-956	327.19
4040	**Mercuric fulminate**	.....	$Hg(ONC)_2{\cdot}\frac{1}{2}H_2O$	.....	293.65
4041	**Mercurochrome**	diNa-diBr-hydroxymercury-fluorescein	$C_{20}H_7O_5Br_2Na_2HgOH{\cdot}3H_2O$	.....	804.75
4042	**Mercury** dibutyl	di-*n*-butyl mercury	$(C_4H_9)_2Hg$	.....	314.83
4043	diethyl	diethyl mercury	$(C_2H_5)_2Hg$	IV-679	258.73
4044	dimethyl	dimethyl mercury	$(CH_3)_2Hg$	IV-678	230.68

Malonyl thiourea 5887
Malonyl urea 621
Malt sugar 4007
Mandelonitrile glucoside, cf. glcde.
Mannite 3609
Mannitol 3609
Mannitol hexaacetate 3610
Mannoheptitol 5090
Mannose 3619
Marsh gas 4061
Martius yellow 2642
Matecite 4286
Matezite 4286
Mecholin 100
Mecholyl 100
Mecholyl bromide 99
Mecholyl iodide 101
Meconine 4017
Medinal 2125
Melaniline 2723
Meletin 5807

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4005	nd./al.	.....	225-6	.....	i.; s. ac.	v. s. h.	i.
4006	col. cr.	$1.049^{\frac{3}{4}^{\circ}}$	30-2	223-4	13	40	20
4007	col. nd.	$1.540^{17^{\circ}}$	d.	.....	v. s.	v. sl. s. c.	i.
4008	rhb./aq.	$1.300^{\frac{20}{4}^{\circ}}$	118.1	d.	$16^{20^{\circ}}$	s.	s.
4009	wh. cr. pd.	.....	.....	.....	99	2	.....
4010	oil	1.124	−10	d. 170	i.	s.	s.; s. chl.
4011	nd.	$1.604^{0^{\circ}}$	112-3	expl.	i.	$2.9^{13^{\circ}}$	$4^{9^{\circ}}$
4012	nd.	.....	134-5	.....	v. s.	sl. s. abs.	.....
4013	wh. pd.	.....	.....	.....	v. s.; s. alk.	v. s.; v. sl. s. act.	v. sl. s.
4014	col. pl.	$0.853^{60^{\circ}}$	60-1	227^{100mm}	i.	$32^{28^{\circ}}$ abs.	v. s.
4015	cr.	.....	36	$203\text{-}4^{26mm}$	sl. s. c. al.	v. s. h.	v. s.
4016	rhb.	.....	$-3H_2O$, 100	d.	d. h.	s.; d. h. a.	sl. s.
4017	col. nd./aq.	.....	102-2.5	subl.	$0.14^{15^{\circ}}$; $4.5^{100^{\circ}}$	s.; s. chl.	s.; s. bz.
4018	pd.	.....	d.	.....	i.	sl. s. a.	s. h. KOH
4019	mn.	$1.573^{250^{\circ}}$	250±	subl.	s. h.	sl. s. h.	i.
4020	nd.	.....	.....	.....	.....	i.	.....
4021	cr.	$0.913^{25^{\circ}}$	62-3	$218^{0.5mm}$	i.; v. sl. s. bz.	3.6 h., abs.	v. sl. s.
4022	nd./al.	.....	90-1	.....	i.	v. s. h.	v. sl. s.
4023	lq.	$0.814^{\frac{18}{4}^{\circ}}$	.....	168-9	.....	.....	.....
4024	col. cr.	$0.890^{\frac{15}{15}^{\circ}}$	42-3*	212	0.04 c.; s. pet.	v. s.; v. s. chl.	v. s.; v. s. ac.
4025	col. lq.	0.9±	−22	98^{16mm}	.....	.....	.....
4026	oil	$0.896^{\frac{20}{20}^{\circ}}$	−6.6	207	sl. s.	∞	∞
4027	col. lq.	$0.919^{\frac{20}{4}^{\circ}}$	.....	227	sl. s.	∞	∞
4028	col. cr.	.....	37-8	.....	i.	s.	v. s.
4029	oil	$0.861^{\frac{20}{4}^{\circ}}$	.....	209±	s. c.	v. s.	.....
4030	rhb./al.	$**1.002^{\frac{20}{4}^{\circ}}$	54-5	301^{748mm}	.....	.....	.....
4031	col. oil	$1.045^{\frac{25}{25}^{\circ}}$	.....	$203\text{-}5^{20mm}$	i.	s.	s.
4032	col. lq.	$0.907^{\frac{15}{4}^{\circ}}$	.....	129^{99mm}	i.	s.	s.; s. chl.
4033	col. nd./ aq. al.	$1.42^{\frac{20}{4}^{\circ}}$	179	d.	i.; s. alk.; s. ac.	s.; s. alk. carb.	sl. s.
4034	col. cr./ aq. al.	.....	152.5	.....	sl. s.	s.; v. sl. s. chl.	s. h. bz.
4035	lf./act.	.....	225-6	.....	.....	sl. s. h.	.....
4036	col. pr./bz.	.....	149	.....	s. h.	s.; s. ac.	s. bz.
4037	col. lf./bz.	.....	251	subl.	i.; s. pyr.	sl. s. h.	s.; s. bz.
4038	pl./al.	.....	188-9 d.	.....	v. sl. s. h.	s. h.	s. bz.
4039	col. lf./bz.	.....	232-3	.....	i.	v. sl. s. h.	i.
4040	cr./aq.	4.42(anh.)	expl.	.....	$0.07^{12^{\circ}}$; $0.17^{49^{\circ}}$	s.; d. h. aq. KOH	s. NH_4OH
4041	gn. scales	.....	.....	.....	s.	0.02	i.; i. chl.
4042	col. lq.	$1.778^{\frac{20}{4}^{\circ}}$	.....	$120\text{-}3^{23mm}$	.....	.....	.....
4043	col. lq.	$2.423^{\frac{23}{4}^{\circ}}$	.....	159	i.	sl. s.	v. s.
4044	col. lq.	$2.954^{\frac{22}{4}^{\circ}}$	.....	95-6	v. sl. s.	v. s.	v. s.

* M. p. β 35.5°; γ 33.5°; δ 31.5°.
** Supercooled liquid.

Mellitic acid 667
Mellophanic acid 681
Menthadiene 3973, 5092-3, 5704-5, 5709
Menthane 3579
Menthanol 4025
Menthene 1258
Mercapto-, cf. also thio- and sulfo-.
Mercapto-ethanol 5904
Mercapto-succinic acid 5911
Mellilotic acid 3711
Melin, cf. glcde.
Melissyl alcohol 4449
Melitose 5549

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4045	**Mercury** dinaphthyl (α)	.....	$(C_{10}H_7)_2Hg$	XVI-949	454.92
4046	dipropyl	dipropyl mercury	$(C_2H_5{\cdot}CH_2)_2Hg$	IV-679	286.78
4047	diphenyl	diphenyl mercury	$(C_6H_5)_2Hg$	XVI-946	354.81
4048	ditolyl (*o*)	ditolyl mercury	$(CH_3{\cdot}C_6H_4)_2Hg$	XVI-947	382.86
4049	ditolyl (*m*)	ditolyl mercury	$(CH_3{\cdot}C_6H_4)_2Hg$	XVI-947	382.86
4050	ditolyl (*p*)	ditolyl mercury	$(CH_3{\cdot}C_6H_4)_2Hg$	XVI-947	382.86
4051	mercaptide	.....	$(C_2H_5{\cdot}S)_2Hg$	I-342	322.85
4052	**Merthiolate**	Na ethylmercuri-thiosalicylate	$C_2H_5{\cdot}Hg{\cdot}S{\cdot}C_6H_4{\cdot}CO_2Na$	.....	404.83
4053	**Mesityl oxide**	.....	$(CH_3)_2C{:}CH{\cdot}CO{\cdot}CH_3$	I-736	98.14
4054	**Mesorcin** (1,3,5;2,4)	.....	$(CH_3)_3C_6H(OH)_2$	VI-939	152.19
4055	**Mesoxalic acid**	dihydroxy malonic	$(HO)_2C(CO_2H)_2$	III-766	136.06
4056	**Metanil yellow**	Na *m*-sulfonate-azo-diphenylamine	$C_6H_5{\cdot}NH{\cdot}C_6H_4{\cdot}N{:}N{\cdot}C_6H_4{\cdot}SO_3Na$	XVI-330	375.37
4057	**Metaphen**	4-NO_2-5-OH-mer-curi-*o*-cresol	$Hg{\cdot}C_7H_5O_3N$	.....	351.73
4058	**Methacrolein**	α-Me-acrolein	$CH_2{:}C(CH_3){\cdot}CHO$	I-731	70.09
4059	**Methallyl** alcohol	isopropenyl carbinol	$CH_2{:}C(CH_3){\cdot}CH_2OH$	I-443	72.10
4060	chloride (β)	γ-Cl-isobutylene	$CH_2{:}C(CH_3){\cdot}CH_2Cl$	I-209	90.55
4061	**Methane**	marsh gas	CH_4	I-56	16.04
4062	**Methionine** (*l*–)	α-NH_2-γ-methyl-thiolbutyric acid	$CH_3{\cdot}S{\cdot}(CH_2)_2{\cdot}CHNH_2{\cdot}CO_2H$	.....	149.21
4063	**Methoxy**-acetic acid	glycolic methyl ether	$CH_3O{\cdot}CH_2{\cdot}CO_2H$	III-232	90.08
4064	acetophenetidine	kryofine	$C_2H_5O{\cdot}C_6H_4{\cdot}NH{\cdot}CO{\cdot}CH_2{\cdot}OCH_3$	XIII-489	209.24
4065	acetophenone (*p*)	*p*-acetyl-anisole (*p*)	$CH_3O{\cdot}C_6H_4{\cdot}COCH_3$	VIII-87	150.17
4066	*tert*-amylbenzene		$CH_3O{\cdot}C_6H_4{\cdot}C_5H_{11}$	VI-549	178.26
4067	benzoic acid (*o*)	salicylic methyl ether	$CH_3O{\cdot}C_6H_4{\cdot}CO_2H$	X-64	152.14
4068	benzoic acid (*m*)	.....	$CH_3O{\cdot}C_6H_4{\cdot}CO_2H$	X-137	152.14
4069	benzoic acid (*p*)	*p*-anisic acid	$CH_3O{\cdot}C_6H_4{\cdot}CO_2H$	X-154	152.14
4070	benzophenone (*p*)	*p*-benzoyl anisole	$CH_3O{\cdot}C_6H_4COC_6H_5$	VIII-159	212.24
4071	benzoyl chloride (*p*)	anisoyl chloride	$CH_3O{\cdot}C_6H_4{\cdot}COCl$	X-163	170.59
4072	benzyl alcohol (*o*)	saligenin-2-Me-ether	$CH_3O{\cdot}C_6H_4{\cdot}CH_2OH$	VI-893	138.16
4073	diphenyl (*o*)	Ph-phenol-Me-ether	$CH_3O{\cdot}C_6H_4{\cdot}C_6H_5$	VI-672	184.23
4074	diphenyl (*p*)	Me Ph-phenol ether	$CH_3O{\cdot}C_6H_4{\cdot}C_6H_5$	VI-674	184.23
4075	ethyl chloro-formate (β)	β-methoxyethyl chlorocarbonate	$Cl{\cdot}CO_2{\cdot}CH_2{\cdot}CH_2{\cdot}OCH_3$	.....	138.55
4076	ethyl formate (β)	.....	$HCO_2{\cdot}CH_2{\cdot}CH_2{\cdot}OCH_3$	*II-19	104.10
4077	methylal	.....	$(CH_3O{\cdot}CH_2)_2O$	I-576	106.12
4078	methyl salicylate	mesotan; salmester	$HO{\cdot}C_6H_4{\cdot}CO_2CH_2{\cdot}OCH_3$	X-83	182.17
4079	phenol (*o*)	guaiacol	$CH_3O{\cdot}C_6H_4{\cdot}OH$	VI-768	124.13
4080	phenol (*m*)	resorcinol Me ether	$CH_3O{\cdot}C_6H_4{\cdot}OH$	VI-813	124.13
4081	phenol (*p*)	hydroquinone methyl ether	$CH_3O{\cdot}C_6H_4{\cdot}OH$	VI-843	124.13
4082	pyridine (*p*)(γ)	.....	$CH_3O{\cdot}C_5H_4N$	XXI-49	109.12
4083	quinoline (*p*)	quinanisole	$CH_3O{\cdot}C_9H_6N$	XXI-85	159.18
4084	**Methyl** abietate	abalyn	$C_{19}H_{29}CO_2{\cdot}CH_3$	.....	316.47
4085	acetamide (*N*)	acet-methylamide	$CH_3{\cdot}CO{\cdot}NH{\cdot}CH_3$	IV-58	73.09
4086	acetanilide (*N*)	exalgin	$CH_3CO{\cdot}N(CH_3)C_6H_5$	XII-245	149.19
4087	acetate	.....	$CH_3CO_2{\cdot}CH_3$	II-124	74.08
4088	acetoacetate	.....	$CH_3CO{\cdot}CH_2{\cdot}CO_2{\cdot}CH_3$	III-632	116.11

Meritol, mixt. of 2312 and 5260.
Mersalyl 5591
Mesaconic acid 4243
Mescaline, cf. alkd.
Mesidine 6251
Mesitol 6266
Mesitylene 6255
Mesitylenic acid 2463
Mesotan 4078
Mesoxalylurea 184-6
Metacresol purple 1551
Metacrolein 147
Metaldehyde 6
Metanilic acid 524
Methacetin 20

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4045	cr./bz.	1.929	243	d.	i.; s. h. chl.	sl. s. h.	s. CS_2
4046	col. lq.	$2.124^{16°}$	.....	189-91	i.	sl. s.	v. s.
4047	nd./bz.	$2.318^{4°}$	124-5	>300 d.	i.; s. chl.	sl. s. h.	sl. s.
4048	tri./bz.	.....	141(107)	219^{14mm}	.....	.....	.....
4049	nd.	.....	102(89)	.....	sl. s. chl.	sl. s.	sl. s.
4050	nd./bz.	.....	238	.....	s. h. bz.	sl. s. h.	s. CS_2
4051	lf./al.	.....	76-7	.....	.....	7 h.	.....
4052	pd.	.....	.....	.....	100	14	i.; i. bz.
4053	lq.	$0.858^{20°}_{4°}$	−59	$129\text{-}30^{750mm}$	$3^{20°}$	∞	∞
4054	lf.	.....	149-50	274.5-5.5	v. sl. s.	s.	s.
4055	hyg. cr.	.....	119-20 sl. d.	.....	v. s.	s.	s.
4056	brn. yel. pd.	.....	.....	.....	s.	.....	.....
4057	yel. pd.	.....	.....	.....	i.; s. h. ac.	i.; s. dil. NaOH	i.; s. NH_4OH
4058	lq.	$0.837^{20°}_{4°}$	.....	68.4	6.4	.....	.....
4059	lq.	$0.852^{20°}_{4°}$	.....	114.5	25	.....	.....
4060	col. lq.	$0.926^{20°}_{4°}$	.....	72-3	<0.1	.....	.....
4061	col. gas	(A)$0.554^{0°}_{760}$	−182.6	−161.4	$0.35^{20°}$ cc.	$47.1^{20°}$ cc.	$104^{100°}$ cc.
4062	hex. pl./ 65% al.	.....	283 d.	.....	s. c.	s.	i.
4063	hyg. lq.	$1.177^{20°}_{4°}$	.....	203-4	∞	∞	∞
4064	col. nd.	.....	98-9	.....	0.17 c.; 2 h.	s.	s.
4065	pl./et.	$1.082^{11°}_{4°}$	38-9	258	v. sl. s.	v. s.	v. s.
4066	lq.	.....	.....	$113\text{-}4^{11mm}$	.....	.....	.....
4067	pl./aq.	1.180	98.5-9.0	200	$0.5^{30°}$	v. s.	v. s.
4068	nd./aq.	.....	107-9	$170\text{-}2^{10mm}$	s. h.	s.	s.
4069	mn./aq.	$1.385^{4°}$	184.2	275-80	$0.03^{19°}$	v. s.	v. s.
4070	pr./et.	.....	61-2	$354\text{-}5^{729mm}$	.....	v. s.	v. s.
4071	col. nd.	.....	22-3	263 sl. d.	i. d.	s. d.	s. bz.
4072	col. lq.	$1.043^{25°}_{25°}$	.....	248-50	v. sl. s.	s.	∞
4073	pr./pet.	.....	29-30	274	.....	.....	.....
4074	lf./al.	.....	90	.....	.....	s. h.	.....
4075	col. lq.	.....	.....	$54\text{-}60^{13mm}$	.....	.....	.....
4076	col. lq.	$1.048^{15°}_{4°}$	.....	131-1.5	.....	.....	.....
4077	col. lq.	$0.959^{20°}_{20°}$	.....	106-8	.....	.....	.....
4078	col. oil	$1.2^{15°}$	.....	162^{42mm}	v. sl. s.	∞; ∞ bz.	∞; ∞ chl.
4079	pr.	$1.140^{15°}_{15°}$	28.3	205	$1.7^{15°}$	v. s.	v. s.
4080	lq.	>1	<−17.5	243.3-4.3	sl. s.	∞; s. alk.	∞
4081	lf./aq.	.....	53	243	.....	.....	v. s. bz.
4082	lq.	.....	.....	$190\text{-}1^{738mm}$	∞	.....	.....
4083	lq.	$1.154^{20°}$	26-8	254^{310mm}	.....	s.	.....
4084	pa. yel. lq.	$1.040^{20°}_{20°}$	.....	360-5 d.	i.	∞	∞
4085	col. nd.	.....	28	206	.....	.....	.....
4086	rhb./al.	$1.004^{105°}_{4°}$	102-4	253^{712mm}	1.7 c.	2	14
4087	col. lq.	$0.924^{20°}_{4°}$	−98.7	59-60	$33^{22°}$	∞	∞
4088	col. lq.	$1.077^{20°}_{4°}$	−80	169-70 sl. d.	38	∞	∞

Methallyl ether 2403
Methanal 3288
Methane sulfonic acid 4382
Methane sulfonic chloride 4383
Methanoic acid 3301
Methanol 4100
Methanthiol 4298
Methenamine 3599
Methenyl-diphenylamine 2721
Methionic acid 4432
Methone 2475
Methoxy-acetaminophenol 18-20
Methoxy-allyl-phenol 2901
Methoxy-aniline 534-6
Methoxy-benzalacetone 528

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4089	**Methyl** acetophenone (*p*)	methyl-*p*-tolyl ketone	$CH_3 \cdot C_6H_4 \cdot CO \cdot CH_3$	VII-307	134.17
4090	acetylsalicylate	methyl aspirin; methyl rhodin	$CH_3CO_2 \cdot C_6H_4 \cdot CO_2 \cdot CH_3$	X-73	194.18
4091	acetylurea	.....	$CH_3 \cdot NH \cdot CO \cdot NH \cdot CO \cdot CH_3$	IV-66	116.12
4092	acridine (4)	.....	$CH_3 \cdot C_{13}H_8N$	XX-470	193.24
4093	acridine (2)	.....	$CH_3 \cdot C_{13}H_8N$	XX-470	193.24
4094	acridine (9)	.....	$CH_3 \cdot C_{13}H_8N$	XX-470	193.24
4095	acrylate	.....	$CH_2 : CH \cdot CO_2 \cdot CH_3$	II-399	86.09
4096	acrylic acid (*α*)	.....	$CH_2 : C(CH_3) \cdot CO_2H$	II-421	86.09
4097	hydrogen adipate	Me adipate (mono)	$CH_3O_2C(CH_2)_4 \cdot CO_2H$	II-652	160.17
4098	adipic acid (*α*)	.....	$HO_2C \cdot CH(CH_3) \cdot (CH_2)_3 \cdot CO_2H$	II-672	160.17
4099	adipic acid (*β*)(*d*)	.....	$HO_2C \cdot (CH_2)_2 \cdot CH \cdot (CH_3) \cdot CH_2 \cdot CO_2H$	II-673	160.17
4100	alcohol	wood alcohol	$CH_3 \cdot OH$	I-273	32.04
4101	alizarin (2;3,4)	3-methyl-alizarin	$CH_3(OH)_2C_6H(CO)_2 : C_6H_4$	VIII-469	254.23
4102	allylamine	.....	$CH_3 \cdot NH \cdot C_3H_5$	IV-206	71.12
4103	allyl carbinol	amylene alcohol	$(CH_3)(C_3H_5) : CHOH$	I-443	86.14
4104	allyl ether	.....	$CH_3 \cdot O \cdot CH_2 \cdot CH : CH_2$	I-437	72.10
4105	amine	amino-methane	$CH_3 \cdot NH_2$	IV-32	31.06
4106	amine hydrochloride	.....	$CH_3NH_2 \cdot HCl$	IV-36	67.52
4107	aminoacetate	methyl glycinate	$NH_2 \cdot CH_2 \cdot CO_2 \cdot CH_3$	IV-340	89.09
4108	aminobenzoate (*o*)	methyl anthranilate	$NH_2 \cdot C_6H_4 \cdot CO_2 \cdot CH_3$	XIV-317	151.16
4109	aminobenzoate (*p*)	.....	$NH_2 \cdot C_6H_4 \cdot CO_2 \cdot CH_3$	XIV-422	151.16
4110	aminobenzoic acid (*o*)	*N*-methyl anthranilic acid	$CH_3NH \cdot C_6H_4 \cdot CO_2H$	XIV-323	151.16
4111	amino ethanol (*β*)	.....	$CH_3NH \cdot CH_2 \cdot CH_2OH$	IV-276	75.11
4112	3-amino-4-hydroxy benzoate	orthoform new	$NH_2(OH)C_6H_3 \cdot CO_2 \cdot CH_3$	XIV-593	167.16
4113	amino-*p*-hydroxybenzoic acid (3)	.....	$CH_3NH(OH)C_6H_3 \cdot CO_2H$	XIV-593	167.16
4114	amino-2-methylheptene (6)	octin	$C_8H_{15} \cdot NHCH_3$	.....	141.25
4115	amino-phenol (*o*)	.....	$CH_3NH \cdot C_6H_4 \cdot OH$	XIII-362	123.15
4116	amino-phenol H_2SO_4	(*o*)	$(C_7H_9ON)_2 \cdot H_2SO_4$	XIII-362	344.38
4117	amino-phenol H_2SO_4	(*p*); metol; elon	$(C_7H_9ON)_2 \cdot H_2SO_4$	XIII-442	344.38
4118	amino-propionic acid (*α*)(*dl*)	.....	$CH_3 \cdot CH(NHCH_3) \cdot CO_2H$	IV-391	103.12
4119	amylbenzene (*m*)	amyl toluene	$CH_3 \cdot C_6H_4 \cdot C_5H_{11}$	V-446	162.26
4120	*n*-amyl ether	.....	$CH_3 \cdot O \cdot C_5H_{11}$	*I-193	102.17
4121	*iso*-amyl ether	.....	$CH_3 \cdot O \cdot C_5H_{11}$	I-400	102.17
4122	*n*-amyl ketone	heptanone-2	$CH_3(CH_2)_4 \cdot CO \cdot CH_3$	I-699	114.18
4123	*iso*-amyl ketone	2-Me-hexanone-5	$CH_3 \cdot CO \cdot C_5H_{11}$	I-701	114.18
4124	*iso*-amyl ketoxime	.....	$CH_3 \cdot C(:NOH) \cdot C_5H_{11}$	I-701	129.20
4125	aniline†	Me-Ph-amine	$C_6H_5 \cdot NH \cdot CH_3$	XII-135	107.15

† See also Nos. 5995-6000.

Methoxy-benzaldehyde 531-2
Methoxy-benzene 537
Methoxy-benzyl alcohol 530
Methoxy-cinchonine, cf. alkd.
Methoxy-cinchoninic acid 5537
Methoxy-coniferin, cf. glcde.
Methoxy-hydroxycinnamic acid 3236-7
Methoxy-styrene 6431-3
Methoxy-styryl ketone 528
Methoxy-tetrahydroquinoline 5874
Methoxylamine 4280
Methyl, cf. also dimethyl.
Methyl-acetanilide 26-8
Methyl-acetoacetic ester 3085
Methyl-acetopyrandione 1656

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4089	nd.	$0.989^{22°}$	28	228^{759mm}	i.	v. s.	v. s.
4090	col. cr./al.	.....	50-1	$134\text{-}6^{9mm}$	i.	s.; s. gly.	s.; s. chl.
4091	mn./aq.	.....	180	.....	v. s. h.	s. h.	v. sl. s. h.
4092	nd./al.	.....	88	.....	v. sl. s. h.	s.	.....
4093	yel. nd./ aq. al.	.....	134	.....	s. bz.	s.	s.
4094	pl./lg.	.....	114-7	360^{740mm}	.....	.....	.....
4095	col. lq.	$0.974^{0°}$	.....	80.3*	.....	s.	s.
4096	pr.	$1.015^{20°}_{4°}$	15-16	161-3	s. h.	∞	∞
4097	lq.	.....	8-9	162^{10mm}	.....	.....	.....
4098	col. cr.	.....	64	$216\text{-}20^{28mm}$	v. s.	v. s.	v. s.
4099	col. cr.	.....	93-4.5	230^{30mm}	v. s.	v. s.	v. s.
4100	col. lq.	$**0.792^{20°}_{4°}$	-97.8	64.7	∞	∞	∞
4101	yel. nd.	.....	250-2	.....	s. alk.	s.	s.
4102	lq.	.....	.....	64-6	s.	.....	.....
4103	lq.	$0.834^{20°}_{0°}$	.....	$115\text{-}6^{750mm}$	12.5	∞	∞
4104	lq.	$0.77^{11°}$	.....	$42\text{-}3^{757mm}$	v. sl. s.	∞	∞
4105	col. gas	$0.699^{-11°}$	-92.5	-6.7^{758mm}	$959^{25°}$ cc. /cc.	s.	.....
4106	pl./al.	.....	226-8	$225\text{-}30^{15mm}$	v. s.	23 h. abs.	i.; i. chl.
4107	lq.	.....	.....	130 d.	.....	.....	.....
4108	col. lq.	$1.168^{18.6°}_{4°}$	24(8.2)	135.5^{15mm}	sl. s.	s.	s.
4109	lf./al.	.....	112	.....	.....	.....	.....
4110	lf./al.	.....	179-82	subl. d.	0.2 c.; 0.4 h.	s.	s.
4111	col. oil	$0.937^{20°}$	.....	159^{747mm}	∞	∞	∞
4112	nd./bz. cr./chl.	....	142§ 110-1	.....	v. sl. s.; i. pet.	18; s. act.	2; s. alk.; s. bz.
4113	cr.	.....	142(110)	.....	s. h.	s.	s.
4114	col. oil	0.795	.....	176-8	i.	s.	s.; s. a.
4115	pl./bz. pet.	.....	86-7	.....	i.	s.	s. bz.
4116	col. cr.	.....	.....	.....	s.	i.	i.
4117	col. nd./aq.	.....	250-60 d.	.....	$4^{25°}$	sl. s.	i.
4118	rhb./al.	.....	280	subl. 292 sl. d.	s.	10 h.; i. c. abs.	.....
4119	lq.	$0.868^{22°}$	.....	207-8	.....	.....	.....
4120	col. lq.	0.75	.....	99-100	.....	.....	.....
4121	lq.	$0.687^{21°}_{4°}$	.....	91^{765mm}	.....	.....	.....
4122	col. lq.	$0.817^{20°}_{20°}$	.....	150	$0.4^{20°}$	s.	s.
4123	col. lq.	$0.813^{20°}$	.....	144	v. sl. s.	∞	∞
4124	oil	$0.888^{20°}_{4°}$	.....	$195\text{-}6^{761mm}$	.....	.....	.....
4125	lq.	$0.989^{20°}_{4°}$	-57	195.5	$0.01^{25°}$	s.	∞

* Polymerizes readily.
** See also special table of specific gravities.
§ HCl salt, m. p. 225°; s. 10/100 aq.

Methyl acet-toluidide 102-4
Methyl-acetyl carbinol 43
Methyl-acetylene 225
Methyl-acrolein 4058
Methyl adipate 2428, 4097
Methyl-allene 1018
Methyl-amyl alcohol 3630-7
Methyl-amyl carbinol (*n*) 3542
Methyl-amyl carbinol (*iso*) 3538
Methyl-aniline violet 5076
Methyl anisate 4301

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4126	**Methyl** *p*-anisyl ketone	*p*-acetonyl-anisole	$CH_3O{\cdot}C_6H_4{\cdot}CH_2{\cdot}CO{\cdot}CH_3$	VIII-106	164.20
4127	anthracene (*α*)	.....	$CH_3{\cdot}C_{14}H_9$	V-674	192.25
4128	anthracene (*β*)	.....	$CH_3{\cdot}C_{14}H_9$	V-674	192.25
4129	anthraquinone (2)	.....	$CH_3{\cdot}C_6H_3(CO)_2C_6H_4$	VII-809	222.23
4130	arsenic acid	methyl arsonic acid	$CH_3{\cdot}AsO(OH)_2$	IV-613	139.96
4131	arsenious oxide	.....	$CH_3{\cdot}As{:}O$	IV-610	105.94
4132	arsine	.....	$CH_3{\cdot}AsH_2$	IV-599	91.96
4133	auramine	.....	$[(CH_3)_2N{\cdot}C_6H_4]_2C{:}N{\cdot}CH_3$	XIV-93	281.39
4134	azide	.....	$CH_3{\cdot}N(N)_2$	I-80	57.06
4135	benzamide (*N*)	.....	$C_6H_5{\cdot}CO{\cdot}NH{\cdot}CH_3$	IX-201	135.16
4136	benzimidazole (2)	.....	$C_6H_4{\cdot}N{:}C(CH_3)NH$	XXIII-145	132.16
4137	benzimidazole (5)	*m*-toliminazole	$CH_3{\cdot}C_6H_3{\cdot}N{:}CHNH$	XXIII-151	132.16
4138	benzoate	oil of niobe	$C_6H_5{\cdot}CO_2{\cdot}CH_3$	IX-109	136.14
4139	benzoylacetate	.....	$C_6H_5CO{\cdot}CH_2{\cdot}CO_2CH_3$	X-673	178.18
4140	*o*-benzoylbenzoate	.....	$C_6H_5CO{\cdot}C_6H_4{\cdot}CO_2{\cdot}CH_3$	X-748	240.25
4141	benzoylene urea (1)	.....	$C_6H_4N(CH_3)CONHCO$	XXIV-375	176.17
4142	benzoylene urea (3)	.....	$C_6H_4NHCON(CH_3)CO$	XXIV-375	176.17
4143	benzoylsalicylate	benzosalin	$C_6H_5CO_2{\cdot}C_6H_4{\cdot}CO_2{\cdot}CH_3$	X-73	256.25
4144	benzylaniline (*N*)	.....	$C_6H_5{\cdot}CH_2{\cdot}N(CH_3){\cdot}C_6H_5$	XII-1024	197.27
4145	benzyl ether	.....	$CH_3{\cdot}O{\cdot}CH_2{\cdot}C_6H_5$	VI-431	122.16
4146	benzyl ketone	phenyl acetone	$CH_3{\cdot}CO{\cdot}CH_2{\cdot}C_6H_5$	VII-303	134.17
4147	bromide	bromomethane	$CH_3{\cdot}Br$	I-67	94.95
4148	bromoacetate	.....	$Br{\cdot}CH_2{\cdot}CO_2{\cdot}CH_3$	II-213	152.99
4149	*o*-bromobenzoate	.....	$Br{\cdot}C_6H_4{\cdot}CO_2{\cdot}CH_3$	IX-348	215.05
4150	*m*-bromobenzoate	.....	$Br{\cdot}C_6H_4{\cdot}CO_2{\cdot}CH_3$	IX-350	215.05
4151	*p*-bromobenzoate	.....	$Br{\cdot}C_6H_4{\cdot}CO_2{\cdot}CH_3$	IX-352	215.05
4152	4-bromohydrindene (7)	.....	$CH_3(Br)C_6H_2(CH_2)_3$	.....	211.10
4153	*α*-bromolaurate	.....	$C_{10}H_{21}CHBrCO_2CH_3$	.....	293.25
4154	butadiene-1,3 (2)	isoprene	$CH_2{:}CH{\cdot}C(CH_3){:}CH_2$	I-252	68.11
4155	butadiene-2,3 (2)	dimethyl-allene (*uns*)	$(CH_3)_2C{:}C{:}CH_2$	I-252	68.11
4156	butylamine (*n*)	.....	$CH_3{\cdot}NH{\cdot}C_4H_9$	IV-157	87.16
4157	*iso*-butylamine	.....	$CH_3{\cdot}NH{\cdot}C_4H_9$	IV-164	87.16
4158	*n*-butylbenzene (*o*)	butyl-toluene	$CH_3{\cdot}C_6H_4{\cdot}C_4H_9$	V-437	148.24
4159	*n*-butylbenzene (*m*)	.....	$CH_3{\cdot}C_6H_4{\cdot}C_4H_9$	V-437	148.24
4160	*n*-butylbenzene (*p*)	.....	$CH_3{\cdot}C_6H_4{\cdot}C_4H_9$	V-437	148.24
4161	*n*-butyl ether	.....	$CH_3{\cdot}O{\cdot}C_4H_9$	I-369	88.15
4162	*iso*-butyl ether	.....	$CH_3{\cdot}O{\cdot}C_4H_9$	I-376	88.15
4163	*n*-butyl ketone	hexanone-2	$CH_3{\cdot}CO{\cdot}C_4H_9$	I-689	100.16
4164	*iso*-butyl ketone	2-Me-pentanone-4	$CH_3{\cdot}CO{\cdot}C_4H_9$	I-691	100.16
4165	butyl ketone (*sec*)	3-Me-pentanone-2	$CH_3{\cdot}CO{\cdot}C_4H_9$	I-693	100.16
4166	butyl ketone (*tert*)	pinacolin	$CH_3{\cdot}CO{\cdot}C(CH_3)_3$	I-694	100.16
4167	*n*-butyl sulfide	.....	$CH_3{\cdot}S{\cdot}C_4H_9$	.....	104.21

Methyl-anisyl ketone 4065
Methyl anthranilate 4108
Methyl-anthranilic acid 4110
Methyl-arsine dichloride 4214
Methyl-arsonic acid 4130
Methyl-aspirin 4090
Methyl-benzaldehyde 5985-7
Methyl-benzene 5960
Methyl-benzoic acid 5982-4
Methyl-benzophenone 5249-51
Methyl-benzoquinone 6001
Methyl-benzothiazole 2909
Methyl-benzoxazol 2908
Methyl-benzoyl-ecgonine, cf. alkd.
Methyl-benzoyl ketoxime 4899

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4126	oil	$1.071_{17}^{17°}$	<−15	267-9	i.	s.	s.
4127	lf./al.	$1.047_{4}^{99.4°}$	86	.....	s. bz.	.....	.....
4128	col. lf.	.....	207	.....	i.; s. bz.	v. sl. s.	v. sl. s.
4129	col. nd./al.	.....	176-7	subl.	s. H_2SO_4	s.	s.; v. s. bz.
4130	mn.	.....	161	.....	v. s.	s.	.....
4131	cr./CS_2	.....	95	d.	.....	.....	.....
4132	col. lq.	.....	.....	2	0.01	∞	∞
4133	yel. cr./al.	.....	133	.....	v. sl. s.	s.	v. s. ac.
4134	col. lq.	$0.869_{15}^{8°}$	expl. > 500	20-1	.....	.....	.....
4135	pl./al.	.....	82	291^{765mm}	s.	sl. s. lg.	i. alk.
4136	nd./aq.	.....	175-6	.....	s. h.; s. NaOH	sl. s.	sl. s.
4137	cr./aq.	.....	114	.....	.....	.....	.....
4138	col. lq.	$1.087_{25}^{25°}$	−12.5	198-9	i.	∞	∞
4139	lt. yel. lq.	$1.173_{4}^{0°}$	.....	152^{15mm}	i.	∞	∞
4140	mn. pr.	$1.190_{4}^{19.4°}$	52	350-2	.....	.....	.....
4141	col. nd.	.....	264-5	.....	s. h.	sl. s.	s. aq. NaOH
4142	col. nd.	.....	242	.....	i.	s.	.....
4143	pr./al.	.....	84-5	270-80 ^{120mm}	i. c.	3; s. bz.	s.; s. chl.
4144	lq.	.....	9.2	305-6	i.	s.	s.
4145	lq.	$0.971_{15}^{15°}$	.....	174	i.	s.	s.
4146	cr.	$1.003^{20°}$	27	210-2	i.	s.	s.
4147	col. gas	$1.732_{0}^{0°}$	−93	4.5^{758mm}	v. sl. s.	s.; s. CS_2	s.; s. chl.
4148	lq.	.....	.....	$51\text{-}2^{15mm}$	.....	.....	.....
4149	lq.	.....	.....	244-6	.....	.....	.....
4150	pl.	.....	31-2	122.5^{15mm}	.....	.....	.....
4151	rhb./aq. al.	1.689	79-80	.....	.....	s.	s.
4152	lt. yel. lq.	.....	.....	$120\text{-}2^{10mm}$	i.	sl. s.	s.
4153	col. lq.	.....	.....	$145\text{-}8^{8mm}$	.....	.....	.....
4154	col. lq.	$0.681_{4}^{20°}$	−120±	33.5-4.0	i.	∞	∞
4155	lq.	$0.683_{4}^{20°}$	−120	40.5-1.5	.....	.....	.....
4156	lq.	$0.736_{4}^{18°}$	.....	91-2	.....	.....	.....
4157	lq.	$0.722^{18°}$	.....	76-8	.....	.....	.....
4158	oil	$0.870_{4}^{18°}$	.....	200-1	i.	sl. s.	s.
4159	oil	$0.861_{4}^{20°}$	.....	197.5	i.	sl. s.	s.
4160	oil	$0.864_{4}^{20°}$	.....	197-8	i.	sl. s.	s.
4161	lq.	$0.744_{4}^{20°}$	.....	71	i.	∞	∞
4162	lq.	$0.751^{0°}$	.....	59^{741mm}	i.	∞	∞
4163	col. lq.	$0.830^{0°}$	−56.9	127.5^{755mm}	v. sl. s.	∞	∞
4164	col. lq.	$0.801_{4}^{20°}$	−84.7	117-9	$2^{20°}$	∞	∞; ∞ bz.
4165	col. lq.	$0.815_{4}^{18°}$	.....	117.8	.....	.....	.....
4166	col. lq.	$0.800^{16°}$	−52.5	106.2	$2.5^{15°}$	s.; v. s. act.	s.
4167	col. lq.	.....	.....	122-4	.....	.....	.....

Methyl blue 6345
Methyl borate 6262
Methyl-bromoacetophenone 4333
Methyl butylacetate 399-400
Methyl-butyl carbinol (*n*) 3625
Methyl-butyl carbinol (*iso*) 3633
Methyl-butyl carbinol (*sec*) 3636
Methyl-butyl carbinol (*tert*) 3627
Methyl-butyl-phenol 1679

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Methyl				
4168	butyne-3 (2)	*iso*-propyl acetylene	$(CH_3)_2CH{\cdot}C{:}CH$	I-251	68.11
4169	butyrate (*n*)	.....	$C_2H_5{\cdot}CH_2{\cdot}CO_2{\cdot}CH_3$	II-270	102.13
4170	*iso*-butyrate	.....	$(CH_3)_2CH{\cdot}CO_2{\cdot}CH_3$	II-290	102.13
4171	butyric acid†(*α*)(*dl*)	Me-Et-acetic acid	$C_2H_5{\cdot}CH(CH_3)CO_2H$	II-304	102.13
4172	caprate	.....	$C_9H_{19}{\cdot}CO_2{\cdot}CH_3$	II-356	186.29
4173	caproate (*n*)	.....	$CH_3(CH_2)_4CO_2{\cdot}CH_3$	II-323	130.18
4174	caprylate	.....	$CH_3(CH_2)_6CO_2{\cdot}CH_3$	II-348	158.23
4175	carbamate	"methyl urethane"	$NH_2{\cdot}CO_2{\cdot}CH_3$	III-21	75.07
4176	carbanilide	.....	$C_6H_5{\cdot}N(CH_3){\cdot}CO{\cdot}NH{\cdot}C_6H_5$	XII-418	226.27
4177	carbitol	diethylene-glycol (mono)methyl ether	$CH_3O{\cdot}CH_2{\cdot}CH_2{\cdot}O{\cdot}CH_2{\cdot}CH_2{\cdot}OH$	.....	120.15
4178	carbitol acetate	.....	$CH_3CO_2{\cdot}C_5H_{11}O_2$	.....	162.18
4179	carbostyril (γ)	lepidone	$CH_3{\cdot}C_9H_6ON$	XXI-107	159.18
4180	carbostyril (*N*)	*N*-Me-*α*-quinolone	$C_6H_4CH{:}CH{\cdot}CO{\cdot}N{\cdot}CH_3$	XXI-304	159.18
4181	carvacryl ketone	2-aceto-*p*-cymene	$CH_3{\cdot}CO{\cdot}C_{10}H_{13}$	VII-336	176.25
4182	cellosolve acetate	.....	$CH_3CO_2{\cdot}CH_2{\cdot}CH_2{\cdot}OCH_3$	II-141	118.13
4183	chloride	chloromethane	$CH_3{\cdot}Cl$	I-59	50.49
4184	chloroacetate	.....	$ClCH_2{\cdot}CO_2{\cdot}CH_3$	II-197	108.53
4185	*o*-chlorobenzoate	.....	$Cl{\cdot}C_6H_4{\cdot}CO_2{\cdot}CH_3$	IX-336	170.59
4186	*β*-chloroethyl ether	.....	$CH_3{\cdot}O{\cdot}CH_2{\cdot}CH_2Cl$	I-337	94.54
4187	chloroformate	Me-chlorocarbonate	$Cl{\cdot}CO_2{\cdot}CH_3$	III-9	94.50
4188	4-chloro-hydrindene (7)	.....	$CH_3(Cl)C_6H_2(CH_2)_3$	.....	166.65
4189	4-chlorophenyl-4-toluene sulfonate	(3,4′-diMe;4-Cl)	$CH_3{\cdot}C_6H_4{\cdot}SO_3{\cdot}C_6H_3(Cl){\cdot}CH_3$	.....	296.76
4190	cholanthrene	.....	$C_{20}H_{13}{\cdot}CH_3$	.....	268.34
4191	cinnamate	.....	$C_6H_5{\cdot}C_2H_2{\cdot}CO_2{\cdot}CH_3$	IX-581	162.18
4192	coumarin (*β*)	.....	$C_6H_4{\cdot}C(CH_3){:}CH{\cdot}CO_2$	XVII-336	160.16
4193	crotonate (*α*)	.....	$C_3H_5{\cdot}CO_2{\cdot}CH_3$	II-410	100.11
4194	*iso*-cyanate	methyl-carbonimide	$CH_3{\cdot}N{:}CO$	IV-77	57.05
4195	*iso*-cyanide	methyl-carbylamine	$CH_3{\cdot}NC$	IV-56	41.05
4196	cyanoacetate	.....	$CH_3O{\cdot}CO{\cdot}CH_2{\cdot}CN$	II-584	99.09
4197	*iso*-cyanurate	.....	$(CH_3)_3(CON)_3$	XXVI-249	171.16
4198	cyclobutane	Me-tetramethylene	$CH_3{\cdot}C_4H_7$	V-20	70.13
4199	cyclohexane	toluene hexahydride	$CH_3(CHC_5H_{10})$	V-29	98.18
4200	cyclohexanol (*o*)	hexahydro-*o*-cresol (*cis*)	$CH_3{\cdot}C_6H_{10}{\cdot}OH$	VI-11	114.18
4201	cyclohexanol (*o*)	(*trans*)	$CH_3{\cdot}C_6H_{10}{\cdot}OH$	.....	114.18
4202	cyclohexanol (*p*)	4-methylhexalin (*cis*)	$CH_3{\cdot}C_6H_{10}{\cdot}OH$	VI-14	114.18
4203	cyclohexanol (*p*)	(*trans*)	$CH_3{\cdot}C_6H_{10}{\cdot}OH$	.....	114.18
4204	cyclohexanone (*o*)	.....	$CH_3{\cdot}C_6H_9{:}O$	VII-14	122.17
4205	cyclohexanone (*m*)	(*dl*)	$CH_3{\cdot}C_6H_9{:}O$	VII-17	122.17
4206	cyclohexanone (*p*)	.....	$CH_3{\cdot}C_6H_9{:}O$	VII-18	122.17
4207	cyclohexene (Δ^1)	toluene tetrahydride	$CH_3{\cdot}C_6H_9$	V-66	96.17
4208	cyclohexene (Δ^3)	.....	$CH_2CH{:}CH(CH_2)_2CH{\cdot}CH_3$	V-67	96.17

† See also No. 6406.

Methyl carbonate 2468
Methyl-carbonimide 4194
Methyl-carbylamine 4195
Methyl cellosolve 3460
Methyl chlorocarbonate 4187
Methyl-chloroform 6151
Methyl-cinnamyl ketone 626

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4168	col. lq.	$0.685^{0°}$	.....	28-97 51mm	i.	∞	∞
4169	col. lq.	$0.898^{20°}_{4°}$	<−95	102.3	1.7	∞	∞
4170	col. lq.	$0.891^{20°}_{4°}$	−84.7	92.6	v. sl. s.	∞	∞
4171	col. lq.	$0.938^{20°}_{20°}$	<−80	174-7	sl. s.	∞	∞
4172	lq.	.....	−18	223-4	i.	∞	∞
4173	col. lq.	$0.904^{0°}_{0°}$	.....	149.5	i.	∞	∞
4174	col. lq.	$0.887^{18°}$	−40	192-4	i.	∞	∞
4175	col. pl.	$1.136^{56°}_{4°}$	54.2	177	$217^{11°}$	$73^{15°}$	s.
4176	nd./al.	.....	104	203-5	sl. s. h.	sl. s. c.	v. s.; v. s. bz.
4177	col. lq.	$1.035^{20°}_{20°}$	.....	193.2	∞	.....	.....
4178	col. lq.	$1.040^{20°}_{20°}$	.....	209.1	∞	.....	.....
4179	nd./aq.	.....	223.7	270^{17mm}	sl. s. h.; s. a.	s. h.; i. alk.	sl. s.; sl. s. bz.
4180	col. nd./lg.	.....	74	324^{728mm} sl. d.	1.4 c.	s.; s. chl.; sl. s. lg.	s. act.; v. s. bz.
4181	lq.	$0.956^{20°}_{4°}$	<−10	240-4	.....	.....	.....
4182	col. lq.	$1.007^{20°}_{20°}$	solid. −70	144.5	∞	.....	.....
4183	col. gas	(A)1.785	−97.7	−24	$280^{16°}$ cc.	$3500^{20°}$cc.	4000 cc., ac.
4184	col. lq.	$1.236^{20°}_{4°}$	−32.7	130^{740mm}	v. sl. s.	∞	∞
4185	col. lq.	.....	.....	234-5	.....	.....	.....
4186	col. lq.	$1.046^{20°}_{4°}$	.....	89-90	i.	∞	∞
4187	col. lq.	$1.236^{15°}$	.....	71-2	d.	∞; ∞ chl.	∞; ∞ bz.
4188	yel. lq.	.....	.....	$111-4^{10mm}$	.....	.....	.....
4189	col. cr.	.....	94-5	.....	i.	sl. s.	v. s.
4190	yel. nd./bz.	.....	176.5-7.5	.....	.....	.....	.....
4191	cr.	$1.042^{36°}_{0°}$	33.4	263	i.	v. s.	v. s.
4192	nd./bz.	.....	82	.....	.....	s.	s. bz.
4193	lq.	$0.981^{4°}$	.....	128	i.	∞	∞
4194	col. lq.	.....	.....	43-5	.....	.....	.....
4195	col. lq.	$0.756^{4°}$	−45	59.6	$10^{15°}$	∞	∞
4196	lq.	$1.123^{15°}_{4°}$	−22.5	203	i.	∞	∞
4197	mn.	.....	175-6	274	sl. s. h.	s.	.....
4198	lq.	$0.694^{20°}_{4°}$	.....	39-42	i.	.....	s.
4199	col. lq.	$0.769^{20°}_{4°}$	−126.3	101	i.	s.	s.
4200	col. lq.	$0.934^{20°}_{4°}$	−9.5	165	v. sl. s.	∞	∞
4201	col. lq.	$0.924^{20°}_{4°}$	−21	166.5	.....	.....	.....
4202	lq.	$0.913^{21°}_{4°}$	.....	$173-4^{750mm}$	v. sl. s.	∞	∞
4203	lq.	$0.912^{21°}_{4°}$	.....	$173-4^{745mm}$	.....	.....	.....
4204	lq.	$0.925^{18°}_{4°}$	.....	162-5	i.	s.	s.
4205	lq.	$0.921^{18°}_{4°}$	.....	$168-9^{738mm}$	i.	s.	s.
4206	lq.	$0.913^{20°}_{4°}$	.....	170^{760mm}	i.	s.	s.
4207	lq.	$0.809^{20°}_{4°}$	.....	110-1	i.	s.	s.
4208	lq.	$0.800^{20°}_{20°}$	.....	103	i.	s.	s.

Methyl citraconate 2469
Methyl citrate 6263
Methyl-cresyl ether 4399-4401
Methyl-cresyl sulfide 4402]
Methyl cyanide 49
Methyl-cyclohexadiene 2286-8

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4209	**Methyl** cyclopentane	.....	$CH_3(CH{\cdot}C_4H_8)$	V-27	84.16
4210	cyclopropane	methyl-trimethylene	$CH_3{\cdot}CH{\cdot}CH_2{\cdot}CH_2$ (ring)	V-18	56.10
4211	diazoaminobenzene (4)	.....	$CH_3{\cdot}C_6H_4{\cdot}N{:}N{\cdot}NH{\cdot}C_6H_5$	XVI-705	211.26
4212	dibromoanthranilate	(3,5)	$Br_2C_6H_2(NH_2){\cdot}CO_2CH_3$	*XIV-553	308.98
4213	dibromocinnamate (α,β)(*dl*)	Me β-Ph-α,β-diBr-propionate	$C_6H_5{\cdot}CHBr{\cdot}CHBr{\cdot}CO_2CH_3$	IX-518	322.01
4214	dichloroarsine	.....	$CH_3{\cdot}AsCl_2$	IV-601	160.86
4215	diethylamine	.....	$CH_3{\cdot}N(C_2H_5)_2$	IV-99	87.16
4216	diethylaminobenzene (*o*)	*o*-diethyltoluidine	$CH_3{\cdot}C_6H_4{\cdot}N(C_2H_5)_2$	XII-786	163.25
4217	diethylaminobenzene (*m*)	*m*-diethyltoluidine	$CH_3{\cdot}C_6H_4{\cdot}N(C_2H_5)_2$	XII-857	163.25
4218	diethylaminobenzene (*p*)	*p*-diethyltoluidine	$CH_3{\cdot}C_6H_4{\cdot}N(C_2H_5)_2$	XII-904	163.25
4219	diphenylamine (*N*)	.....	$CH_3{\cdot}N(C_6H_5)_2$	XII-180	183.24
4220	diphenylamine (*p*)	Ph-*p*-tolylamine	$CH_3{\cdot}C_6H_4{\cdot}NH{\cdot}C_6H_5$	XII-905	183.24
4221	diphenyl carbinol	.....	$(C_6H_5)_2C(OH){\cdot}CH_3$	VI-685	198.25
4222	disulfide	dimethyl-disulfide	$CH_3{\cdot}S{\cdot}S{\cdot}CH_3$	I-291	94.19
4223	epichlorohydrin(β)	.....	$O{\cdot}CH_2{\cdot}C(CH_3){\cdot}CH_2Cl$ (ring)	.....	106.55
4224	ethyl-acetaldehyde	2-methyl-butanal-1	$C_2H_5{\cdot}CH(CH_3){\cdot}CHO$	I-682	86.13
4225	β-ethylacrolein(α)	2-Me-pentene-2-al-1	$C_2H_5{\cdot}CH{:}C(CH_3)CHO$	I-735	98.14
4226	ethylamine	.....	$CH_3{\cdot}NH{\cdot}C_2H_5$	IV-94	59.11
4227	ethylamine HCl	.....	$C_2H_5(CH_3)NH{\cdot}HCl$	IV-94	95.58
4228	ethylaniline	.....	$C_6H_5{\cdot}N(CH_3)C_2H_5$	XII-162	135.20
4229	ethyl carbonate	.....	$CH_3O{\cdot}CO{\cdot}OC_2H_5$	III-4	104.10
4230	ethyl ether	.....	$CH_3{\cdot}O{\cdot}C_2H_5$	I-314	60.09
4231	ethyl ethyl-phenyl-malonate	.....	$CH_3O_2C{\cdot}C(C_6H_5){:}(C_2H_5)CO_2C_2H_5$	.....	250.28
4232	ethyl ketone	butanone	$CH_3{\cdot}CO{\cdot}C_2H_5$	I-666	72.10
4233	ethyl ketoxime	butanoxime	$CH_3{\cdot}C(:NOH){\cdot}C_2H_5$	I-668	87.12
4234	ethyl ketone semicarbazone	.....	$C_3H_8{:}N{\cdot}NHCONH_2$	III-102	129.16
4235	ethyl malonic acid	.....	$C_2H_5(CH_3)C{:}(CO_2H)_2$	II-664	146.14
4236	ethyl oxalate	.....	$CH_3O{\cdot}(CO)_2{\cdot}OC_2H_5$	II-535	132.11
4237	ethyl succinate	.....	$C_7H_{12}O_4$	II-609	160.17
4238	ethyl sulfide	.....	$CH_3{\cdot}S{\cdot}C_2H_5$	I-343	76.15
4239	ethyl sulfone	.....	$CH_3{\cdot}SO_2{\cdot}C_2H_5$	I-343	108.15
4240	fluoride	fluoromethane	$CH_3{\cdot}F$	I-59	34.03
4241	formanilide	.....	$C_6H_5(CH_3)N{\cdot}CHO$	XII-234	135.16
4242	formate	.....	$HCO_2{\cdot}CH_3$	II-18	60.05
4243	fumaric acid (*trans*)	mesaconic acid	$CH_3{\cdot}C(CO_2H){:}CH{\cdot}CO_2H$	II-763	130.10
4244	furfural (2,5)	.....	$CH_3{\cdot}C_4H_2O{\cdot}CHO$	XVII-289	110.11
4245	furfurane (2)	sylvane	$CH_3{\cdot}C_4H_3O$	XVII-36	82.10
4246	furoate	.....	$C_4H_3O{\cdot}CO_2CH_3$	XVIII-274	126.11
4247	furoylacetate (α)	.....	$C_4H_3O{\cdot}CO{\cdot}CH_2{\cdot}CO_2CH_3$	.....	168.14
4248	furylacrylate (β)	.....	$C_4H_3O{\cdot}CH{:}CH{\cdot}CO_2CH_3$	XVIII-300	152.14
4249	gallate	gallicin	$(HO)_3C_6H_2{\cdot}CO_2CH_3$	X-483	184.14
4250	glucoside (α)(*d*)	.....	$CH_3O{\cdot}C_6H_{11}O_5$	.....	194.18

Methyl-cyclopentadecanone 4446
Methyl-diethyl carbinol 3637
Methyl-dihydroxyfuchsone 5573
Methyl-dioxolane 3207
Methyl-diphenylyl ketone 5144
Methyl-dipropyl carbinol 4969
Methyl enanthylate 4263
Methyl-esculetin 5604
Methyl ether 2478
Methyl-ethyl-, cf. also ethyl-methyl-.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4209	col. lq.	$0.749^{20°}_{4°}$	−140.5	72^{742mm}	i.	.....	s.
4210	col. gas	$0.691^{-20°}_{0°}$	.....	4-5	i.	.....	s.
4211	yel. lf.	.....	90-1	d.	i.	.....	.....
4212	nd.	.....	87-8	.....	.....	s.	.....
4213	mn. pl./ CS_2	.....	115-6	.....	.....	.....	.....
4214	col. lq.	$1.838^{20°}_{4°}$	−59	133-6	sl. s.	.....	.....
4215	col. lq.	.....	.....	65-7	v. s.	s.	s.
4216	lq.	.....	.....	$208\text{-}9^{755mm}$	i.	s.	s.
4217	lq.	.....	.....	231-2	i.	s.	s.
4218	lq.	$0.924^{15.5°}$	.....	228-9	.....	.....	.....
4219	col. lq.	$1.048^{20°}_{4°}$	−7.6	295-6	i.	s.	s.
4220	cr.	.....	87-9	$317\text{-}8^{728mm}$	i.	s.	s.
4221	pr./et.	.....	80-1	$175\text{-}80^{20mm}$	v. s. bz.	.....	v. s.
4222	lq.	$1.057^{16°}_{4°}$	.....	116-8	.....	.....	.....
4223	lq.	$1.103^{20°}_{4°}$	.....	122.3	3.1	.....	.....
4224	lq.	$0.807^{20°}$	.....	90-2	i.	.....	.....
4225	lq.	$0.854^{25°}_{4°}$	.....	137.3^{759mm}	i.	.....	.....
4226	col. lq.	.....	.....	34-5	.....	.....	.....
4227	lf./al. et.	.....	130-3	.....	v. s.	v. s.	i.; s. chl.
4228	lq.	.....	.....	201	i.	∞	∞
4229	lq.	$1.002^{27°}$	−14.5	109.2	i.	∞	∞
4230	col. lq.	$0.725^{0°}_{0°}$	.....	10.8	s.	∞	∞
4231	yel. lq.	.....	.....	$165\text{-}70^{20mm}$	i.	s.	s.
4232	col. lq.	$0.805^{20°}_{4°}$	−85.9	79.6	37	∞	∞; ∞ bz.
4233	col. oil	$0.923^{20°}_{4°}$	.....	152-3	10	∞	∞
4234	lf./aq.	.....	148	.....	v. s. h.	v. s.	.....
4235	pr. or nd.	.....	122	d. 180	v. s.	v. s.	v. s.
4236	lq.	$1.156^{0°}_{0°}$	.....	173.7	i.	v. s.	v. s.
4237	lq.	$1.093^{0°}$	<−20	208.2	i.	v. s.	v. s.
4238	oil	$0.837^{20°}$	−104.8	66.9	i.	∞	∞
4239	nd.	.....	36	.....	v. s.	v. s.	v. sl. s. c.
4240	gas	.....	.....	−78.2	$166^{15°}$ cc.	.....	.....
4241	lq.	$1.095^{20°}_{4°}$	13	253^{716mm}	v. sl. s.	v. s.	.....
4242	lq.	$0.974^{20°}_{4°}$	−99.8	32	$30^{20°}$	∞	s. Me al.
4243	cr. pd.	1.466	202	250 d.	$2.7^{18°}$; $118^{100°}$	$30.6^{17°}$, 90% al.	v. sl. s. chl.
4244	oil	$1.109^{18°}$	.....	186-7	3.3	v. s.	.....
4245	col. lq.	0.916	.....	65^{759mm}	.....	.....	.....
4246	col. lq.	$1.179^{21-4°}_{4°}$	.....	181.3	i.	∞	∞
4247	yel. lq.	.....	.....	$148\text{-}52^{13mm}$	i.	s.	s.
4248	col. lq.	.....	27.5	$227\text{-}8^{774mm}$	i.; s. lg.	s.; s. bz.	s.
4249	mn./Me al.	.....	194-8	.....	$1.07^{23°}$	v. s.	s.
4250	col. nd./al.	.....	165-6	.....	63	1.6	i.

Methyl-ethylacetic acid 4171
Methyl-ethyl acetone 4165
Methyl-ethyl-acetylene 5087
Methyl-ethylbenzene 3166-8
Methyl-ethyl-*n*-butyl carbinol 4968
Methyl-ethyl carbinol 1035
Methyl-ethyl ketone diethylsulfone 6326
Methyl-ethyl-*n*-propyl carbinol 3540
Methyl-ethyl-*iso*-propyl carbinol 3529
Methyl-ethyl-protocatechuic aldehyde 6419

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4251	**Methyl** glutaric acid (α)	2-methyl-pentandioic acid	$CH_3{\cdot}CH(CO_2H){\cdot}CH_2{\cdot}CH_2{\cdot}CO_2H$	II-655	146.14
4252	glutaric acid (β)	3-Me-pentandioic	$CH_3{\cdot}CH(CH_2CO_2H)_2$	II-659	146.14
4253	glycerinate (d)	.....	$CH_2OH{\cdot}CHOH{\cdot}CO_2{\cdot}CH_3$	III-397	120.10
4254	glycerine chlorohydrin (β), mono	.....	$ClCH_2{\cdot}C(CH_3)OH{\cdot}CH_2OH$	.....	124.57
4255	glycolate	.....	$HO{\cdot}CH_2{\cdot}CO_2{\cdot}CH_3$	III-236	90.08
4256	glyoxalidine	2-Me-Δ^2-imidazoline	$CH_3{\cdot}C{:}N(CH_2)_2NH$	XXIII-31	84.12
4257	glyoxaline (1)	1-methyl-imidazole	$CH_3{\cdot}N{\cdot}CH{:}N{\cdot}CH{:}CH$	.....	82.10
4258	guanidine	.....	$CH_3NH{\cdot}CH_3N_2$	IV-68	73.10
4259	guanidine nitrate	.....	$C_2H_7N_3{\cdot}HNO_3$	IV-69	138.12
4260	guanidine sulfate	.....	$(C_2H_7N_3)_2{\cdot}H_2SO_4$	.....	244.28
4261	heptadecyl ketone	nonadecanone-2	$CH_3(CH_2)_{16}{\cdot}CO{\cdot}CH_3$	I-718	282.49
4262	heptenone	.....	$(CH_3)_2C{:}CH(CH_2)_2{\cdot}CO{\cdot}CH_3$	I-741	126.19
4263	n-heptylate	Me oenanthylate	$CH_3(CH_2)_5CO_2CH_3$	II-339	144.21
4264	n-heptyl ether	.....	$CH_3{\cdot}O{\cdot}(CH_2)_6CH_3$	I-414	130.22
4265	heptyl ketone	nonanone-2	$CH_3{\cdot}CO{\cdot}(CH_2)_6CH_3$	I-709	142.23
4266	hexyl ketone	oxtanone-2	$CH_3{\cdot}CO{\cdot}(CH_2)_5CH_3$	I-704	128.21
4267	hydantoin (β)	.....	$C_4H_6O_2N_2$	XXIV-244	114.10
4268	hydantoin (γ)	lactyl urea	$C_4H_6O_2N_2{\cdot}H_2O$	XXIV-279	132.12
4269	hydrazine	.....	$CH_3{\cdot}NH{\cdot}NH_2$	IV-546	46.07
4270	hydrazine sulfate	.....	$CH_3{\cdot}NH{\cdot}NH_2{\cdot}H_2SO_4$	IV-547	144.15
4271	hydrazobenzene (o)	β-Ph-o-tolylhydrazine	$CH_3{\cdot}C_6H_4{\cdot}NH{\cdot}NH{\cdot}C_6H_5$	XV-497	198.26
4272	hydrazobenzene (m)	.....	$CH_3{\cdot}C_6H_4(NH)_2C_6H_5$	XV-506	198.26
4273	hydrazobenzene (p)	.....	$CH_3{\cdot}C_6H_4(NH)_2C_6H_5$	XV-511	198.26
4274	hydroxybenzoate (p)	nipagin	$HO{\cdot}C_6H_4{\cdot}CO_2CH_3$	X-158	152.14
4275	3-hydroxy-1,4-naphthoquinone (2)	phthiocol	$CH_3(OH)C_{10}H_4O_2$	.....	188.17
4276	hydroxynaphthoquinone acetate	phthiocol monoacetate	$C_{13}H_{10}O_4$	.....	230.21
4277	hydroxynaphthoquinone acetate	phthiocol triacetate	$C_{17}H_{16}O_6$	.....	316.30
4278	hydroxynaphthoquinone oxime	phthiocol monoxime	$C_{11}H_8O_2{:}NOH$	.....	203.19
4279	hydroxylamine (β)	.....	$CH_3{\cdot}NH{\cdot}OH$	IV-534	47.06
4280	hydroxylamine HCl	(α)	$CH_3O{\cdot}NH_2{\cdot}HCl$	I-288	83.52
4281	hypochlorite	.....	$CH_3{\cdot}O{\cdot}Cl$	I-282	66.49
4282	indole (1)	.....	C_9H_9N	XX-308	131.17
4283	indole (2)	methyl ketole	$C_6H_4{\cdot}CH{:}C(CH_3){\cdot}NH$	XX-311	131.17
4284	indole (3)	skatole	$C_6H_4C(CH_3){:}CH{\cdot}NH$	XX-316	131.17
4285	indole (5)	.....	$CH_3{\cdot}C_6H_3{\cdot}CH{:}CH{\cdot}NH$	XX-317	131.17
4286	inositol	d-inositol Me ether	$(HO)_5C_6H_6{\cdot}OCH_3$	VI-1193	194.18

Methyl-ethyl-pyridine 161, 1524-5
Methyl-exaltone 4446
Methyl fumarate 2487
Methyl glycinate 4107
Methyl-glycine 5600
Methyl-glycocyamidine 1540
Methyl-granatonine, cf. alkd.
Methyl green 3594
Methyl-guanylglycine 1539
Methyl-heptyl carbinol (n) 4919

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4251	pr./aq.	.....	77-8	214-5^{22mm}	v. s.	v. s.	v. s.
4252	pr. or pl.	.....	86-7	.....	v. s.	v. s.	v. s.
4253	lq.	1.281$^{\frac{15}{15}°}$	.....	119-20^{14mm}	∞	∞	v. sl. s.
4254	lq.	1.237$^{\frac{20}{4}°}$	.....	95-6^{7mm}	∞	.....	.....
4255	lq.	1.168$^{18°}$	.....	151.2	.....	.....	.....
4256	col. hyg. cr.	.....	105	195-8	s.	s.	i.; s. chl.
4257	lq.	1.036^{100}	−6	197-9	∞	.....	.....
4258	col. delq.	.....	d.	.....	v. s.	s.	.....
4259	col. cr./al.	.....	149-50	.....	s.	.....	.....
4260	cr./aq.	.....	239-40	.....	.....	.....	.....
4261	lf.	0.811$^{55.5°}$	55-6	266.5^{110mm}	v. s. chl.	v. s.	v. s.
4262	lq.	0.860$^{20°}$	.....	173-4	i.	∞	∞
4263	lq.	0.881$^{\frac{15}{4}°}$	.....	172-3	i.	.....	.....
4264	lq.	0.795$^{\frac{0}{0}}$	.....	149.8	i.	∞	∞
4265	lq.	0.832$^{20°}$	−19 ±	194-6	i.	s.	s.
4266	col. lq.	0.819$^{\frac{20}{4}°}$	−16	172.9	i.	∞	∞
4267	pr.	.....	156-7	subl.	s.	s.	3
4268	rhb.	.....	145(anh.)	.....	s.	s.	sl. s.
4269	hyg. lq.	.....	.....	87^{745mm}	s.	∞	∞
4270	cr./Me al.	.....	142	.....	v. s.	v. sl. s.	.....
4271	lf./al.	.....	101-2	.....	i.	sl. s. c.	s.
4272	lt. yel. cr.	.....	59-61	.....	i.; s. bz.	v. s.	sl. s.
4273	pl./lg.	.....	86-7	.....	v. s. bz.	v. s.	v. s.
4274	nd./aq. al.	.....	131	270-80 d.	0.25	s.; s. act.	s.
4275	yel. pr./aq. Me al.	.....	172-3	vol. in steam	s.; s. dil. alk.	s.	s.
4276	yel. nd.	.....	106-7	.....	i.; s. alk.	s. Me al.	s. pyr.
4277	col. pr.	.....	158-9	.....	i.	s. Me al.	.....
4278	yel. nd.	.....	199-200 d.	.....	i.	s.	s. pyr.
4279	hyg. pr.	1.000$^{\frac{20}{4}°}$	42	62.5^{15mm}	v. s.	v. s.	sl. s.
4280	pr./al. et.	.....	149	.....	s.	s.	i.
4281	gas	.....	.....	12^{726mm}	.....	.....	.....
4282	lq.	1.071$^{0°}$	<−20	242.4	i.	v. s.	v. s.
4283	nd.	1.07	59-60	272^{750mm}	s. h.; s. HCl	v. s.	v. s.
4284	lf./lg.	.....	95	265-6^{755mm}	0.05 c.	s.; s. chl.	s.; s. bz.
4285	nd./aq.	.....	58.5	.....	s. h.	s.	s.; s. bz.
4286	cr./aq.	1.52	186-7	.....	v. s.	i. abs.	i.; i. chl.

Methyl-hexalin 4200-3
Methyl-hexyl carbinol 4962
Methyl-hydrocupreine, cf. alkd.
Methyl hydrogen sulfate 4384
Methyl-hydroquinone 2372
Methyl-imidazole 4257
Methyl-imidazoline 4256

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4287	**Methyl** iodide	iodomethane	CH_3I	I-70	141.95
4288	iodobenzoate (*o*)	.....	$I{\cdot}C_6H_4{\cdot}CO_2CH_3$	IX-364	262.06
4289	iodobenzoate (*m*)	.....	$I{\cdot}C_6H_4{\cdot}CO_2CH_3$	IX-365	262.06
4290	iodobenzoate (*p*)	.....	$I{\cdot}C_6H_4{\cdot}CO_2CH_3$	IX-367	262.06
4291	isatin (*O*)	.....	$C_6H_4{\cdot}N{:}C(OCH_3)CO$	XXI-583	161.15
4292	isatin (*N*)	.....	$C_6H_4N(CH_3){\cdot}CO{\cdot}CO$	XXI-446	161.15
4293	isatin (5)	*p*-methyl isatin	$CH_3{\cdot}C_6H_3{\cdot}CO{\cdot}CO{\cdot}NH$	XXI-509	161.15
4294	lactate	.....	$CH_3{\cdot}CHOH{\cdot}CO_2CH_3$	III-280	104.10
4295	laurate	.....	$CH_3(CH_2)_{10}CO_2CH_3$	II-361	214.34
4296	levulinate	.....	$CH_3CO(CH_2)_2CO_2CH_3$	III-675	130.14
4297	*d*-mannoside (*α*)	.....	$CH_3O{\cdot}C_6H_{11}O_5$	I-907	194.18
4298	mercaptan	methanthiol	$CH_3{\cdot}SH$	I-288	48.10
4299	mercaptobenzo-thiazole (2)	.....	$C_6H_4{\cdot}N{:}C(SCH_3){\cdot}S$	XXVII-109	181.26
4300	methoxybenzoate (*o*)	.....	$CH_3O{\cdot}C_6H_4CO_2CH_3$	X-71	166.17
4301	methoxybenzo-ate (*p*)	methyl anisate	$CH_3O{\cdot}C_6H_4CO_2CH_3$	X-159	166.17
4302	methylanthra-nilate (*N*)	methylamino-methyl benzoate	$CH_3NH{\cdot}C_6H_4{\cdot}CO_2{\cdot}CH_3$	XIV-324	165.19
4303	myristate	.....	$CH_3(CH_2)_{12}CO_2CH_3$	II-365	242.39
4304	naphthalene (*α*)	.....	$C_{10}H_7{\cdot}CH_3$	V-566	142.19
4305	naphthalene (*β*)	.....	$C_{10}H_7{\cdot}CH_3$	V-567	142.19
4306	1,4-naphthoquin-one (2)	.....	$CH_3{\cdot}C_{10}H_5O_2$	.....	172.17
4307	naphthoquinone diacetate	(2;1,4)	$CH_3{\cdot}C_{10}H_5{:}(O_2C{\cdot}CH_3)_2$	.....	258.26
4308	naphthoquinone monoxime	(2;4,1)	$CH_3{\cdot}C_{10}H_5O{:}NOH$	.....	187.19
4309	naphthylamine (*α*)	.....	$C_{10}H_7{\cdot}NHCH_3$	XII-1221	157.21
4310	naphthylamine (*β*)	.....	$C_{10}H_7{\cdot}NHCH_3$	XII-1273	157.21
4311	naphthyl ether (*α*)	.....	$CH_3{\cdot}O{\cdot}C_{10}H_7$	VI-606	158.19
4312	naphthyl ether (*β*)	nerolin; yara yara	$CH_3{\cdot}O{\cdot}C_{10}H_7$	VI-640	158.19
4313	naphthyl ketone (*β*)	*β*-acetonaphthone	$CH_3{\cdot}CO{\cdot}C_{10}H_7$	VII-402	170.20
4314	nitramine	nitraminomethane	$CH_3{\cdot}NH{\cdot}NO_2$	IV-567	76.06
4315	nitrate	.....	$CH_3O{\cdot}NO_2$	I-284	77.04
4316	nitrite	.....	$CH_3O{\cdot}NO$	I-284	61.04
4317	nitrobenzoate (*o*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CO_2CH_3$	IX-372	181.14
4318	nitrobenzoate (*m*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CO_2CH_3$	IX-378	181.14
4319	nitrobenzoate (*p*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CO_2CH_3$	IX-390	181.14
4320	nitrocinnamate (*o*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH{:}CH{\cdot}CO_2CH_3$	IX-605	207.18
4321	nitrocinnamate (*m*)(*trans*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH{:}CH{\cdot}CO_2CH_3$	IX-606	207.18
4322	nitrocinnamate (*p*)(*trans*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH{:}CH{\cdot}CO_2CH_3$	IX-607	207.18
4323	nitrolic acid	.....	$HC(:NOH)NO_2$	II-92	90.04
4324	*n*-nonyl ketone	undecanone-2	$CH_3(CH_2)_8{\cdot}CO{\cdot}CH_3$	I-713	170.29
4325	octadiene-4,6 (2)	.....	$CH_3{\cdot}CH{:}(CH)_2{:}CH{\cdot}CH_2CH(CH_3)_2$	I-260	124.22
4326	*n*-octyl ketone	decanone-2	$CH_3{\cdot}CO{\cdot}C_8H_{17}$	I-711	156.26
4327	oleate	.....	$C_{17}H_{33}CO_2CH_3$	II-467	296.48

Methyl-iodoform 6237
Methyl-isoeugenol 3224
Methyl itaconate 2498
Methyl-ketole 4283
Methyl malate 2500
Methyl maleate 2501
Methyl-maleic acid 1510
Methyl-malic acid 1514
Methyl malonate 2502
Methyl-malonic acid 5652
Methyl mesaconate 2504
Methyl-morphine, cf. alkd.
Methyl mustard oil 4388
Methyl nonylate 4331
Methyl oenanthylate 4263

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4287	col. lq.	2.279^{20}_{4}°	−64.4	42.4	$1.8^{15°}$	∞	∞
4288	lq.	.....	.....	277-8^{729mm}	.....	.....	.....
4289	nd.	.....	50	276-7^{739mm}	i.; i. lg.	s. h.	s. h.
4290	rhb./et. al.	2.020^{100}	114	subl.	.....	.....	.....
4291	red lf./aq.	.....	101-2	.....	sl. s. c.	s. alk.	s. h. HCl
4292	red nd./ aq.	.....	134	.....	s. aq. NaOH	.....	.....
4293	red nd./ aq. al.	.....	187	.....	v. sl. s. h.; s. alk.	s.; s. h. HCl	sl. s.
4294	lq.	$1.090^{19°}$	.....	144.8	d.	s.	s.
4295	lq.	.....	5	148^{18mm}	i.	.....	.....
4296	lq.	1.047^{20}_{4}°	.....	196	.....	.....	.....
4297	col. nd./al.	1.473^{7}_{4}°	193-4	.....	$30.7^{15°}$	3	i.
4298	lq. or gas	0.868	−121	5.8^{752mm}	s.	v. s.	v. s.
4299	pr./aq. al.	.....	52	.....	s. conc. a.	.....	.....
4300	lq.	1.157^{19}_{4}°	.....	245-6	.....	s.	.....
4301	pl./al.	.....	48-9	255-6	i.	s.	s.
4302	cr./pet.	$1.120^{15°}$	18-9	256	i.	s.	s.
4303	cr./al.	.....	18-9	295^{751mm}	i.	.....	.....
4304	oil	$1.001^{19°}$	−22	241-2	i.	v. s.	v. s.
4305	mn.	1.029^{20}_{4}°	35-6	241-2	i.	v. s.	v. s.
4306	yel. nd./ al.	.....	106	volt. in steam	i.; sl. s. pet.	s.; s. bz.	s.
4307	col. pr./aq. Me al.	.....	114	.....	i.	s.	v. s. act.
4308	hex. pl./aq. Me al.	.....	166-8	.....	i.	s.	s. pyr.
4309	oil	.....	.....	293-5	s. CS_2	s.	s.
4310	oil	.....	.....	308-10^{761mm}	.....	.....	.....
4311	col. oil	1.096^{1}_{4}°	<−10	265-9	i.	s.	s.; s. bz.
4312	lf./et.	.....	72	274	sl. s. CS_2	sl. s.	s.; s. bz.
4313	nd./lg.	.....	55-6	301-3	.....	.....	.....
4314	nd./et.	1.243^{8}_{4}°	38	.....	v. s.	v. s.	sl. s.
4315	lq.	$1.203^{25°}$	expl.	65	.....	s.	s.
4316	gas	lq. $0.991^{15°}$	.....	−12	.....	s.	s.
4317	yel. lq.	$1.286^{20°}$	−8	275	i. pet.	s.	s.
4318	col. nd.	.....	78.5	279	.....	sl. s.	sl. s.
4319	mn.	.....	96	.....	i.	s.	s.
4320	col. nd./ aq.	.....	72-3	187-9^{15mm}	v. sl. s. h.	s. h.	.....
4321	yel. pr./ Me al.	.....	123-4	d.	i.; v. sl. s. CS_2	v. sl. s.; s. chl.	v. sl. s.; s. bz.
4322	col. nd./al.	.....	160-1	281-6	.....	sl. s.	i.
4323	nd./et.	.....	64-8 d.	.....	s.	s.	s.
4324	col. oil	0.828^{20}_{20}°	15	223-6^{756mm}	i.	s.	s.
4325	lq.	0.752^{18}_{4}°	.....	149	i.	.....	.....
4326	lq.	$0.825^{20°}$	3.5	211	i.	s.	s.
4327	oil	$0.879^{18°}$	.....	190-1^{10mm}	i	∞	∞

Methyl oxalate 4329
Methyl pentenal 4225
Methyl phenol 1545-7
Methyl-phenylamine 4125
Methyl-phenyl carbinol 5186
Methyl phenyl-dibromopropionate 4213
Methyl-phenyl diketone 72
Methyl-phenyl ether 537
Methyl-phenyl glyoxal 72
Methyl-phenyl ketone 51

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4328	**Methyl** orange	tropeolin D; orange III	$(CH_3)_2N{\cdot}C_6H_4{\cdot}N{:}N{\cdot}C_6H_4{\cdot}SO_3Na$	XVI-331	327.33
4329	oxalic acid	Me acid oxalate	$CH_3O_2C{\cdot}CO_2H$	II-534	104.06
4330	palmitate	.....	$C_{15}H_{31}CO_2CH_3$	II-372	270.44
4331	pelargonate	methyl nonylate	$CH_3(CH_2)_7CO_2CH_3$	II-353	172.26
4332	2,4-pentandiol (2)	.....	$(CH_3)_2C(OH){\cdot}CH_2{\cdot}CHOH{\cdot}CH_3$	I-486	118.17
4333	phenacyl bromide (*p*)	ω-Br-*p*-methyl-acetophenone	$CH_3{\cdot}C_6H_4{\cdot}CO{\cdot}CH_2Br$	VII-309	213.08
4334	phenazine (2)	tolazine	$CH_3{\cdot}C_6H_3{:}N_2{:}C_6H_4$	XXIII-237	194.23
4335	phenylacetate	.....	$C_6H_5{\cdot}CH_2{\cdot}CO_2CH_3$	IX-434	150.17
4336	phenylenediamine	(*N*)(*p*)	$CH_3NH{\cdot}C_6H_4{\cdot}NH_2$	XIII-71	122.17
4337	phenylenediamine HCl (*N*)(*p*)	*p*-amino-methyl-aniline di-HCl	$C_7H_{10}N_2{\cdot}2HCl$	.....	195.10
4338	phenylhydrazine	(α,α)	$C_6H_5{\cdot}N(CH_3){\cdot}NH_2$	XV-117	122.17
4339	phenylhydrazine sulfate (α,α)	.....	$(C_7H_{10}N_2)_2{\cdot}H_2SO_4$	XV-118	342.41
4340	phenylhydrazine	(α,β)	$C_6H_5{\cdot}NH{\cdot}NH{\cdot}CH_3$	XV-118	122.17
4341	phosphine	.....	$CH_3{\cdot}PH_2$	IV-580	48.03
4342	3-phytyl-1,4-naphthoquinone (2)	vitamin K-1	$C_{31}H_{46}O_2$	.....	450.68
4343	3-phytyl-1,4-naphthoquinone di-acetate (2)	dihydrovitamin K-1 diacetate	$C_{35}H_{52}O_4$	.....	536.77
4344	piperidine (*N*)	.....	$C_5H_{10}N{\cdot}CH_3$	XX-16	99.17
4345	piperidine (2)	α-pipecoline	$CH_3{\cdot}CH(CH_2)_4{\cdot}NH$	XX-95	99.17
4346	piperidine (3)	β-pipecoline	$CH_2{\cdot}NH{\cdot}(CH_2)_3{\cdot}CH{\cdot}CH_3$	XX-100	99.17
4347	piperidine (4)	γ-pipecoline	$(CH_2)_2{\cdot}NH{\cdot}(CH_2)_2{\cdot}CH{\cdot}CH_3$	XX-101	99.17
4348	propargyl ether	.....	$CH_3{\cdot}O{\cdot}CH_2{\cdot}C{:}CH$	I-454	70.09
4349	propionate	.....	$C_2H_5{\cdot}CO_2CH_3$	II-239	88.10
4350	*n*-propylamine	.....	$CH_3{\cdot}NH{\cdot}CH_2{\cdot}C_2H_5$	IV-137	73.14
4351	*n*-propylbenzene (*m*)	*m*-propyl toluene	$CH_3{\cdot}C_6H_4{\cdot}CH_2{\cdot}C_2H_5$	V-418	134.21
4352	*n*-propylbenzene (*p*)	*p*-propyl toluene	$CH_3{\cdot}C_6H_4{\cdot}CH_2{\cdot}C_2H_5$	V-419	134.21
4353	*n*-propyl ether	.....	$CH_3{\cdot}O{\cdot}CH_2{\cdot}C_2H_5$	I-354	74.12
4354	*iso*-propyl ether	.....	$CH_3{\cdot}O{\cdot}CH(CH_3)_2$	I-362	74.12
4355	*n*-propyl ketone	pentanone-2	$CH_3{\cdot}CO{\cdot}CH_2{\cdot}C_2H_5$	I-676	86.13
4356	propyl ketone oxime	(*n*)	$CH_3{\cdot}C(:NOH){\cdot}C_3H_7$	I-677	101.15
4357	*iso*-propyl ketone	2-methyl-butanone-3	$CH_3{\cdot}CO{\cdot}CH(CH_3)_2$	I-682	86.13
4358	*iso*-propyl ketoxime	.....	$CH_3{\cdot}C(:NOH){\cdot}C_3H_7$	I-683	101.15
4359	*iso*-propyl ketone semicarbazone	.....	$C_3H_7(CH_3)C{:}N{\cdot}NH{\cdot}CO{\cdot}NH_2$	III-103	143.19
4360	5-pyrazolone (3)	.....	$CH_2{\cdot}CO{\cdot}NH{\cdot}N{:}C{\cdot}CH_3$	XXIV-19	98.10

Methyl-phenyl-nitrosoamine 4887
Methyl-phenylphenol ether 4073-4
Methyl phosphate 6268
Methyl phthalate 2530-2
Methyl *iso*-phthalic acid 6397
Methyl picrate 6290
Methyl-picrylnitramine 5873
Methyl pivalate 4404
Methyl-proline-methylbetaine, *cf.* alkd.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4328	red pd.	.....	.....	.....	0.2 c.	i.	.....
4329	cr.	.....	37 ±	108-9 12mm	.....	.....	.....
4330	col. cr.	.....	29.5-30.5	196 15mm	i.	s.	s.
4331	lq.	$0.877^{17.5°}$	.....	213-4 757mm	i.	s.	s.
4332	lq.	$0.924^{\frac{17}{4}°}$	.....	196	s.	s.	s.
4333	lf./al.	.....	50-1	.....	i. d.	v. s. d.	v. s.
4334	nd.	.....	117	350 ±, sl. d.	sl. s. h.	s.; s. H_2SO_4	s.; s. chl.
4335	lq.	$1.044^{16°}$	d. 360	220	i.	∞	∞
4336	col. lf.	.....	35.5	257-9.5	s.	s.	s.
4337	yel. pd.	.....	.....	.....	v. s.	sl. s.	i.
4338	yel. lq.	$1.038^{\frac{21}{4}:6°}$	.....	131 35mm	sl. s. h.	∞; ∞ chl.	∞; ∞ bz.
4339	lf.	.....	.....	.....	v. s.	v. sl. s. c.	.....
4340	oil	$1.04^{\frac{15}{15}°}$	.....	110-2 12-15mm	.....	s.	s.
4341	col. gas	.....	.....	−14 759mm	i.	sl. s.	7000° cc.
4342	pa. yel. oil	.....	.....	.....	i.	s. abs.	s. act.; s. pet.
4343	col. nd./al.	.....	62-3	.....	i.	v. s.; v. s. bz.	v. s. act.
4344	lq.	$0.821^{15°}$	.....	107	.....	.....	.....
4345	lq.	$0.862^{20°}$	.....	118-9 753mm	s.	i. aq. KOH	.....
4346	lq.	$0.864^{\frac{0}{4}°}$	.....	125-6	s.	.....	.....
4347	lq.	$0.867^{0°}$	.....	127-9	s.	.....	.....
4348	lq.	$0.83^{12.5°}$	.....	61-2	v. sl. s.	∞	∞
4349	col. lq.	$0.915^{\frac{20}{4}°}$	−87.5	79.7	$0.5^{20°}$	∞	∞
4350	lq.	$0.720^{17°}$	.....	62-4	s.	s.	.....
4351	lq.	$0.863^{16°}$	.....	182	i.	s. abs.	∞
4352	lq.	$0.864^{\frac{15.4}{4}°}$	.....	183-4	i.	s. abs.	∞
4353	col. lq.	$0.738^{20°}$	.....	39-40	sl. s.	∞	∞
4354	col. lq.	$0.735^{\frac{20}{20}°}$	.....	32.5 777mm	v. sl. s.	∞	∞
4355	col. lq.	$0.812^{\frac{15}{15}°}$	−77.8	102	v. sl. s.	∞	∞
4356	oil	$0.910^{\frac{20}{4}°}$	.....	168 748mm	s.	∞	∞
4357	col. lq.	$0.803^{\frac{20}{0}°}$	−92	95	v. sl. s.	∞	∞
4358	lq.	.....	.....	157-8	s.	∞	∞
4359	cr./et.	.....	110-4	.....	s.	v. s.	v. s.
4360	pr./aq.; nd./al.	.....	216-7	subl.	v. s. h.; sl. s. Na_2CO_3	sl. s. h.	sl. s. aq. a.

Methyl-propenyl ketone 3213
Methyl-*iso*-propyl-acetophenone 4181
Methyl-*iso*-propylbenzene 1622-4
Methyl-propyl carbinol (*n*) 405
Methyl-propyl carbinol (*iso*) 407
Methyl-*iso*-propyl-phenanthrene 5555
Methyl-*iso*-propyl-phenol 1255, 5938
Methyl-pyridine 5300-2

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4361	**Methyl** pyrogallol (1;3,4,5)	trihydroxy-toluene	$CH_3 \cdot C_6H_2(OH)_3$	VI-1112	140.13
4362	pyrrole (1)	*N*-methyl pyrrole	$C_4H_4N \cdot CH_3$	XX-163	81.11
4363	pyrrole (2)(*α*)	.....	$CH_3 \cdot C_4H_4N$	XX-170	81.11
4364	pyrrole (3)(*β*)	.....	$CH_3 \cdot C_4H_4N$	XX-171	81.11
4365	pyrroline (*N*)	1-Me-3-pyrroline	$CH_3 \cdot N \cdot CH_2(CH)_2CH_2$	XX-133	83.13
4366	pyruviate	.....	$C_3H_3O_3 \cdot CH_3$	III-616	102.09
4367	quinoline (2)	quinaldine	$CH_3 \cdot C_9H_6N$	XX-388	143.18
4368	quinoline ethiodide	quinaldine ethiodide	$CH_3 \cdot C_9H_6N:(I)C_2H_5$	XX-392	299.16
4369	quinoline (3)	*Py*-3 (*β*)	$CH_3 \cdot C_9H_6N$	XX-394	143.18
4370	quinoline (4)	cincholepidine; lepidine (4)	$C_6H_4N:CH \cdot CH:C \cdot CH_3$	XX-395	143.18
4371	quinoline ethiodide	lepidine ethiodide	$CH_3 \cdot C_9H_6N:(I)C_2H_5$	XX-396	299.16
4372	quinoline (6)	*p*-toluquinoline	$CH_3 \cdot C_9H_6N$	XX-398	143.18
4373	quinoline ethiodide	*p*-toluquinoline EtI	$CH_3 \cdot C_9H_6N:(I)C_2H_5$	XX-398	299.16
4374	quinoline (7)	*m*-toluquinoline	$CH_3 \cdot C_9H_6N$	XX-400	143.18
4375	quinoline (8)	*o*-toluquinoline	$CH_3 \cdot C_9H_6N$	XX-401	143.18
4376	red	*p*-diMe-amino-azobenzene-*o'*-carboxylic	$HO_2C \cdot C_6H_4 \cdot N:N \cdot C_6H_4 \cdot N(CH_3)_2$	XVI-329	269.29
4377	red, Na salt	.....	$C_{15}H_{14}O_2N_3Na$	*XVI-316	291.28
4378	red, para	(4',4)	$NaO_2C \cdot C_6H_4 \cdot N:N \cdot C_6H_4 \cdot N(CH_3)_2$	XVI-329	291.28
4379	salicylaldehyde (3)	(3;6,1)	$CH_3 \cdot C_6H_3(OH)CHO$	VIII-100	136.14
4380	salicylate (*o*)	oil of wintergreen	$HO \cdot C_6H_4 \cdot CO_2CH_3$	X-70	152.14
4381	stearate	.....	$C_{17}H_{35}CO_2CH_3$	II-379	298.49
4382	sulfonic acid	methane sulfonic acid	$CH_3 \cdot SO_3H$	IV-4	96.10
4383	sulfonic chloride	Me-sulfone chloride	$CH_3 \cdot SO_2Cl$	IV-5	114.55
4384	sulfuric acid	Me-hydrogen sulfate	$CH_3O \cdot SO_2 \cdot OH$	I-283	112.10
4385	tetraacetyl-*d*-glucoside (*α*)	.....	$CH_3O \cdot C_{14}H_{19}O_9$	.....	362.33
4386	tetramethyl-glucoside	.....	$(CH_3O)_5C_6H_7O$	.....	250.29
4387	thiocyanate	.....	$CH_3 \cdot S \cdot CN$	III-175	73.11
4388	*iso*-thiocyanate	methyl mustard oil	$CH_3 \cdot N:C:S$	IV-77	73.11
4389	thiotoluene (*β*)	3-methyl-thiophene	$CH_3 \cdot C_4H_3S$	XVII-38	98.16
4390	thiourea	Me-thiocarbamide	$NH_2 \cdot CS \cdot NH \cdot CH_3$	IV-70	90.14
4391	*iso*-thiourea sulfate	.....	$(C_2H_6N_2S)_2 \cdot H_2SO_4$	*III-78	278.36
4392	toluate (*o*)	.....	$CH_3 \cdot C_6H_4 \cdot CO_2CH_3$	IX-463	150.17
4393	toluate (*m*)	.....	$CH_3 \cdot C_6H_4 \cdot CO_2CH_3$	IX-475	150.17
4394	toluate (*p*)	.....	$CH_3 \cdot C_6H_4 \cdot CO_2CH_3$	IX-484	150.17
4395	toluene sulfonate	(1,4)	$CH_3 \cdot C_6H_4 \cdot SO_3CH_3$	XI-99	186.22
4396	toluidine (*o*)	.....	$CH_3 \cdot C_6H_4 \cdot NHCH_3$	XII-784	121.18
4397	toluidine (*m*)	.....	$CH_3 \cdot C_6H_4 \cdot NHCH_3$	XII-856	121.18
4398	toluidine (*p*)	.....	$CH_3 \cdot C_6H_4 \cdot NHCH_3$	XII-902	121.18
4399	*o*-tolyl ether	Me *o*-cresyl ether	$CH_3 \cdot O \cdot C_6H_4 \cdot CH_3$	VI-352	122.16
4400	*m*-tolyl ether	*m*-cresyl Me ether	$CH_3 \cdot O \cdot C_6H_4 \cdot CH_3$	VI-376	122.16
4401	*p*-tolyl ether	.....	$CH_3 \cdot O \cdot C_6H_4 \cdot CH_3$	VI-392	122.16
4402	*p*-tolyl sulfide	thiocresol Me ether	$CH_3 \cdot S \cdot C_6H_4 \cdot CH_3$	VI-417	138.22
4403	trichloroacetate	.....	$Cl_3C \cdot CO_2CH_3$	II-208	177.43
4404	trimethylacetate	methyl pivalate	$(CH_3)_3C \cdot CO_2CH_3$	II-302	116.16

Methyl-quercetin 5556
Methyl-quinaldine 2541, 2544
Methyl quinolinate 2539
Methyl-quinoline carboxylic acid 5528-32
Methyl-quinolone 4180
Methyl-resorcinol 2371, 2373, 4998
Methyl-rhodin 4090
Methyl rosaniline 3593
Methyl-salicylic acid 3833, 4067
Methyl sebacate 2551
Methyl-styrene (*α*) 5224
Methyl-styrene (dimer) 2476
Methyl-styryl ketone 626
Methyl succinate 2554-5
Methyl-succinic acid 5520
Methyl sulfate 2559

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4361	nd./bz.	.....	129	.....	d. fused alk.	.....	.....
4362	lq.	$0.920^{10°}$	.....	$114\text{-}5^{748mm}$	i.	∞	∞
4363	lq.	0.945	.....	$147\text{-}8^{750mm}$	sl. d. a.	.....	.....
4364	lq.	.....	.....	$142\text{-}3^{743mm}$	sl. d. a.	.....	.....
4365	col. lq.	.....	.....	79-80	∞	s.	s.; s. chl.
4366	lq.	$1.154^{0°}$	.....	134-7	.....	.....	.....
4367	lq.	$1.059^{20°}_{4°}$	−1	$244\text{-}5^{750mm}$	v. sl. s.	s. chl.	s.
4368	yel. nd./al.	.....	233-4	.....	s.	v. sl. s.	i.
4369	cr.	$1.067^{20°}_{4°}$	16	250^{710mm}	i.	s.	s.
4370	lq.	$1.086^{20°}$	9-10	261-3	sl. s.	∞; ∞ bz.	∞; ∞ lg.
4371	yel. cr./al.	.....	142-3	.....	s.	s.	i.
4372	lq.	$1.068^{20°}$	−22	258-9	v. sl. s.	s.	s.
4373	cr.	.....	171-3	.....	.....	.....	.....
4374	yel. oil	$1.061^{20°}_{4°}$	39	257.6^{750mm}	v. sl. s.	s.	s.
4375	lq.	$1.073^{20°}$	.....	247.8^{760mm}	v. sl. s.	∞	∞
4376	vl. nd. or red pd.	.....	179-83	.....	v. sl. s.	s.	s. ac.
4377	red pl.	.....	.....	.....	s.	.....	.....
4378	or. pd.	.....	.....	.....	.....	.....	.....
4379	lf./aq.al.	$1.091^{59°}_{4°}$	56	217-8	v. sl. s.	s.	s.; s. chl.
4380	col. lq.	$1.182^{25°}_{25°}$	−8.3	222.2	$0.07^{30°}$	∞; s. chl.	∞
4381	col. cr.	.....	38-9	$214\text{-}5^{15mm}$	i.	s.	s.
4382	col. lq.	$1.481^{18°}_{4°}$	.....	167^{10mm}	∞	.....	.....
4383	lq.	$1.481^{18°}_{4°}$	.....	161.5^{730mm}	i. c.; d. h.	.....	s.
4384	oil	.....	<−30	d.	v. s.	s.	∞ abs.
4385	col. rhb./al.	.....	101	.....	i.; s. chl.	s.; s. act.	s.; s. pet.
4386	col. lq.	$1.108^{20°}$	.....	$145\text{-}50^{13mm}$	sl. s.	s.; s. chl.	sl. s.
4387	lq.	$1.069^{24°}_{4°}$	−51	130-3	v. sl. s.	∞	∞
4388	col. cr.	$1.069^{37°}_{4°}$	35-6	119^{759mm}	v. sl. s.	∞	∞
4389	oil	1.025	.....	114	.....	.....	.....
4390	pr.	.....	118-9	.....	v. s.	v. s.	sl. s.
4391	cr. pd.	.....	241-2 d.	.....	v. s.	.....	.....
4392	col. lq.	$1.073^{15°}$	<−50	213	i.	∞	∞
4393	col. lq.	$1.066^{15°}$	.....	215	i.	.....	.....
4394	cr./pet.	.....	33-4	217	i.	v. s.	v. s.
4395	cr./et. lg.	.....	28	.....	i.; s. bz.	v. s.	v. s.
4396	lq.	$0.973^{15°}$	.....	206-7	i.	∞	∞
4397	lq.	.....	.....	206-7	i.	∞	∞
4398	lq.	$0.935^{55°}_{4°}$	.....	$209\text{-}11^{761mm}$	i.	∞	∞
4399	lq.	$0.985^{15°}_{15°}$	.....	171-2	i.	v. s.	v. s.
4400	lq.	$0.977^{15°}_{15°}$	.....	177	.....	.....	.....
4401	lq.	$0.976^{15°}_{15°}$	.....	176	.....	.....	.....
4402	lq.	$1.030^{16°}_{4°}$	.....	209^{747mm}	.....	.....	.....
4403	lq.	$1.489^{19°}_{19°}$	−17.5	$152\text{-}3^{765mm}$	d.	d.	s.
4404	lq.	$0.891^{0°}_{4°}$	.....	100-2	.....	.....	.....

Methyl sulfide 2560
Methyl sulfite 2561
Methyl sulfonal 6326
Methyl sulfone chloride 4383
Methyl tartrate 2564-5
Methyl-tartronic acid 4000
Methyl-tertrahydroquinoline 3930
Methyl-tetramethylene 4198
Methyl-theobromine, cf. alkd.
Methyl-thiocarbamide 4390
Methyl-thionine chloride 4427
Methyl-thiophene 4389
Methyl-tolyl ketone 4089
Methyl-trimethylene 4210
Methyl-tritane 2756-7
Methyl-trityl ether 6332

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4405	**Methyl** (tyrosine *N*)(*l*+)	ratanhin; andirine	$CH_3NH{\cdot}C_9H_9O_3$	XIV-612	195.21
4406	umbelliferone (*β*)	7-OH-4-Me coumarin	$C_{10}H_8O_3$	XVIII-31	176.16
4407	undecylenate	.....	$CH_2{:}CH(CH_2)_8CO_2{\cdot}CH_3$	II-459	198.30
4408	*n*-undecyl ketone	tridecanone-2	$CH_3{\cdot}CO(CH_2)_{10}CH_3$	I-715	198.34
4409	*n*-undecyl ketone semicarbazone	.....	$C_{11}H_{23}(CH_3)C{:}N{\cdot}NH{\cdot}CO{\cdot}NH_2$	*I-371	255.40
4410	uracil (1)	.....	$CO{\cdot}(CH)_2NH{\cdot}CO{\cdot}N{\cdot}$ | ——— | CH_3	XXIV-316	126.11
4411	uracil (3)	.....	$CO{\cdot}NH{\cdot}CO(CH)_2{\cdot}N{\cdot}$ | ——— | CH_3	XXIV-316	126.11
4412	uracil (4)	.....	$(NH{\cdot}CO)_2CH{:}C{\cdot}CH_3$ | ——— |	XXIV-342	126.11
4413	uracil (5)	thymine	$(CO{\cdot}NH)_2CH{:}C{\cdot}CH_3$ $_7$| ——— |	XXIV-353	126.11
4414	urea (*N*)	.....	$CH_3{\cdot}NH{\cdot}CO{\cdot}NH_2$	IV-64	74.08
4415	urea nitrate	.....	$C_2H_6ON_2{\cdot}HNO_3$	IV-65	137.10
4416	urethane	*cf. also* Me-carbamate	$CH_3{\cdot}NH{\cdot}CO_2C_2H_5$	IV-64	103.12
4417	uric acid (1)	.....	$C_6H_6O_3N_4$	XXVI-524	182.14
4418	uric acid (3)	.....	$C_6H_6O_3N_4{\cdot}\frac{1}{2}H_2O$	XXVI-524	191.15
4419	uric acid (7)	.....	$C_6H_6O_3N_4{\cdot}H_2O$	XXVI-525	200.16
4420	*n*-valerate	.....	$CH_3{\cdot}(CH_2)_3{\cdot}CO_2CH_3$	II-301	116.16
4421	*iso*-valerate	.....	$(CH_3)_2C_2H_3{\cdot}CO_2CH_3$	II-311	116.16
4422	vinyl carbinol	buten-1-ol-3	$CH_2{:}CH{\cdot}CHOH{\cdot}CH_3$	I-441	72.10
4423	*l*-xyloside (*β*)	.....	$CH_3O{\cdot}C_5H_9O_4$	.....	164.16
4424	**Methylal**	dimethoxy-methane	$CH_2(OCH_3)_2$	I-574	76.09
4425	**Methylene**-amino-acetonitrile	(dimolecular)	$(CH_2{:}N{\cdot}CH_2{\cdot}CN)_2$	II-89	136.16
4426	blue (base)	*N,N,N′,N′*,-tetra-Me-thionine	$[(CH_3)_2N]_2C_{12}H_6{\cdot}NS(OH)$	XXVII-393	301.40
4427	blue chloride	Me-thionine chloride	$C_{16}H_{18}N_3S(Cl){\cdot}3H_2O$	XXVII-395	373.89
4428	bromide	dibromomethane	$CH_2{:}Br_2$	I-67	173.86
4429	chloride	dichloromethane	$CH_2{:}Cl_2$	I-60	84.94
4430	diacetate	.....	$(CH_3CO_2)_2CH_2$	II-152	132.11
4431	dianiline	.....	$(C_6H_5{\cdot}NH)_2CH_2$	XII-184	198.26
4432	disulfonic acid	methionic acid	$CH_2{:}(SO_2OH)_2$	I-579	176.16
4433	fluoride	difluoromethane	$CH_2{:}F_2$	I-59	52.03
4434	iodide	diiodomethane	$CH_2{:}I_2$	I-71	267.87
4435	**Michler's** hydrol (*p,p′*)	.....	$[(CH_3)_2N{\cdot}C_6H_4]_2{:}CHOH$	XIII-698	270.36
4436	ketone (*p,p′*)	.....	$[(CH_3)_2N{\cdot}C_6H_4]_2CO$	XIV-89	268.35
4437	**Morpholine-ethanol ethyl ether**	.....	$O{:}(CH_2CH_2)_2{:}N{\cdot}C_2H_4{\cdot}O{\cdot}C_2H_5$	.....	159.22
4438	**Mucic** acid	.....	$(CHOH)_4(CO_2H)_2$	III-581	210.14
4439	acid, allo-	.....	$(CHOH)_4(CO_2H)_2$	III-576	210.14

"Methyl urethane" 4175
Methyl violet 5076-7
Methyl yellow 2431
Methylene-aniline 512
Methylene dicyanide 4006
Methylene-diethyl ether 2172
Methylene-diphenyl ether 6447
Methylene-dipropyl ether 5458
Methylene-propylene dioxide 6285
Methylene-succinic acid 3928
Methylol-acetamide 3291
Metol 4117
Metoquinone, mixt. of 2314 and 4117
Metrazol 5079
Metycaine 764
Mezcaline, cf. alkd.
MI (mustard imitator) gas 1473
Mianine 1290
Michler's hydride 5834
Milk sugar 3947
Mirbane 4646

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4405	col. nd.	.....	257	d. 280	$0.14^{20°}$; $0.5^{100°}$	0.007 abs.	i.; s. NH_4OH
4406	nd./al.*	.....	185-6	d.	v. sl. s. h.; s. alk.	s.; s. ac.; i. Na_2CO_3	v. sl. s.; sl. s. chl.
4407	lq.	$0.889^{15°}$	−27.5	248-9	.....	.....	.....
4408	cr.	$0.823^{28°}$	28-9	260-5	i.	v. s.	v. s.
4409	cr.	.....	122-6	.....	.....	.....	.....
4410	pr./aq. al.	.....	174-5	.....	v. s.	v. s.	i. bz.
4411	pr./al.	.....	232	.....	s.; i. dil. HCl	s. h.	s. aq. NaOH
4412	nd./al.	.....	d. 270-80	.....	$0.7^{22°}$; s. alk.	sl. s.; s. H_2SO_4	v. sl. s.; s. NH_4OH
4413	pl./aq.	.....	326 d.	.....	$0.4^{25°}$; s. alk.	sl. s.; s. H_2SO_4	v. sl. s.
4414	pr./aq.	1.204	101-2	d.	v. s.	v. s.	i.
4415	col. cr.	.....	128-32	.....	.....	.....	.....
4416	col. lq.	$1.009^{\frac{18}{4}°}$	.....	170	$95^{16°}$	s.	.....
4417	cr.	.....	>360 d.	.....	0.05 h.	v. sl. s.	.....
4418	cr.	.....	>360 d.	.....	0.2 h.	.....	s. alk.
4419	cr.	.....	>370 d.	.....	$1.3^{100°}$	.....	s. alk.
4420	lq.	$0.910^{0°}$	.....	127.3	v. sl. s.	∞	∞
4421	col. lq.	$0.881^{\frac{20}{4}°}$	.....	116-7^{764mm}	v. sl. s.	∞	∞
4422	lq.	$0.831^{\frac{20}{4}°}$	<−80	97	∞	.....	.....
4423	cr./EtOAc	.....	155-6	.....	.....	.....	.....
4424	col. lq.	$0.888^{\frac{18}{4}°}$	−104.8	42-3	33	∞	∞
4425	col. pr./ aq.	.....	129.5	.....	s. h.	s. h.	i.; i. bz.
4426	dark, amor.	.....	.....	.....	v. s.	v. s.	i.
4427	gn. b. met. /aq. HCl	.....	$-2H_2O$, 100	$-3H_2O$, 150	4	2	i.; s. chl.
4428	col. lq.	$2.495^{\frac{20}{4}°}$	−52.8	98.5^{756mm}	$1.173^{0°}$; $1.15^{20°}$	∞; ∞ act.	∞
4429	col. lq.	$1.336^{\frac{20}{4}°}$	−96.7	40-1	$2^{20°}$	∞	∞
4430	lq.	$1.132^{\frac{20}{20}°}$	.....	170	sl. s.	v. s.	∞
4431	pl./et. pet.	.....	65	208-9 d.	i.; i. pet.	s.	s.
4432	hyg. nd.	.....	.....	.....	s.	s.	.....
4433	gas	.....	.....	.....	.....	.....	.....
4434	col. lq.	$3.325^{\frac{20}{4}°}$	5.7(5.2)	180 d.	$1.6^{0°}$; $1.4^{20°}$	∞	∞
4435	gn. lf./bz.	.....	96-7	.....	i.; s. bz.	s. h.	s.; s. ac.
4436	lf./al.	.....	174	>360 d.	i.; v. s. bz.	sl. s.	v. sl. s.
4437	col. lq.	$0.965^{\frac{20}{20}°}$	.....	206.2	∞	.....	.....
4438	pd.	.....	206-14 d.	.....	$0.33^{14°}$; $1.6^{100°}$	i.	i.; s. alk.
4439	nd./aq.	.....	166-71 d.	.....	9 h.	sl. s.	.....

*Crysts. $+1H_2O$/aq.; $-H_2O$, 110°.

Monacetin 3382
Monazol 3800
Monobutyrin 3392
Monochlorohydrin 3395-6
Monoethanolamine 2907
Monopropionin 3413
Monosalicylin 3414
Monostearin 3415-6
Monosulfonic acid-F 4510
Monotol 4117
Monotropitoside, cf. glcde.
Moogrol 3014
Morin 5806
Mor(in)tannic acid 5070
Morphine, cf. alkd.
Morphol 2360
Morpholine 2235
Morpholine-ethanol 2236
Morpholine-ethanol ethyl ether 4437
Moss starch 3969

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4440	**Mucic** acid, talo-	(*d* or *l*)	$(CHOH)_4(CO_2H)_2$	III-577	210.14
4441	**Mucobromic acid**	.....	$HO_2C{\cdot}CBr{:}CBr{\cdot}CHO$	III-728	257.89
4442	**Mucochloric acid**	.....	$HO_2C{\cdot}CCl{:}CCl{\cdot}CHO$	III-727	168.97
4443	**Muconic acid**	.....	$(\cdot CH{:}CH{\cdot}CO_2H)_2$	II-803	142.11
4444	**Mudarol**	mudarin	$C_{30}H_{47}O(OH)$	.....	440.68
4445	**Murexide**	ammonium salt purpuric acid	$C_8H_4O_6N_5{\cdot}NH_4{\cdot}H_2O$	XXV-499	302.21
4446	**Muscone** (*l*)	3-Me-cyclopentadecanone	$CH_3{\cdot}C_{15}H_{27}{:}O$	.....	238.40
4447	**Myochrysine**	Na aurothiomalate	$NaO_2C{\cdot}CH_2{\cdot}CH{:}(SAu)CO_2Na$	.....	390.32
4448	**Myricyl** acetate	.....	$CH_3CO_2{\cdot}C_{31}H_{63}$	*II-63	494.86
4449	alcohol	melissyl alcohol	$C_{31}H_{63}OH$	*I-222	452.82
4450	**Myristic** acid	tetradecanoic acid	$CH_3(CH_2)_{12}{\cdot}CO_2H$	II-365	228.36
4451	aldehyde	tetradecanal	$CH_3(CH_2)_{12}{\cdot}CHO$	I-716	212.36
4452	amide	myristamide	$C_{13}H_{27}{\cdot}CO_2NH_2$	II-368	227.38
4453	anhydride	.....	$(C_{13}H_{27}CO)_2O$	II-367	438.71
4454	anilide	myristanilide	$C_{13}H_{27}CO{\cdot}NHC_6H_5$	XII-257	303.47
4455	chloride	myristoyl chloride	$C_{13}H_{27}{\cdot}COCl$	II-368	246.81
4456	nitrile	tridecyl cyanide	$C_{13}H_{27}{\cdot}CN$	II-368	209.36
4457	**Myristyl bromide**	.....	$CH_3(CH_2)_{12}CH_2Br$	.....	277.29
4458	**Naphthalene**	.....	$C_{10}H_8$	V-531	128.16
4459	dicarboxylic acid	naphthalic acid (1,4)	$C_{10}H_6(CO_2H)_2$	IX-917	216.18
4460	dicarboxylic acid	naphthalic acid (1,8)	$C_{10}H_6(CO_2H)_2$	IX-918	216.18
4461	disulfonic acid (1,5)	Armstrong's acid	$C_{10}H_6(SO_3H)_2$	XI-212	288.28
4462	disulfonic acid (1,6)	(δ)	$C_{10}H_6(SO_3H)_2$	XI-213	288.28
4463	disulfonic acid (2,6)	.....	$C_{10}H_6(SO_3H)_2$	XI-215	288.28
4464	disulfonic acid (2,7)	(α)	$C_{10}H_6(SO_3H)_2$	XI-216	288.28
4465	sulfinic acid (α)	.....	$C_{10}H_7{\cdot}SO_2H$	XI-15	192.22
4466	sulfinic acid (β)	.....	$C_{10}H_7{\cdot}SO_2H$	XI-16	192.22
4467	sulfone amide (α)	.....	$C_{10}H_7{\cdot}SO_2NH_2$	XI-157	207.24
4468	sulfone chloride (α)	.....	$C_{10}H_7{\cdot}SO_2Cl$	XI-157	226.67
4469	sulfone chloride (β)	.....	$C_{10}H_7{\cdot}SO_2Cl$	XI-173	226.67
4470	sulfonic acid (α)	.....	$C_{10}H_7{\cdot}SO_3H{\cdot}2H_2O$	XI-155	244.26
4471	sulfonic acid (β)	.....	$C_{10}H_7{\cdot}SO_3H{\cdot}H_2O$	XI-171	226.24
4472	sulfonic Na salt	(β)	$C_{10}H_7O_3SNa$	XI-171	230.21
4473	tetrachloride	(1,2,3,4)	$C_{10}H_8Cl_4$	V-492	269.99
4474	**Naphthalic anhydride**	(1,8)	$C_{10}H_6{:}(CO)_2O$	XVII-521	198.17
4475	**Naphthasultam**	(1,8)	$C_{10}H_7O_2NS$	.....	205.22
4476	disulfonate Na	(2,4)	$C_{10}H_4O_8NS_3Na_3{\cdot}8\frac{1}{2}H_2O$	XXVII-356	584.45
4477	**Naphthazarin** (5,8;1,4)	5,8-dihydroxy-α-naphthoquinone	$(HO)_2C_{10}H_4O_2$	VIII-412	190.15
4478	***iso*-Naphthazarin**	(2,3;1,4)	$(HO)_2C_{10}H_4O_2$	VIII-411	190.15
4479	**Naphthoflavone** (α)	7,8-benzoflavone	$C_{19}H_{12}O_2$	XVII-390	272.29
4480	**Naphthoic** acid (α)	.....	$C_{10}H_7{\cdot}CO_2H$	IX-647	172.17
4481	acid (β)	isonaphthoic acid	$C_{10}H_7{\cdot}CO_2H$	IX-656	172.17
4482	aldehyde (α)	.....	$C_{10}H_7{\cdot}CHO$	VII-400	156.17
4483	aldehyde (β)	.....	$C_{10}H_7{\cdot}CHO$	VII-401	156.17
4484	amide (α)	.....	$C_{10}H_7{\cdot}CONH_2$	IX-648	171.19

Mudarin 4444
Munjistin 2305
Murexan 6384
Murrayin, cf. glcde.
Muscarine, cf. alkd.
Muscle sugar 1602-3
Musk, artificial 6296
Musk xylene 6297
Mustard gas 1985
Mustard imitator gas 1473
Mustard oils, cf. also *iso*-thiocyanates.
Mustard oil 220
Mustard oil acetic acid 2369
Mycose 6054
Myrbane oil 4646

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4440	lf./act.	.....	158 ± d.	.....	v. s.	v. s. h.	i.
4441	pl./et. lg.	.....	122-5	.....	v. s. h.	v. s.	v. s.
4442	pl./aq.	.....	127	.....	s. h.	s.	s.; i. lg.
4443	nd./aq.	.....	298 d.	.....	0.002 c.	s. h.	s. h. ac.
4444	hex./al. et.	.....	176	.....	i.	s.	s.
4445	gn. red pd.	.....	.....	.....	v. sl. s. c.	i.	i.
4446	col. oil	$0.922^{\frac{17}{4}°}$	*	328	v. sl. s.	∞	.....
4447	lt. yel. pd.	.....	.....	.....	v. s.	.....	.....
4448	nd.	.....	73-5	.....	.....	.....	.....
4449	nd. or lf.	$0.777^{95°}$	88	.....	i.	v. sl. s. c.; v. sl. s. pet.	v. s.; v. s. bz.
4450	col. lf.	$0.853^{\frac{70}{4}°}$	57-8	250.5^{100mm}	i.; v. s. bz.	v. s. abs.	v. s.
4451	cr.	.....	23.5	166^{24mm}	.....	.....	.....
4452	nd.	.....	102	217^{12mm}	i.	s.	sl. s.
4453	col. cr.	.....	51	$198^{0.1mm}$	.....	.....	.....
4454	nd./al.	.....	84	113^{10mm}	i.; s. chl.	v. s. bz.	v. s.
4455	col. lq.	.....	−1	168^{15mm}	d.	d.	s.
4456	cr.	$0.828^{\frac{19}{4}°}$	19	226.5^{100mm}	.....	s.	.....
4457	col. lq.	.....	3-5	.....	i.	.....	s.
4458	col. pl./al.	$1.145^{\frac{20}{4}°}$	80.2	217.9	$0.003^{25°}$; v. s. CCl_4	$9.5^{19.5°}$; v. s. CS_2	v. s.; $46^{16°}$ bz.
4459	nd.	.....	>240	.....	i. h.	s.	.....
4460	nd./al.	.....	270	.....	v. sl. s.	s. h.	sl. s.
4461	lf.	.....	d.	.....	v. s.	s.	i.
4462	cr.	.....	.....	d. 125	v. s.	s.	i.
4463	hyg. lf.	.....	.....	.....	s.	.....	.....
4464	hyg. nd.	.....	.....	.....	s.	sl. c. HCl	.....
4465	nd./aq.	.....	98-9	.....	s.	s.	sl. s.
4466	nd.	.....	105	.....	s.	s.	s.
4467	cr./al.	.....	150	.....	.....	v. s.	v. s.
4468	lf./et.	.....	68	195^{13mm}	i.	v. s.	v. s.
4469	lf.	.....	79	201^{13mm}	i.	sl. s. pet.	s. bz.
4470	cr.	.....	90	.....	v. s.	v. s.	sl. s.
4471	hyg. cr.	.....	125**	.....	$77^{30°}$	0.2 h. bz.	.....
4472	cr./aq.	.....	.....	d.	$6^{23.9°}$	.....	.....
4473	mn./chl.	.....	182	.....	i.	v. sl. s. h.	sl. s. h.
4474	nd./al.	.....	273-4	.....	sl. s. ac.	v. sl. s.	v. sl. s.
4475	nd./bz.	.....	177-8	.....	s. h.	sl. s.	s.
4476	yel. lf./aq. al.	.....	$-8H_2O$, 160	.....	v. s.	sl. s.	.....
4477	brn. nd./ al.	.....	subl. vac.	.....	sl. s. h.	sl. s.; s. alk.	sl. s.
4478	brn. lf./ac.	.....	276-80	subl.	sl. s. h.	sl. s.	v. sl. s.
4479	cr./aq. al.	.....	155-6	.....	.....	.....	.....
4480	nd./aq. al.	.....	160-1	300	v. sl. s. h.	s. h.	s.
4481	mn.	.....	184	>300	sl. s. h.	s.	s.
4482	lq.	$1.148^{\frac{20}{4}°}$	.....	291.6	.....	.....	.....
4483	lf./h. aq.	$1.078^{99.4°}$	60.5-1.0	.....	s. h.	v. s.	v. s.
4484	nd./al.	.....	202	.....	.....	v. sl. s.	.....

* Oxime, m. p. 45°; semicarbazone, m. p. 134°.
** Crysts. + $3H_2O$, m. p. 83°; anh., m. p. 91°.

Myristamide 4452
Myristanilide 4454
Myristoyl chloride 4455
Myristyl alcohol 5750
Nandinine, cf. alkd.
Napelline, cf. alkd.
Naphthacetol 31
Naphthalene acetic acid 4528
Naphthalene decahydride 1631-2
Naphthalic acid 4459-60
Naphthalidine 4529

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Naphthoic				
4485	amide (β)	.....	$C_{10}H_7 \cdot CONH_2$	IX-657	171.19
4486	chloride (β)	β-naphthoyl chloride	$C_{10}H_7 \cdot COCl$	IX-657	190.62
4487	nitrile (α)	α-naphthyl cyanide	$C_{10}H_7 \cdot CN$	IX-649	153.17
4488	nitrile (β)	β-naphthyl cyanide	$C_{10}H_7 \cdot CN$	IX-659	153.17
4489	**Naphthol** (α)	α-hydroxy naphthalene	$C_{10}H_7 \cdot OH$	VI-596	144.16
4490	**Naphthol** (β)	β-hydroxy naphthalene	$C_{10}H_7 \cdot OH$	VI-627	144.16
4491	disulfonic acid (β)	(2;3,6); R-acid	$HO \cdot C_{10}H_5(SO_3H)_2$	XI-288	304.28
4492	disulfonic Ca	R-acid Ca salt	$HO \cdot C_{10}H_5(SO_3)_2Ca$	.....	342.35
4493	disulfonic K	R-acid K salt	$HO \cdot C_{10}H_5(SO_3K)_2$	.....	380.46
4494	disulfonic Na	R-acid Na salt	$HO \cdot C_{10}H_5(SO_3Na)_2$	XI-289	348.26
4495	disulfonic K (β)	(2;6,8); G-acid K	$HO \cdot C_{10}H_5(SO_3K)_2$	.....	380.46
4496	disulfonic Na (β)	G-acid Na salt	$HO \cdot C_{10}H_5(SO_3Na)_2$	XI-290	348.26
4497	phthalein (α)	.....	$C_8H_4O_2(C_{10}H_6OH)_2$	XVIII-157	418.42
4498	sulfonic acid (α)	(1,2); Schaeffer's (α)	$HO \cdot C_{10}H_6 \cdot SO_3H$	XI-269	224.22
4499	sulfonic Ca (α)	Schaeffer's Ca (α)	$(C_{10}H_7O_4S)_2Ca \cdot H_2O$	XI-270	504.53
4500	sulfonic K (α)	Schaeffer's K	$C_{10}H_7O_4SK \cdot \frac{1}{2}H_2O$	XI-270	271.32
4501	sulfonic Na (α)	Schaeffer's Na	$C_{10}H_7O_4SNa$	XI-269	246.21
4502	sulfonic acid (α)	(1,4); Neville-Winther	$HO \cdot C_{10}H_6 \cdot SO_3H$	XI-271	224.22
4503	sulfonic acid (α)	(1-OH; 5-SO_3H)	$HO \cdot C_{10}H_6 \cdot SO_3H$	XI-273	224.22
4504	sulfonic acid (α)	(1,8)	$HO \cdot C_{10}H_6 \cdot SO_3H \cdot H_2O$	XI-275	242.24
4505	sulfonic acid (β)	(2-OH; 1-SO_3H)	$HO \cdot C_{10}H_6 \cdot SO_3H$	XI-281	224.22
4506	sulfonic Ca (β)	(2,1); asaprol	$(C_{10}H_7O_4S)_2Ca \cdot 3H_2O$	.....	540.56
4507	sulfonic acid (β)	(2,6); Schaeffer's (β)	$HO \cdot C_{10}H_6 \cdot SO_3H$	XI-282	224.22
4508	sulfonic Ca (β)	Schaeffer's Ca (β)	$(C_{10}H_7O_4S)_2Ca \cdot 5H_2O$	XI-282	576.59
4509	sulfonic K (β)	Schaeffer's K (β)	$C_{10}H_7O_4SK \cdot xH_2O$	XI-283	(262.31)
4510	sulfonic acid (β)	(2-OH; 7-SO_3H)	$HO \cdot C_{10}H_6 \cdot SO_3H$	XI-285	224.22
4511	sulfonic Na (β)	(2,7); F-acid Na	$C_{10}H_7O_4SNa \cdot 2\frac{1}{2}H_2O$	XI-286	291.25
4512	sulfonic Na (β)	(2,8) Bayer-acid Na	$C_{10}H_7O_4SNa$	XI-286	246.21
4513	**Naphtho**-phenazine	(α,β)	$C_{10}H_6{:}N_2{:}C_6H_4$	XXIII-276	230.26
4514	quinaldine (α)	.....	$C_{13}H_8NCH_3$	XX-471	193.24
4515	quinaldine (β)	.....	$C_{13}H_8NCH_3$	XX-471	193.24
4516	quinaldine (γ)	.....	$C_{13}H_8NCH_3$	.....	193.24
4517	quinoline (α)	.....	$C_{13}H_9N$	XX-463	179.21
4518	quinoline (β)	5,6-benzoquinoline	$C_{13}H_9N$	XX-464	179.21
4519	quinoline HCl (β)	.....	$C_{13}H_9N \cdot HCl \cdot 2H_2O$	XX-465	251.71
4520	quinone (α)(1,4)	.....	$C_{10}H_6O_2$	VII-724	158.15
4521	quinone (β)(1,2)	.....	$C_{10}H_6O_2$	VII-709	158.15
4522	quinone-4-sulfonate Na (β)	.....	$C_{10}H_5O_2 \cdot SO_3Na$	XI-330	260.20
4523	quinone (amphi)	(2,6)	$C_{10}H_6O_2$	VII-733	158.15
4524	sulfone (1,8)	naphthosultone	$C_{10}H_6O \cdot SO_2$	XIX-43	206.21
4525	**Naphthoylaceto-nitrile** (β)	.....	$C_{10}H_7 \cdot CO \cdot CH_2 \cdot CN$	.....	195.21
4526	**Naphthyl** acetate (α)	.....	$CH_3CO_2 \cdot C_{10}H_7$	VI-608	186.20
4527	acetate (β)	.....	$CH_3CO_2 \cdot C_{10}H_7$	VI-644	186.20
4528	acetic acid (α)	.....	$C_{10}H_7 \cdot CH_2CO_2H$	IX-666	186.20
4529	amine (α)	1-NH_2-naphthalene	$C_{10}H_7 \cdot NH_2$	XII-1212	143.18

Naphthane 1631-2
Naphthanthracene 650
Naphthenic acid 3577
Naphthionic acid 4541, 4544
Naphthol yellow 2642
Naphthol yellow-S 3241
Naphtho-hydroquinone 2348, 2350
Naphtho-nitrile 4487-8
Naphtho-picric acid 6305
Naphtho-quinone oxime 4892

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4485	pl./al.	.....	192	.....	s. bz.	s. h.	s.; s. chl.
4486	cr.	.....	43	304-6	d.	s. h. bz.	s. h.
4487	nd./lg.	$1.111_{\frac{25}{25}}^{\circ}$	36-7	299	.....	v. s.	.....
4488	lf./lg.	$1.094_{\frac{60}{60}}^{\circ}$	66	305-6	v. sl. s.	s.	s.
4489	mn.	1.224^{4°	96; subl.	278-80	sl. s. h.; s. alk.	v. s.; s. bz.	v. s.; s. chl.
4490	mn.	1.217^{4°	122-3	285-6	0.1c.; 1.25 h.	v. s.	v. s.; s. chl.
4491	delq. nd.	.....	.....	.....	v. s.	v. s.	i.
4492	cr.	.....	.....	.....	30.6^{25°	61^{90° aq.	.....
4493	cr.	.....	.....	.....	29.5^{25°	58^{100° aq.	.....
4494	col. nd.	.....	.....	.....	25.2^{25°	v. sl. s.	41^{90° aq.
4495	col. cr.	.....	.....	.....	8.01^{25°	.....	32^{90° aq.
4496	col. cr.	.....	.....	.....	34.2^{20°	.....	63^{90° aq.
4497	cr./bz.*	.....	253-5*	.....	i.	s.	s. alk.
4498	pl./aq.	.....	>250	.....	v. s. h.	.....	i.
4499	cr.	.....	.....	.....	v. sl. s.	.....	.....
4500	pr./aq.	.....	.....	.....	2.8^{18°	v. sl. s.	i. KCl
4501	cr./al.	.....	.....	.....	6.29^{25°	23^{90° aq.	.....
4502	pl./aq.	.....	170 d.	.....	v. s.	.....	.....
4503	hyg. cr.	.....	110-20	.....	v. s.	.....	.....
4504	cr.	.....	106-7	$-H_2O$, 180	v. s.	.....	.....
4505	cr.	.....	.....	.....	v. s.	.....	.....
4506	wh. pd.	.....	50±	.....	6.6	4	.....
4507	lf.	.....	125	.....	v. s.	v. s.	.....
4508	col. lf.	.....	.....	.....	4.76^{20°	s.	16^{90° aq.
4509	nd. or lf.	.....	.....	.....	v. s. h.	i.	i.
4510	nd./HCl	.....	115-6**	d. 150	s.	s.	i.; i. bz.
4511	lf.	.....	.....	.....	8^{15°	.....	.....
4512	lf.	.....	.....	.....	v. s.	v. sl. s.	.....
4513	yel. nd./bz.	.....	142.5	>360	sl. s. bz.	v. sl. s.	v. sl. s.
4514	lq.	.....	.....	>300	.....	.....	.....
4515	nd./aq. al.	.....	82	>300	sl. s.	s.	s.
4516	cr.	.....	91-2	.....	.....	.....	.....
4517	mn./et.	.....	52	223^{47mm}	v. sl. s.	s.	s.; s. bz.
4518	pl./h. aq.	.....	93.5	350^{721mm}	sl. s. h.; s. aq. a.	v. s.	v. s.; v. s. bz.
4519	nd.	.....	.....	.....	v. s.	i.	.....
4520	yel. tri.	.....	125-6	subl. 100	v. sl. s. c.	v. s. h.	s.
4521	red nd./et.	.....	d. 115-20	.....	s.; s. H_2SO_4	s. bz.	s.
4522	cr./50% al.	.....	.....	.....	v. s.	i.	.....
4523	red pr.	.....	135	.....	i. pet.	s. d.	v. sl. s.
4524	pr./bz.	.....	154	>360 sl. d.	sl. s. CS_2	sl. s.; v. s. chl.	s. h. bz.
4525	yel. nd.	.....	118-20	.....	i.	s.	sl. s.
4526	nd./al.	.....	46-9	.....	.....	s.	s.
4527	nd./al.	.....	69-70	.....	s. chl.	s.	s.
4528	col. nd./aq.	.....	133	.....	s. h.	3.3	s.; s. bz.
4529	rhb./aq. al.	$1.123_{\frac{25}{25}}^{\circ}$	50; subl.	300.8	0.17 c.	v. s.	v. s.

* Crysts. + C_6H_6; loses C_6H_6 > 100°; m. anh. 253-5°.
** Crysts. + $1H_2O$, m. p. 108-9; + $2H_2O$, m. p. 95°; + $4H_2O$, m. p. 67°.

Naphtho-resorcinol 2349
Naphtho-salol 4569
Naphtho-sultone 4524
Naphthoyl chloride 4486

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4530	**Naphthyl** amine (β)	amino-naphthalene	$C_{10}H_7 \cdot NH_2$	XII-1265	143.18
4531	amine HCl (α)	.....	$C_{10}H_7 \cdot NH_2 \cdot HCl$	XII-1220	179.65
4532	amine HCl (β)	.....	$C_{10}H_7 \cdot NH_2 \cdot HCl$	XII-1272	179.65
4533	amine-4,8-disulfonic acid (α)	α,S-acid; δ-acid	$NH_2 \cdot C_{10}H_5(SO_3H)_2$	XIV-787	303.30
4534	amine-4,8-disulfonic acid (β)	β,C-acid	$NH_2 \cdot C_{10}H_5(SO_3H)_2$	XIV-786	303.30
4535	amine-5,7-disulfonic acid (β)	.....	$C_{10}H_9O_6NS_2 \cdot 5H_2O$	XIV-783	303.30
4536	amine-5,7-disulfonic K salt (β)	.....	$C_{10}H_8O_6NS_2K$	.....	341.39
4537	amine-6,8-disulfonic acid (β)	β,γ-acid; amido-G acid	$NH_2 \cdot C_{10}H_5(SO_3H)_2 \cdot 4H_2O$	XIV-784	375.36
4538	amine-6,8-disulfonic K salt (β)	.....	$C_{10}H_8O_6NS_2K$	.....	341.39
4539	amine-6,8-disulfonic Na salt (β)	.....	$C_{10}H_8O_6NS_2Na$	.....	325.29
4540	amine-6,8-disulfonic Na salt (β)	.....	$C_{10}H_7O_6NS_2Na_2$	.....	348.29
4541	amine-*p*-sulfonic acid (α)	naphthionic acid; (1,4)	$NH_2 \cdot C_{10}H_6 \cdot SO_3H$	XIV-739	223.24
4542	amine-*p*-sulfonic Na (α)	naphthionic Na salt	$C_{10}H_8O_3NSNa \cdot 4H_2O$	XIV-739	317.33
4543	amine sulfonic acid (α)	Schollkopf's acid; peri acid; (1,8)	$NH_2 \cdot C_{10}H_6 \cdot SO_3H$	XIV-752	223.24
4544	amine sulfonic acid	(α)(1,2)	$NH_2 \cdot C_{10}H_6 \cdot SO_3H$	XIV-757	223.24
4545	amine sulfonic acid (α)(4,2)	Cleve's γ-acid	$NH_2 \cdot C_{10}H_6 \cdot SO_3H$	XIV-757	223.24
4546	amine sulfonic (α)	(5,2); Cleve's β-acid	$NH_2 \cdot C_{10}H_6 \cdot SO_3H$	XIV-758	223.24
4547	amine sulfonic (α)	(8,2); Cleve's θ-acid	$NH_2 \cdot C_{10}H_6 \cdot SO_3H$	XIV-765	223.24
4548	amine sulfonic (α)	(5,1); Laurent's acid	$NH_2 \cdot C_{10}H_6 \cdot SO_3H$	XIV-744	223.24
4549	amine sulfonic (β)	(2,1); Tobias' acid	$NH_2 \cdot C_{10}H_6 \cdot SO_3H$	XIV-738	223.24
4550	amine sulfonic (β)	(6,1); Dahl's acid	$NH_2 \cdot C_{10}H_6 \cdot SO_3H$	XIV-748	223.24
4551	amine sulfonic (β)	(7,1); Dahl's acid	$NH_2 \cdot C_{10}H_6 \cdot SO_3H$	XIV-750	223.24
4552	amine sulfonic (β)	(6,2); Bronner's acid	$NH_2 \cdot C_{10}H_6 \cdot SO_3H$	XIV-760	223.24
4553	amine sulfonic (β)	(7,2); δ-acid	$NH_2 \cdot C_{10}H_6 \cdot SO_3H$	XIV-763	223.24
4554	amine-3,6,8-trisulfonic acid (α)	Koch acid; amino-H acid	$NH_2 \cdot C_{10}H_4(SO_3H)_3 \cdot 6H_2O$	XIV-801	487.42
4555	amine-3,6,8-trisulfonic Na (β)	Koch acid Na; amino-H acid Na	$C_{10}H_6O_9NS_3Na_3$	.....	449.33
4556	benzoate (α)	.....	$C_6H_5CO_2 \cdot C_{10}H_7$	IX-125	248.27
4557	benzoate (β)	.....	$C_6H_5CO_2 \cdot C_{10}H_7$	IX-125	248.27
4558	*iso*-cyanate (α)	.....	$C_{10}H_7 \cdot N:CO$	XII-1244	169.17
4559	*iso*-cyanate (β)	.....	$C_{10}H_7 \cdot N:CO$	XII-1297	169.17
4560	ether (α)	dinaphthyl ether	$C_{10}H_7 \cdot O \cdot C_{10}H_7$	VI-607	270.31
4561	ether (α,β')	dinaphthyl ether	$C_{10}H_7 \cdot O \cdot C_{10}H_7$	VI-642	270.31
4562	ether (β)	dinaphthyl ether	$C_{10}H_7 \cdot O \cdot C_{10}H_7$	VI-642	270.31
4563	hydrazine (α)	.....	$C_{10}H_7 \cdot NH \cdot NH_2$	XV-561	158.20

Naphthylamine red-G 3732
Naphthyl-benzamidine 689
Naphthyl bromide 956-7
Naphthyl chloride 1402-3
Naphthyl cyanide 4487-8
Naphthyl-ethyl ether 3093-4
Naphthyl fluoride 3273
Naphthyl iodide 3891-2
Naphthyl-mercaptan 5913-4
Naphthyl-nitrosohydroxylamine 4581

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4530	lf./aq.	$1.061^{\frac{25}{4}°}$	111-2	306.1	v. s. h.	s.	s.
4531	nd.	.....	.....	subl.	$3.8^{20°}$	s.	s.
4532	lf.	.....	.....	.....	v. s.	v. s.	.....
4533	cr.	.....	.....	.....	s. alk.	.....	.....
4534	pr.	.....	.....	.....	s. alk.	v. sl. s. H_2SO_4	.....
4535	rhb./aq.	.....	.....	.....	$23^{20°}$	$10^{29°}$ aq.*	$24^{54°}$ aq.*
4536	cr.	.....	.....	.....	$3.4^{18°}$	$67^{1°}$ aq.	.....
4537	nd./aq.	.....	.....	.....	$9^{20°}$	sl. s.	.....
4538	cr.	.....	.....	.....	$12.8^{20°}$	$34^{78°}$ aq.	.....
4539	cr.	.....	.....	.....	$2.7^{18°}$	$12^{78°}$ aq.	.....
4540	cr.	.....	.....	.....	v. sl. s.	.....	.....
4541	nd. + $\frac{1}{2}H_2O$	.....	d.	.....	$0.03^{100°}$; $0.2^{100°}$	i.; s. alk.	i.
4542	mn. or rhb.	.....	$-3\frac{1}{2}H_2O$, 80	$-4H_2O$, 130	s.; v. sl. s. aq. alk.	sl. s.	i.
4543	nd. + $1H_2O$	.....	d.	.....	$0.02^{21°}$; $0.4^{100°}$	s. ac.	.....
4544	nd./aq.	.....	262-5 d.	.....	$0.24^{0°}$; $3.1^{100°}$	i.	i. bz.
4545	nd.	.....	.....	.....	sl. s.	.....	.....
4546	cr./aq.	.....	.....	.....	$0.1^{16°}$	i.	i.
4547	nd. + $1H_2O$	.....	.....	.....	$0.46^{25°}$	v. sl. s.	v. sl. s.
4548	cr. + $1H_2O$	.....	d.	$-H_2O$, 110	0.1 c.	i.	i.
4549	cr./HCl	.....	.....	.....	d. h.	.....	.....
4550	pl./aq.	.....	.....	.....	$0.03^{20°}$	i.	i.
4551	pr./aq.	.....	.....	.....	$0.06^{20°}$	i.	.....
4552	cr. + $1H_2O$	.....	.....	.....	$0.01^{20°}$; $0.16^{100°}$	.....	.....
4553	cr. + $1H_2O$	.....	.....	.....	$0.02^{20°}$; $0.3^{100°}$	.....	.....
4554	cr.	.....	.....	.....	$200^{18°}$	$12.5^{18°}$	.....
4555	cr.	.....	.....	.....	$7.21^{20°}$	$16^{54°}$ aq.	.....
4556	cr./et. al.	.....	56	.....	.....	.....	v. s.
4557	nd./al.	.....	107-10	.....	i.; s. chl.	s. h.	sl. s.
4558	col. lq.	1.18	.....	269-70	d.	s.; s. pet.	s.; s. chl.
4559	lf.	.....	55-6	.....	d.	v. s.	s.; s. bz.
4560	lf./al.	.....	110	>360	i.; s. bz.	sl. s. c.	s.
4561	nd./et. al.	.....	81	264^{15mm}	s. bz.	.....	s.
4562	nd./al.	.....	105; d. 380	250^{19mm} sl. d.	v. s. bz.	s. h.	v. s.; sl. s. c. ac.
4563	col. cr.	.....	116-7	203^{20mm}	v. sl. s. c.	v. s. h.	sl. s.

* Solubility of anhy. compd.

Naphthalene ethylene 2
Narceine, cf. alkd.
Narcissine, cf. alkd.
Narcosine, cf. alkd.
Narcotine, cf. alkd.
Naringin, cf. glcde.
Neoarsphenamine 5593
Neobornyval 868
Neocinchophen 3130
Neol 376
Neomenthol 4025
Neomenthyl acetate 4028
Neonal 2999
Neoquinophan 3130

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Naphthyl				
4564	hydrazine HCl (α)	.....	$C_{10}H_7 \cdot NH \cdot NH_2 \cdot HCl$	XV-562	194.66
4565	hydrazine (β)	.....	$C_{10}H_7 \cdot NH \cdot NH_2$	XV-568	158.20
4566	hydrazine HCl (β)	.....	$C_{10}H_7 \cdot NH \cdot NH_2 \cdot HCl$	XV-568	194.66
4567	hydroxylamine (α)	.....	$C_{10}H_7 \cdot NHOH$	XV-32	159.18
4568	salicylate (α)	alphol	$HOC_6H_4CO_2C_{10}H_7$	X-80	264.27
4569	salicylate (β)	betol	$HOC_6H_4CO_2C_{10}H_7$	X-80	264.27
4570	***iso*-thiocyanate (α)**	.....	$C_{10}H_7 \cdot N:CS$	XII-1244	185.23
4571	**Naphthylene** diamine (1,2)	diamino-naphthalene	$C_{10}H_6(NH_2)_2$	XIII-196	158.20
4572	diamine (1,4)	.....	$C_{10}H_6(NH_2)_2$	XIII-201	158.20
4573	diamine (1,5)	.....	$C_{10}H_6(NH_2)_2$	XIII-203	158.20
4574	diamine (1,6)	.....	$C_{10}H_6(NH_2)_2$	XIII-204	158.20
4575	diamine (1,7)	.....	$C_{10}H_6(NH_2)_2$	XIII-205	158.20
4576	diamine (1,8)	.....	$C_{10}H_6(NH_2)_2$	XIII-205	158.20
4577	diamine (2,3)	.....	$C_{10}H_6(NH_2)_2$	XIII-207	158.20
4578	diamine (2,6)	.....	$C_{10}H_6(NH_2)_2$	XIII-208	158.20
4579	diamine (2,7)	.....	$C_{10}H_6(NH_2)_2$	XIII-208	158.20
4580	**Neo**-dorm(e)	α-*iso*-Pr-α-Br-butyramide	$(CH_3)_2CH \cdot C(C_2H_5) \cdot (Br)CONH_2$	.....	208.11
4581	oupfer(r)on	α-naphthyl-nitroso-hydroxylamine NH_4	$C_{10}H_7N(NO)ONH_4$	*XVI-396	205.21
4582	synephrine HCl	α-OH-β-methyl-aminoethyl-3-OH benzene HCl	$HO \cdot C_6H_4 \cdot CHOH \cdot CH_2 \cdot NHCH_3 \cdot HCl$	.....	203.67
4583	**Nembutal**	pentobarbital Na	$C_2H_5 \cdot C_4HN_2O_3Na \cdot CH(CH_3) \cdot C_3H_7$	.....	248.26
4584	**Neurine**	trimethyl vinyl ammonium hydroxide	$CH_2:CH \cdot N(CH_3)_3 \cdot OH$	IV-203	103.16
4585	**Neutral red**	toluylene red	$C_{15}H_{16}N_4 \cdot HCl$	XXV-401	288.78
4586	**Nitranilic acid**	3,6-diNO_2-2,5-diOH-quinone	$(NO_2)_2C_6(OH)_2O_2 \cdot aq.$	VIII-384	230.09
4587	**Nitro**-acenaphthene	(5-nitro)	$(NO_2)C_{10}H_5:(CH_2)_2$	V-588	199.20
4588	acetanilide (o)	.....	$NO_2 \cdot C_6H_4 \cdot NHCOCH_3$	XII-691	180.16
4589	acetanilide (m)	.....	$NO_2 \cdot C_6H_4 \cdot NHCOCH_3$	XII-703	180.16
4590	acetanilide (p)	.....	$NO_2 \cdot C_6H_4 \cdot NHCOCH_3$	XII-719	180.16
4591	*p*-acetanisidide (3)	(3;1,4)	$NO_2 \cdot C_6H_3(OCH_3) \cdot NHCOCH_3$	XIII-522	210.19
4592	acetic acid	.....	$NO_2 \cdot CH_2 \cdot CO_2H$	II-225	105.05
4593	2-acetnaphthalide (1)	1-NO_2-2-acetyl-naphthylamine	$NO_2 \cdot C_{10}H_6 \cdot NHCOCH_3$	XII-1313	230.22
4594	acetophenone (ω)	benzoyl-nitro-methane	$C_6H_5 \cdot CO \cdot CH_2 \cdot NO_2$	VII-289	165.14
4595	acetophenone (m)	.....	$NO_2 \cdot C_6H_4 \cdot CO \cdot CH_3$	VII-288	165.14
4596	*p*-acetphenetidide	(3;1,4)	$NO_2 \cdot C_6H_3(OC_2H_5) \cdot NHCOCH_3$	XIII-522	224.21
4597	acet-*p*-toluidide	3-NO_2-4-acetyl-aminotoluene	$NO_2 \cdot C_6H_3(CH_3) \cdot NHCOCH_3$	XII-1002	194.19
4598	4-acetylamino-phenylacetate	(3;4,1)	$NO_2 \cdot C_6H_3(NHCO \cdot CH_3) \cdot O_2CCH_3$	.....	238.20
4599	alizarin (3)(β)	alizarin orange	$(HO)_2C_{14}H_5O_2 \cdot NO_2$	VIII-447	285.20
4600	alizarin (4)(α)	.....	$(HO)_2C_{14}H_5O_2 \cdot NO_2$	VIII-447	285.20

Neosalvarsan 5593
Neothesin 764
Neotropin 1709
Nepaline, cf. alkd.
Nerline, cf. alkd.
Nerol 1724 or 2516
Neroli, artificial 4108
Nerolin 4312
Neroline 3094
Neuronal 2131
Neville Winther acid 4502
Niamid 5488
Niazo 1709
Nicotinamide 5493
Nicotinamide flavionate 5494
Nicotinamide picrate 5495
Nicotine, cf. alkd.
Nicotinic acid 5488, 5496
Nicotinic flavionate 5491
Nicotinic picrate 5492

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4564	pl./HCl	.....	.....	.....	s. c.	.....	.....
4565	col. lf./aq.	.....	124-5	.....	sl. s. h.	s. h.	sl. s.
4566	nd./aq.	.....	.....	.....	s. h.	.....	.....
4567	cr./aq.	.....	79	.....	s.	s.	s.
4568	col. cr.	.....	83	.....	i.; s. oil	s.	s.
4569	col. cr./al.	.....	95	.....	i.	s. h.	s.; s. bz.
4570	nd./al.	.....	58	.....	i.	s. h.	s.
4571	lf./aq.	.....	96-8	150-1$^{0.5mm}$	sl. s. h.	s.	s.
4572	pr./h. aq.	.....	120	.....	sl. s. h.	v. s.	v. s.
4573	pr./et.	.....	189.5	.....	s. h.	s. h.	s.
4574	nd./aq.	$1.147^{\frac{99}{4}.4^{\circ}}$	77.5	.....	s. h.	s. h.	s. h.
4575	nd./aq.	.....	117.5	.....	sl. s.	s.	v. sl. s.
4576	cr./aq. al.	$1.127^{\frac{99}{4}.4^{\circ}}$	66.5	205^{12mm}	sl. s. h.	∞	∞
4577	lf./et.	.....	191-3	.....	.....	s.	s.
4578	nd./aq.	.....	216-8	.....	v. sl. s. h.	sl. s.	sl. s.
4579	lf./aq.	.....	159	.....	.....	.....	.....
4580	col. cr.	.....	50-1	subl.	0.7 c.; d. h.	s.; s. pet.	s.; s. bz.
4581	lf./al. NH_3	.....	125-6	.....	s.	s. Me al.	i.
4582	col. cr.	.....	139-41	.....	s.	s.	.....
4583	wh. cr. pd.	.....	.....	.....	s.	s.	i.
4584	syrup, poison.	.....	.....	.....	s.	d. aq. NH_4Cl	.....
4585	gn. pd.	.....	.....	.....	d., −HCl	s.	.....
4586	yel. pl.	.....	$-H_2O$, 100	expl. 170	v. s.	v. s.	i.
4587	yel. nd./lg.	.....	101-2	.....	s. h.	s.	s.
4588	yel. mn.	$1.419^{15^{\circ}}$	93-4	.....	s. h.; s. chl.	s.; v. s. 10% KOH	s.
4589	col. lf.	.....	154	.....	sl. s. h.	s.	i.; s. chl.
4590	rhb.	.....	215-6	.....	s. h.	s.; s. KOH	s.
4591	yel. nd./al.	.....	117-8	.....	s. h.	s.; s. bz.	s.; s. ac.
4592	nd./chl.	.....	87-9 d.	.....	d.	v. s.	v. s.; i. pet.
4593	yel. rhb. nd./al.	.....	123.5	.....	sl. s. h.; v. sl. s. lg.	s.; s. bz.; s. ac.	v. sl. s.
4594	lf./aq. al.	.....	106-8	.....	i. c.	v. s.	v. s.
4595	nd.	.....	80-1	202	.....	s.	.....
4596	yel. nd./aq.	.....	103-4	.....	.....	s. abs.	s.; s. chl.
4597	yel. nd./ pet.	.....	96; softens 94	.....	sl. s. h.	s.	.....
4598	yel. pr./ aq. al.	.....	147-8	.....	.....	.....	.....
4599	yel. lf./al.	.....	244 d.	subl. sl. d.	sl. s.	s. chl., bz.	s. aq. alk.
4600	yel. nd./al.	.....	289 d.	.....	v. sl. s.; s. H_2SO_4	s. chl., bz.	s. aq. alk.

Nicotyrine 2809
Ninhydrin 6239
Niobe oil 4138
Nioform 1392
Nipagin 4274
Nipasol 5415
Nirvanol 3126
Nitramine 5873
Nitramino-methane 4314
Nitraniline 4618-20
Nitric ether 3096
Nitrilo-malonic acid 1583
Nitro-acetamino-dimethylbenzene 4871
Nitro-acetylamino-anisole 4591
Nitro-acetylamino-phenetole 4596

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Nitro				
4601	2-aminoanisole (4)	(4;1,2)	$NO_2 \cdot C_6H_3(OCH_3)NH_2$	XIII-389	168.15
4602	2-aminoanisole (5)	5-nitro-*o*-anisidine	$NO_2 \cdot C_6H_3(OCH_3)NH_2$	XIII-390	168.15
4603	4-aminoanisole (3)	(3;1,4)	$NO_2 \cdot C_6H_3(OCH_3)NH_2$	XIII-521	168.15
4604	*o*-aminobenzoic acid (3)	(3;1,2) nitro-anthranilic acid	$NO_2 \cdot C_6H_3(CO_2H) \cdot NH_2$	XIV-373	182.13
4605	*o*-aminobenzoic acid (4)	(4;1,2)	$NO_2 \cdot C_6H_3(CO_2H) \cdot NH_2$	XIV-374	182.13
4606	*o*-aminobenzoic acid (5)	(5;1,2)	$NO_2 \cdot C_6H_3(CO_2H) \cdot NH_2$	XIV-375	182.13
4607	*o*-aminobenzoic acid (6)	(6;1,2)	$NO_2 \cdot C_6H_3(CO_2H) \cdot NH_2$	XIV-378	182.13
4608	*m*-aminobenzoic acid (5)	(5;1,3)	$NO_2 \cdot C_6H_3(CO_2H) \cdot NH_2$	XIV-415	182.13
4609	*p*-aminobenzoic acid (2)	(2;1,4)	$NO_2 \cdot C_6H_3(CO_2H) \cdot NH_2$	XIV-439	182.13
4610	*o*-aminophenol (3)	(3;2,1)	$NO_2 \cdot C_6H_3(NH_2)OH$	.....	154.12
4611	*o*-aminophenol (4)	(4;2,1)	$NO_2 \cdot C_6H_3(NH_2)OH$	XIII-388	154.12
4612	*o*-aminophenol (5)	(5;2,1)	$NO_2 \cdot C_6H_3(NH_2)OH$	XIII-390	154.12
4613	*o*-aminophenol (6)	(6;2,1)	$NO_2 \cdot C_6H_3(NH_2)OH$	XIII-391	154.12
4614	*m*-aminophenol (5)	(5;3,1)	$NO_2 \cdot C_6H_3(NH_2)OH$	XIII-422	154.12
4615	*p*-aminophenol (2)	(2;4,1)	$NO_2 \cdot C_6H_3(NH_2)OH$	XIII-520	154.12
4616	*p*-aminophenol (3)	(3;4,1)	$NO_2 \cdot C_6H_3(NH_2)OH$	XIII-521	154.12
4618	aniline (*o*)	*o*-nitraniline	$NO_2 \cdot C_6H_4 \cdot NH_2$	XII-687	138.12
4619	aniline (*m*)	*m*-nitraniline	$NO_2 \cdot C_6H_4 \cdot NH_2$	XII-698	138.12
4620	aniline (*p*)	*p*-nitraniline	$NO_2 \cdot C_6H_4 \cdot NH_2$	XII-711	138.12
4621	aniline-4-sulfonic acid (2)	nitrosulfanilic acid	$NO_2 \cdot C_6H_3(NH_2)SO_3H$	XIV-708	218.18
4622	aniline-2-sulfonic acid (4)	(4;1,2)	$NO_2 \cdot C_6H_3(NH_2)SO_3H$	XIV-686	218.18
4623	anisole (*o*)	.....	$CH_3O \cdot C_6H_4 \cdot NO_2$	VI-217	153.13
4624	anisole (*m*)	.....	$CH_3O \cdot C_6H_4 \cdot NO_2$	VI-224	153.13
4625	anisole (*p*)	.....	$CH_3O \cdot C_6H_4 \cdot NO_2$	VI-230	153.13
4626	anthracene (9)	nitrosoanthron	$C_{14}H_9 \cdot NO_2$	V-666	223.22
4627	anthraquinone (1)	.....	$C_6H_4(CO)_2C_6H_3 \cdot NO_2$	VII-791	253.20
4628	anthraquinone (2)	.....	$O_2C_{14}H_7 \cdot NO_2$	VII-792	253.20
4629	anthraquinone-2-carbonyl chloride	(1-NO_2)	$O_2C_{14}H_6(NO_2)COCl$	.....	315.66
4630	anthraquinone-5-sulfonic acid (1)	(1-NO_2)	$O_2C_{14}H_6(NO_2)SO_3H$	XI-336	333.26
4631	anthraquinone-8-sulfonic acid (1)	(1-NO_2)	$O_2C_{14}H_6(NO_2)SO_3H$	XI-337	333.26
4632	barbituric acid (5)	dilituric acid	$NO_2 \cdot C_4H_3O_3N_2 \cdot 3H_2O$	XXIV-474	227.14
4633	benzalacetophenone	(1,3)	$NO_2 \cdot C_6H_4 \cdot CH{:}CH \cdot CO \cdot C_6H_5$	VII-482	253.25
4634	benzal bromide (*p*)	.....	$NO_2 \cdot C_6H_4 \cdot CH{:}Br_2$	V-336	294.95
4635	benzal chloride (*m*)	.....	$NO_2 \cdot C_6H_4 \cdot CH{:}Cl_2$	V-332	206.03
4636	benzal chloride (*p*)	.....	$NO_2 \cdot C_6H_4 \cdot CH{:}Cl_2$	V-332	206.03

Nitro-acetylamino-toluene 4597
Nitro-acetylnaphthylamine 4593
Nitro-allyl 4829
Nitro-aminophenetole 4795
Nitro-aminotoluene 4849-58
Nitro-amylene glycol 4789
Nitro-anisidine 4602
Nitro-anthranilic acid 4604-7
Nitro base 4883

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4601	red nd./al.	$1.207^{15°}$	118	.....	s. h. bz.	s.; s. ac.	v. sl. s. lg.
4602	pa. yel. nd.	$1.211^{15°}$	139-40	.....	.....	.....	.....
4603	red/aq. al.	.....	123	.....	sl. s.	s.	s.
4604	yel. mn.	$1.558^{15°}$	204/	.....	i.	v. s.	v. s.
4605	yel. red nd.	.....	269.5	.....	v. sl. s. h.	s. xylene	.....
4606	lt. yel. nd.	.....	270-80 d.	.....	s. h.	s.	s.
4607	yel. lf./aq.	.....	183-4 d.	.....	s. h.	v. s.	v. s.
4608	yel. pr./aq.	.....	208	.....	sl. s.	s. h.	sl. s.; v. s. h. ac.
4609	red nd./ aq.	.....	240	.....	s. h.	v. s.	v. s. ac.
4610	cr.	.....	136	.....	.....	.....	.....
4611	or. pr.	.....	142-3	.....	sl. s. c.	v. s.	v. s.
4612	brn.nd./aq.	.....	201-2	.....	.....	s. h.	.....
4613	red nd./ aq. al.	.....	110-1	.....	v. sl. s. c.	s.; v. s. chl.	v. s.; v. s. bz.
4614	yel. cr.	.....	165	.....	v. sl. s. bz., chl.	v. s.	v. s.
4615	red nd./al.	.....	128-31	.....	.....	.....	.....
4616	red pr./et. al.	.....	154	.....	s.	s.	s.
4618	yel. rhb.	$1.442^{15°}$	71.5	.....	s. h.	v. s.	v. s.
4619	yel. rhb.	1.43	114	>285	$0.11^{20°}$	$7.1^{20°}$	$7.9^{20°}$
4620	yel. mn.	$1.437^{14°}$	146-7	.....	$0.08^{18.5°}$; 2.2 h.	$5.8^{20°}$	$6.1^{20°}$
4621	yel. nd.	.....	.....	.....	v. s.; s. aq. H_2SO_4	sl. s.	s. conc. HCl
4622	yel. cr.	.....	.....	.....	.....	.....	.....
4623	col. cr.	$1.254^{20°}_{4°}$	9.4	272-3	i.	∞	∞
4624	nd./al.	$1.373^{18°}$	38	258	i.	s.	.....
4625	pr./al.	$1.233^{20°}$	54	274	v. sl. s.	v. s.	v. s.
4626	yel. nd./al.	.....	146	>360	i. aq. alk.	sl. s.	v. s. bz.
4627	nd./ac.	.....	230	subl.	i.	sl. s.	v. sl. s.
4628	yel. nd./al.	.....	184.5-5.0	$270\text{-}17^{mm}$	s. H_2SO_4	v. sl. s. c.	sl. s.; v. s. chl.
4629	tan flakes	.....	230 d.	.....	i.	i.	i.
4630	yel. cr./aq.	.....	.....	.....	s.	i.	i.
4631	yel. cr./aq.	.....	.....	.....	sl. s.	i.	i.
4632	pr./aq.	.....	176 d. (anh.)	.....	$0.09^{25°}$	s.; s. alk.	i.
4633	yel. nd./ al. or bz.	.....	144-5	.....	i. lg.; v. s. bz.	s.; s. chl.	i.; s. ac.
4634	nd./al.	.....	82.0-2.5	.....	i.	s.	s.
4635	mn.	.....	65	.....	i.	v. s. h.	v. s.
4636	pr./al.	.....	46	.....	i.	v. s.	v. s.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4637	**Nitro** benzaldehyde (*o*)	.....	$NO_2 \cdot C_6H_4 \cdot CH:O$	VII-243	151.12
4638	benzaldehyde phenylhydrazone (*o*)	.....	$NO_2 \cdot C_6H_4 \cdot CH:N \cdot NH \cdot C_6H_5$	XV-136	241.24
4639	benzaldehyde (*m*)	.....	$NO_2 \cdot C_6H_4 \cdot CH:O$	VII-250	151.12
4640	benzaldehyde (*p*)	.....	$NO_2 \cdot C_6H_4 \cdot CH:O$	VII-256	151.12
4641	benzalfurfural-acetone (*m*)	.....	$NO_2 \cdot C_6H_4 \cdot CH:CH \cdot CO \cdot CH:CH \cdot C_4H_3O$	.....	269.25
4642	benzamide (*o*)	.....	$NO_2 \cdot C_6H_4 \cdot CO \cdot NH_2$	IX-373	166.13
4643	benzamide (*m*)	.....	$NO_2 \cdot C_6H_4 \cdot CO \cdot NH_2$	IX-381	166.13
4644	benzamide (*p*)	.....	$NO_2 \cdot C_6H_4 \cdot CO \cdot NH_2$	IX-394	166.13
4645	benzanilide (*m*)	.....	$NO_2C_6H_4CONHC_6H_5$	XII-267	242.23
4646	benzene	oil of mirbane	$C_6H_5 \cdot NO_2$	V-233	123.11
4647	benzeneazo-chromotropic Na salt	*p*-nitrobenzeneazo-1,8-di*OH*-naphthalene-3,6-disulfonic Na	$NO_2 \cdot C_6H_4 \cdot N:N \cdot C_{10}H_3(OH)_2(SO_3Na)_2$	.....	513.37
4648	benzeneazo-α-naphthol (*p*)	.....	$NO_2 \cdot C_6H_4 \cdot N:N \cdot C_{10}H_6(OH)$	XVI-151	293.27
4649	benzeneazo-orcinol (*p*)	(4′;4,6,2)	$NO_2 \cdot C_6H_4 \cdot N:N \cdot C_6H_2(OH)_2CH_3$	.....	273.24
4650	benzeneazo-resorcinol (*m*)	(3′;2,4)	$NO_2 \cdot C_6H_4 \cdot N:N \cdot C_6H_3(OH)_2$	.....	259.22
4651	benzeneazo-resorcinol (*p*)	(4′;2,4)	$NO_2 \cdot C_6H_4 \cdot N:N \cdot C_6H_3(OH)_2$	XVI-181	259.22
4652	benzeneazo-salicylic acid (*p*)	(4′;4,3)	$NO_2 \cdot C_6H_4 \cdot N:N \cdot C_6H_3(OH)CO_2H$	XVI-247	287.23
4653	benzeneazo-salicylic Na (*p*)	alizarin yellow R	$C_{13}H_8O_5N_3Na$	.....	309.22
4654	benzene sulfonic acid (*o*)	.....	$NO_2 \cdot C_6H_4 \cdot SO_3H$	XI-67	203.17
4655	benzene sulfonic acid (*m*)	.....	$NO_2 \cdot C_6H_4 \cdot SO_3H$	XI-68	203.17
4656	benzene sulfonic Na	(*m*)	$NO_2 \cdot C_6H_4 \cdot SO_3Na$	XI-68	225.16
4657	benzene sulfonic chloride (*m*)	.....	$NO_2 \cdot C_6H_4 \cdot SO_2Cl$	XI-69	221.62
4658	benzhydrazide (*o*)	.....	$NO_2 \cdot C_6H_4CO \cdot NH \cdot NH_2$	IX-375	181.15
4659	benzhydrazide (*m*)	.....	$NO_2 \cdot C_6H_4CO \cdot NH \cdot NH_2$	IX-388	181.15
4660	benzhydrazide (*p*)	.....	$NO_2 \cdot C_6H_4CO \cdot NH \cdot NH_2$	IX-399	181.15
4661	benzidine (2)	.....	$NO_2(NH_2)C_6H_3 \cdot C_6H_4 \cdot NH_2$	XIII-235	229.23
4662	benzimidazole (6)	.....	$HN \cdot CH:N \cdot C_6H_3 \cdot NO_2$	XXIII-135	163.13
4663	benzoic acid (*o*)	.....	$NO_2 \cdot C_6H_4 \cdot CO_2H$	IX-370	167.12
4664	benzoic acid (*m*)	.....	$NO_2 \cdot C_6H_4 \cdot CO_2H$	IX-376	167.12
4665	benzoic Na (*m*)	.....	$C_7H_4O_4NNa \cdot 3H_2O$	IX-377	243.16
4666	benzoic acid (*p*)	.....	$NO_2 \cdot C_6H_4 \cdot CO_2H$	IX 389	167.12
4667	benzonitrile (*o*)	.....	$NO_2 \cdot C_6H_4 \cdot CN$	IX-374	148.12
4668	benzonitrile (*m*)	.....	$NO_2 \cdot C_6H_4 \cdot CN$	IX-385	148.12

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4637	yel. nd./ aq.	.....	40.9 (37.9)	153^{23mm}	v. sl. s.	v. s.	v. s.; s. bz.
4638	red nd.	.....	154-5	.....	v. s. act.; i. lg.	sl. s.	sl. s.
4639	nd./aq.	.....	58	164^{23mm}	sl. s. h.	v. s. h.	s.; s. chl.
4640	pr./aq.	.....	106.5	.....	v. sl. s.	v. s.	sl. s.
4641	yel. pd.	.....	120-4	.....	i.	sl. s. h.	i.
4642	nd./aq. al.	$1.462^{\frac{3}{4}2^\circ}$	176.6	317	s. h.	s. h.	s.
4643	yel. mn./ aq.	.....	142-3	310-5	v. sl. s.	s.	s.
4644	nd./aq.	.....	200-1.4	.....	sl. s.	s.	s.
4645	lf./al.	.....	153-4	subl.	sl. s.	s.	s.; s. bz.
4646	lt. yel. lq.	$1.205^{\frac{1}{4}8^\circ}$	5.6-5.7	210.9	0.2	v. s.	∞ ; ∞ bz.
4647	red brn. pd.	.....	.....	.....	s.	i.	.....
4648	red gn. nd.	.....	234-5	d. 255-60	s. am. al.; v. sl. s. chl.	v. sl. s.; s. xylene	v. sl. s.; v. sl. s. bz.
4649	dark red pd.	.....	210-2 d.	.....	i.	s.	sl. s.
4650	brn. pd.	.....	174-5 d.	.....	i.	s.	sl. s.
4651	red pd./ Me al.	.....	199-200	.....	s. alk.; v. sl. s. ac.	v. sl. s. h.	v. sl. s. toluene
4652	or. brn. nd./aq. ac.	.....	254-7 d.	.....	s. ac.	s.	sl. s. h. toluene
4653	brn. yel. pd.	.....	.....	.....	s.	.....	.....
4654	hyg. lf.	.....	70	d.	v. s.	s.; s. alk.	i.
4655	hyg. lf.	.....	.....	.....	.....	s. h.	.....
4656	pl./aq.	.....	.....	.....	v. s.	.....	.....
4657	mn. pr./ et.; nd./lg.	.....	63-4	.....	i.; d. h.	s. h.	.....
4658	yel. brn./ aq.	.....	120-1	.....	s.	s.; i. chl.	i.; i. bz.
4659	nd./aq.	.....	152	.....	sl. s.	sl. s.	i.; i. bz.
4660	yel. nd./aq.	.....	210	.....	v. sl. s.	v. sl. s.	i.; i. bz.
4661	red nd./aq.	.....	143(117)	.....	sl. s. h.	.....	.....
4662	nd./aq.	.....	204	.....	sl. s.; s. alk. carb.	s.; s. a.; sl. s. chl.	sl. s.; sl. s. bz.
4663	tri./aq.	1.575	147.5	.....	0.65^{20°	28^{11°, 90%	22^{11°
4664	mn.	1.494	140-1	.....	$0.24^{16.5^\circ}$	$31^{11.7^\circ}$	$25^{10.2^\circ}$
4665	mn.	.....	.....	.....	s. h.	.....	.....
4666	pa. yel. mn.	$1.550^{\frac{3}{4}2^\circ}$	240-2	subl.	0.02^{15°	0.9^{10°, 90%	$2.2^{12.5^\circ}$
4667	nd./aq.	.....	109-10	.....	s. h.	s.	s. ac.
4668	nd./aq.	.....	117-8	subl.	s. h.	s.	v. s.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4669	**Nitro** benzonitrile (*p*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CN$	IX-397	148.12
4670	benzophenone (*o*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CO{\cdot}C_6H_5$	VII-425	227.21
4671	benzophenone (*m*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CO{\cdot}C_6H_5$	VII-425	227.21
4672	benzophenone (*p*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CO{\cdot}C_6H_5$	VII-426	227.21
4673	benzoyl chloride (*o*)	.....	$NO_2{\cdot}C_6H_4{\cdot}COCl$	IX-373	185.57
4674	benzoylchloride(*m*)	.....	$NO_2{\cdot}C_6H_4{\cdot}COCl$	IX-381	185.57
4675	benzoyl chloride (*p*)	.....	$NO_2{\cdot}C_6H_4{\cdot}COCl$	IX-394	185.57
4676	benzoyl formic acid (*o*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CO{\cdot}CO_2H{\cdot}$ aq.	X-664	195.13
4677	benzyl acetate (*p*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH_2{\cdot}O_2C{\cdot}CH_3$	VI-451	195.17
4678	benzyl alcohol (*o*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH_2OH$	VI-447	153.13
4679	benzyl alcohol (*m*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH_2OH$	VI-449	153.13
4680	benzyl alcohol (*p*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH_2OH$	VI-450	153.13
4681	benzyl bromide (*p*)	ω-Br-*p*-nitrotoluene	$NO_2{\cdot}C_6H_4{\cdot}CH_2Br$	V-334	216.04
4682	benzyl chloride (*o*)	ω-Cl-*o*-nitrotoluene	$NO_2{\cdot}C_6H_4{\cdot}CH_2Cl$	V-327	171.58
4683	benzyl chloride (*m*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH_2Cl$	V-329	171.58
4684	benzyl chloride (*p*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH_2Cl$	V-329	171.58
4685	benzyl cyanide (*o*)	nitro-α-toluic nitrile	$NO_2{\cdot}C_6H_4{\cdot}CH_2{\cdot}CN$	IX-455	162.14
4686	benzyl cyanide (*m*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH_2{\cdot}CN$	IX-455	162.14
4687	benzyl cyanide (*p*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH_2{\cdot}CN$	IX-456	162.14
4688	bromoform	bromopicrin	$NO_2{\cdot}CBr_3$	I-77	297.77
4689	butandiol	2-nitro-2-methyl-1, 3-propandiol	$CH_3{\cdot}C{\cdot}NO_2{:}$ $(CH_2OH)_2$	I-480	135.12
4690	butane (1)	1-nitrobutane	$C_2H_5{\cdot}CH_2{\cdot}CH_2{\cdot}NO_2$	I-123	103.12
4691	butane (2)	2-nitrobutane	$C_2H_5{\cdot}CHNO_2{\cdot}CH_3$	I-123	103.12
4692	butane (α)(*iso*)	1-nitro-2-Me-propane	$(CH_3)_2CH{\cdot}CH_2{\cdot}NO_2$	I-129	103.12
4693	butane (*tert*)	2-nitro-2-Me-propane	$(CH_3)_3C{\cdot}NO_2$	I-129	103.12
4694	1-butanol (2)	β-NO_2-butyl alcohol	$C_2H_5{\cdot}CHNO_2{\cdot}CH_2OH$	I-370	119.12
4695	butanol	2NO_2-2-Me-propanol	$(CH_3)_2CNO_2{\cdot}CH_2OH$	I-378	119.12
4696	camphor (α)(3)	.....	$C_8H_{14}{\cdot}CO{\cdot}CH{\cdot}NO_2$ |_____|	VII-129	197.23
4697	chloroform	chloropicrin	$NO_2{\cdot}CCl_3$	I-76	164.39
4698	chlorophenol	(1;2,4)	$HO{\cdot}C_6H_3(Cl){\cdot}NO_2$	VI-240	173.56
4699	chlorophenol	(1;2,3)	$HO{\cdot}C_6H_3(Cl){\cdot}NO_2$	VI-239	173.56
4700	chlorophenol	(1;3,4)	$HO{\cdot}C_6H_3(Cl){\cdot}NO_2$	VI-240	173.56
4701	chlorophenol	(1;4,2)	$HO{\cdot}C_6H_3(Cl){\cdot}NO_2$	VI-238	173.56
4702	chlorophenol	(1;4,3)	$HO{\cdot}C_6H_3(Cl){\cdot}NO_2$	VI-239	173.56
4703	chlorophenol	(1;5,2)	$HO{\cdot}C_6H_3(Cl){\cdot}NO_2$	VI-238	173.56
4704	chlorophenol	(1;5,3)	$HO{\cdot}C_6H_3(Cl){\cdot}NO_2$	VI-239	173.56
4705	chlorophenol	(1;6,2)	$HO{\cdot}C_6H_3(Cl){\cdot}NO_2$	VI-239	173.56
4706	chlorophenol	(1;6,3)	$HO{\cdot}C_6H_3(Cl){\cdot}NO_2$	VI-240	173.56
4707	cinnamic acid (*o*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH{:}CH{\cdot}CO_2H$	IX-604	193.15
4708	cinnamic acid (*m*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH{:}CH{\cdot}CO_2H$	IX-605	193.15
4709	cinnamic acid (*p*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CH{:}CH{\cdot}CO_2H$	IX-606	193.15
4710	*p*-cresol (2)	3-NO_2-4-OH-toluene	$NO_2{\cdot}C_6H_3(CH_3)OH$	VI-412	153.13

Nitro-benzoylhydrazine 4658-60
Nitro-benzylidene bromide 4634
Nitro-benzylidene chloride 4635-6
Nitro-bromobenzene 960-2
Nitro-bromobenzoic acid 964
Nitro-butyl alcohol 4694-5
Nitro-carb(in)ol 4765

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4669	yel. lf./al.	.....	147-9	.....	sl. s.	s. h.	s. ac.
4670	mn./al.	.....	105	.....	.....	sl. s. abs.	.....
4671	nd./al.	.....	94-5	234^{18mm}	.....	s. h.	.....
4672	lf./abs. al.	.....	138	.....	v. sl. s.	s. h.	sl. s. CS_2
4673	col. cr.	.....	75(20)	205^{105mm}	d.	d.	s.
4674	cr.	.....	34-5	275-8 sl. d.	d.	d.	v. s.
4675	nd./lg.	.....	72	154^{15mm}	d.	d.	s.
4676	pr./aq.	.....	46-7; 122 d. (anh.)	.....	∞ h.	.....	.....
4677	yel. nd./al.	.....	78	.....	.....	s. h.	.....
4678	nd./aq.	.....	74	270 sl. d.	sl. s.	v. s.	v. s.
4679	cr.	.....	27	$175\text{-}80^{3mm}$	.....	.....	.....
4680	nd./aq.	.....	93	185^{12mm}	s. h.	v. s.	v. s.
4681	nd./al.	.....	99-100	.....	i.	$2^{19°}$	v. s.
4682	cr.	.....	48-9	.....	i.	v. s. h.	v. s. h.
4683	yel. nd.	.....	45-7	$173\text{-}83^{30mm}$	i.	v. s.	v. s.
4684	nd./al.	.....	71	.....	i.	v. s. h.	s.
4685	nd./aq.	.....	84	.....	v. s. h.	s.	s.
4686	cr.	.....	61-2	.....	v. sl. s.	s.	s.
4687	lf./al.	.....	116-7	.....	i.	s.	.....
4688	pr.	$2.811^{12.5°}$	10.3	$*127^{118mm}$	i.	s.	s.
4689	mn. cr.	.....	147-9	d.	$80^{20°}$	$45^{20°}$	$4^{20°}$
4690	lq.	.....	.....	151-2	.....	.....	.....
4691	lq.	$0.988^{0°}$	.....	$138\text{-}9^{747mm}$	.....	.....	.....
4692	col. lq.	$0.9877^{0°}$	.....	$158\text{-}9^{755mm}$	i.	s.	s.
4693	cr.	.....	24	126^{748mm}	i. alk.	∞	∞ ; ∞ bz.
4694	lq.	$1.134^{20°}_{20°}$	−47	105^{10mm}	$20^{20°}$	$\infty^{20°}$	$\infty^{20°}$
4695	cr./Me al.	.....	90.5	95.5^{10mm}	$350^{20°}$	$490^{20°}$	$120^{20°}$
4696	mn./bz.	.....	102-3	.....	i.	s.	s.; v. s. bz.
4697	lq.	$1.651^{22.8°}_{4°}$	−64	112.3^{766mm}	$0.17^{18°}$	37 cc., 80% al.	s.
4698	col. nd./aq.	.....	111	.....	v. s. chl.	v. s.	v. s.
4699	cr./aq.	.....	120	.....	.....	.....	.....
4700	nd./bz.	.....	133	.....	.....	.....	.....
4701	yel. mn.	.....	87	.....	v. sl. s.	s.	v. s.
4702	nd./aq.	.....	126-7	.....	.....	.....	.....
4703	yel. pr./aq.	.....	38.9 (32.7)	.....	sl. s.	s.	s.; s. ac.
4704	cr.	.....	147	.....	.....	.....	.....
4705	yel. nd./aq.	.....	70-1	.....	v. sl. s.	v. s. chl.	.....
4706	nd./aq.	.....	118-9	.....	.....	.....	.....
4707	nd./al.	.....	243-5	subl.	i.	$0.2^{25°}$ abs.	.....
4708	col./al.	.....	200-1	.....	.....	$1^{25°}$ abs.	.....
4709	lt. yel./al.	.....	286-8	.....	v. sl. s. h.	$0.01^{25°}$	v. sl. s.; i. CS_2
4710	yel./aq. al.	$1.240^{3.8°}_{4°}$	32	125^{22mm}	v. sl. s.	v. s.	v. s.

* Explosive.

Nitro-chalcone 4633
Nitro-chloroaniline 1407-11
Nitro-chlorobenzene 1412-4
Nitro-chlorobenzene sulfonic acid 1415
Nitro-chloroethane 1416-7
Nitro-chloronaphthalene 1418-9
Nitro-chloropropane 1420-1

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Nitro				
4711	cumene (*o* and *p*)	.....	$NO_2 \cdot C_6H_4 \cdot CH(CH_3)_2$	.....	165.19
4712	cumene, pseudo-	(5;1,2,4)	$NO_2 \cdot C_6H_2(CH_3)_3$	V-404	165.19
4713	cumene, pseudo-	(6;1,2,4)	$NO_2 \cdot C_6H_2(CH_3)_3$	V-404	165.19
4714	*p*-cymene (2;1,4)	2-nitrocymene	$NO_2 \cdot C_6H_3(CH_3) \cdot C_3H_7$	V-424	179.21
4715	decane	1-nitro-2,7-dimethyl-octane	$(CH_3)_2CH(CH_2)_4 \cdot CH(CH_3)CH_2NO_2$	I-169	187.28
4716	decane	2-nitro-2,7-dimethyl-octane	$(CH_3)_2C(NO_2)(CH_2)_4 \cdot CH(CH_3)_2$	I-169	187.28
4717	diethylaniline (*o*)	.....	$NO_2 \cdot C_6H_4 \cdot N(C_2H_5)_2$	.....	194.23
4718	diethylaniline (*m*)	.....	$NO_2 \cdot C_6H_4 \cdot N(C_2H_5)_2$	XII-702	194.23
4719	diethylaniline (*p*)	.....	$NO_2 \cdot C_6H_4 \cdot N(C_2H_5)_2$	XII-715	194.23
4720	dimethylaniline (*o*)	.....	$NO_2 \cdot C_6H_4 \cdot N(CH_3)_2$	XII-690	166.18
4721	dimethylaniline (*m*)	.....	$NO_2 \cdot C_6H_4 \cdot N(CH_3)_2$	XII-701	166.18
4722	dimethylaniline (*p*)	.....	$NO_2 \cdot C_6H_4 \cdot N(CH_3)_2$	XII-714	166.18
4723	diphenyl (2)	.....	$C_6H_5 \cdot C_6H_4 \cdot NO_2$	V-582	199.20
4724	diphenyl (3)	.....	$C_6H_5 \cdot C_6H_4 \cdot NO_2$	V-582	199.20
4725	diphenyl (4)	.....	$C_6H_5 \cdot C_6H_4 \cdot NO_2$	V-583	199.20
4726	diphenylamine (*o*)	.....	$C_6H_5 \cdot NH \cdot C_6H_4 \cdot NO_2$	XII-690	214.22
4727	diphenylamine (*p*)	.....	$C_6H_5 \cdot NH \cdot C_6H_4 \cdot NO_2$	XII-715	214.22
4728	diphenylamine-2-sulfonic acid (4)	.....	$C_6H_5 \cdot NH \cdot C_6H_3(NO_2) \cdot SO_3H$	XIV-686	294.28
4729	diphenyl ether (2)	.....	$C_6H_5 \cdot O \cdot C_6H_4 \cdot NO_2$	VI-218	215.20
4730	diphenyl ether (3)	.....	$C_6H_5 \cdot O \cdot C_6H_4 \cdot NO_2$	VI-224	215.20
4731	diphenyl ether (4)	.....	$C_6H_5 \cdot O \cdot C_6H_4 \cdot NO_2$	VI-232	215.20
4732	diphenylene oxide	2-NO_2-dibenzfuran	$NO_2 \cdot C_{12}H_7 : O$	XVII-72	213.18
4733	ethane	.....	$CH_3 \cdot CH_2 \cdot NO_2$	I-99	75.07
4734	ethylacetanilide	(*p*)	$NO_2 \cdot C_6H_4 \cdot N(C_2H_5) \cdot COCH_3$	XII-720	208.21
4735	ethyl alcohol	2-nitro-ethanol-1	$HO \cdot CH_2 \cdot CH_2 \cdot NO_2$	I-339	91.07
4736	ethylbenzene (*o*)	.....	$NO_2 \cdot C_6H_4 \cdot C_2H_5$	V-358	151.16
4737	ethylbenzene (*p*)	.....	$NO_2 \cdot C_6H_4 \cdot C_2H_5$	VI-358	151.16
4738	fluorene (2)	.....	$NO_2 \cdot C_{12}H_7 : CH_2$	V-628	211.21
4739	formaldehyde-phenylhydrazone	benzene-azo-nitro-methane	$C_6H_5NH \cdot N : CH \cdot NO_2$	XV-235	165.15
4740	furan (2)	.....	$NO_2 \cdot C_4H_3O$	XVII-28	113.07
4741	furoic acid (5)	nitro-pyromucic acid	$NO_2 \cdot C_4H_2O \cdot CO_2H$	XVIII-287	157.08
4742	guaiacol (4)	(4;2,1)	$NO_2 \cdot C_6H_3(OCH_3)OH$	VI-788	169.13
4743	guanidine	.....	$NO_2 \cdot NH \cdot C(NH) \cdot NH_2$	III-126	104.07
4744	heptane (1)	.....	$C_6H_{13} \cdot CH_2 \cdot NO_2$	I-155	145.20
4745	heptane (2)	.....	$C_5H_{11} \cdot CHNO_2 \cdot CH_3$	I-156	145.20
4746	heptane	2-NO_2-2,4-dimethylpentane	$(CH_3)_2CNO_2 \cdot CH_2 \cdot CH(CH_3)_2$	I-158	145.20
4747	heptane	3-NO_2-2,2-dimethylpentane	$(CH_3)_3C \cdot CH(NO_2) \cdot C_2H_5$	I-157	145.20
4748	heptane	3-NO_2-3-Et-pentane	$(C_2H_5)_3C \cdot NO_2$	I-157	145.20
4749	hexane (1)	.....	$CH_3(CH_2)_4CH_2NO_2$	I-147	131.17

Nitro-dibenzfuran 4732
Nitro-dichloroaniline 2021
Nitro-dichlorobenzene 2022-6
Nitro-dichlorophenol 2029-30
Nitro-dimethylbenzene 4865-70

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4711	lq.	.....	−35	224 d.	.....	.....	.....
4712	col. or gn.	.....	65(45-6)	265	col.: v. sl. s. pet.	s. h.	gn.: v. s. pet.
4713	pr.	.....	20	.....	.....	.....	.....
4714	oil	$1.067^{20°}_{4}$	.....	152^{15mm}	.....	.....	.....
4715	lq.	$0.925^{21°}_{0}$	.....	235-7 d.	.....	.....	.....
4716	lq.	$0.909^{20°}_{4}$	.....	$235\text{-}7^{749mm}$ d.	.....	.....	.....
4717	yel. oil	.....	.....	$153\text{-}5^{20mm}$	sl. s.	s.	s.
4718	yel. oil	.....	.....	288-90	.....	.....	.....
4719	yel. mn./al.	1.225	77-8	.....	.....	v. s. h.	sl. s. lg.
4720	yel. oil	$1.179^{20°}_{4}$	.....	$151\text{-}3^{30mm}$	sl. s.	v. s.	v. s.
4721	red mn.	$1.313^{17°}$	60-1	280-5	i.	s.	s.
4722	yel. nd.	.....	163-4	.....	i.	s. h.	s. h. ac.
4723	rhb.	1.44	37	320	i.	s.	v. s.
4724	yel. lf.	.....	61	.....	i.	v. s.	v. s. ac.
4725	nd./al.	.....	113-4	340	i.	sl. s. c.	v. s.
4726	or./aq. al.	.....	75-6	.....	.....	.....	.....
4727	yel. nd.	.....	132-3	.....	i. dil. a.	s.	s. ac.
4728	gn. lf./HCl	.....	.....	.....	v. s.	v. s.	.....
4729	yel. oil	$1.258^{15°}$	<−20	235^{60mm}	i.	s. abs.	s. bz.
4730	yel. oil	$1.245^{15°}$	.....	$202\text{-}4^{14mm}$	.....	.....	.....
4731	tab.	.....	56-7	320±	i.	sl. s. c.	v. s.
4732	yel. nd./ac.	.....	181-2	.....	s. h. ac.	sl. s. h.	sl. s.
4733	lq.	$1.052^{20°}_{20°}$	−90	114.8^{761mm}	$4.5^{20°}$; s. a alk.	∞; ∞ chl.	∞
4734	lf.	.....	118-9	.....	v. sl. s.; s. bz.	s.; i. lg.	v. sl. s.; s. CS_2
4735	col. lq.	$1.270^{15°}$	<−80	194^{765mm}	v. s.	v. s.	v. s.
4736	col. oil	$1.126^{24.5°}$	−23	227-8	i.	v. s.	s.
4737	col. oil	$1.124^{25°}$	−32	245-6	i.	v. s.	v. s.
4738	nd./50% ac.	.....	156-7	.....	.....	.....	.....
4739	or. pr.	.....	85-6 (75-6)	.....	s. lg.	s. chl.	s. bz.
4740	lt. yel./pet.	.....	28	.....	v. sl. s.	s. alk.	s.
4741	lt. yel./aq.	.....	185	subl.	v. sl. s.	s.	s.; i. chl.
4742	yel. nd./aq.	.....	104-5	.....	.....	.....	.....
4743	nd./aq.	.....	246-7	.....	$9^{100°}$	sl. s.	v. sl. s.
4744	lt. yel. oil	$0.948^{17°}$	.....	193-5	i.	v. s.	v. s.
4745	lq.	$0.947^{0°}$	.....	194-8 sl. d.	s. conc. alk.	.....	.....
4746	lq.	$0.956^{0°}_{0}$	.....	$181\text{-}2^{742mm}$	.....	.....	.....
4747	lq.	$0.940^{20°}_{20°}$	.....	$89\text{-}90^{40mm}$	.....	.....	.....
4748	lq.	$0.955^{0°}$	.....	185-90	.....	.....	.....
4749	col. lq.	$0.949^{20°}$	.....	$193\text{-}4^{765mm}$	i.	v. s.	v. s. al. alk.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4750	**Nitro** hexane	3-NO_2-2,2-dimethylbutane	$(CH_3)_3C{\cdot}CH(NO_2){\cdot}CH_3$	I-151	131.17
4751	hexane	2-NO_2-2-Mepentane	$(CH_3)_2C(NO_2){\cdot}C_3H_7$	I-149	131.17
4752	hippuric acid (*m*)	.....	$NO_2{\cdot}C_6H_4{\cdot}CO{\cdot}NH{\cdot}CH_2{\cdot}CO_2H$	IX-383	224.17
4753	*o*-hydroxybenzoic acid (3;2,1)	3-nitrosalicylic acid	$NO_2{\cdot}C_6H_3(OH){\cdot}CO_2H{\cdot}H_2O$	X-114	201.13
4754	*o*-hydroxybenzoic acid (4;2,1)	4-nitrosalicylic acid	$NO_2{\cdot}C_6H_3(OH)CO_2H$	X-116	183.12
4755	*o*-hydroxybenzoic acid (5;2,1)	5-nitrosalicylic acid	$NO_2{\cdot}C_6H_3(OH)CO_2H$	X-116	183.12
4756	*o*-hydroxybenzoic acid (6;2,1)	6-nitrosalicylic acid	$NO_2{\cdot}C_6H_3(OH)CO_2H$	.....	183.12
4757	*m*-hydroxybenzoic acid (2;3,1)	.....	$NO_2C_6H_3(OH)CO_2H{\cdot}H_2O$	X-146	201.13
4758	*m*-hydroxybenzoic acid (4;3,1)	.....	$NO_2{\cdot}C_6H_3(OH)CO_2H$	X-146	183.12
4759	*m*-hydroxybenzoic acid (6;3,1)	.....	$NO_2C_6H_3(OH)CO_2H{\cdot}H_2O$	X-147	201.13
4760	*p*-hydroxybenzoic acid (3;4,1)	.....	$NO_2{\cdot}C_6H_3(OH)CO_2H$	X-181	183.12
4761	isatin (5)	.....	$NO_2{\cdot}C_6H_3{\cdot}NH{\cdot}CO{\cdot}CO$	XXI-456	192.13
4762	malonic dialdehyde	2-nitro-propandial	$NO_2{\cdot}CH(CHO)_2$	I-766	117.06
4763	malonic ester	.....	$NO_2{\cdot}CH(CO_2C_2H_5)_2$	II-596	205.17
4764	mesitylene (1,3,5;2)	.....	$(CH_3)_3C_6H_2{\cdot}NO_2$	V-410	165.19
4765	methane	.....	$CH_3{\cdot}NO_2$	I-74	61.04
4766	*N*-methylacetanilide (*p*)	.....	$NO_2{\cdot}C_6H_4{\cdot}N(CH_3){\cdot}COCH_3$	XII-719	194.19
4767	*N*-methylaniline (*o*)	.....	$NO_2{\cdot}C_6H_4{\cdot}NHCH_3$	XII-689	152.15
4768	*N*-methylaniline (*m*)	.....	$NO_2{\cdot}C_6H_4{\cdot}NHCH_3$	XII-700	152.15
4769	*N*-methylaniline (*p*)	.....	$NO_2{\cdot}C_6H_4{\cdot}NHCH_3$	XII-714	152.15
4770	2-methylanthraquinone (1)	.....	$NO_2(CH_3)C_{14}H_6O_2$	VII-811	267.23
4771	4'-methyldiphenylamine (4)	.....	$NO_2{\cdot}C_6H_4{\cdot}NH{\cdot}C_7H_7$	XII-906	228.24
4772	naphthalene (α)	.....	$NO_2{\cdot}C_{10}H_7$	V-553	173.16
4773	naphthalene (β)	.....	$NO_2{\cdot}C_{10}H_7$	V-555	173.16
4774	naphthoic acid (8,1)	.....	$NO_2{\cdot}C_{10}H_6{\cdot}CO_2H$	IX-653	217.17
4775	α-naphthol (2,1)	.....	$NO_2{\cdot}C_{10}H_6{\cdot}OH$	VI-615	189.16
4776	α-naphthol (4,1)	.....	$NO_2{\cdot}C_{10}H_6{\cdot}OH$	VI-615	189.16
4777	β-naphthol (1,2)	.....	$NO_2{\cdot}C_{10}H_6{\cdot}OH$	VI-653	189.16
4778	β-naphthol (5,2)	.....	$NO_2{\cdot}C_{10}H_6{\cdot}OH$	VI-654	189.16
4779	β-naphthol (8,2)	.....	$NO_2{\cdot}C_{10}H_6{\cdot}OH$	VI-655	189.16
4780	α-naphthylamine	(2,1)	$NO_2{\cdot}C_{10}H_6{\cdot}NH_2$	XII-1258	188.18
4781	β-naphthylamine	(1,2)	$NO_2{\cdot}C_{10}H_6{\cdot}NH_2$	XII-1313	188.18
4782	β-naphthylamine	(5,2)	$NO_2{\cdot}C_{10}H_6{\cdot}NH_2$	XII-1314	188.18
4783	β-naphthylamine	(8,2)	$NO_2{\cdot}C_{10}H_6{\cdot}NH_2$	XII-1315	188.18

Nitro-hydroxytoluene 4710
Nitro-iodobenzene 3893-5
Nitro-malonyl urea 4632
Nitro-mannite 4011
Nitro-methylquinoline 4830

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4750	col. pr.	.....	40	167.5-8^{748mm}	v. s. pet.	v. s.	v. s.
4751	lq.	0.949^{0}_{0}°	.....	172-6^{756mm}	i. alk.	.....	.....
4752	nd./aq.	.....	165-7	.....	$0.4^{23°}$	s.	s.
4753	rhb./aq.	.....	123-5; 148 -9(anh.)	.....	$0.13^{15.5°}$	v. s.; s. bz.	v. s.; s. chl.
4754	col. nd./aq.	.....	226-35	.....	s. h.; s. chl.	s.; i. lg.	sl. s. bz.
4755	nd./aq.	$1.650^{20°}$	228-30	.....	$0.18^{22°}$	v. s.; s. act.	v. s.
4756	cr.	.....	130	.....	s. act.	sl. s.	v. s.
4757	pl./aq.	.....	178	.....	v. sl. s.	s.	s.
4758	yel. lf./aq.	.....	230	.....	v. sl. s.	.....	.....
4759	yel. nd./aq.	.....	169	.....	v. s.	v. s.	v. s.
4760	nd./aq.	.....	185-6	.....	v. s. h.	v. s.	s.
4761	nd./al.	.....	248-50	.....	sl. s.	s.	s. alk.
4762	pr.	.....	50-1	.....	d.; v.s.chl.	v. s.	v. s.
4763	col. oil	$1.199^{20°}_{4}$	.....	152-3^{38mm}	i.	.....	.....
4764	rhb./al.	.....	44	255	.....	v. s. h.	.....
4765	oil	$1.138^{20°}_{20}$	-28.5	101.5^{765mm}	$9.5^{20°}$	s.; s. alk.	s.
4766	lf./aq.	.....	152-3	.....	.....	s.	s.
4767	red nd./ pet.	.....	36-7	.....	v. sl. s. c.	s.	s.
4768	red yel./al.	.....	67-8	.....	s. h.	s.	s.
4769	br. yel./al.	.....	151-2	.....	s. bz.	s.	v. sl. s. lg.
4770	pa. yel. nd./ac.	.....	269-70	subl.; d. 330-2	sl. s. bz.; s. $C_6H_5NO_2$	v. sl. s.; sl. s. chl.	v. sl. s.
4771	yel. nd./al. or bz.	.....	138-9	.....	v. s. ac.; v.sl.s.bz.	v. s. h.	v. sl. s.
4772	yel. nd./al.	$1.223^{61.5°}$	59-60	304	i.; s. CS_2	s.; s. chl.	s.
4773	col./al.	.....	79	165^{15mm}	i.	v. s.	v. s.
4774	pr./al.	.....	215	.....	0.04	4.7	sl. s.
4775	yel. nd./al.	.....	128	.....	v. sl. s.	s.	.....
4776	col. cr.	.....	164	.....	s. h.	v. s.	v. s. ac.
4777	yel. nd./al.	.....	103	.....	i.; s. alk.	s.; s. ac.	v. s.
4778	lt. yel./aq.	.....	147	.....	v. s. h.	v. s.	v. s.
4779	yel. nd./aq.	.....	144-5	.....	s. bz.	s.; s. chl.	s.
4780	red yel. mn.	.....	144	.....	.....	s.	.....
4781	red yel./al.	.....	126-7	.....	s. h.	s.	s. ac.
4782	red nd./al.	.....	143.5	.....	s. bz.	s.	i. lg.
4783	red nd.	.....	104-5	.....	i. lg.	s.	s.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4784	**Nitro** nonane (1)	.....	$CH_3(CH_2)_7CH_2NO_2$	I-166	173.25
4785	nonane	2-NO_2-2,6-dimethylheptane	$(CH_3)_2C(NO_2)\cdot(CH_2)_3CH(CH_3)_2$	I-167	173.25
4786	octane (1)	.....	$CH_3(CH_2)_6CH_2NO_2$	I-161	159.22
4787	octane	1-NO_2-2,5-dimethylhexane	$(CH_3)_2CH(CH_2)_2\cdot CH(CH_3)CH_2NO_2$	I-163	159.22
4788	octane	2-NO_2-2,5-dimethylhexane	$(CH_3)_2C(NO_2)\cdot(CH_2)_2CH(CH_3)_2$	I-163	159.22
4789	pentandiol	2-NO_2-2-Et-1,3-propandiol	$C_2H_5\cdot C(NO_2)\cdot(CH_2OH)_2$	I-483	149.15
4790	pentane (1)	.....	$CH_3(CH_2)_3CH_2NO_2$	I-133	117.15
4791	pentane (3)	.....	$(C_2H_5)_2CH\cdot NO_2$	I-133	117.15
4792	pentane	2-NO_2-2-Me-butane	$(CH_3)_2C(NO_2)C_2H_5$	I-140	117.15
4793	pentane	4-NO_2-2-Me-butane	$(CH_3)_2CH(CH_2)_2NO_2$	I-140	117.15
4794	phenanthraquinone	(2)	$NO_2\cdot C_6H_3(CO)_2C_6H_4NO_2\cdot$	VII-806	253.20
4795	*p*-phenetidine (3)	3-NO_2-4-NH_2-phenetole	$C_6H_3(NH_2)OC_2H_5$	XIII-521	182.18
4796	phenetole (*o*)	.....	$C_2H_5O\cdot C_6H_4\cdot NO_2$	VI-218	167.16
4797	phenetole (*m*)	.....	$C_2H_5O\cdot C_6H_4\cdot NO_2$	VI-224	167.16
4798	phenetole (*p*)	.....	$C_2H_5O\cdot C_6H_4\cdot NO_2$	VI-231	167.16
4799	phenol (*o*)	.....	$HO\cdot C_6H_4\cdot NO_2$	VI-213	139.11
4800	phenol Na (*o*)	Na nitrophenoxide	$NaO\cdot C_6H_4\cdot NO_2$	VI-217	161.10
4801	phenol K (*o*)	K nitrophenoxide	$KO\cdot C_6H_4\cdot NO_2\cdot\frac{1}{2}H_2O$	VI-217	186.21
4802	phenol (*m*)	.....	$HO\cdot C_6H_4\cdot NO_2$	VI-222	139.11
4803	phenol (*p*)	.....	$HO\cdot C_6H_4\cdot NO_2$	VI-226	139.11
4804	phenol Na (*p*)	.....	$NaC_6H_4O_3N\cdot 2H_2O$	VI-230	197.13
4805	phenol Na (*p*)	.....	$NaC_6H_4O_3N\cdot 4H_2O$	VI-230	233.16
4806	*o*-phenol sulfonic acid	(1;4,2)	$HOC_6H_3(NO_2)SO_3H\cdot 3H_2O$	XI-237	273.22
4807	*p*-phenol sulfonic acid	(1;2,4)	$HOC_6H_3(NO_2)SO_3H\cdot 3H_2O$	XI-246	273.22
4808	phenylacetate (*o*)	.....	$NO_2\cdot C_6H_4\cdot O_2CCH_3$	VI-219	181.14
4809	phenylacetic acid (*p*)	*p*-NO_2-α-toluic acid	$NO_2\cdot C_6H_4\cdot CH_2CO_2H$	IX-455	181.14
4810	phenylarsonic acid	(*m*)	$NO_2\cdot C_6H_4\cdot AsO(OH)_2$	XVI-869	247.03
4811	phenyl *iso*-cyanate	.....	$NO_2\cdot C_6H_4\cdot N{:}CO$	XII-725	164.12
4812	phenylglycine (*p*)	.....	$NO_2\cdot C_6H_4\cdot NH\cdot CH_2\cdot CO_2H$	XII-725	196.16
4813	phenylhydrazine (*m*)	.....	$NO_2\cdot C_6H_4\cdot NH\cdot NH_2$	XV-460	153.14
4814	phenylhydrazine (*m*)	HCl salt	$NO_2\cdot C_6H_4\cdot N_2H_3\cdot HCl$	XV-460	189.61
4815	phenylhydrazine (*p*)	.....	$NO_2\cdot C_6H_4\cdot NH\cdot NH_2$	XV-468	153.14
4816	phenylhydrazine (*p*)	HCl salt	$NO_2\cdot C_6H_4\cdot N_2H_3\cdot HCl$	XV-468	189.61
4817	phenylpropiolic acid	(*o*)	$NO_2\cdot C_6H_4\cdot C{:}C\cdot CO_2H$	IX-636	191.14
4818	phenylpropiolic acid	(*p*)	$NO_2\cdot C_6H_4\cdot C{:}C\cdot CO_2H$	IX-637	191.14
4819	*o*-phthalic acid (3)	.....	$NO_2\cdot C_6H_3(CO_2H)_2$	IX-823	211.13
4820	*o*-phthalic acid (4)	.....	$NO_2\cdot C_6H_3(CO_2H)_2$	IX-828	211.13

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4784	lt. yel. lq.	$0.923^{17°}$	.....	215-8 d.	.....	.....	.....
4785	lq.	$0.915^{18°}_{0}$	.....	113-4 ^{25mm}	.....	.....	.....
4786	lt. yel. lq.	$0.935^{20°}$	.....	206-10 sl. d.	.....	.....	.....
4787	lq.	.....	.....	100-5 ^{20mm}	.....	.....	.....
4788	lq.	$0.921^{20°}_{0}$	−18	201-2 ^{755mm}	s. alk.	.....	.....
4789	nd./aq.	.....	57-8	d.	v. s.	s.	s.
4790	col. lq.	$0.948^{20°}$	.....	172-3	.....	.....	.....
4791	lq.	$0.958^{0°}$	.....	152-5 ^{746mm}	i.	s.	s.
4792	lq.	$0.97^{0°}$	.....	149-51 ^{748mm}	.....	.....	.....
4793	lq.	$0.960^{20.6°}_{4}$	.....	164 ^{756mm}	.....	.....	.....
4794	yel. lf./ac.	.....	257-8	.....	.....	v. sl. s.	sl. s. ac.
4795	red pr./al.	.....	113	.....	.....	s. h.	s.; s. chl.
4796	oil	$1.190^{15°}$	5-6	275	v. sl. s.	v. s.	v. s.
4797	yel. cr.	.....	34	169 ^{70mm}	v. sl. s.	v. s. h.	v. s.
4798	col. mn.	$1.18^{15°}$	59-60	283 ^{758mm}	v. sl. s.	v. s. h.	v. s.
4799	yel. mn.	$1.295^{45°}$	44-5	214.5	s. h.	v. s.	v. s.; s. bz.
4800	red lf./al.	.....	.....	.....	v. s.	v. sl. s. NaOH	.....
4801	or. nd./al.	$1.682^{20°}$	.....	.....	$16^{6°}$	$21^{15°}$ aq.	.....
4802	col. mn.	$1.485^{20°}$	96-7	194 ^{70mm}	$1.35^{20°}$	v. s.	s.; i. pet.
4803	yel. pr.	$1.48^{20°}$	113-4	subl.	$1.6^{25°}$	v. s.	v. s.
4804	or. cr./aq.	.....	$-2H_2O$, 110	.....	6.5 c.	.....	.....
4805	yel. mn./aq.	.....	.....	.....	s.	.....	.....
4806	nd.	.....	d. 110	.....	v. s.	v. s.	sl. s.
4807	nd./aq.	.....	51.5; 141-2 (anh.)	.....	v. s.	v. s.	v. s. chl.
4808	col. nd./lg.	.....	39-40	253 d.	v. s. bz.	v. s.	v. s.
4809	nd./aq.	.....	152-3	.....	v. sl. s. c.	s.	s.; s. chl.
4810	lf./aq.	.....	d.	.....	$2^{18°}$	sl. s. chl.	i. lg.
4811	nd.	.....	56-7	.....	s. h. lg.	s. chl.	s.; s. bz.
4812	yel. cr./aq.	.....	225-30 d.	.....	v. sl. s.	v. s. h.	sl. s.
4813	yel. nd./al.	.....	93	.....	v. sl. s. h.	v. sl. s. bz.	s. ac.
4814	yel. pl.	.....	.....	.....	v. sl. s. c.	v. sl. s. c.	sl. s. HCl
4815	or. red nd.	.....	157	.....	s. h.	v. s.	s.
4816	or. red pl.	.....	214-5 d.	.....	s.	i.	i.
4817	nd./aq.	.....	157 d.	expl. 155-6	s. h.	s.; i. CS_2	v. sl. s. chl.
4818	nd./al.	.....	181-93 d.	.....	sl. s.	s. h.	s.; i. pet.
4819	lt. yel./aq.	.....	222*	.....	$2^{25°}$	v. s. h.	sl. s.
4820	lt. yel. cr.	.....	164-5	.....	v. s.	v. s.	s.

* Sealed tube.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4821	**Nitro** *m*-phthalic acid (5)	.....	$NO_2 \cdot C_6H_3(CO_2H)_2$	IX-840	211.13
4822	*p*-phthalic acid (2)	.....	$NO_2 \cdot C_6H_3(CO_2H)_2$	IX-851	211.13
4823	phthalic anhydride	(3)	$NO_2 \cdot C_6H_3(CO)_2O$	XVII-486	193.11
4824	phthalide (6)	.....	$NO_2 \cdot C_6H_3 \cdot CH_2 \cdot O \cdot CO$	XVII-313	179.13
4825	phthalimide (3)	.....	$NO_2 \cdot C_6H_3(CO)_2NH$	XXI-505	192.13
4826	phthalimide (4)	.....	$NO_2 \cdot C_6H_3(CO)_2NH$	XXI-506	192.13
4827	propane (1)	.....	$CH_3 \cdot CH_2 \cdot CH_2 \cdot NO_2$	I-115	89.09
4828	propane (2)	*β*-nitropropane	$(CH_3)_2CH \cdot NO_2$	I-116	89.09
4829	propene (3,1)	nitroallyl	$CH_2:CH \cdot CH_2 \cdot NO_2$	I-203	87.08
4830	quinaldine (6)	6-NO_2-2-Me-quinoline	$NO_2 \cdot C_9H_5N \cdot CH_3$	XX-394	188.18
4831	quinoline (5)(*ana*)	.....	$NO_2 \cdot C_9H_6N$	XX-371	174.15
4832	quinoline (6)(*p*)	.....	$NO_2 \cdot C_9H_6N$	XX-372	174.15
4833	quinoline (7)(*m*)	.....	$NO_2 \cdot C_9H_6N$	XX-372	174.15
4834	quinoline (8)(*o*)	.....	$NO_2 \cdot C_9H_6N$	XX-373	174.15
4835	*iso*-quinoline (5 or 8)	.....	$NO_2 \cdot C_6H_3:C_3H_3N$	XX-386	174.15
4836	resorcinol (2)	(2;1,3)	$NO_2 \cdot C_6H_3(OH)_2$	VI-823	155.11
4837	salol (*α*)	5-nitrosalol	$NO_2 \cdot C_6H_3(OH) \cdot CO_2 \cdot C_6H_5$	X-118	259.21
4838	styrene (*o*)	.....	$NO_2 \cdot C_6H_4 \cdot CH:CH_2$	V-478	149.14
4839	styrene (*m*)	.....	$NO_2 \cdot C_6H_4 \cdot CH:CH_2$	V-478	149.14
4840	styrene (*p*)	.....	$NO_2 \cdot C_6H_4 \cdot CH:CH_2$	V-478	149.14
4841	styrene (*ω*)(*β*)	.....	$C_6H_5 \cdot CH:CH \cdot NO_2$	V-478	149.14
4842	tartaric acid	.....	$(NO_2 \cdot O \cdot CH \cdot CO_2H)_2$	III-509	240.09
4843	thiophene (2)	.....	$NO_2 \cdot C_4H_3S$	XVII-35	129.13
4844	toluene† (*o*)	.....	$CH_3 \cdot C_6H_4 \cdot NO_2$	V-318	137.13
4845	toluene (*m*)	.....	$CH_3 \cdot C_6H_4 \cdot NO_2$	V-321	137.13
4846	toluene (*p*)	.....	$CH_3 \cdot C_6H_4 \cdot NO_2$	V-323	137.13
4847	*o*-toluene sulfonic acid	(1;4,2)	$CH_3 \cdot C_6H_3(NO_2) \cdot SO_3H \cdot 2H_2O$	XI-90	253.23
4848	*p*-toluene sulfonyl chloride	(1;2,4)	$CH_3 \cdot C_6H_3(NO_2) \cdot SO_2Cl$	XI-111	235.64
4849	*o*-toluidine (3;1,2)	.....	$NO_2 \cdot C_6H_3(CH_3)NH_2$	XII-843	152.15
4850	*o*-toluidine (4;1,2)	.....	$NO_2 \cdot C_6H_3(CH_3)NH_2$	XII-844	152.15
4851	*o*-toluidine (5;1,2)	.....	$NO_2 \cdot C_6H_3(CH_3)NH_2$	XII-846	152.15
4852	*o*-toluidine (6;1,2)	.....	$NO_2 \cdot C_6H_3(CH_3)NH_2$	XII-848	152.15
4853	*m*-toluidine (2;1,3)	.....	$NO_2 \cdot C_6H_3(CH_3)NH_2$	XII-876	152.15
4854	*m*-toluidine (4;1,3)	.....	$NO_2 \cdot C_6H_3(CH_3)NH_2$	XII-876	152.15
4855	*m*-toluidine (5;1,3)	.....	$NO_2 \cdot C_6H_3(CH_3)NH_2$	XII-877	152.15
4856	*m*-toluidine (6;1,3)	.....	$NO_2 \cdot C_6H_3(CH_3)NH_2$	XII-877	152.15
4857	*p*-toluidine (2;1,4)	.....	$NO_2 \cdot C_6H_3(CH_3)NH_2$	XII-996	152.15
4858	*p*-toluidine (3;1,4)	.....	$NO_2 \cdot C_6H_3(CH_3)NH_2$	XII-1000	152.15
4859	trimethylol-methane	2-NO_2-2-methylol-1,3-propandiol	$NO_2 \cdot C(CH_2OH)_3$	I-520	151.12
4860	tyrosine (3)(*l*)	.....	$NO_2 \cdot C_6H_3(OH) \cdot CH_2 \cdot CH(NH_2) \cdot CO_2H$	XIV-620	226.19
4861	undecane (1)	.....	$CH_3(CH_2)_9CH_2 \cdot NO_2$	I-170	201.30
4862	uracil (5)	.....	$NO_2 \cdot C:CH \cdot (NHCO)_2$	XXIV-320	157.09

†See also No. 5213.

Nitro-propandial 4762
Nitro-*iso*-propyl-methyl-benzene 4714
Nitro-pyromucic acid 4741
Nitro-salicylic acid 4753-6
Nitro-sulfanilic acid 4621
Nitro-toluic acid (*α*) 4809
Nitro-toluic nitrile (*α*) 4685-7

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4821	col. cr.	.....	255 sl. d.	.....	$0.15^{15°}$; $81^{99°}$	v. s.	v. s.
4822	nd./h. aq.	.....	263-70	.....	s. h.	s. h.	.....
4823	col. nd./ac.	.....	162-3	.....	s. act.	s. h.	v. sl. s. bz.
4824	nd.	.....	141	.....	i. c.; v. s. h. chl.	sl. s. c.	sl. s.; i. alk. carb.
4825	yel. lf./al.	.....	215-6	subl.	i.; s. ac.	s. h.	i.; i. lg.
4826	yel. lf.	.....	195-7	subl.	v. sl. s. h.	s.; s. ac.	s. act.
4827	oil	$1.003^{\frac{20}{20}°}$	−108	131.6	$1.4^{20°}$	∞	∞
4828	lq.	$1.024^{0°}$	−93	120.3	$1.7^{20°}$	$\infty^{20°}$	$\infty^{20°}$
4829	col. lq.	$1.051^{21°}$	.....	125-30	i.	s.	s.
4830	yel. nd./aq.	.....	163-4	.....	v. sl. s.	s.	i.
4831	nd./aq.	.....	72	subl.	v. sl. s. h.	s. h.	s. bz.
4832	nd.	.....	149-50	subl.	sl. s. c.	sl. s. c.	sl. s.; s. bz.
4833	nd./al.	.....	132-3	.....	.....	v. sl. s. c.	s.
4834	mn./al.	.....	88-9	.....	s. h.	s.	s.; s. bz.
4835	nd./aq.	.....	110	subl.	s. h.	s.	s.; s. bz.
4836	or./aq. al.	.....	83-5	d. > 180°	.....	.....	.....
4837	nd./al.	.....	151-2	.....	.....	s.	s. ac.
4838	oil	.....	12-13.5	.....	s. H_2SO_4	.....	.....
4839	yel. oil	.....	−5	.....	v. s. lg.	v. s. abs.	v. s.
4840	pr./lg.	.....	29	d.	v. sl. s. c. lg.	s. h.	v. s. h.
4841	yel. pr./al.	.....	58	250-60 d.	v. sl. s. h.	s.	v. s.
4842	silky nd.	.....	d.	.....	d. 0°	v. s. c.; d. h.	v. s.; i. bz.
4843	mn./al.	.....	46	224-5	i. alk.	s.	s.
4844	yel. lq.	$1.163^{\frac{20}{4}°}$	(α) −10.6; (β) −4.1	222.3	v. sl. s.; s. pet.	∞; ∞ bz.	∞
4845	lq.	$1.160^{\frac{18}{4}°}$	15.5-16	230-1	v. sl. s.	∞; ∞ bz.	∞
4846	rhb.	$1.139^{\frac{15}{15}°}$	51.9	237.7	v. sl. s.	s.; s. bz.	s.; s. chl.
4847	pl./aq.	.....	130 (anh.)	.....	$47.7^{23°}$	v. s.	v. s.; s. chl.
4848	pl./et.	.....	33-4	.....	d.	d.	.....
4849	or./45% al.	.....	97	.....	sl. s.	s.; s. chl.	s.; s. bz.
4850	yel. mn.	$1.365^{15°}$	105-7	.....	v. sl. s.	s.	s.
4851	yel. mn.	$1.366^{15°}$	129-30	.....	v. sl. s. h.	s.	.....
4852	yel. rhb.	$1.378^{15°}$	91-2	305 d.	1.3 h.	v. s.	v. s.; v. s. bz.
4853	yel. nd.	.....	53	.....	sl. s. c.	s.	.....
4854	yel. lf./aq.	.....	109-10	.....	s. bz.	s.	s.; s. chl.
4855	yel. brn. nd.	.....	98	.....	sl. s. c.	s.	v. s.; s. bz.
4856	yel. nd./aq.	.....	135-8	.....	s. h.	s.	s.
4857	yel. nd./aq.	.....	81.5	.....	sl. s. h.	v. s. h.	s.
4858	red mn.	$1.312^{17°}$	116-7	.....	sl. s. h.	s.	.....
4859	nd. or pr.	.....	165-70 d.	.....	$220^{20°}$	$45^{20°}$	$1^{20°}$
4860	pa. yel. nd./aq.	.....	237	.....	v. sl. s. h.	i.; s. alk.	i.; s. aq. a.
4861	yel. lq.	$0.900^{15°}$	.....	d.	.....	v. s.	v. s.
4862	col. nd.	.....	expl. 130-70	.....	sl. s. c.	s.	.....

Nitroso-amyl ketone 79
Nitroso-anthron 4626
Nitroso-barbituric acid 6445
Nitroso-benzylaniline 828
Nitroso-diethylamine 2191
Nitroso-dimethylamine 2513
Nitroso-diphenylamine 2733
Nitroso-dipropylamine 2790-1

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4863	**Nitro** urea	.....	$NO_2{\cdot}NH{\cdot}CO{\cdot}NH_2$	III-125	105.06
4864	urethane	.....	$NO_2{\cdot}NH{\cdot}CO_2C_2H_5$	III-125	134.09
4865	*o*-xylene (3;1,2)	.....	$NO_2{\cdot}C_6H_3(CH_3)_2$	V-367	151.16
4866	*o*-xylene (4;1,2)	.....	$NO_2{\cdot}C_6H_3(CH_3)_2$	V-368	151.16
4867	*m*-xylene (2;1,3)	.....	$NO_2{\cdot}C_6H_3(CH_3)_2$	V-378	151.16
4868	*m*-xylene (4;1,3)	.....	$NO_2{\cdot}C_6H_3(CH_3)_2$	V-378	151.16
4869	*m*-xylene (5;1,3)	.....	$NO_2{\cdot}C_6H_3(CH_3)_2$	V-378	151.16
4870	*p*-xylene (2;1,4)	.....	$NO_2{\cdot}C_6H_3(CH_3)_2$	V-387	151.16
4871	*m*-xylidine (5), aceto-	(5;1,3,4)	$NO_2{\cdot}C_6H_2(CH_3)_2{\cdot}NH{\cdot}COCH_3$	XII-1128	208.21
4872	**Nitron**	4,5-dihydro-1,4-diPh-3,5-phenylimino-1,2,4-triazole	$C_{20}H_{16}N_4$	XXVI-349	312.36
4873	**Nitroso**-acetone (*iso*)	pyroracemic aldoxime	$CH_3{\cdot}CO{\cdot}CH{:}NOH$	I-763	87.08
4874	acetophenone (*iso*)	Ph-glyoxaloxime	$C_6H_5{\cdot}CO{\cdot}CH{:}NOH$	VII-671	149.14
4875	aniline (*p*)	*p*-quinone-imide-oxime tautomer	$ON{\cdot}C_6H_4{\cdot}NH_2$ or $HN{:}C_6H_4{:}NOH$	VII-625	122.12
4876	benzene	.....	$C_6H_5{\cdot}NO$	V-230	107.11
4877	benzoic acid (*o*)	.....	$ON{\cdot}C_6H_4{\cdot}CO_2H$	IX-368	151.12
4878	benzoic acid (*m*)	.....	$ON{\cdot}C_6H_4{\cdot}CO_2H$	IX-369	151.12
4879	benzoic acid (*p*)	.....	$ON{\cdot}C_6H_4{\cdot}CO_2H$	IX-369	151.12
4880	*n*-butyric acid (*iso*)	(*α*)	$C_2H_5{\cdot}C(:NOH){\cdot}CO_2H$	III-629	117.10
4881	*m*-cresol (4)	(4;3,1)	$ON{\cdot}C_6H_3(CH_3)OH$	VII-648	137.13
4882	diethylaniline (*p*)	.....	$ON{\cdot}C_6H_4{\cdot}N(C_2H_5)_2$	XII-684	178.23
4883	dimethylaniline (*p*)	.....	$ON{\cdot}C_6H_4{\cdot}N(CH_3)_2$	XII-677	150.18
4884	diphenylamine (*p*)	*p*-NO-Ph aniline	$ON{\cdot}C_6H_4{\cdot}NH{\cdot}C_6H_5$	XII-207	198.22
4885	ethylaniline (*N*)	Et-Ph-nitrosoamine	$C_6H_5{\cdot}N(NO)C_2H_5$	XII-580	150.18
4886	*N*-ethyl-urethane	*N*-NO-*N*-Et carbamate	$C_2H_5N(NO){\cdot}CO_2C_2H_5$	IV-129	146.15
4887	methylaniline (*N*)	.....	$C_6H_5{\cdot}N(NO)CH_3$	XII-579	136.15
4888	methyl-ethyl ketone (*iso*)	diacetyl monoxime	$CH_3COC(:NOH){\cdot}CH_3$	I-772	101.10
4889	methyl-*n*-hexyl ketone	(*iso*)	$CH_3{\cdot}CO{\cdot}C(:NOH){\cdot}(CH_2)_4CH_3$	I-795	157.21
4890	methyl-propyl ketone (*iso*)	.....	$CH_3{\cdot}CO{\cdot}C(:NOH){\cdot}C_2H_5$	I-776	115.13
4891	*N*-methyl-urethane	.....	$CH_3N(NO){\cdot}CO_2C_2H_5$	IV-85	132.12
4892	*α*-naphthol (1,4)	naphthoquinone oxime tautomer	$HO{\cdot}C_{10}H_6{\cdot}NO$ or $O{:}]C_{10}H_6{:}NOH$	VII-727	173.16
4893	*α*-naphthol (1,2)	2-nitroso-naphthol-1	$HO{\cdot}C_{10}H_6{\cdot}NO$	VII-715	173.16
4894	*β*-naphthol (2,1)	1-nitroso-naphthol-2	$HO{\cdot}C_{10}H_6{\cdot}NO$	VII-712	173.16
4895	*β*-naphthylamine	(2,1)	$ON{\cdot}C_{10}H_6{\cdot}NH_2$	VII-717	172.18
4896	nitrobenzene (*o*)	.....	$ON{\cdot}C_6H_4{\cdot}NO_2$	V-256	152.11
4897	phenylhydrazine (*α*)	.....	$C_6H_5{\cdot}N(NO){\cdot}NH_2$	XV-416	137.14
4898	piperidine (*N*)	.....	$C_5H_{10}N{\cdot}NO$	XX-83	114.15
4899	propiophenone (*α*)	(*iso*); methyl-benzoyl ketoxime (*β*)	$C_6H_5{\cdot}CO{\cdot}C(:NOH){\cdot}CH_3$	VII-677	163.17
4900	resorcinol (4)	2-OH-*p*-benzoquinone-1-oxime tautomer	$ON{\cdot}C_6H_3(OH)_2$ or $O{:}C_6H_3(:NOH)OH$	VIII-235	139.11

Nitroso-naphthyl-hydroxylamine 4581
Nitroso-oxindol 3923
Nitroso-phenol 5546
Nitroso-phenylaniline 4884
Nitroso-phenyl-hydroxylamine 1574
Nitrous ether 3097
Noctal 5390
Nonadecanone 4261
Nonanal 5043
Nonanamide 5045
Nonandioic acid 596
Nonanoic acid 5042
Nonanol 4918-25
Nonanone 1900, 4265
Nonanoyl chloride 5046

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4863	wh. pd./aq.	.....	155-6 d.	.....	s. h.	s.	s.
4864	lf./lg.	.....	64	.....	s.	v. s.	v. s.
4865	yel. oil	$1.147^{15°}$	15	240-5	.....	.....	.....
4866	yel. pr./al.	$1.139\frac{30°}{80}$	29-30	258 sl. d.	i.	$\infty^{30°}$	v. s.
4867	lq.	$1.112^{15°}$	.....	225^{744mm}	.....	.....	.....
4868	yel. lq.	$1.135^{15°}$	2	244	i.	s.	s.
4869	col. nd./al.	.....	74-5	273^{739mm}	.....	.....	.....
4870	yel. lq.	$1.132^{15°}$	.....	238.9^{739mm}	.....	.....	.....
4871	yel. nd./aq.	.....	172-3	.....	.....	.....	.....
4872	yel. lf./al.	.....	189-90 d.	.....	i.; s. act.	s. h.; s. bz.	v. sl. s.; s. chl.
4873	lf./et.	$1.074^{67.5°}$	69	subl.	v. s.	v. sl. s. pet.	v. s.
4874	mn./aq. al.	.....	126-8	.....	s. h.	s. alk.	.....
4875	b. nd./bz.	.....	173-4	.....	s.	s. bz.	.....
4876	col. rhb.*	.....	67.5-8.0	$57-9^{18mm}$	i.	s.	sl. s. lg.
4877	cr./al.	.....	210 d.	.....	s. ac.	s. h.	v. sl. s.
4878	col. cr.	.....	d. 230	.....	.....	.....	.....
4879	yel. pd.	.....	d. 250	.....	sl. s. bz.	sl. s. h.	sl. s. ac.
4880	nd./aq.	.....	169-70	.....	sl. s.	s.	sl. s.
4881	nd./aq.	.....	158-60	.....	sl. s. h.	s.; s. bz.	v. sl. s.
4882	gn. mn.	$1.24^{15°}$	84	.....	v. sl. s.	s.	s.
4883	gn. tri.	.....	86-7	.....	i.	s.	s.
4884	gn. pl./bz.	.....	144.6	.....	sl. s.; v. s. chl.	v. s.; sl. s. lg.	v. s.; s. bz.
4885	yel. oil	$1.087\frac{20°}{4°}$	.....	$119-20^{15mm}$	i.	.....	.....
4886	red oil	$1.071\frac{20°}{4°}$	.....	86^{36mm}	.....	.....	.....
4887	yel. oil	$1.124\frac{20°}{4°}$	12-15	128^{19mm}	.....	s.	s.
4888	pr./chl.	.....	76	185-6	sl. s.	v. s.; s. alk.	v. s.; s. chl.
4889	cr./lg.	.....	58-9	133^{11mm}	.....	.....	v. s.
4890	lf./lg.	.....	58-9	183-7 sl. d.	sl. s. c.	v. s.; v. s. chl.	v. s.
4891	yel. red lq.	$1.122\frac{20°}{4°}$	<-20	65^{13mm}	sl. s. h.	∞	∞; ∞ bz.
4892	nd./aq. al.	.....	193-4	.....	i.	v. s.	v. s.
4893	yel. nd./aq.	.....	162-4 d.	.....	s. h.	v. s.	sl. s.
4894	brn. pr./al.	.....	109.5	.....	$0.1^{20°}$	$2.4^{13°}$	v. sl. s. pet.
4895	gn./aq. al.	.....	150-2	.....	sl. s. h.	v. s. h.	s. h.
4896	yel. cr./act.	.....	126**	.....	i.; i. pet.	s. h.	v. s. chl.
4897	lt. yel. lf.	.....	51	.....	s.	poisonous	s.
4898	lt. yel. oil	$1.063\frac{18.5°}{4°}$	.....	217-8	s.	v. s. aq. a.	.....
4899	nd./aq.	.....	113-4	.....	s. alk.	.....	.....
4900	yel. nd. + $1H_2O$/ aq.	.....	$-H_2O$, 105; d. 148	.....	s.; s. chl.	v. s.; s. ac.	s.; i. bz.; i. CS_2

* Green as liquid or in solution.
** Green when liquid.
Nonene 4930
Nonyl cyanide 1207
Nonylic acid 5042
Nor-arecaidine, cf. alkd.
Nosophen 5813
Nostal 5390
Novacetyl 118
Novarsenobenzol 5593
Novatophan 3130
Novonal 2137
Nucin 3787
Numal 5370
Nupercaine 1025

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4901	**Nitroso** R salt	(1;3,6;2)	$ON{\cdot}C_{10}H_4(SO_3Na)_2{\cdot}OH$	.....	377.26
4902	thymol (*p*)	(quinoneoxime tautomer)	$ON{\cdot}C_{10}H_{12}{\cdot}OH$ or $O{:}C_{10}H_{12}{:}NOH$	VII-664	179.21
4903	toluene (*o*)	.....	$CH_3{\cdot}C_6H_4{\cdot}NO$	V-317	121.13
4904	toluene (*m*)	.....	$CH_3{\cdot}C_6H_4{\cdot}NO$	V-318	121.13
4905	toluene (*p*)	.....	$CH_3{\cdot}C_6H_4{\cdot}NO$	V-318	121.13
4906	triacetonamine (*N*)	.....	$C_9H_{16}ON{\cdot}NO$	XXI-251	184.23
4907	**Nonacosane**	.....	$C_{29}H_{60}$	I-176	408.77
4908	**Nonadecane** (*n*)	.....	$CH_3{\cdot}(CH_2)_{17}{\cdot}CH_3$	I-174	268.51
4909	**Nonadecylic acid**	.....	$CH_3{\cdot}(CH_2)_{17}{\cdot}CO_2H$	II-389	298.49
4910	**Nonane** (*n*)	.....	$CH_3{\cdot}(CH_2)_7{\cdot}CH_3$	I-165	128.25
4911	**Nonane** (*iso*)	2-methyl-octane	$(CH_3)_2CH{\cdot}C_6H_{13}$	I-166	128.25
4912	**Nonane**	2,4-diMe-heptane	C_9H_{20}	*I-64	128.25
4913	**Nonane**	2,5-diMe-heptane	C_9H_{20}	I-167	128.25
4914	**Nonane**	2,6-diMe-heptane	$[(CH_3)_2CH{\cdot}CH_2]_2CH_2$	I-167	128.25
4915	**Nonane**	4-ethyl-heptane	$C_2H_5{\cdot}CH(CH_2C_2H_5)_2$	I-167	128.25
4916	**Nonane**	3-methyl-octane	$(C_2H_5)(CH_3)CH{\cdot}(CH_2)_4CH_3$	I-166	128.25
4917	**Nonane**	4-methyl-octane	C_9H_{20}	*I-63	128.25
4918	**Nonyl** alcohol (*n*)	nonanol-1	$CH_3(CH_2)_7CH_2OH$	I-423	144.25
4919	alcohol (*n*)	nonanol-2	$C_7H_{15}{\cdot}CHOH{\cdot}CH_3$	I-423	144.25
4920	alcohol (*n*)	nonanol-3	$C_6H_{13}{\cdot}CHOH{\cdot}C_2H_5$	I-424	144.25
4921	alcohol (*n*)	nonanol-5	$(C_4H_9)_2CHOH$	I-424	144.25
4922	alcohol	2-methyl-octanol-2	$(CH_3)_2C(OH)C_6H_{13}$	I-424	144.25
4923	alcohol	4-ethyl-heptanol-4	$C_2H_5{\cdot}C(OH){:}(CH_2{\cdot}CH_2{\cdot}CH_3)_2$	I-424	144.25
4924	alcohol	2-Me-4-Et-hexanol-4	$(C_2H_5)_2C(OH){\cdot}CH_2{\cdot}CH(CH_3)_2$	I-425	144.25
4925	alcohol	2,6-diMe-heptanol-4	$[(CH_3)_2CH{\cdot}CH_2]_2{:}CHOH$	I-425	144.25
4926	amine (*n*)	1-amino-nonane	$CH_3(CH_2)_7CH_2NH_2$	IV-198	143.27
4927	bromide (2)	2-bromo-nonane	$C_7H_{15}{\cdot}CHBr{\cdot}CH_3$	I-166	207.16
4928	chloride (2)	2-chloro-nonane	$C_7H_{15}{\cdot}CHCl{\cdot}CH_3$	I-166	162.70
4929	iodide (*n*)	1-iodo-nonane	$CH_3(CH_2)_7{\cdot}CH_2I$	I-166	254.16
4930	**Nonylene** (β)	nonene-2	$C_6H_{13}{\cdot}CH{:}CH{\cdot}CH_3$	I-223	126.23
4931	**Norbixin** (*trans*)	(stable)(β)	$C_{24}H_{28}O_4$	XXX-109	380.46
4932	**Norbixin** (*cis*)	(labile)	$C_{24}H_{28}O_4$	XXX-110	380.46
4933	methyl ester (*cis*)	(labile)-bixin	$C_{25}H_{30}O_4$	XXX-112	394.49
4934	**Novocaine**	ethocaine; procaine HCl	$C_{13}H_{20}O_2N_2{\cdot}HCl$	XIV-424	272.77
4935	base	procaine	$NH_2{\cdot}C_6H_4CO_2(CH_2)_2{\cdot}N(C_2H_5)_2$	XIV-424	236.31
4936	**Octa**-chloropropane	perchloro-propane	C_3Cl_8	I-108	319.69
4937	cosane	.....	$C_{28}H_{58}$	I-176	394.74
4938	decane	*n*-octadecane	$CH_3{\cdot}(CH_2)_{16}{\cdot}CH_3$	I-173	254.48
4939	decyl alcohol (*n*)	octadecanol-1	$CH_3(CH_2)_{16}CH_2OH$	I-431	270.48
4940	iodide (*n*)	1-iodo-octadecane	$CH_3(CH_2)_{16}CH_2I$	I-173	380.40
4941	decylene (α)	octadecene-1	$CH_3(CH_2)_{15}CH{:}CH_2$	I-226	252.47
4942	decyne-1	hexadecyl acetylene	$CH_3(CH_2)_{15}C{:}CH$	I-262	250.45
4943	**Octandiol** (1,8)	.....	$HO{\cdot}(CH_2)_8{\cdot}OH$	I-490	146.22
4944	**Octane** (*n*)	.....	$CH_3{\cdot}(CH_2)_6{\cdot}CH_3$	I-159	114.22
4945	**Octane**	2,2,3,3-tetramethyl-butane	$[(CH_3)_3C]_2$	I-165	114.22

NW acid 4502
Nyctanthin 1555
Octa-decadienoic acid 3976
Octa-decanal 5633
Octa-decanoic acid 5631
Octa-decanol 4939
Octa-decanoyl chloride 5637
Octa-decatrienoic acid 3977
Octa-decene 4941
Octa-decynoic acid 5639
Octa-diene 1530
Octa-methylene 1617
Octa-methylene dicyanide 5606
Octaldehyde 1222
Octandial 5650

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4901	yel. cr.	.....	.....	.....	2.5	sl. s.	.....
4902	lt. yel. nd./chl.	.....	160-4 sl. d.	.....	v. sl. s. h.; s. alk.	s.	s.; s. chl.
4903	nd. or pr.	.....	72.5	.....	v. s. chl.	v. s.	v. s.
4904	nd.	.....	53.5	.....	i.	.....	s.
4905	col.nd./lg.*	.....	48.5	.....	v. sl. s.	v. s. Me al.	v. s. bz.
4906	nd./aq. al.	1.14	72-3	subl.	.....	v. s.	v. s.
4907	cr.	lq. $0.780^{63.8°}$	63.8	$346\text{-}8^{40mm}$	.....	.....	.....
4908	cr.	$0.777^{32°}_{4}$	32	330	i.	sl. s.	s.
4909	lf./al.	.....	66.5	$297\text{-}8^{100mm}$	i.	.....	.....
4910	col. lq.	$0.718^{20°}_{4}$	−53.7	150.5^{759mm}	i.	s. abs.	s.
4911	lq.	$0.713^{20°}_{4}$	−80.5	143.3^{760mm}	.....	.....	.....
4912	col. lq.	$0.717^{20°}_{4}$	.....	133^{752mm}	i.	∞	∞
4913	col. lq.	$0.714^{20°}_{4}$	.....	135.8	.....	.....	.....
4914	lq.	$0.712^{20°}$	.....	133^{756mm}	i.	.....	s.
4915	lq.	$0.741^{20°}$	.....	138.5	i.	.....	s.
4916	lq.	$0.721^{17°}$	−108	144.2	i.	.....	s.
4917	col. lq.	$0.725^{20°}_{4}$	−119.3	142^{771mm}	i.	.....	.....
4918	lq.	$0.828^{20°}_{4}$	−5	213.5	i.	∞	∞
4919	lq.	$0.823^{20°}_{4}$	−35	193-4	i.	s.	s.
4920	lq.	$0.825^{20°}_{4}$	−22	194.5^{750mm}	i.	v. s.	v. s.
4921	oil	$0.823^{20°}$	.....	193^{766mm}	i.	∞	∞
4922	lq.	.....	.....	178	i.	s.	s.
4923	lq.	$0.835^{20°}$	.....	179.5	i.	s.	s.
4924	lq.	$0.840^{22°}$	.....	172	i.	s.	s.
4925	lq.	$0.816^{12°}_{4}$	.....	$172\text{-}4^{750mm}$	i.	s.	s.
4926	lq.	.....	.....	201	.....	.....	.....
4927	lq.	$1.081^{20°}$	.....	$208\text{-}9^{767}$ d.	.....	.....	.....
4928	col. lq.	$0.856^{20°}$	.....	190^{764mm}	.....	.....	.....
4929	lq.	$1.287^{18°}_{4}$	.....	117^{15mm}	.....	.....	.....
4930	lq.	$0.754^{15°}_{15}$	.....	148-9	i.	.....	.....
4931	b. red cr.	.....	>300	.....	i.	i.	s. h. pyr.
4932	red nd./ac.	.....	254-5	.....	i.; s. pyr.	s. alk.	i.
4933	vl. cr./ac.	.....	198	.....	i.; s. pyr.	sl. s. h.	$0.3^{20°}$ chl.
4934	nd./abs. al.	.....	156	.....	v. s.	.....	i.
4935	cr./lg.	.....	59-60**	.....	sl. s.	s.	s. chl.
4936	pl.	.....	160	$268\text{-}9^{734mm}$	s. lg.	s.	s.
4937	cr.	lq. $0.779^{61.6°}$	61.6	$316\text{-}8^{40mm}$	.....	.....	.....
4938	cr.	$0.775^{28°}_{4}$	28.0(27.4)	317	i.	sl. s.	s.
4939	lf.	$0.812^{58°}_{4}$	58.5	210.5^{15mm}	i.	s.	s.
4940	cr. lf.	.....	33.5-4.0	$170^{0.5mm}$	.....	v. sl. s. c.	.....
4941	cr.	$0.791^{18°}_{4}$	18	179^{15mm}	.....	.....	.....
4942	cr.	$0.796^{30°}$	26	180^{15mm}	.....	.....	.....
4943	nd.	.....	63	172^{20mm}	sl. s.	v. s.	sl. s.
4944	col. lq.	$0.703^{20°}_{4}$	−56.5	125.7	i.	sl. s.	s.
4945	lf.	.....	102.2	106.5	i.	sl. s.	s.

* Green as liquid or in solution.
** Needles + $2H_2O$/aq. al., m. p. 51°.
Octandioic acid 5649
Octandione 78
Octanoic acid 1220
Octanol 4961-9
Octanone 2963, 4266
Octanoyl chloride 1225
Octene 4984-90
Octin 4114

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4946	**Octane**	2,2,3-triMe-pentane	$(CH_3)_3C{\cdot}CH(CH_3){\cdot}C_2H_5$	*I-62	114.22
4947	**Octane** ("iso")	2,2,4-triMe-pentane	$(CH_3)_3C{\cdot}CH_2{\cdot}CH{:}(CH_3)_2$	.....	114.22
4948	**Octane**	2,3,3-triMe-pentane	$C_2H_5{\cdot}C(CH_3)_2{\cdot}CH{:}(CH_3)_2$	.....	114.22
4949	**Octane**	2,3,4-triMe-pentane	$[(CH_3)_2CH]_2CH{\cdot}CH_3$	.....	114.22
4950	**Octane**	2-Me-3-Et-pentane	$(C_2H_5)_2CH{\cdot}CH{:}(CH_3)_2$	I-164	114.22
4951	**Octane**	2,3-dimethyl-hexane	$(CH_3)_2CH{\cdot}CH(CH_3){\cdot}CH_2{\cdot}C_2H_5$	*I-62	114.22
4952	**Octane**	2,4-dimethyl-hexane	$C_2H_5{\cdot}CH(CH_3){\cdot}CH_2{\cdot}CH(CH_3)_2$	I-162	114.22
4953	**Octane**	2,5-dimethyl-hexane	$[(CH_3)_2CH{\cdot}CH_2{\cdot}]_2$	I-162	114.22
4954	**Octane**	3,4-dimethyl-hexane	$[C_2H_5{\cdot}CH(CH_3){\cdot}]_2$	I-163	114.22
4955	**Octane**	3-ethyl-hexane	$(C_2H_5)_2CH{\cdot}CH_2{\cdot}C_2H_5$	*I-62	114.22
4956	**Octane** (*iso*)	2-methyl-heptane	$(CH_3)_2CH(CH_2)_4CH_3$	I-161	114.22
4957	**Octane**	3-methyl-heptane	$C_2H_5{\cdot}CH(CH_3){\cdot}(CH_2)_3{\cdot}CH_3$	I-162	114.22
4958	**Octane**	4-methyl-heptane	$(C_2H_5CH_2)_2CH{\cdot}CH_3$	I-162	114.22
4959	**Octyl** acetate (*n*)	(*See also* No. 1219)	$CH_3{\cdot}CO_2C_8H_{17}$	II-134	172.26
4960	acetate	2-Et-hexyl acetate	$CH_3{\cdot}CO_2CH_2{\cdot}CH{:}(C_2H_5)(C_4H_9)$	.....	172.26
4961	alcohol (*n*)	octanol-1	$CH_3(CH_2)_6CH_2OH$	I-418	130.22
4962	alcohol (capryl alcohol)	octanol-2	$CH_3(CH_2)_5CHOH{\cdot}CH_3$	I-419	130.22
4963	alcohol	2-Me-3-Et-pentanol-3	$(C_2H_5)_2C(OH){\cdot}CH(CH_3)_2$	I-423	130.22
4964	alcohol	2,2,4-trimethyl-pentanol-4	$(CH_3)_3CCH_2C(OH){:}(CH_3)_2$	I-423	130.22
4965	alcohol	2-Et-hexanol-1	$C_4H_9(C_2H_5)CH{\cdot}CH_2OH$	.....	130.22
4966	alcohol	3-Et-hexanol-3	$(C_2H_5)_2C(OH){\cdot}C_3H_7$	I-421	130.22
4967	alcohol	2-methyl-heptanol-2	$(CH_3)_2C(OH){\cdot}CH_2{\cdot}(CH_2)_3CH_3$	I-420	130.22
4968	alcohol (*dl*)	3-methyl-heptanol-3	$C_2H_5(CH_3)C(OH){\cdot}CH_2{\cdot}CH_2{\cdot}C_2H_5$	I-421	130.22
4969	alcohol (*dl*)	4-methyl-heptanol-4	$(C_2H_5CH_2)_2C(OH){\cdot}CH_3$	I-421	130.22
4970	amine (*n*)	1-amino-octane	$CH_3(CH_2)_7NH_2$	IV-196	129.24
4971	amine (*n*)(*sec*)	2-amino-octane	$C_6H_{13}{\cdot}CH(NH_2){\cdot}CH_3$	IV-196	129.24
4972	amine	2-Et-1-amino-hexane	$C_4H_9(C_2H_5)CH{\cdot}CH_2{\cdot}NH_2$	.....	129.24
4973	bromide (*n*)	1-bromo-octane	$CH_3(CH_2)_6CH_2Br$	I-160	193.13
4974	bromide (*n*)(*sec*)	2-bromo-octane	$C_6H_{13}{\cdot}CHBr{\cdot}CH_3$	I-160	193.13
4975	chloride (*n*)	1-chloro-octane	$CH_3(CH_2)_6CH_2Cl$	I-159	148.67
4976	chloride (*n*)(*sec*)	2-chloro-octane	$C_6H_{13}{\cdot}CHCl{\cdot}CH_3$	I-160	148.67
4977	cinnamate (*n*)(*sec*)	.....	$C_6H_5{\cdot}CH{:}CH{\cdot}CO_2{\cdot}CH(CH_3)C_6H_{13}$	*IX-230	260.36
4978	fluoride (*n*)	1-fluoro-octane	$CH_3(CH_2)_6CH_2F$	I-159	132.22
4979	formate (*d*)	β-octyl formate	$HCO_2{\cdot}C_8H_{17}$	II-22	158.23
4980	iodide (*n*)	1-iodo-octane	$CH_3(CH_2)_6CH_2I$	I-160	240.14
4981	nitrate (*n*)	.....	$CH_3(CH_2)_7O{\cdot}NO_2$	I-419	175.22
4982	nitrite (*n*)	.....	$CH_3(CH_2)_7O{\cdot}NO$	I-419	159.22

Octyl acetate (*sec*) 1219
Octyl cyanide 5047
Octylene 1923
Oenanthaldoxime 3522
Oenanthole 3521
Oenanthone 2267
Oenanthylic acid 3520
Oenanthylic nitrile 3648
Oenanthylidene 3558
Oestriol 2902
Oestroform 2903
Oil of apples 496
Oil of bananas 398
Oil of bitter almonds 642
Oil of cinnamon 1501

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4946	col. lq.	$0.717^{20°}_{4}$	−112.3	109.8^{760mm}	i.	sl. s.	s.
4947	col. lq.	$0.692^{20°}_{4}$	−107.4	99.3^{760mm}	i.	sl. s.	s.
4948	col. lq.	$0.726^{20°}_{4}$	.....	113.6^{760mm}	i.	sl. s.	s.
4949	col. lq.	$0.720^{20°}_{4}$	−110	113.4^{760mm}	i.	sl. s.	s.
4950	lq.	$0.703^{20°}_{4}$	.....	114	i.	sl. s.	s.
4951	lq.	$0.712^{20°}_{4}$	.....	115.8	i.	sl. s.	s.
4952	lq.	$0.703^{20°}_{4}$	.....	109.8	i.	sl. s.	s.
4953	col. lq.	$0.694^{20°}_{4}$	−90.7	109.2	i.	sl. s.	s.
4954	lq.	$0.719^{20°}_{4}$	.....	117.9	i.	sl. s.	s.
4955	lq.	$0.713^{20°}_{4}$	.....	118.6	i.	sl. s.	s.
4956	col. lq.	$0.698^{20°}_{4}$	−111.3	117.2	i.	sl. s.	s.
4957	lq.	$0.705^{20°}_{4}$	.....	119.0	i.	sl. s.	s.
4958	lq.	$0.717^{20°}_{4}$	.....	118	i.	sl. s.	s.
4959	col. lq.	$0.885^{0°}_{4}$	−38.5	210	i.	s.	s.
4960	col. lq.	$0.873^{20°}_{20°}$	−93	199	$<0.03^{20°}$	∞	∞
4961	col. lq.	$0.827^{20°}_{4}$	−16	194-5	sl. s.	∞	∞ ; ∞ chl.
4962	col. lq.	$0.822^{20°}_{4}$	−38.6	179-80	v. sl. s.	∞	∞
4963	lq.	$0.830^{20°}$	.....	$160\text{-}175^{0mm}$	.....	s.	s.
4964	lq.	$0.842^{20°}$	−20	146.5-7.5	i.	sl. s.	s.
4965	col. lq.	$0.834^{20°}_{20°}$	< −76	184	$0.1^{20°}$	s.	s.
4966	lq.	$0.838^{20°}_{4}$	.....	160.5	.....	∞	∞
4967	lq.	$0.879^{20°}$	.....	162	.....	.....	.....
4968	lq.	$0.820^{21°}$	.....	162	i.	.....	.....
4969	lq.	$0.825^{20°}$	.....	161.5	i.	.....	.....
4970	col. lq.	$0.777^{27°}$	.....	$175\text{-}77^{45mm}$	v. sl. s.	s.	s.
4971	lq.	$0.771^{25°}_{4}$	.....	164-5	.....	.....	.....
4972	lq.	$0.792^{20°}_{20°}$	.....	167-8	.....	.....	.....
4973	col. lq.	$1.118^{15°}$	−15	202-3	i.	∞	∞
4974	lq.	$1.099^{22°}$	.....	188-9	.....	.....	.....
4975	lq.	$0.892^{0°}_{4}$	.....	182.5-3.5	i.	.....	.....
4976	lq.	$0.871^{15°}$	.....	171-3	i.	.....	s.
4977	lq.	$0.972^{17°}_{4}$	.....	240^{60mm}	.....	.....	.....
4978	col. lq.	$0.804^{21°}$	.....	142.5^{754mm}	i.	.....	.....
4979	col. lq.	$0.872^{12.5°}$	.....	82^{20mm}	i.	.....	.....
4980	lq.	$1.337^{16°}_{4}$	−45.9	225.5	.....	.....	.....
4981	lq.	$0.975^{0°}_{4}$	.....	$110\text{-}22^{0mm}$	.....	.....	.....
4982	gn. lq.	$0.862^{17°}$	.....	175-7	.....	.....	.....

Oil of garlic 1684
Oil of mirbane 4646
Oil of mustard 220
Oil of niobe 4138
Oil of pears 398
Oil of wintergreen 4380
Oil red 5664
Oil scarlet 5664
Olein 3430
Olifiant gas 3192
Omal 6164
Ononin, cf. glcde.
Opianin, cf. alkd.
Opianyl 4017
Opin, cf. alkd.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
4983	**Octyl** stearate (*n*) (*sec*)	.....	$C_{17}H_{35}CO_2{\cdot}CH(CH_3){\cdot}C_6H_{13}$	*II-173	396.68
4984	**Octylene** (α)†	octene-1	$CH_3(CH_2)_5CH{:}CH_2$	I-221	112.21
4985	**Octylene**	2,3,3-trimethyl-pentene-1	$C_2H_5{\cdot}C(CH_3)_2{\cdot}C(CH_3){:}CH_2$	.....	112.21
4986	**Octylene**	2,4,4-trimethyl-pentene-1	$(CH_3)_3C{\cdot}CH_2{\cdot}C(CH_3){:}CH_2$	I-222	112.21
4987	**Octylene**	2,3,4-trimethyl-pentene-2	$(CH_3)_2CH{\cdot}C(CH_3){:}C(CH_3)_2$	.....	112.21
4988	**Octylene**	3,4,4-trimethyl-pentene-2	$(CH_3)_3C{\cdot}C(CH_3){:}CH{\cdot}CH_3$	.....	112.21
4989	**Octylene**	3-ethyl-hexene-2	$CH_3{\cdot}CH{:}C(C_2H_5){\cdot}CH_2{\cdot}C_2H_5$	I-222	112.21
4990	**Octylene**	2-methyl-heptene-2	$(CH_3)_2C{:}CH{\cdot}CH_2{\cdot}CH_2{\cdot}C_2H_5$	I-222	112.21
4991	**Octyne-1**	caprylidene	$CH_3{\cdot}(CH_2)_5{\cdot}C{\vdots}CH$	I-258	110.19
4992	**Oleic acid**	.....	$CH_3(CH_2)_7CH{:}CH{\cdot}(CH_2)_7CO_2H$	II-463	282.45
4993	**Opianic acid**	(5,6;2,1)	$(CH_3O)_2C_6H_2{:}(CHO)CO_2H$	X-990	210.18
4994	**Orange I**	*p*-sulfobenzene-azo-α-naphthol Na	$NaO_3S{\cdot}C_6H_4{\cdot}N{:}N{\cdot}C_{10}H_6{\cdot}OH$	*XVI-296	350.32
4995	**Orange II**	*p*-sulfobenzene-azo-β-naphthol Na	$NaO_3S{\cdot}C_6H_4{\cdot}N{:}N{\cdot}C_{10}H_6{\cdot}OH$	*XVI-296	350.32
4996	**Orange IV**	4'-anilino-azo-benzene-4-sulfonic Na	$NaO_3S{\cdot}C_6H_4{\cdot}N{:}N{\cdot}C_6H_4{\cdot}NH{\cdot}C_6H_5$	*XVI-319	375.37
4997	**Orcein**	.....	$C_{28}H_{24}O_7N_2$	.....	500.49
4998	**Orcinol**	5-methyl resorcinol	$CH_3{\cdot}C_6H_3(OH)_2$	VI-882	124.13
4999	**Orcin-phthalein**	.....	$C_{22}H_{16}O_5$	XIX-236	360.35
5000	**Ornithine**	α,δ-diaminovaleric acid	$H_2N{\cdot}(CH_2)_3{\cdot}CH{:}(NH_2)CO_2H$	IV-420	132.16
5001	**Orsellinic acid** (4,6;2,1)	.....	$(HO)_2C_6H_2(CH_3){\cdot}CO_2H{\cdot}aq.$	X-412	168.14
5002	**Ortal sodium**	*n*-hexyl-ethyl-barbituric Na	$C_6H_{13}(C_2H_5){:}C_4HO_2N_2ONa$	.....	262.29
5003	**Orthochrom T**	.....	$C_{23}H_{22}N_2{\cdot}(C_2H_5I)$	XXIII-310	482.40
5004	**Ostruthin**	.....	$C_{19}H_{22}O_3$	.....	298.37
5005	**Oxalenediur-amidoxime**	oxaldiureide-dioxime	$[H_2N{\cdot}CO{\cdot}NH{\cdot}C{\cdot}(:NOH)]_2$	III-65	204.15
5006	**Oxalic** acid	ethandioic acid	$HO_2C{\cdot}CO_2H$	II-502	90.04
5007	acid	ethandioic acid	$(CO_2H)_2{\cdot}2H_2O$	II-502	126.07
5008	Na salt	sodium oxalate	$(CO_2Na)_2$	II-513	134.01
5009	amide	oxamide	$(CO_2NH_2)_2$	II-545	88.07
5010	anilide	oxanilide	$(CO{\cdot}NH{\cdot}C_6H_5)_2$	XII-284	240.25
5011	chloride	oxalyl chloride	$Cl{\cdot}CO{\cdot}CO{\cdot}Cl$	II-542	126.93
5012	imide	oximide	$CO{\cdot}CO{\cdot}NH$ |_____|	XXI-368	71.04
5013	**Oxaluric** acid	.....	$NH_2{\cdot}CO{\cdot}NH{\cdot}CO{\cdot}CO_2H$	III-64	132.08
5014	amide	oxalan	$C_3H_5O_3N_3$	III-65	131.09
5015	**Oxamaethane**	ethyl oxamate	$NH_2{\cdot}CO{\cdot}CO_2C_2H_5$	II-544	117.10

† See also di-iso-butylene.

Orange-III 4328
Orange-GS 4996
Orange-N 4996
Orcin (β) 2380
Oreson 3400
Orexin 5182
Orizabin, cf. glcde.
Orthamine 5256
Orthanilic acid 523
Orthoform new 4112
Ortol, mixt. of 2314 and 4116
Ouabain, cf. glcde.
Oxalacetic ester 2192
Oxalacetone 2939

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
4983	col. cr.	$0.841^{\frac{3}{4}8°}$	34	235^{6mm}	.....	.....	.....
4984	lq.	$0.721^{\frac{1}{4}8°}$	.....	126	i.	∞	∞
4985	col. lq.	$0.736^{\frac{20}{4}°}$	.....	108.2^{760mm}	.....	.....	.....
4986	col. lq.	$0.715^{\frac{20}{4}°}$	−93.6	101.2^{760mm}	.....	.....	.....
4987	col. lq.	.....	.....	114.3^{739mm}	.....	.....	.....
4988	col. lq.	$0.740^{\frac{20}{4}°}$	.....	111.9^{760mm}	.....	.....	.....
4989	lq.	$0.736^{\frac{20}{0}°}$	.....	119.4	i.	.....	.....
4990	col. lq.	$0.725^{\frac{20}{0}°}$	.....	122.4^{756mm}	i.	.....	.....
4991	lq.	$0.743^{\frac{25}{4}°}$	< −70	$131-2^{762mm}$	.....	.....	.....
4992	col. nd.	$0.854^{\frac{7}{4}8°}$	14	$285-6^{100mm}$	i.	∞	∞
4993	nd./aq.	.....	150	.....	0.25 c.; 1.7 h.	s.	s.
4994	or. red pd.	.....	.....	.....	s.	.....	.....
4995	or. red pd.	.....	.....	.....	s.	.....	.....
4996	or. yel. pd.	.....	.....	.....	s.	.....	.....
4997	brn. cr.	.....	.....	.....	i. chl., CS_2	s.; s. ac.	i.; i. bz.
4998	pr./bz.	$1.290^{4°}$	107-8*	287-90	v. s.	v. s.	v. s.
4999	pr./act.	.....	d. >230	.....	i.; s. h. ac.	s.; s. alk.	i.; i. bz.
5000	syrup	.....	.....	.....	v. s.	v. s.	sl. s.
5001	cr.	.....	176 d. (anh.)	$-H_2O$, 100	s. gly.	v. s.	$22^{20°}$
5002	wh. pd.	.....	.....	.....	v. s.	s.	i.
5003	gn. pr./al.	.....	.....	.....	sl. s. h.	s. h.	.....
5004	cr./aq. al.	.....	117-9	.....	i.; i. pet.	s. h.	s. chl.
5005	nd./aq. al.	.....	191-2 d.	.....	i. c.; i. bz.; s. a.	s.; i. lg.; s. alk.	i.; i. chl.
5006	col. rhb.	1.90	186-7 d.	subl. > 100	$10^{20°}$; $120^{100°}$	$24^{15°}$ abs.	$1.3^{15°}$ abs.
5007	col. mn.	$1.653^{\frac{1}{4}0°}$	101.5	$-2H_2O$, 100	.....	.....	.....
5008	cr. pd.	.....	.....	.....	$3.2^{16°}$	i.	6.6 h. aq.
5009	mn.	1.667	417-9 d.	.....	$0.047^{.3°}$; $0.6^{100°}$	i.	i.
5010	pl./bz.	.....	247-50	>320	i. h.	sl. s. h.	sl. s. h.
5011	col. lq.	$1.488^{\frac{1}{4}3°}$	−12	$63-4^{763mm}$	d.	d.	s.
5012	pr.	.....	.....	.....	v. sl. s.; d. h.	sl. s. NH_4OH	.....
5013	cr.	.....	.....	.....	v. sl. s.; d. h.	.....	.....
5014	cr. ppt.	.....	d.	.....	i. c.	s. H_2SO_4	s. d. KOH
5015	rhb.	.....	114-5	.....	s.	v. sl. s. bz.	s.

* Crysts. + $1H_2O$/aq., m. p. 56° ±.

Oxalan 5014
Oxaldiureide dioxime 5005
Oxalic nitrile 1588
Oxalyl chloride 5011
Oxalyl urea 5036
Oxamide 5009
Oxanilide 5010
Oximide 5012
Oximido-mesoxalyl urea 6445
Oxindole 2686
Oxine 3825
Oxy-, cf. also hydroxy-.
Oxyacanthine, cf. alkd.
Oxycaproic acid 3759

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5016	**Oxamic** acid	.....	$NH_2{\cdot}CO{\cdot}CO_2H$	II-543	89.05
5017	hydrazide	amino-oxamide	$NH_2{\cdot}CO{\cdot}CO{\cdot}NH{\cdot}NH_2$	II-559	103.08
5018	**Oxanilic acid**	.....	$C_6H_5NH{\cdot}CO{\cdot}CO_2H$	XII-281	165.14
5019	**Oxanthranol**	anthrahydroquinone	$C_6H_4(COCHOH)C_6H_4$	VIII-190	210.22
5020	diacetate	.....	$C_{14}H_8(O_2C{\cdot}CH_3)_2$	VI-1034	294.29
5021	**Oxindol** †	.....	$C_6H_4{\cdot}CH_2{\cdot}CO{\cdot}NH$ (ring)	XXI-282	133.14
5022	**Palmitic** acid	hexadecanoic acid	$CH_3(CH_2)_{14}{\cdot}CO_2H$	II-370	256.42
5023	aldehyde	hexadecanal	$CH_3(CH_2)_{14}{\cdot}CHO$	I-717	240.42
5024	aldehyde oxime	.....	$C_{15}H_{31}{\cdot}CH{:}NOH$	I-717	255.43
5025	amide	.....	$C_{15}H_{31}{\cdot}CO{\cdot}NH_2$	II-374	255.43
5026	anhydride	.....	$(C_{15}H_{31}CO)_2O$	II-374	494.82
5027	chloride	palmityl chloride	$C_{15}H_{31}{\cdot}CO{\cdot}Cl$	II-374	274.87
5028	nitrile	pentadecyl cyanide	$C_{15}H_{31}{\cdot}CN$	II-375	237.42
5029	**Palmitolic acid**	.....	$CH_3(CH_2)_7C{\vdots}C{\cdot}(CH_2)_5{\cdot}CO_2H$	II-494	252.38
5030	**Palmitone**	.....	$(C_{15}H_{31})_2CO$	I-719	450.81
5031	**Panthesin**	.....	$C_{18}H_{32}O_5N_2S$	.....	388.51
5032	**Pantocaine**	*p*-butylaminobenzoyl-dimethylaminoethanol	$C_4H_9NH{\cdot}C_6H_4CO_2{\cdot}(CH_2)_2N(CH_3)_2HCl$	.....	300.82
5033	**Pantothenic** acid (*dl*)	.....	$HOCH_2C(CH_3)_2CH{\cdot}(OH)CONH{\cdot}(CH_2)_2{\cdot}CO_2H$	.....	219.23
5034	acid (*d*)	.....	$C_9H_{17}O_5N$	.....	219.23
5035	Ca salt (*d*)	.....	$(C_9H_{16}O_5N)_2Ca$	.....	476.53
5036	**Parabanic acid**	oxalyl urea	$C_3H_2O_3N_2$	XXIV-449	114.06
5037	**Paracotoin**	.....	$CH_2O_2{:}C_{11}H_6O_2$	.....	216.18
5038	**Pararosaniline** base (4,4′,4″)	triamino-triphenylcarbinol	$HO{\cdot}C(C_6H_4{\cdot}NH_2)_3$	XIII-750	305.37
5039	hydrochloride	parafuchsin	$C_{19}H_{18}N_3Cl{\cdot}H_2O$	XIII-752	341.83
5040	**Parvoline** (α)	2,4-diEt-pyridine	$C_9H_{13}N$	XX-253	135.20
5041	**Parvoline** (β)	3,4-diEt-pyridine	$C_9H_{13}N$	XX-253	135.20
5042	**Pelargonic** acid	nonanoic acid	$CH_3(CH_2)_7{\cdot}CO_2H$	II-352	158.23
5043	aldehyde	nonanal	$CH_3(CH_2)_7{\cdot}CHO$	I-708	142.23
5044	aldehyde oxime	.....	$C_8H_{17}{\cdot}CH{:}NOH$	I-708	157.25
5045	amide	nonanamide	$CH_3(CH_2)_7CO{\cdot}NH_2$	II-353	157.25
5046	chloride	pelargonyl chloride	$CH_3(CH_2)_7{\cdot}COCl$	II-353	176.68
5047	nitrile	octyl cyanide	$CH_3(CH_2)_7{\cdot}CN$	II-354	139.23
5048	**Penta**-aminobenzene	.....	$(NH_2)_5C_6H$	XIII-346	153.19
5048.1	bromoacetone	.....	$Br_3C{\cdot}CO{\cdot}CHBr_2$	I-659	399.58
5049	bromobenzene	.....	Br_5C_6H	V-215	472.65
5050	bromoethane	.....	$CHBr_2{\cdot}CBr_3$	I-95	424.61
5051	bromophenol	.....	$Br_5C_6{\cdot}OH$	VI-206	488.65
5052	chloroaniline	.....	$Cl_5C_6{\cdot}NH_2$	XII-631	265.37
5053	chlorobenzene	.....	Cl_5C_6H	V-205	250.35
5054	chloroethane	pentalin	$CHCl_2{\cdot}CCl_3$	I-87	202.31
5055	chloroethylbenzene	alkazene-32	$Cl_5C_6{\cdot}C_2H_5$	V-355	278.41
5056	chloro-1-keto-1,2,3,4-tetrahydronaphthalene	2,2,3,4,4-penta-Cl	$C_{10}H_5OCl_5$	VII-370	318.43
5057	chlorophenol	.....	$Cl_5C_6{\cdot}OH$	VI-194	266.35
5058	cosane	.....	$C_{25}H_{52}$	I-175	352.67

† See also No. 2686.

Oxychalcone 3763
Oxydimorphine, cf. alkd.
Oxyjuglon(e) 4477
Oxymethyl-acetamide 3291
Oxyneurine 846
Oxyneurine HCl, cf. alkd.
Oxypurine, cf. alkd.
Palmitin 3431
Palmityl chloride 5027
Papaveraldine, cf. alkd.
Papaverine, cf. alkd.
Parabutyraldehyde 1162, 1165
Paracamphoric acid 1197
Paraconine, cf. alkd.
Paraformaldehyde 3290
Parafuchsine 5039
Parafuchsine carbinol base 5038
Paralactic acid 3939
Paraldehyde 7
Paraldol 170

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5016	cr. pd.	.....	210 d.	.....	v. sl. s.	i. abs.	i.
5017	col. lf./aq.	.....	221-3 d.	.....	$0.3^{20°}$	i.; s. a.	i.; s. alk.
5018	nd./bz.	.....	150	.....	sl. s. h.	v. s.	v. s.
5019	yel. nd.	.....	.....	.....	.....	s.	s. alk.
5020	nd./ac.	.....	108-9	.....	.....	s.	s. ac.
5021	col. nd./aq.	.....	120	22^{773mm}	s. h.	s.	s.; s. alk.
5022	col. pl.	$0.849^{\frac{7}{4}0°}$	63-4	271.5^{100mm}	i.; v. sl. s. pet.	$9.3^{20°}$ abs.	s.; s. chl.
5023	wh. wax	.....	34	$200\text{-}2^{29mm}$	i.	s.	s.
5024	nd./aq. al.	.....	88	.....	sl. s. bz.	sl. s. pet.	s.; s. chl.
5025	cr. lf.	.....	106-7	$235\text{-}6^{12mm}$	.....	.....	.....
5026	col. cr.	.....	64	.....	.....	.....	.....
5027	col. cr.	.....	12	$194\text{-}5^{17mm}$	d.	d.	sl. s.
5028	pl.	$0.822^{\frac{31}{4}°}$	31	251.5^{100mm}	i.	s.	s.
5029	nd./aq.	.....	42	240^{15mm}	i.	v. s.	v. s.
5030	lf./al.	$0.800^{\frac{83}{4}°}$	82.8	.....	i.	.....	.....
5031	wh. pd.	.....	157-9	.....	33	s.	.....
5032	wh. pd.	.....	148-50*	.....	14	s.	i.
5033	col. syrup	.....	.....	.....	s.	s.	s. act.
5034	syrup	.....	.....	.....	s.	s.	s. act.
5035	col. cr.	.....	.....	.....	s.	s. Me al.	sl. s. act.
5036	mn.	.....	243 d.	subl. 100	$4.7^{8°}$	s.	i.
5037	yel. cr.	.....	162	.....	.....	s.	s.; s. chl.
5038	col. lf.	.....	205 d.	.....	v. sl. s.	s.	i.
5039	gn. met.	.....	d. 250	.....	$0.31^{22°}$	.....	.....
5040	lq.	$0.934^{0°}$	.....	188	sl. s.	s.	.....
5041	lq.	0.916	.....	209^{710mm}	.....	.....	.....
5042	col. oil	$0.906^{\frac{20}{4}°}$	12.5	253-4	v. sl. s.	s.; s. chl.	s.
5043	lq.	$0.827^{\frac{19}{19}°}$	.....	185	.....	.....	.....
5044	lf./aq. al.	.....	63-4	.....	i.	s.	s.
5045	col. cr.	.....	99-100	.....	i. c.	sl. s.	sl. s.
5046	col. lq.	$0.946^{\frac{15}{4}°}$	<−60	215.4^{760mm}	d.	d.	s.
5047	col. lq.	$0.786^{16°}$	.....	214-6	i.	s.	s.
5048	salts only	.....	.....	.....	.....	.....	.....
5048.1	rhb. nd./al.	.....	79-80(72)	subl.	i. c.	v. s.	v. s.
5049	nd./ac.	.....	293	.....	i.; s. bz.	sl. s.	sl. s.
5050	mn. pr.	3.312	56-7	210^{300mm} d.	i.	s.	v. s.
5051	mn./al.	.....	225-6	subl.	i.	sl. s.	sl. s.
5052	nd./al.	.....	232	.....	sl. s. lg.	s.	s.
5053	nd./al.	$1.834^{17°}$	85-6	275-7	i.	s. h.	v. s.
5054	col. lq.	$1.671^{\frac{25}{4}°}$	−22	162	i.	∞	∞
5055	cr./al. bz.	$1.552^{\frac{60}{25}°}$	53	305±	i.; v. s. bz.	$2^{25°}$ Me al.	$166^{25°}$
5056	mn./bz.	.....	156-7	d. >200, −HCl	s. h. bz.	v. s.	i.
5057	mn.	$1.978^{22°}$	188-9	309^{754mm} d.	$0.003^{50°}$	v. s.	$148^{25°}$
5058	cr.	$0.791^{60°}$	53.3	$282\text{-}4^{40mm}$	.....	s. abs.	.....

* Free base, m. p. 153-4°.

Param 2080
Paramorphine, cf. alkd.
Pararosolic acid 593
Parietic acid 2306
Parillin, cf. glcde.
Paris green 3594
Parodyne 565
Paviin, cf. glcde.
P.D.H. 5261
Pear oil 398
Peganine, cf. alkd.
Pelargonamide 5045
Pelargone 2685
Pelargonyl chloride 5046
Pelletierine, cf. alkd.
Pellotine, cf. alkd.
Penta-acetyl glucose 3362-3

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5059	**Penta** decanaldoxime	.....	$C_{14}H_{29}\cdot CH{:}NOH$	I-716	241.41
5060	decane (*n*)	.....	$CH_3(CH_2)_{13}\cdot CH_3$	I-172	212.41
5061	decyl acetate (*n*)	.....	$CH_3CO_2\cdot C_{15}H_{31}$	II-136	270.44
5062	decyl alcohol (*n*)	pentadecanol-1	$CH_3(CH_2)_{13}\cdot CH_2OH$	I-429	228.41
5063	decyl bromide	1-bromo-pentadecane	$CH_3(CH_2)_{13}\cdot CH_2Br$	I-172	291.31
5064	diene-1,3	piperylene	$CH_3CH{:}CH\cdot CH{:}CH_2$	I-251	68.11
5065	diene-2,3	.....	$CH_3CH{:}C{:}CHCH_3$	I-251	68.11
5066	erythritol	pentaerythrite	$C(CH_2OH)_4$	I-528	136.15
5067	erythritol tetra-acetate	.....	$C(CH_2O_2CCH_3)_4$	II-150	304.29
5068	ethylbenzene	.....	$(C_2H_5)_5C_6H$	V-471	218.37
5069	glycerol	.....	$CH_3\cdot C(CH_2OH)_3$	I-520	120.15
5070	hydroxy benzophenone	mori(n)tannic acid; maclurin	$(HO)_2C_6H_3\cdot CO\cdot C_6H_2(OH)_3\cdot H_2O$	VIII-538	280.23
5071	iodobenzene	.....	I_5C_6H	V-229	707.67
5072	iodoethane	.....	$CHI_2\cdot CI_3$	*I-31	659.63
5073	methyl-amino-benzene	.....	$(CH_3)_5C_6\cdot NH_2$	XII-1182	163.25
5074	methyl benzene	.....	$(CH_3)_5C_6H$	V-443	148.24
5075	methyl benzoic acid	.....	$(CH_3)_5C_6\cdot CO_2H$	IX-569	192.25
5076	methyl para-rosaniline	methyl violet base	$C_{24}H_{29}ON_3$	XIII-755	375.50
5077	methyl pararosaniline chloride	methyl violet dye salt †	$C_{24}H_{28}N_3\cdot Cl$	XIII-755	393.95
5078	methyl phenol	.....	$(CH_3)_5C_6\cdot OH$	VI-551	164.24
5079	methylene-tetrazol	metrazol; cardiazol	$\cdot N(CH_2)_5C{:}(N_3)$	.....	138.17
5080	triacontane (*n*)	.....	$CH_3(CH_2)_{33}\cdot CH_3$	I-177	492.93
5081	**Pentaldol**	2,2-diMe-propan-3-ol-1-al	$(CH_3)_2C(CHO)\cdot CH_2OH$	I-833	102.13
5083	**Pentane**	*n*-pentane	$(C_2H_5)_2CH_2$	I-130	72.15
5084	**Pentane** (*iso*)	2-methyl-butane	$(CH_3)_2CH\cdot C_2H_5$	I-134	72.15
5085	**Pentane** (*neo*)	2,2-dimethyl-propane	$(CH_3)_4C$	I-141	72.15
5086	**Pentyne-1**	propyl acetylene	$C_2H_5\cdot CH_2\cdot C{:}CH$	I-250	68.11
5087	**Pentyne-2**	valerylene	$C_2H_5\cdot C{:}C\cdot CH_3$	I-250	68.11
5088	**Perchloro**-ether	.....	$Cl_5C_2\cdot O\cdot C_2Cl_5$	II-210	418.61
5089	methyl mercaptan	.....	$Cl_3C\cdot S\cdot Cl$	III-135	185.90
5090	**Perseite** (*d*)	mannoheptitol	$C_7H_{16}O_7$	I-548	212.20
5091	**Phanodorn**	Et-cyclohexenyl-barbituric acid	$(C_2H_5)(C_6H_9){:}C_4H_2O_3N_2$	.....	236.26
5092	**Phellandrene** (α)(*d*)	*p*-menthadiene-1,5	$C_{10}H_{16}$	V-129	136.23
5093	**Phellandrene** (β)	*p*-menthadiene-2,1(7)	$C_{10}H_{16}$	V-132	136.23
5094	**Phenacyl** acetate	ω-acetoxy-acetophenone	$C_6H_5\cdot CO\cdot CH_2\cdot O\cdot CO\cdot CH_3$	VIII-92	178.18
5095	**Phenanthrene**	.....	$(C_6H_4CH)_2$	V-667	178.22
5096	hydroquinone	(9,10)	$C_{14}H_8(OH)_2$	VI-1035	210.22
5097	**Phenanthraquinone**	phenanthrene quinone	$C_6H_4(CO)_2C_6H_4$	VII-796	208.20
5098	**Phenanthrol** (2)	.....	$C_{14}H_9OH$	VI-704	194.22
5099	**Phenanthrol** (3)	.....	$C_{14}H_9OH$	VI-705	194.22

† Commercial dye mostly penta- with some hexa-methyl derivative.

Penta-diazenone 5480
Penta-decanol 5062
Penta-decyl cyanide 5028
Penta-erythrite 5066
Penta-hydroxy-flavone 5806-7
Penta-methylene 1619
Penta-methylene-diamine 1184
Penta-methylene-dibromide 1857
Penta-methylene-dicyanide 5311
Penta-methylene-diiodide 2396
Pentalin 5054
Pentanal 6400
Pentandioic acid 3376
Pentandiolamine 243
Pentane diethylsulfone 5872
Pentanoic acid 6399
Pentanol 404-5, 408
Pentanone 2180, 4355
Pentanpentol 572, 6478
Pentanthiol 467-8
Pentaphen 476

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5059	nd./aq. al.	.....	86	.....	sl. s. c. pet.	sl. s. c.	v. s.; sl. s. bz.
5060	col. lq.	$0.770^{\frac{20}{4}°}$	10	270.5	i.	v. s.	v. s.
5061	wax	.....	10-1	230^{70mm}	.....	.....	.....
5062	cr.	.....	45-6	.....	.....	.....	.....
5063	cr.	.....	14-5	.....	.....	.....	.....
5064	lq.	$0.679^{\frac{25}{4}°}$	.....	42-4	.....	.....	.....
5065	lq.	$0.702^{\frac{20}{0}°}$	.....	49-51	.....	.....	.....
5066	cr.	.....	260	.....	$5.6^{15°}$	.....	.....
5067	nd./aq. or bz.	.....	83-4	.....	.....	.....	.....
5068	lq.	$0.896^{\frac{20}{4}°}$	<−20	277	i.	.....	.....
5069	nd./abs. al.	.....	199	subl.	v. s.	v. s.	i.
5070	yel. pr./aq.	.....	200(anh.)	$-H_2O$, 130-40	$0.5^{15°}$	s.	s.
5071	cr./al.	.....	172	.....	s. h. ac.	sl. s. c.	sl. s.
5072	col./ac.	.....	182-4	.....	s. ac.	s.	s. bz.
5073	mn./al.	.....	151-2	278-80	i. h.	s.	s.
5074	pr./aq. al.	$0.847^{\frac{19}{4}°}$	53	230-1	i.	v. s.	.....
5075	nd./aq. al.	.....	210.5	subl.	v. sl. s.	v. s. h.	.....
5076	salts only	.....	.....	.....	.....	.....	.....
5077	red or b. vl.	.....	.....	.....	s.	.....	.....
5078	nd./al.	.....	125	267	0.15 h.	s. h. aq. NaOH	.....
5079	wh. cr. pd.	.....	57-8	.....	s.	s.	s.
5080	cr.	$0.782^{\frac{7.1}{4}.7°}$	$\alpha 75; \beta 72$	331^{15mm}	.....	.....	.....
5081	col. nd./al.	.....	96-7	$172\text{-}3^{747mm}$ d.	5 c.	2.5 c.	s.
5083	col. lq.	$0.630^{\frac{18}{4}°}$	−129.7	36.3	i.	∞	∞
5084	col. lq.	$0.621^{19°}$	−160.0	27.95	i.	∞	∞
5085	lq.	$0.613^{\frac{20}{4}°}$	−20	9.5	i.	s.	s.
5086	col. lq.	$0.722^{0°}$	−95	48-9	i.	.....	s.
5087	lq.	$0.713^{\frac{17}{4}.2°}$	−101	55.5	i.	.....	.....
5088	tet.	$1.900^{14.5°}$	69	d.	.....	.....	.....
5089	yel. lq.	$1.695^{17.5°}$	.....	149 sl. d.	.....	.....	.....
5090	nd.	.....	188	.....	$6.9^{18°}$	s. h.	$44^{74°}$ aq.
5091	wh. cr. pd.	.....	173±	.....	sl. s.	22	6
5092	lq.	$0.845^{20°}$	.....	175	.....	i.	s.
5093	lq.	$0.852^{\frac{20}{4}°}$	.....	171-2	i.	i.	s.
5094	rhb. pl./et. or lg.	.....	48-9	270	i.; s. chl.	s.; sl. s. bz.	s.; sl. s. lg.
5095	pl./al.	$1.179^{25°}$	99-100	340	i.; s. CS_2	$2^{14°}$; 10 h.	v. s.; s. bz.
5096	col. nd.	.....	147-8	.....	s. h.	v. s.	v. s.; v.s.bz.
5097	or. nd.	$1.405^{4°}$	206.5-7.5	>300; subl.	v. sl. s.	s. h.; s. bz.	sl. s.
5098	lf./aq. al.	.....	168-9	.....	.....	v. s.	v. s.
5099	nd./aq. al.	.....	119-22	.....	sl. s. h.	v. s.	v. s.

Pentazane 5523
Pentendioic acid 3370
Pentene, cf. amylene.
Pentene 498, 501
Pentenoic acid 190
Pentenol 3189
Pentobarbital 4583
Pentolite 2895
Pentylene, cf. amylene.
Pentylene glycol 503
Perbromo-benzene 3561
Perbromo-ethane 3562
Perbromo-ethylene 5721
Percaine 1025
Perchloro-benzene 3563
Perchloro-ethane 3564
Perchloro-ethylene 5741
Perchloro-propane 4936
Peri acid 4543
Periodo-benzene 3589
Periodo-ethylene 5812
Periplocin, cf. glcde.
Pernoston 1061
Phaseolunatin, cf. glcde.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5100	**Phenanthrol** (9)	phenanthrone	$C_{14}H_9OH$	VI-706	194.22
5101	**Phenanthroline** (*o*)	(1,10)	$C_{12}H_8N_2$	XXIII-227	180.20
5102	**Phenanthroline** (*m*)	(1,5)	$C_{12}H_8N_2 \cdot 2H_2O$	XXIII-227	216.23
5103	**Phenanthroline** (*p*)	(1,8)	$C_{12}H_8N_2 \cdot 4H_2O$	XXIII-228	252.26
5104	**Phenazine**	azophenylene	$C_6H_4:N_2:C_6H_4$	XXIII-223	180.20
5105	**Phenetidine** (*o*)	*o*-aminophenetole	$C_2H_5O \cdot C_6H_4 \cdot NH_2$	XIII-359	137.18
5106	**Phenetidine** (*m*)	.....	$C_2H_5O \cdot C_6H_4 \cdot NH_2$	XIII-404	137.18
5107	**Phenetidine** (*p*)	.....	$C_2H_5O \cdot C_6H_4 \cdot NH_2$	XIII-436	137.18
5108	citrate	citrophen	$C_8H_{11}ON \cdot C_6H_8O_7$	XIII-437	329.30
5109	hydrochloride	.....	$C_8H_{11}ON \cdot HCl$	XIII-437	173.64
5110	tartrate	vinopyrin	$C_8H_{11}ON \cdot C_4H_6O_6$	XIII-437	287.26
5111	**Phenetole**	ethyl-phenyl ether	$C_2H_5 \cdot O \cdot C_6H_5$	VI-140	122.16
5112	**Phenetyl urea** (*p*)	dulcin; sucrol; valzin	$C_2H_5O \cdot C_6H_4 \cdot NH \cdot CO \cdot NH_2$	XIII-480	180.20
5113	**Phenobarbital**	Et-Ph-barbituric acid; luminal; gardenal	$(C_2H_5)(C_6H_5):C_4H_2O_3N_2$	*XXIV-423	232.23
5114	Na salt	"soluble"	$C_{12}H_{11}O_3N_2Na$	.....	254.22
5115	**Phenocoll**	glycine-*p*-phenetidide	$C_2H_5O \cdot C_6H_4 \cdot NH \cdot CO \cdot CH_2 \cdot NH_2 \cdot H_2O$	XIII-506	212.24
5116	hydrochloride	phenamine-HCl	$C_{10}H_{14}O_2N_2 \cdot HCl$	XIII-506	230.69
5117	salicylate	salocoll	$C_{10}H_{14}O_2N_2 \cdot C_7H_6O_3$	.....	332.35
5118	**Phenol**	carbolic acid	$C_6H_5 \cdot OH$	VI-113	94.11
5119	Na salt	sodium phenoxide	$C_6H_5ONa \cdot 3H_2O$	VI-136	170.15
5120	Na salt	.....	$C_6H_5ONa \cdot 2C_6H_5OH$	*VI-78	304.31
5121	phthalein	.....	$C_{20}H_{14}O_4$	XVIII-143	318.31
5122	phthalin	phthalin	$C_{20}H_{16}O_4$	X-455	320.33
5123	sulfonic acid (*o*)	.....	$HO \cdot C_6H_4 \cdot SO_3H \cdot \frac{3}{4}H_2O$	XI-234	187.68
5124	sulfonic acid (*m*)	.....	$HO \cdot C_6H_4 \cdot SO_3H \cdot 2H_2O$	XI-239	210.20
5125	sulfonic acid (*p*)	.....	$HO \cdot C_6H_4 \cdot SO_3H$	XI-241	174.17
5126	sulfonic Na (*p*)	Na sulfocarbolate	$C_6H_5O_4SNa \cdot 2H_2O$	XI-241	232.19
5127	sulfonphthalein	phenol red	$C_{19}H_{14}O_5S$	XIX-91	354.36
5128	tricarboxylic acid	(2;1,3,5)	$HOC_6H_2(CO_2H)_3 \cdot aq.$	X-580	226.14
5129	**Phenoxthine**	phenothioxine; dibenzothioxine (1,4)	$C_6H_4 \cdot O \cdot C_6H_4 \cdot S$ (ring)	XIX-45	200.24
5130	**Phenoxy**-acetic acid	.....	$C_6H_5O \cdot CH_2 \cdot CO_2H$	VI-161	152.14
5131	acetic amide	phenoxyacetamide	$C_6H_5O \cdot CH_2 \cdot CONH_2$	VI-162	151.16
5132	acetone	ω-acetoanisole	$C_6H_5O \cdot CH_2 \cdot COCH_3$	VI-151	150.17
5133	benzoic acid (*o*)	salicylic phenyl ether	$C_6H_5O \cdot C_6H_4 \cdot CO_2H$	X-65	214.21
5134	butyronitrile (γ)	.....	$C_6H_5O \cdot (CH_2)_3 \cdot CN$	VI-164	161.20
5135	β′-chloroethyl ether	(β)	$C_6H_5O \cdot (CH_2)_2 \cdot O \cdot CH_2 \cdot CH_2Cl$	.....	200.66
5136	ethyl alcohol	phenyl cellosolve	$C_6H_5O \cdot (CH_2)_2 \cdot OH$	VI-146	138.16
5137	ethyl aniline	(*N*)(β)	$C_6H_5O \cdot (CH_2)_2 \cdot NH \cdot C_6H_5$	.....	213.27
5138	**Phenthiazine**	thiodiphenylamine	$C_6H_4 \cdot NH \cdot C_6H_4 \cdot S$ (ring)	XXVII-63	199.26
5139	**Phenyl** acetaldehyde	α-toluylaldehyde	$C_6H_5 \cdot CH_2 \cdot CHO$	VII-292	120.14
5140	acetamide	.....	$C_6H_5 \cdot CH_2 \cdot CO \cdot NH_2$	IX-437	135.16

Phenacaine HCl 2910
Phenacyl acetone 52
Phenacyl alcohol 754
Phenacyl amine 239
Phenacyl bromide 887
Phenacyl chloride 1303
Phenanthrene-quinone 5097
Phenanthrone 5100
Phenazone 565
Phenic acid 5118
Phenodin 3499
Phenol propionic acid 3711-3

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5100	col. nd.	.....	152-3	.....	v. sl. s.	v. s.	v. s.
5101	cr./bz.	.....	98-100*	>300	0.3	s.	s.
5102	pl./aq.	.....	66; anh. 78	>360	s. h.; i. bz.	v. s.	v. sl. s.
5103	nd./aq.	.....	173(anh.)	subl. > 100	s. h.	s.	sl. s.
5104	yel. nd.	.....	170-1	>360	v. sl. s.	2 c.; s. h.	s.
5105	oil	.....	<-21	228-9	i.	s.	s.
5106	lq.	.....	.....	180-205^{100mm}	i.	s.	s.
5107	lq.	1.061$^{15°}$	3-4	254-5	i.	s.	s.
5108	wh. cr. pd.	.....	186-8	.....	2.5	sl. s.	.....
5109	col. pl.	.....	233-4	subl.	v. s.	.....	.....
5110	col. lf.	.....	168 ±	d. 150-5	v. s.	sl. s.	i.
5111	col. lq.	0.967$^{20°}_{4°}$	-30.2	172	i.	∞	∞
5112	lf./aq. al.	.....	173-4	.....	0.12$^{15°}$; 0.5$^{100°}$	4	s.
5113	lf./aq.	.....	174 (156; 166)	.....	0.1 c.; s. h.	14; s. alk.	10
5114	wh. cr. pd.	.....	.....	.....	100	11	i.; i. chl.
5115	nd.	.....	95 ± ; 100.5 (anh.)	.....	sl. s.	s.	.....
5116	wh. cr. pd.	.....	.....	.....	5	s.	sl. s.
5117	wh. nd.	.....	.....	.....	0.5 c.	5 h. aq.	.....
5118	col. nd.	1.071$^{25°}_{4°}$	42-3	181.4	8.2$^{15°}$; ∞$^{65.3°}$	∞	∞
5119	col. cr.	.....	.....	d. by CO_2	23.8 c.	7.4$^{100°}$	20$^{25°}$ gly.
5120	cr.	.....	.....	.....	80$^{25°}$ ±	.....	.....
5121	col. rhb.	1.277$^{32°}_{4°}$	261	.....	0.2$^{20°}$; s. h.	21 c.; s. alk.	5.9 c.; v. sl. s. chl.
5122	nd./aq. al.	.....	225	.....	0.02$^{20°}$	.....	.....
5123	cr.	.....	50 d.	.....	v. s.	v. s.	.....
5124	nd.	.....	-1.5H_2O, 100	-2H_2O, 140	.....	.....	.....
5125	delq. nd.	.....	.....	.....	s.	s.	.....
5126	col. mn.	.....	.....	.....	24 c.; 125 h.	0.8 c.; 8 h.	.....
5127	red nd./ac.	.....	.....	.....	0.03 h.	0.3	i.; s. alk.
5128	cr./aq.	.....	-H_2O, 120	d. 180	0.5$^{100°}$	s. h.	sl. s.; i. chl
5129	nd./al.	1.226$^{60°}_{25°}$	56-7	185-7^{23mm}	i.; 165$^{25°}$ bz.	7$^{25°}$ Me al. 200$^{25°}$act.	165$^{25°}$
5130	nd./aq.	.....	98-9	285 sl. d.	1.2$^{100°}$; v. s. h.	s.; s. ac.	29$^{25°}$; 3$^{25°}$ bz.
5131	nd./aq.	.....	101-2	.....	v. sl. s. h.	s. h.	.....
5132	col. oil	.....	.....	229-30	.....	.....	.....
5133	lf./aq. al.	.....	113-14.5	355 sl. d.	sl. s. h.	v. s.	v. s.
5134	nd.	.....	45-6	287-9^{765mm}	.....	.....	.....
5135	pa. yel. lq.	.....	.....	138-43^{8mm}	i.	s.	s.
5136	oil	1.109$^{20°}_{0°}$	12.5	244.7	2$^{25°}$	∞ ; s. KOH	∞ ; ∞ bz.
5137	cr.	1.070$^{80°}_{25°}$	44-9	202^{10mm}	i.; v. s. bz.	v. s.; v. s. act.	v. s.; v. s. CCl_4
5138	yel. lf./al.	.....	184-5	subl. 371	i.; 3$^{25°}$ bz.	2$^{25°}$; 27$^{25°}$ act.	7$^{25°}$
5139	lq.	1.025$^{20°}$	.....	193-4	v. sl. s.	∞	∞
5140	lf.	.....	156-7	d. 280-90	v. sl. s. c.	s.	v. sl. s.

* Crysts. + 1H_2O/aq., m. p. 92-3°; anh., m. p. 117°.

Phenol red 5127
Phenol-tetrachlorophthalein 5744
Phenoquin 5234
Phenothiazine 5138
Phenothioxine 5129
Phenoval 1008
Phenoxy-acetamide 5131
Phenoxy-ethyl bromide 969
Phenoxy-phenol 3770
Phenyl-, cf. also diphenyl-.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5141	**Phenyl** acetate	acetyl phenol	$C_6H_5{\cdot}O{\cdot}CO{\cdot}CH_3$	VI-152	136.14
5142	acetic acid	α-toluic acid	$C_6H_5{\cdot}CH_2{\cdot}CO_2H$	IX-431	136.14
5143	acetanilide	phenacetyl-anilide	$C_6H_5CH_2CO{\cdot}NHC_6H_5$	XII-275	211.25
5144	acetophenone (*p*)	Me-diphenylyl ketone	$C_{12}H_9{\cdot}CO{\cdot}CH_3$	VII-443	196.24
5145	acetyl chloride	.....	$C_6H_5{\cdot}CH_2{\cdot}CO{\cdot}Cl$	IX-436	154.59
5146	acetylene	.....	$C_6H_5{\cdot}C{:}CH$	V-511	102.13
5147	acridine (9)	.....	$C_6H_5{\cdot}C_{13}H_8N$	XX-514	255.30
5148	alanine (*dl*)	α-amino-β-phenyl-propionic acid	$C_6H_5CH_2{\cdot}CH(NH_2){\cdot}CO_2H$	XIV-498	165.19
5149	alanine (β)(*l*)	α-amino-hydrocin-namic acid	$C_6H_5CH_2{\cdot}CH(NH_2){\cdot}CO_2H$	XIV-495	165.19
5150	alanine (β,β)	β-amino-hydrocin-namic acid	$C_6H_5{\cdot}CH(NH_2){\cdot}CH_2{\cdot}CO_2H$	XIV-493	165.19
5151	angelic acid	α-ethyl-cinnamic acid	$C_6H_5{\cdot}CH{:}C(C_2H_5){\cdot}CO_2H$	IX-623	176.21
5152	angelic acid (*stereo isomer*)	.....	$C_6H_5{\cdot}CH{:}C(C_2H_5){\cdot}CO_2H$	IX-623	176.21
5153	aniline (*o*)	2-amino-diphenyl	$C_6H_5{\cdot}C_6H_4{\cdot}NH_2$	XII-1317	169.22
5154	aniline (*m*)	3-amino-diphenyl	$C_6H_5{\cdot}C_6H_4{\cdot}NH_2$	XII-1318	169.22
5155	aniline (*p*)	4-amino-diphenyl	$C_6H_5{\cdot}C_6H_4{\cdot}NH_2$	XII-1318	169.22
5156	anthracene (9)	.....	$C_6H_5{\cdot}C_{14}H_9$	V-725	254.31
5157	anthranilic acid (*N*)(*o*)	*o*-anilino-benzoic acid	$C_6H_5NH{\cdot}C_6H_4{\cdot}CO_2H$	XIV-327	213.23
5158	arsonic acid	Ph-arsinic acid	$C_6H_5{\cdot}AsO(OH)_2$	XVI-868	202.03
5159	benzoate	.....	$C_6H_5{\cdot}CO_2{\cdot}C_6H_5$	IX-116	198.21
5160	benzoic acid (*o*)	diPh-carboxylic acid	$C_6H_5{\cdot}C_6H_4{\cdot}CO_2H$	IX-669	198.21
5161	benzoic acid (*m*)	.....	$C_6H_5{\cdot}C_6H_4{\cdot}CO_2H$	IX-671	198.21
5162	benzoic acid (*p*)	.....	$C_6H_5{\cdot}C_6H_4{\cdot}CO_2H$	IX-671	198.21
5163	benzoylene urea (3)	.....	$C_6H_4{\cdot}NH{\cdot}CO{\cdot}N{\cdot}(C_6H_5){\cdot}CO$	XXIV-376	238.24
5164	benzylcarbinol	.....	$C_6H_5{\cdot}CHOH{\cdot}CH_2{\cdot}C_6H_5$	VI-683	198.25
5165	benzylurethane	ethyl *N*-Ph-*N*-benzyl-carbamate	$C_6H_5CH_2(C_6H_5)N{\cdot}CO_2C_2H_5$	.....	255.30
5166	bromoacetate	.....	$Br{\cdot}CH_2{\cdot}CO_2C_6H_5$	VI-154	215.05
5167	carbamate	"phenyl urethane"	$NH_2{\cdot}CO_2{\cdot}C_6H_5$	VI-159	137.13
5168	carbylamine chloride	*iso*-cyanophenyl chloride	$C_6H_5{\cdot}N{:}CCl_2$	XII-447	174.03
5169	chloroacetate	.....	$Cl{\cdot}CH_2{\cdot}CO_2C_6H_5$	VI-153	170.59
5170	4-chlorobenzene-sulfonate	.....	$Cl{\cdot}C_6H_4{\cdot}SO_3{\cdot}C_6H_5$	.....	268.71
5171	cinchonoyl-urethane	fantan	$C_6H_5{\cdot}C_9H_5N{\cdot}NH{\cdot}CO_2C_2H_5$	.....	292.32
5172	cinnamic acid (α)(*trans*)	.....	$C_6H_5{\cdot}CH{:}C(C_6H_5){\cdot}CO_2H$	IX-691	224.25
5173	cinnamic acid (α)(*cis*)	.....	$C_6H_5{\cdot}CH{:}C(C_6H_5){\cdot}CO_2H$	IX-693	224.25
5174	cinnamic acid (β)	.....	$(C_6H_5)_2C{:}CH{\cdot}CO_2H$	IX-699	224.25
5175	crotonic acid (γ)(3)	.....	$C_{10}H_{10}O_2$	IX-614	162.18

Phenyl-acetanilide 5143
Phenyl-acetone 4146
Phenyl-acetonitrile 800
Phenyl-aceturic acid 110
Phenyl acetylsalicylate 120
Phenyl acid 5208
Phenyl-acrolein 1501
Phenyl-acrylic acid 591, 1497-8, 1500
Phenyl-amine 513
Phenyl-aminophenol 3767-9
Phenyl-azide 6079
Phenyl-benzamide 715
Phenyl-benzene 2695
Phenyl-benzimidazole 690
Phenyl-benzochromone 4479
Phenyl-benzopyrone 3243
Phenyl-benzothiazole 687
Phenyl-benzylamine 786
Phenyl-benzyl ketone 1660
Phenyl bromide 902
Phenyl-butane 1049-52
Phenyl-butyl ketone 1117-8
Phenyl-butyne 3120
Phenyl-carbamide 5253

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5141	col. lq.	$1.073_{25}^{25°}$	.....	195.8^{756mm}	v. sl. s.	∞ ; ∞ chl.	∞
5142	lf.	$1.081_{4}^{80°}$	76-7	265.5	s. h.	v. s.	v. s.
5143	pr./al.	.....	117-8	.....	i. aq. KOH	s.; i. H_2SO_4	s.
5144	pr./act.	.....	121	325-7	.....	s.	s. act.
5145	col. lq.	$1.168_{4}^{20°}$	.....	170^{250mm}	d.	d.	.....
5146	col. lq.	$0.930_{4}^{20°}$	-43	142-3	i.	∞	∞
5147	yel. pr.	.....	181	403-4	i.; s. bz.	s. h.	s.
5148	lf./al.	.....	271-3 d.	.....	sl. s. c.	v. sl. s. h.	i.
5149	cr./aq.	.....	d. 275-83	.....	3.1$^{25°}$	v. sl. s.	v. sl. s.
5150	cr./aq.	.....	231 d.	.....	s. h.; s. alk.	s. h.; s. aq. a.	sl. s.
5151	nd./aq.	.....	104-5	.....	0.01$^{25°}$; s. h.	v. s.	sl. s. pet.
5152	nd./aq.	.....	82	.....	sl. s. h.	s.	s.; s. bz.
5153	cr./aq. al.	.....	45-6	299^{760mm}	sl. s.	s.	.....
5154	nd.	.....	30	254^{135mm}	sl. s.	s.	s.
5155	lf./aq. al.	.....	50-2	302	s. h.	s.	s.
5156	lf./al.	.....	152-3	417	s. h. bz.	s. h.	s. h.
5157	nd./al.	.....	183-4	d. > 184	v. sl. s. h.	s. h.	v. sl. s.
5158	cr./aq.	1.760	157-8	$-H_2O$ > 158	3.3$^{28°}$	15.5$^{26°}$	i. chl.
5159	mn.	1.235$^{31°}$	70-1	314	i.	v. s. h.	v. s. h.
5160	cr./aq. al.	.....	113-4	343-4	i. c.	s.	s. bz.
5161	lf./al.	.....	160-1	.....	sl. s.	s.	s.
5162	nd./al.	.....	219-20	subl.	sl. s. h.	s.	s.
5163	nd.	.....	282	.....	i.	sl. s.	s. NaOH
5164	nd./aq. al.	.....	67-8	167-70^{10mm}	0.06 h.	420$^{7°}$	v. s.
5165	col. lq.	.....	.....	180-2^{12mm}	.....	.....	.....
5166	lf./al.	.....	32	140^{20mm}	.....	.....	.....
5167	nd./aq.	1.078$^{63.8°}$	141-3	.....	sl. s.	s.	.....
5168	lq.	.....	.....	209-10	sl. d. h.	d.	.....
5169	nd./al.	.....	44-5	230-5	i.	s.	s.
5170	col. cr.	.....	90-1	.....	i.	s. h.	s.
5171	yel. wh. cr.	.....	173-4	.....	i.; s. chl.	sl. s.; sl. s. bz.	sl. s.
5172	wh. nd./ aq. al.	.....	172	subl.	s. h.	s.	s.
5173	nd.	.....	137-8	.....	s. h.	.....	.....
5174	lf./al.	.....	162	.....	sl. s. h.	s.	s.
5175	pl./bz.	.....	65	.....	s. bz.	s.; s. CS_2	s.

Phenyl carbinol 782
Phenyl carbonate 2711
Phenyl-carbonimide 5177
Phenyl-carbylamine 5178
Phenyl-catechol 2339
Phenyl cellosolve 5136
Phenyl chloride 1324
Phenyl-chloroform 735
Phenyl-cinchonic acid 5234
Phenyl-cyanamide 1578
Phenyl-*iso*-cyandichloride 5168
Phenyl cyanide 716
Phenyl-diacetamide 1670
Phenyl-dibromopropionic acid 1830
Phenyl-dichlorophosphine 5270
Phenyl-dimethylpyrazolone 565
Phenyl disulfide 2715
Phenyl-ethane 2973
Phenyl-ethanolamine 2930
Phenyl ether 2719
Phenyl-ethylacetic acid 3119
Phenyl-ethyl bromide 937-8
Phenyl-ethyl carbinol 3123
Phenyl-ethyl ether 5111

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5176	**Phenyl** crotonic acid (*iso*)	.....	$C_6H_5{\cdot}CH{:}CH{\cdot}CH_2{\cdot}CO_2H$	IX-612	162.18
5177	*iso*-cyanate	phenyl carbonimide	$C_6H_5{\cdot}N{:}CO$	XII-437	119.12
5178	*iso*-cyanide	phenyl carbylamine	$C_6H_5{\cdot}N{:}C$	XII-191	103.12
5179	cyclohexane	cyclohexylbenzene	$C_6H_5{\cdot}CH(CH_2)_4{\cdot}CH_2$	V-503	160.25
5180	3,4-dichlorobenzene sulfonate	.....	$Cl_2C_6H_3{\cdot}SO_3{\cdot}C_6H_5$	.....	303.16
5181	diethanolamine	.....	$(HO{\cdot}CH_2{\cdot}CH_2)_2N{\cdot}C_6H_5$	XII-183	181.23
5182	dihydroquinazoline	orexin	$C_6H_4{\cdot}CH_2{\cdot}N(C_6H_5){\cdot}CH{:}N$	XXIII-137	208.25
5183	ditolylmethane (4,4′)	.....	$C_6H_5{\cdot}CH(C_6H_4{\cdot}CH_3)_2$	V-712	272.37
5184	di-*o*-xenyl phosphate	phosphen 6	$(C_{12}H_9O)_2{:}PO{\cdot}OC_6H_5$	.....	478.46
5185	ethyl acetate (*β*)	.....	$C_6H_5{\cdot}C_2H_4{\cdot}O_2CCH_3$	VI-479	164.20
5186	ethyl alcohol (*α*)	Me-Ph-carbinol	$C_6H_5{\cdot}CHOH{\cdot}CH_3$	VI-475	122.16
5187	ethyl alcohol (*β*)	benzyl carbinol	$C_6H_5{\cdot}CH_2{\cdot}CH_2OH$	VI-478	122.16
5188	ethylamine (*α*)(*dl*)	.....	$C_6H_5{\cdot}CH(NH_2){\cdot}CH_3$	XII-1094	121.18
5189	ethylamine (*β*)	*ω*-phenyl-ethylamine	$C_6H_5{\cdot}CH_2{\cdot}CH_2{\cdot}NH_2$	XII-1096	121.18
5190	ethyl benzoate (*β*)	.....	$C_6H_5CO_2{\cdot}C_2H_4{\cdot}C_6H_5$	.....	226.26
5191	ethyl chloride (*β*)	*β*-Cl-ethyl benzene	$C_6H_5{\cdot}CH_2CH_2Cl$	V-354	140.61
5192	ethyl cinnamate (*β*)	.....	$C_6H_5{\cdot}CH{:}CH{\cdot}CO_2{\cdot}CH_2{\cdot}CH_2{\cdot}C_6H_5$	.....	252.30
5193	*d*-glucosazone	Ph-*d*-fructosazone	$(C_6H_5NHN)_2C_6H_{10}O_4$	XV-225	358.39
5194	glycine (*N*)	anilino-acetic acid	$C_6H_5{\cdot}NH{\cdot}CH_2{\cdot}CO_2H$	XII-468	151.16
5195	glycine *o*-carboxylic acid	.....	$HO_2C{\cdot}C_6H_4{\cdot}NHCH_2{\cdot}CO_2H$	XIV-348	195.17
5196	hydrazine	.....	$C_6H_5{\cdot}NH{\cdot}NH_2$	XV-67	108.14
5197	hydrazine HCl	.....	$C_6H_5N_2H_3{\cdot}HCl$	XV-108	144.61
5198	hydrazine-*p*-sulfonic acid	.....	$H_2N{\cdot}NH{\cdot}C_6H_4{\cdot}SO_3H$	XV-639	188.20
5199	hydrazoquinoline	(*α*)	$C_6H_5(NH)_2C_9H_6N$	XXII-564	235.28
5200	hydroxylamine (*β*)	.....	$C_6H_5{\cdot}NH{\cdot}OH$	XV-2	109.12
5201	hydroxylamine (*β*)	(oxalate salt)	$2C_6H_5NHOH{\cdot}H_2C_2O_4$	.....	308.28
5202	3-methylpyrazolone	(*N*)	$C_4H_5ON_2{\cdot}C_6H_5$	XXIV-20	174.20
5203	morpholine (4)	.....	$(CH_2)_2{\cdot}O{\cdot}(CH_2)_2{\cdot}N{\cdot}C_6H_5$	XXVII-6	163.21
5204	naphthalene (*α*)	.....	$C_6H_5{\cdot}C_{10}H_7$	V-687	204.26
5205	naphthalene (*β*)	.....	$C_6H_5{\cdot}C_{10}H_7$	V-687	204.26
5206	*α*-naphthylamine	(*N*)	$C_6H_5{\cdot}NH{\cdot}C_{10}H_7$	XII-1224	219.27
5207	*β*-naphthylamine	(*N*)	$C_6H_5{\cdot}NH{\cdot}C_{10}H_7$	XII-1275	219.27
5208	1-naphthylamine-8-sulfonic acid	(*N*); phenyl (peri) acid	$C_6H_5{\cdot}NH{\cdot}C_{10}H_6{\cdot}SO_3H$	XIV-753	299.33
5209	*α*-naphthyl carbinol	.....	$C_6H_5{\cdot}CHOH{\cdot}C_{10}H_7$	VI-710	234.28
5210	*α*-naphthyl ketone	benzoyl-naphthalene	$C_6H_5{\cdot}CO{\cdot}C_{10}H_7$	VII-510	232.27
5211	*β*-naphthyl ketone	.....	$C_6H_5{\cdot}CO{\cdot}C_{10}H_7$	VII-511	232.27
5212	nitroamine	.....	$C_6H_5{\cdot}NH{\cdot}NO_2$	.....	138.12
5213	nitromethane	*ω*-nitrotoluene	$C_6H_5{\cdot}CH_2{\cdot}NO_2$	V-325	137.13

Phenyl-ethyl-hydantoin 3126
Phenyl-ethyl ketone 3129
Phenyl-ethyl sulfide 3132
Phenyl-ethylene 5646
Phenyl-ethylene oxide 5648
Phenyl fluoride 3258
Phenyl-formanilide 3306
Phenyl-fructosazone 5193
Phenyl-glycine ethyl ester 3125
Phenyl-glyoxaloxime 4874
Phenyl-glyoxylic acid 758
Phenyl-hydrocinnamic acid 2739
Phenyl-hydroquinone 2338
Phenyl-hydroxycrotonic acid 637
Phenyl iodide 3879

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5176	nd./aq.	.....	88	302 sl. d.	sl. s. h.	v. s.	v. s.
5177	lq.	$1.096^{\frac{20}{4}\circ}$	.....	166^{769mm}	d.	d.	v. s.
5178	col. lq.	$0.978^{15\circ}$	.....	78^{40mm}	d.	d.	s.
5179	oil	$0.944^{\frac{20}{0}\circ}$	7-8	239^{745mm}	.....	.....	.....
5180	col. nd.	.....	82-5	.....	i.	s. h.	v. s.
5181	cr.	.....	58-9	>350 sl. d.	$5^{25\circ}$;$23^{25\circ}$ bz.	v. s.; v. s. act.	$29^{25\circ}$
5182	pl./et. lg.	$1.290^{4\circ}$	95	d.	i.	s.	s.
5183	nd./Me al.	.....	55-6	.....	v. s. bz.	sl. s. c.	v. s.
5184	col. lq.	$1.20^{\frac{60}{4}\circ}$	.....	285-330^{5mm}	i.	v. s.	∞ bz.; ∞ CCl_4
5185	lq.	$1.051^{22.5\circ}$	.....	232	.....	.....	.....
5186	lq.	$1.019^{\frac{13}{4}\circ}$	.....	203.6^{745mm}	i.	∞	∞
5187	col. oil	$1.023^{\frac{13}{4}\circ}$	.....	$219\text{-}21^{750mm}$	$1.6^{20\circ}$	s. aq. al.	∞
5188	oil	$0.940^{15\circ}$	.....	187.5^{741mm}	$4.2^{20\circ}$	∞	∞
5189	lq.	$0.958^{\frac{24}{4}\circ}$	.....	198	s.	∞	∞
5190	yel. lq.	.....	.....	$204\text{-}6^{25mm}$	i.	s.	s.
5191	oil	$1.069^{\frac{25}{4}\circ}$	.....	190-200 sl. d.	.....	.....	.....
5192	col. cr.	.....	57-8	.....	i.	sl. s.	v. s.
5193	yel. nd.	.....	205 d.	.....	i.	0.66 abs.	25 c. pyr.
5194	cr.	.....	127	.....	s.	s.	sl. s.
5195	nd./Me al.	.....	218-20	.....	sl. s.	s.	s.; i. bz.
5196	lt. yel. oil	$1.097^{\frac{23.7}{4}\circ}$	19.6*	243.5	sl. s. h.	∞; ∞ chl.	∞; ∞ bz.
5197	lf./al.	.....	240-3	.....	v. s.	s.	i.
5198	cr./al.	.....	286	.....	$0.6^{12\circ}$; 3 h.	sl. s.	.....
5199	nd./al.	.....	191	.....	s. chl.	sl. s.	i.; s. ac.
5200	col. nd.	.....	81-2	.....	2 c.; 10 h.	v. s.	v. s.; v. sl. s. lg.
5201	col. nd.	.....	120-2 d.	.....	sl. s.	s.	i.
5202	pr./aq.	.....	128	191^{17mm}	$1^{20\circ}$	v. s. h.	v. sl. s.
5203	cr./al. et.	.....	57	270±	$1.0^{20\circ}$	s.	s.
5204	waxy	.....	45±	336-7	v. s. bz.	v. s.	v. s.
5205	lf./al.	.....	102.5	345-6	v. s. bz.	sl. s.	sl. s.
5206	pr./al.	.....	62	335^{528mm}	s. bz.	s.; s. ac.	s.; s. chl.
5207	rhb./Me al.	.....	107-8	395.5	i.; s. h. bz.	v. s. h.	v. s. h.
5208	lf.	.....	.....	.....	v. sl. s.	.....	.....
5209	cr./al.	.....	88	>360	i.	v. s.	v. s.
5210	rhb./al.	.....	75.5	385	i.	$2.4^{12\circ}$ abs.	.....
5211	rhb./al.	.....	82	398^{754mm}	i.	$2^{12\circ}$ abs.	.....
5212	lf./lg.	.....	46	expl. 98	sl. s. c.	v. s.	sl. s. lg.
5213	yel. lq.	$1.160^{\frac{20}{0}\circ}$	.....	$141\text{-}2^{35}$ sl. d.	.....	.....	.....

* Crysts. + $\frac{1}{2}H_2O$, m. 24° ±.

Phenyl mercaptan 5915
Phenyl-mercuric acetate 4036
Phenyl-mercuric chloride 4037
Phenyl-mercuric nitrate 4038
Phenyl-methyl-, cf. also methyl-phenyl-.
Phenyl-methylamino-propanol, cf. alkd.
Phenyl-methyl carbinol 5186
Phenyl-methyl-hydrazine 4338-40
Phenyl-methyl ketone 51
Phenyl mustard oil 5241
Phenyl-naphthyl-methane 817-8

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5214	**Phenyl** phenacyl bromide	ω-Br-*p*-phenyl-acetophenone	$C_6H_5 \cdot C_6H_4 \cdot CO \cdot CH_2 \cdot Br$	.....	275.14
5215	phenacyl chloride	ω-Cl-*p*-phenyl-acetophenone	$C_6H_5 \cdot C_6H_4 \cdot CO \cdot CH_2 \cdot Cl$	VII-443	230.69
5216	phenol (*o*)	2-hydroxy-diphenyl	$C_6H_5 \cdot C_6H_4 \cdot OH$	VI-672	170.20
5217	phenol (*m*)	3-hydroxy-diphenyl	$C_6H_5 \cdot C_6H_4 \cdot OH$	VI-673	170.20
5218	phenol (*p*)	4-hydroxy-diphenyl	$C_6H_5 \cdot C_6H_4 \cdot OH$	VI-674	170.20
5219	phosphine	.....	$C_6H_5 \cdot PH_2$	XVI-757	110.10
5220	propiolic acid	.....	$C_6H_5 \cdot C{:}C \cdot CO_2H$	IX-633	146.14
5221	propionate	.....	$C_2H_5 \cdot CO_2 \cdot C_6H_5$	VI-154	150.17
5222	*n*-propyl bromide	(γ)	$C_6H_5 \cdot (CH_2)_3 \cdot Br$	V-391	199.09
5223	propylene (α,α)	*iso*-allylbenzene	$C_6H_5 \cdot CH{:}CH \cdot CH_3$	V-481	118.17
5224	propylene (β)	α-methyl-styrene	$C_6H_5 \cdot C(CH_3){:}CH_2$	V-484	118.17
5225	propylene (γ)	.....	$C_6H_5 \cdot CH_2 \cdot CH{:}CH_2$	V-484	118.17
5226	pyridine (2)(α)	.....	$C_6H_5 \cdot C_5H_4N$	XX-424	155.19
5227	pyridine (3)(β)	.....	$C_6H_5 \cdot C_5H_4N$	XX-424	155.19
5228	pyridine (4)(γ)	.....	$C_6H_5 \cdot C_5H_4N$	XX-424	155.19
5229	pyrrole (*N*)	.....	$C_4H_4N \cdot C_6H_5$	XX-164	143.18
5230	quinoline (2)(α)	.....	$C_6H_5 \cdot C_9H_6N$	XX-481	205.25
5231	quinoline (4)	.....	$C_6H_5 \cdot C_9H_6N$	XX-483	205.25
5232	quinoline (6)(*p*)	.....	$C_6H_5 \cdot C_9H_6N$	XX-483	205.25
5233	quinoline (8)(*o*)	.....	$C_6H_5 \cdot C_9H_6N$	XX-484	205.25
5234	quinoline-4-carboxylic acid (2)	2-Ph-cinchonic acid; atophan	$C_6H_5 \cdot C_9H_5N \cdot CO_2H$	XXII-103	249.26
5235	salicylate	salol	$HO \cdot C_6H_4 \cdot CO_2 \cdot C_6H_5$	X-76	214.21
5236	semicarbazide (1)	.....	$C_6H_5NH \cdot NH \cdot CO \cdot NH_2$	XV-287	151.17
5237	semicarbazide (4)	.....	$C_6H_5 \cdot NH \cdot CO \cdot N_2H_4$	XII-378	151.17
5238	stearate	.....	$C_{17}H_{35}CO_2 \cdot C_6H_5$	VI-155	360.56
5239	succinic acid (α)	(*dl*)	$C_6H_5 \cdot C_2H_3(CO_2H)_2$	IX-865	194.18
5240	thioacetamide	thio-Ph-acetamide	$C_6H_5 \cdot CH_2 \cdot CS \cdot NH_2$	IX-460	151.22
5241	*iso*-thiocyanate	phenyl mustard oil	$C_6H_5 \cdot N{:}C{:}S$	XII-453	135.18
5242	thiohydantoic acid	phenyl-pseudothiohydantoic acid	$C_6H_5N{:}C(NH_2) \cdot S \cdot CH_2 \cdot CO_2H$	XII-411	210.25
5243	thiosemicarbazide	(1)	$C_6H_5NH \cdot NH \cdot CS \cdot NH_2$	XV-294	167.23
5244	thiourea	Ph thiocarbamide	$C_6H_5 \cdot NH \cdot CS \cdot NH_2$	XII-388	152.21
5245	toluene (*o*)	.....	$C_6H_5 \cdot C_6H_4 \cdot CH_3$	V-596	168.23
5246	toluene (*m*)	.....	$C_6H_5 \cdot C_6H_4 \cdot CH_3$	V-596	168.23
5247	toluene (*p*)	.....	$C_6H_5 \cdot C_6H_4 \cdot CH_3$	V-597	168.23
5248	*p*-toluene sulfonate	.....	$CH_3 \cdot C_6H_4 \cdot SO_3 \cdot C_6H_5$	XI-99	248.29
5249	*o*-tolyl ketone	Me benzophenone	$C_6H_5 \cdot CO \cdot C_6H_4 \cdot CH_3$	VII-439	196.24
5250	*m*-tolyl ketone	.....	$C_6H_5 \cdot CO \cdot C_6H_4 \cdot CH_3$	VII-440	196.24
5251	*p*-tolyl ketone	.....	$C_6H_5 \cdot CO \cdot C_6H_4 \cdot CH_3$	VII-440	196.24
5252	*p*-tolyl sulfone	Me diphenyl sulfone	$C_6H_5 \cdot SO_2 \cdot C_6H_4 \cdot CH_3$	VI-418	232.29
5253	urea	phenyl carbamide	$C_6H_5 \cdot NH \cdot CO \cdot NH_2$	XII-346	136.15
5254	urethane†(*N*)	Et-Ph-carbamate	$C_6H_5 \cdot NH \cdot CO_2C_2H_5$	XII-320	165.19
5255	xanthydrol (9)	.....	$C_6H_5 \cdot C_{13}H_8O(OH)$	XVII-138	274.30
5256	**Phenylene** diamine	1,2-diaminobenzene	$NH_2 \cdot C_6H_4 \cdot NH_2$	XIII-6	108.14
5257	diamine HCl (*o*)	.....	$C_6H_4(NH_2)_2 \cdot 2HCl$	XIII-14	181.07
5258	diamine (*m*)	1,3-diaminobenzene	$NH_2 \cdot C_6H_4 \cdot NH_2$	XIII-33	108.14
5259	diamine HCl (*m*)	.....	$C_6H_4(NH_2)_2 \cdot 2HCl$	XIII-38	181.07
5260	diamine (*p*)	1,4-diaminobenzene	$NH_2 \cdot C_6H_4 \cdot NH_2$	XIII-61	108.14
5261	diamine HCl (*p*)	.....	$C_6H_4(NH_2)_2 \cdot 2HCl$	.....	181.07
5262	diamine sulfonic acid (*p*)	2,5-diaminobenzene 1-sulfonic acid	$(NH_2)_2C_6H_3 \cdot SO_3H \cdot 2H_2O$	XIV-712	224.23

† See also No. 5167.

Phenyl-nitrosohydroxylamine 1574
Phenyl-oxydisulfide 2716
Phenyl-pentane 421-4
Phenyl peri acid 5208
Phenyl-phenol methyl ether 4073-4
Phenyl-phenylenediamine 313-4
Phenyl phosphate 6341
Phenyl phosphite 6343
Phenyl phthalate 2737
Phenyl-phthalimide 5273
Phenyl-propionaldehyde 3706
Phenyl-propionamide 3707
Phenyl-propionic acid 3683, 3704
Phenyl-propionitrile 3709
Phenyl-propionyl chloride 3708
Phenyl-propyl alcohol 3122, 3705
Phenyl-propyl carbinol 5436-7
Phenyl-propyl ketone 5439-40
Phenyl-pyrocatechol 2339
Phenyl succinate 2748
Phenyl-sulfanilic acid 2701

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5214	col. nd.	.....	124-5	.....	.....	$1.3^{25°}$	6.7 $^{18°}$ al.
5215	yel. cr. pd.	.....	126-7	.....	.....	v. s. h.	.....
5216	nd./pet.	.....	56-7	275	i.; s. lg.	s.; s. alk.	s.
5217	nd./aq.	.....	75-β	>300	sl. s.	v. s.	s. KOH
5218	nd./aq. al.	.....	164-5	305-8	i.; s. alk.	v. s.	v. s.
5219	lq.	$1.001^{15°}$	.....	160-1	.....	.....	.....
5220	nd./aq.	.....	136-7	subl.	v. sl. s.	v. s.	v. s.
5221	pr.	$1.047^{\frac{25}{25}°}$	20	211^{760mm}	.....	.....	.....
5222	col. lq.	.....	.....	$121\text{-}2^{20mm}$	.....	.....	s.
5223	col. lq.	$0.914^{\frac{20}{4}°}$	.....	176-7	i.	s.	s.
5224	col. lq.	$0.914^{\frac{20}{4}°}$	<-20	165^{764mm}	i.	∞	∞
5225	col. lq.	$0.893^{\frac{20}{6}°}$	.....	156-7	i.	s.	s.
5226	lq.	>1	.....	$269\text{-}70^{749mm}$	i.	s.	s.
5227	oil	>1	.....	$269\text{-}70^{749mm}$	i.	s.	s.
5228	lf./aq.	.....	77-8	274-5	s. h.	s.	s.
5229	pl.	.....	62	234	i.; s. pet.	s.; s. chl.	s.; s. bz.
5230	nd./aq. al.	.....	86	363	sl. s.	s. h.	s.
5231	nd./et.	.....	61-2	.....	i.	v. s.	v. s.
5232	cr./al.	$1.195^{20°}$	110-1	260^{77mm}	v. sl. s.	s.	s.
5233	lq.	.....	.....	283^{187mm}	s. bz.	s.	s.
5234	nd./Me al.	.....	217-9	.....	i.; s. alk.; 4h. Me al.	5 h. abs.; 3 h. act.	s.; s. a.; 0.4 h. bz.
5235	rhb./al.	$1.250^{\frac{20}{4}°}$	42-3	$172\text{-}3^{12mm}$	0.015	v. s. h.	s.; 80 bz.
5236	lf./aq.	.....	172	.....	s. h.	s.; s. act.	sl. s.
5237	rhb./aq.	.....	122	d. 140-70	sl. s. h.	s.	i.
5238	cr.	.....	52	267^{15mm}	i.	.....	.....
5239	cr./aq.	.....	168	$-H_2O$ > 168	s. h.; s. ac.	s.; i. lg.	s.; i. bz.
5240	rhb./al.	.....	97-8	d.	v. sl. s. h.	s.	s.
5241	col. lq.	$1.138^{\frac{15}{15}}$	-21	219-20	i.	s.	s.
5242	col. nd.	.....	157-8	.....	v. sl. s.; s. a.; s. alk.	v. sl. s.; sl. s. CS_2	v. sl. s.; v. sl. s. bz.
5243	pr./al.	.....	200-1 d.	.....	sl. s.	s. h.	sl. s.
5244	nd./aq.	1.3	154	.....	$0.26^{18°}$	s.	$5.9^{100°}$ aq.
5245	lq.	$1.010^{\frac{20}{4}°}$	.....	261-4	i.	s. abs.	s.
5246	lq.	$1.031^{0°}$	.....	272-7	i.	s. abs.	s.
5247	lf./lg.	$1.015^{27°}$	47-8	267	i.	s. abs.	s.
5248	rhb. nd./al.	.....	94-5	.....	i.; v. s. bz.	v. s.	v. s.
5249	col. lq.	.....	<-18	$312\text{-}5^{735mm}$	i.	v. s. 80% al.	v. s.
5250	lq.	$1.088^{17.5°}$	.....	321^{761mm}	∞ chl.	∞	∞
5251	mn.	.....	59-60(55)	326.5	i.; s. bz.	s.	s.
5252	pl./al.	.....	124.5	.....	sl. s. ac.	$1.62^{20°}$	sl. s. bz.
5253	mn.	1.302	147	d. 160	s. h.	s.	sl. s.
5254	pl./al.	$1.106^{\frac{30}{4}°}$	52-3	237 sl. d.	i. c.	s.	s.
5255	pr./bz. lg.	.....	159-60	subl.	sl. s. ac.	s. h.; s. bz.	s.; i. lg.
5256	lf./aq.	.....	103-4	256-8	s. h.	v. s.	v. s.
5257	nd.	.....	.....	.....	v. s.	.....	.....
5258	rhb.	$1.139^{\frac{5}{15}°}$	62.8	284-7	v. s.	v. s.	s.
5259	col. nd.	.....	.....	.....	v. s.	s.	.....
5260	mn.	.....	140	267	1 c.	s.	s.; s. chl.
5261	col. tri.	.....	.....	.....	v. s.	sl. s.	i. HCl
5262	pl./aq.	.....	.....	.....	s.	i.	i.; i. bz.

Phenyl sulfide 2749
Phenyl sulfone 2750
Phenyl-thiocarbamide 5244
Phenyl-tolylamine 4220
Phenyl-tolyl-hydrazine 4271-3
Phenyl-tolyl-methane 842-3
Phenyl-trityl ketone 731
"Phenyl urethane" 5167
Phenylene-cyclotriazine 252
Phenylene-dimercaptan 2820-2822
Phenylene-diphenyl 2703-5
Phenylene-guanidine 263
Phenylene-urea 709
Phillyrin, cf. glcde.
Phillyroside, cf. glcde.
Phloretinic acid 3713
Phloridzin, cf. glcde.
Phlorizin, cf. glcde.
Phloroglucinol 6218-9
Phloroglucinol carboxylic acid 6222
Phlorol 3114
Phlorone 2550
Phlorrhizin, cf. glcde.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Phenylene				
5263	diamine sulfonic acid (*p*) HCl	.....	$C_6H_8O_3N_2S{\cdot}2HCl$	.....	261.13
5264	**Phloretin**	dihydronaringenin	$C_{15}H_{14}O_5$	VIII-498	274.26
5265	**Phloroglucinol** triethyl ether	(1,3,5)	$C_6H_3(OC_2H_5)_3$	VI-1103	210.26
5266	trimethyl ether	(1,3,5)	$C_6H_3(OCH_3)_3$	VI-1101	168.19
5267	trioxime (1,3,5)	.....	$C_6H_6(:NOH)_3$	XV-34	171.16
5268	**Phorone**	*sym*-diisopropylidene acetone	$[(CH_3)_2C{:}CH]_2CO$	I-751	138.20
5269	***iso*-Phorone**	1,1,3-triMe-cyclohexene-3-one-5	$(CH_3)_3C_6H_5O$	VII-65	138.20
5270	**Phosphenyl chloride**	Ph-diCl-phosphine	$C_6H_5{\cdot}PCl_2$	XVI-763	178.99
5271	**Phosphobenzene**	.....	$C_6H_5{\cdot}P{:}P{\cdot}C_6H_5$	XVI-824	216.16
5272	**Phthalamidic acid** (*o*)	*o*-phthalamic acid	$NH_2{\cdot}CO{\cdot}C_6H_4{\cdot}CO_2H$	IX-809	165.14
5273	**Phthalanil**	*N*-Ph-phthalimide	$C_6H_5{\cdot}N{:}C_8H_4O_2$	XXI-464	223.22
5274	**Phthalic** acid (*o*)	phthalic acid	$C_6H_4(CO_2H)_2$	IX-791	166.13
5275	acid Na	(mono Na salt)	$C_8H_5O_4Na{\cdot}2H_2O$	IX-796	224.15
5276	acid (*m*)	isophthalic acid	$C_6H_4(CO_2H)_2$	IX-832	166.13
5277	acid (*p*)	terephthalic acid	$C_6H_4(CO_2H)_2$	IX-841	166.13
5278	aldehyde†(*o*)	.....	$C_6H_4(CHO)_2$	VII-674	134.13
5279	aldehyde (*m*)	.....	$C_6H_4(CHO)_2$	VII-675	134.13
5280	aldehyde (*p*)	.....	$C_6H_4(CHO)_2$	VII-675	134.13
5281	amide (*o*)	phthaldiamide	$C_6H_4(CO{\cdot}NH_2)_2$	IX-814	164.16
5282	anhydride (*o*)	.....	$C_6H_4(CO)_2O$	XVII-469	148.11
5283	dichloride (*o*) (*sym*)	phthalyl dichloride	$C_6H_4(COCl)_2$	IX-805	203.03
5284	dichloride (*o*)(*uns*)	phthalyl dichloride	$C_6H_4{\cdot}CO{\cdot}O{\cdot}C{:}Cl_2$	IX-805	203.03
5285	dichloride (*m*)	isophthalyldichloride	$C_6H_4(COCl)_2$	IX-834	203.03
5286	dichloride (*p*)	terephthalyl diCl	$C_6H_4(COCl)_2$	IX-844	203.03
5287	imide (*o*)	*o*-phthalimide	$C_6H_4(CO)_2NH$	XXI-458	147.13
5288	nitrile (*m*)	isophthalic nitrile	$C_6H_4(CN)_2$	IX-836	128.13
5289	nitrile (*p*)	terephthalic nitrile	$C_6H_4(CN)_2$	IX-846	128.13
5290	**Phthalide**	.....	$C_6H_4{\cdot}CH_2{\cdot}O{\cdot}CO$	XVII-310	134.13
5291	**Phthalonic acid**	(1,2)	$C_6H_4(CO_2H){\cdot}CO{\cdot}CO_2H$	X-857	194.14
5292	**Phthalophenone**	triPh-carbinol-*o*-carboxylic anhyd.	$(C_6H_5)_2C{\cdot}C_6H_4{\cdot}CO{\cdot}O$	XVII-391	286.31
5293	**Phytadiene**	.....	$C_{20}H_{38}$	I-263	278.50
5294	**Phytane**	.....	$C_{20}H_{42}$	I-174	282.54
5295	**Phytanol**	dihydrophytol	$C_{20}H_{41}OH$	.....	298.54
5296	sodium	.....	$C_{20}H_{41}ONa$	.....	320.53
5297	**Phytene**	.....	$C_{20}H_{40}$	I-227	280.52
5298	**Phytol**	.....	$C_{20}H_{39}OH$	I-453	296.52
5299	**Picene**	.....	$C_{22}H_{14}$	V-735	278.33
5300	**Picoline** (α)	2-methyl-pyridine	$CH_3{\cdot}C_5H_4N$	XX-234	93.12
5301	**Picoline** (β)	3-methyl-pyridine	$CH_3{\cdot}C_5H_4N$	XX-239	93.12

† See also Nos. 162-4.

Phosgene 1247
Phosphen-1 2707
Phosphen-2 1907
Phosphen-3 2713
Phosphen-4 2046
Phosphen-5 2762
Phosphen-7 6120
Phosphen-8 6165
Phosphen-9 6360
Phosphen-11 1146
Photo-glycin 3800
Photol 4117
Phthal alcohol 6497-9
Phthalamic acid 5272

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5263	tan pd.	.....	.....	.....	s.	sl. s.	i.
5264	lf.	.....	253-5 d.	.....	v. sl. s. h.	∞	$0.35^{16°}$ abs.
5265	cr.	.....	43	175^{24mm}	i.	v. s.	v. s.
5266	pr./al.	.....	52.5	255.5	i.	v. s.	v. s.
5267	pd.	.....	expl. 155	.....	v. sl. s.	v. sl. s.	sl. s. chl.
5268	yel. gn. pr.	$0.885^{\frac{20°}{4°}}$	28	197.2^{743mm}	$0.1^{50°}$	s.	s.
5269	lq.	$0.923^{\frac{20°}{20°}}$	.....	215-6	i.	.....	.....
5270	fum. lq.	$1.319^{20°}$	.....	224.6	d.	∞ bz.	∞ CS_2
5271	lt. yel. pd.	.....	149-50	.....	i. h.	i.	i.; s. h. bz.
5272	pr.	.....	148-9	155 d.	s.	s.	sl. s.
5273	nd./al.	.....	205	subl.	i.	s.	.....
5274	mn./aq.	$1.593^{\frac{20°}{4°}}$	191* 231†	.....	$0.54^{14°}$; $18^{99°}$	$11.7^{18°}$ abs.	$0.68^{15°}$
5275	pr./aq.	.....	$-H_2O$, 100	.....	$10^{25°}$	.....	.....
5276	nd./h. aq.	.....	347-8	subl.	$0.01^{25°}$; 0.2 h.	s.; s. ac.	i. bz.; i. pet.
5277	cr. or amor.	.....	subl. > 300	.....	0.001 c.	sl. s. h.	i.; s. alk.
5278	lt. yel. nd.	.....	56	.....	1.4 h.	v. s.	v. s.
5279	nd.	.....	89-90	.....	sl. s.	v. s.	i. pet.
5280	nd./aq.	.....	115-6	$245-8^{771mm}$	1.7 h.	v. s.	s.
5281	cr.	.....	219-20 d.	.....	v. sl. s. c.	v. sl. s.	i.
5282	rhb.	$1.527^{4°}$	130.8	284.5	v. sl. s.	s.	sl. s.
5283	col. lq.	$1.414^{\frac{25°}{25°}}$	16	281.1	d.	d.	s.
5284	cr.	.....	88-9	275.2^{720mm}	.....	.....	.....
5285	cr.	.....	41	276	d.	d.	.....
5286	nd.	.....	78-9	259	.....	.....	.....
5287	cr./et.	.....	238	subl.	$0.04^{25°}$	5; s. alk.	s. h.; i. bz.
5288	nd.	.....	161.5	subl.	s. h.; i. lg.	v. s. h.	v. s. h.
5289	nd./bz.	.....	222	.....	i.; s. h. ac.	sl. s. h.	v. sl. s. h.
5290	nd./aq.	$1.164^{\frac{20°}{4°}}$	73(65)	290	v. sl. s.	s.	.....
5291	pr./bz. al.	.....	144.5	.....	$115^{15°}$	s.	s.; sl. s. chl.
5292	lf./al.	.....	115	419-28 sl. d.	d. h.	s.; s. H_2SO_4	i. c. alk.
5293	lq.	$0.826^{\frac{20°}{4°}}$	.....	$185-8^{22mm}$	∞ pet.	∞ Me al.	∞ ac.
5294	lq.	$0.803^{\frac{20°}{4°}}$	.....	$169.5^{9.5mm}$	v. sl. s. ac.	v. sl. s.	.....
5295	oil	$0.840^{\frac{20°}{4°}}$	.....	202^{10mm}	i.	s.	s.
5296	oil	.....	.....	.....	.....	s. pet.	s.
5297	col. oil	$0.817^{\frac{20°}{4°}}$	.....	$177-8^{10.5mm}$	v. s. pet.	sl. s. h.	sl. s.
5298	col. oil	$0.852^{\frac{20°}{4°}}$	.....	204^{10mm}	i.	∞ Me al.	∞
5299	col. lf.	.....	364	518-20	i.	v. sl. s.	v. sl. s.
5300	col. lq.	$0.950^{\frac{15°}{4°}}$	−70	128.8	v. s.	∞	∞
5301	col. lq.	$0.961^{\frac{15°}{4°}}$	.....	143.5	∞	∞	∞

* Sealed tube.
† Heated rapidly.

Phthaldiamide 5281
Phthalimide 5287
Phthalimino-ethyl bromide 940
Phthalin 5122
Phthalyl dichloride 5283-4
Phthiocol 4275
Phthiocol acetate 4276-7
Phthiocol oxime 4278
Phyllyrin, cf. glcde.
Physostigmine, cf. alkd.
Picein, cf. glcde.
Piceoside, cf. glcde.
Picoline dicarboxylic acid 6398

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5302	**Picoline** (γ)	4-methyl-pyridine	$CH_3{\cdot}C_5H_4N$	XX-240	93.12
5303	**Picramic** acid	4,6-diNO_2-2-NH_2-phenol	$HO{\cdot}C_6H_2(NH_2):(NO_2)_2$	XIII-394	199.12
5304	sodium salt	sodium picramate	$C_6H_4O_5N_3Na{\cdot}H_2O$	XIII-395	239.13
5305	**Picrolonic acid**	4-NO_2-3-Me-1-*p*-NO_2-phenylpyrazolone-5	$C_{10}H_8O_5N_4$	.....	264.20
5306	**Picropodophyllin**	.....	$C_{22}H_{22}O_8$	.....	414.40
5307	**Picrorocellin**	.....	$C_{20}H_{22}O_4N_2$	.....	354.39
5308	**Picryl chloride** (1;2,4,6)	.....	$Cl{\cdot}C_6H_2(NO_2)_3$	V-273	247.56
5309	**Pimelic** acid	heptandioic acid	$(CH_2)_5(CO_2H)_2$	II-670	160.17
5310	acid (*iso*)	.....	$(C_2H_5)(CH_3)C{\cdot}CH_2(CO_2H)_2$	II-685	160.17
5311	nitrile	.....	$(CH_2)_5(CN)_2$	II-671	122.17
5312	**Pinacol**	2,3-diMe-butandiol-2,3	$[(CH_3)_2C{\cdot}OH]_2$	I-487	118.17
5313	hydrate	pinacone hydrate	$C_6H_{14}O_2{\cdot}6H_2O$	I-488	226.27
5314	**Pinacoline semicarbazone**	.....	$C_5H_{12}C{:}N{\cdot}NH{\cdot}CO{\cdot}NH_2$	III-104	157.21
5315	**Pinacolyl acetate**	.....	$CH_3CO_2{\cdot}C_6H_{13}$	II-133	144.21
5316	**Pinacyanole**	sensitol red	$C_{23}H_{20}N_2{\cdot}C_2H_5I$	XXIII-320	480.39
5317	**Pinane** (*d*)	.....	$C_{10}H_{18}$	V-93	138.24
5318	**Pinene** (α)(*dl*)	.....	$C_{10}H_{16}$	V-144	136.23
5319	hydrochloride	artificial camphor	$C_{10}H_{16}{\cdot}HCl$	V-94	172.69
5320	**Pinol** (*dl*)	sobrerone	$C_{10}H_{16}O$	XVII-45	152.23
5321	**Piperic acid**	.....	$CH_2O_2{:}C_6H_3{\cdot}C_5H_5O_2$	XIX-281	218.20
5322	**Piperidine**	hexazane	$CH_2(CH_2)_4NH$	XX-6	85.15
5323	**Piperonal**	heliotropine	$CH_2O_2{:}C_6H_3{\cdot}CHO$	XIX-115	150.13
5324	acetophenone	.....	$C_8H_6O_2{:}CH{\cdot}COC_6H_5$	XIX-141	252.26
5325	**Piperonyl** alcohol	.....	$CH_2O_2{:}C_6H_3{\cdot}CH_2OH$	XIX-67	152.14
5326	phloroglucinol-dimethyl ether	protocotoin; (2,4-diMeO)	$(CH_3O)_2C_{14}H_8O_4$	XIX-242	302.27
5327	**Piperonylic acid**	.....	$CH_2O_2{:}C_6H_3{\cdot}CO_2H$	XIX-269	166.13
5328	**Proflavine**	3,6-diNH_2-acridine sulfate; trypaflavine	$C_{13}H_{11}N_3{\cdot}H_2SO_4{\cdot}H_2O$	*XXII-650	325.33
5329	**Pregnan(e)diol**	23(α),20(α)	$C_{21}H_{36}O_2$	.....	320.50
5330	**Pregnan(e)diol**	3(α),20(β)	$C_{21}H_{36}O_2$	.....	320.50
5331	**Pregnan(e)diol**	3(β),20(α)	$C_{21}H_{36}O_2$	.....	320.50
5332	**Pregnan(e)diol**	3(β),20(β)	$C_{21}H_{36}O_2$	.....	320.50
5333	**Progesterone**(α)	.....	$C_{21}H_{30}O_2$	.....	314.45
5334	**Progesterone**(β)	progestin; corporin	$C_{21}H_{30}O_2$	.....	314.45
5335	**Proline** (*l*–)	pyrrolidine-2-carboxylic acid	$HN{\cdot}(CH_2)_3{\cdot}CH{\cdot}CO_2H$	XXII-2	115.13
5336	**Prominal**	1-Me-5-Et-5-Ph-barbituric acid	$(C_6H_5)(C_2H_5)(CH_3){\cdot}C_4HO_3N_2$	.....	246.26
5337	**Prontosil**† (4,1;1′,2′,4′)	prontosil red; rubiazol; streptozon	$H_2NSO_2{\cdot}C_6H_4{\cdot}N{:}N{\cdot}C_6H_3(NH_2)_2{\cdot}HCl$	.....	327.79
5338	**Propane**	.....	$CH_3{\cdot}CH_2{\cdot}CH_3$	I-104	44.09
5339	***iso*-Propanolamine**	α-NH_2-*iso*Pr alcohol	$NH_2{\cdot}CH_2CHOH{\cdot}CH_3$	IV-289	75.11

† *p*-Aminobenzene-sulfonamide also sometimes called "Prontosil."

Picolinic acid 5486
Picramide 6289
Picric acid 6310
Picrocrocin, cf. glcde.
Picryl-hydrazine 6311
Pictol 4117
Pilocarpidine, cf. alkd.
Pilocarpine, cf. alkd.
Pilosine, cf. alkd.
Piloty's acid 674
Pimelin ketone 1606
Pinacolin 4166
Pinacolin alcohol 3627
Pinacolon(e) 4166
Pinacone 5312
Pineapple oil 1534-5
Pinene HCl 864
Pinite 4286
Pinatol 4286
Pipecoline 4345-7
Pipecolyl carbinol 2931
Piperazine 2225
Piperidinic acid 279
Piperine, cf. alkd.
Piperylene 5064
Piria acid 4541
Pitayine, cf. alkd.
Pivalic acid 6245
Pivalic aldehyde 6243

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5302	lq.	$0.957\frac{1}{4}^{5°}$	.....	143.1	∞	∞	∞
5303	red nd./al.	.....	169	.....	$0.14^{22°}$; s. ac.	s.; sl. s. chl.	sl. s.; s. bz.
5304	red crust	.....	.....	.....	$2^{16°}$	.....	.....
5305	yel. lf.	.....	116.5	d. 125	$0.12^{17°}$	sl. s.	.....
5306	col. nd./bz.	.....	228	.....	i.; s. alk.	s.	s. chl.
5307	col. pr./al.	.....	190-220	.....	i.; s. chl.	s. h.	sl. s.
5308	yel. mn.	$1.797^{20°}$	83	.....	i.; d. aq. alk.; s.bz.	v. s. h.; s. h. chl.	sl. s.; sl. s. pet.
5309	mn./aq.	$1.329^{15°}$	103-5	272^{100mm}	$2.5^{14°}$	v. s.	v. s.
5310	rhb./aq.	.....	103-4	d. 135	$15.4^{15°}$	v. s.	v. s. h.
5311	col. lq.	$0.949^{18°}$	.....	$175\text{-}6^{14mm}$	i.	∞	∞
5312	col. nd.	0.967	41-3(38)*	$171\text{-}2^{739mm}$	sl. s. c.; s. h.	v. s.	v. s.; sl. s. CS_2
5313	cr./aq.	.....	46-7**	d. $-H_2O$	sl. s. c.	s.	s.
5314	nd./aq.	.....	157	.....	sl. s. c.	s.	v. s.
5315	col. lq.	.....	.....	143^{757mm}	.....	.....	.....
5316	b. gn./al.	.....	276-8	.....	sl. s.	s.	s. pyr.
5317	col. lq.	$0.839^{20°}_{4°}$	−45	169.4	.....	.....	.....
5318	col. lq.	$0.878^{20°}_{4°}$	−55	154-6	v. sl. s.	∞ abs.	∞
5319	cr. lf.	.....	131-2	207-8	i.	33	s.
5320	lq.	$0.953^{20°}_{20°}$	.....	183-4	s. bz.	s.	s.
5321	yel. nd./al.	.....	216-7	subl. sl. d.	i.; 2 h.	3.6 c.	s.; sl. s. bz.
5322	lq.	$0.860^{20°}_{4°}$	−9	106	∞	∞	.....
5323	cr./aq.	.....	37	263	$0.1^{0°}$; $0.66^{78°}$	$15^{0°}$; $55^{78°}$	∞
5324	yel. nd./al.	.....	122	.....	.....	.....	.....
5325	nd.	.....	52-3	d.	s. h.	∞	∞
5326	lt. yel. mn./al.	.....	141-2	.....	i.; s. alk.; s. ac.	s.; i. alk. carb.	s.; s. bz.; s. chl.
5327	nd./al.	.....	228	subl.	v. sl. s. h.	sl. s. h.	sl. s.
5328	red nd.	.....	.....	.....	1 c.	s.	i.; i. chl.
5329	col. cr./act.	.....	237-9	.....	sl. s.	s.	s.
5330	col. cr./al.	.....	232-4	.....	sl. s.	s.	s.
5331	col. cr./et.	.....	182-4	.....	sl. s.	s.	s.
5332	cr./aq. al.	.....	174-6	.....	sl. s.	s.	s.
5333	pr.	.....	128.5	.....	i.	s.	s.
5334	nd./pet.	.....	121	.....	i.	s.	s.
5335	hyg. nd./ al. et.	.....	220-2 d.	.....	v. s.	$1.6^{19°}$	i.
5336	col. cr.	.....	176	.....	s. h.	s.	.....
5337	red cr. pd.	.....	247-51	.....	0.25	.....	.....
5338	col. gas	(A)1.562 $0.585^{-44.5°}_{4°}$	−187.1	−42.2	$6.5^{17.8°}$ cc.	$926^{16.6°}$ cc.	$1299^{16.6°}$ cc.
5339	lq.	$0.973^{18°}$	.....	160-1	v. s.	s.	i.

* Crysts. + $6H_2O$/aq., m. p. 47°.
** Anhydrous crysts./et., m. p. 38°; b. p. 172-5°.

Planocaine 4935
Poirrier's blue 6344
Polygonin, cf. glcde.
Populin, cf. glcde.
Porphyroxine, cf. alkd.
Potassium myronate, cf. glcde.
Pragmoline 82
Prehnitic acid 680
Prehnitol 5827
Prehnitylic acid 6257
Primulin, cf. glcde.
Procaine 4935
Progestin(e) 5334
Proline-betaine, cf. alkd.
Prontosil album 527
Propadiene 183
Propanal 5352
Propandioic acid 4002
Propandiol 5465, 6286
Propandithiol 6284

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5340	**Propargyl** acetate	.....	$CH_3CO_2{\cdot}CH_2{\cdot}C{:}CH$	II-140	98.10
5341	alcohol	propyne-1-ol-3	$HC{:}C{\cdot}CH_2OH$	I-454	56.06
5342	bromide	3-bromo-propyne-1	$HC{:}C{\cdot}CH_2Br$	I-248	118.97
5343	chloride	chloro-allylene	$HC{:}C{\cdot}CH_2Cl$	I-248	74.51
5344	iodide	3-iodo-propyne-1	$HC{:}C{\cdot}CH_2I$	I-248	165.97
5345	**Propenyl** chloride†	1-chloro-propene-1	$CH_3{\cdot}CH{:}CHCl$	I-198	76.53
5346	chloride (*iso*)	2-chloro-propene-1	$CH_3{\cdot}CCl{:}CH_2$	I-198	76.53
5347	guaethol	(4;1,2)	$CH_3{\cdot}CH{:}CH{\cdot}C_6H_3{:}(OH)(OC_2H_5)$	.....	178.22
5348	**Propiolic** acid	propynoic acid	$HC{:}C{\cdot}CO_2H$	II-477	70.05
5349	aldehyde	propargyl aldehyde	$HC{:}C{\cdot}CHO$	I-750	54.05
5350	**Propionaldol**	.....	$C_2H_5{\cdot}CHOH{\cdot}CH{:}(CH_3)CHO$	I-836	116.16
5351	**Propionic** acid	propanoic acid	$CH_3{\cdot}CH_2{\cdot}CO_2H$	II-234	74.08
5352	aldehyde	propanal	$CH_3{\cdot}CH_2{\cdot}CHO$	I-629	58.08
5353	aldehyde oxime	propionaldoxime	$C_2H_5{\cdot}CH{:}NOH$	I-631	73.09
5354	aldehyde semi-carbazone (α)	.....	$C_2H_5{\cdot}CH{:}N{\cdot}NH{\cdot}CO{\cdot}NH_2$	III-101	115.14
5355	aldehyde semi-carbazone	.....	$C_2H_5{\cdot}CH{:}N{\cdot}NH{\cdot}CO{\cdot}NH_2$	III-101	115.14
5356	amide	propionamide	$C_2H_5{\cdot}CO{\cdot}NH_2$	II-243	73.09
5357	anhydride	.....	$(C_2H_5{\cdot}CO)_2O$	II-242	130.14
5358	anilide	propionanilide	$C_2H_5{\cdot}CO{\cdot}NH{\cdot}C_6H_5$	XII-250	149.19
5359	bromide	propionyl bromide	$C_2H_5{\cdot}CO{\cdot}Br$	II-243	136.99
5360	chloride	propionyl chloride	$C_2H_5{\cdot}CO{\cdot}Cl$	II-243	92.53
5361	fluoride	propionyl fluoride	$C_2H_5{\cdot}CO{\cdot}F$	II-243	76.07
5362	iodide	propionyl iodide	$C_2H_5{\cdot}CO{\cdot}I$	II-243	183.99
5363	nitrile	ethyl cyanide	$CH_3{\cdot}CH_2{\cdot}CN$	II-245	55.08
5364	**Propyl** acetanilide (*N*)	acetyl *n*-propyl-aniline	$C_6H_5{\cdot}N(COCH_3){\cdot}CH_2{\cdot}C_2H_5$	XII-246	177.24
5365	acetate (*n*)	.....	$CH_3CO_2{\cdot}CH_2{\cdot}C_2H_5$	II-129	102.13
5366	acetate (*iso*)	.....	$CH_3CO_2{\cdot}CH(CH_3)_2$	II-130	102.13
5367	acetoacetate (*iso*)	.....	$CH_3COCH_2CO_2C_3H_7$	III-659	144.17
5368	alcohol (*n*)	propanol-1	$CH_3{\cdot}CH_2{\cdot}CH_2OH$	I-350	60.09
5369	alcohol (*iso*)	propanol-2	$(CH_3)_2CHOH$	I-360	60.09
5370	allyl barbituric acid (*iso*)	numal; alurate	$(C_3H_5)(C_3H_7){:}C_4H_2O_3N_2$	.....	210.23
5371	amine (*n*)	1-aminopropane	$CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}NH_2$	IV-136	59.11
5372	amine (*iso*)	2-aminopropane	$(CH_3)_2CH{\cdot}NH_2$	IV-152	59.11
5373	*p*-aminobenzoate	propesine	$NH_2{\cdot}C_6H_4{\cdot}CO_2C_3H_7$	XIV-423	179.21
5374	aniline (*n*)(*N*)	.....	$C_6H_5{\cdot}NH{\cdot}CH_2{\cdot}C_2H_5$	XII-166	135.20
5375	aniline (*iso*)(*p*)	cumidine	$(CH_3)_2CH{\cdot}C_6H_4{\cdot}NH_2$	XII-1147	135.20
5376	arsonic acid (*n*)	.....	$C_3H_7{\cdot}AsO(OH)_2$	IV-615	168.01
5377	benzaldehyde (*iso*) (*p*)	*p*-cuminic aldehyde	$(CH_3)_2CH{\cdot}C_6H_4{\cdot}CHO$	VII-318	148.20
5378	benzene (*n*)	.....	$C_6H_5{\cdot}CH_2{\cdot}C_2H_5$	V-390	120.19
5379	benzene (*iso*)	cumene	$C_6H_5{\cdot}CH(CH_3)_2$	V-393	120.19
5380	benzoate (*n*)	.....	$C_6H_5{\cdot}CO_2{\cdot}CH_2{\cdot}C_2H_5$	IX-112	164.20
5381	benzoate (*iso*)	.....	$C_6H_5{\cdot}CO_2{\cdot}CH(CH_3)_2$	IX-112	164.20
5382	benzoic acid (*n*)(*o*)	.....	$C_3H_7{\cdot}C_6H_4{\cdot}CO_2H$	IX-544	164.20
5383	benzoic acid (*iso*) (*o*)	*o*-cuminic acid	$(CH_3)_2CH{\cdot}C_6H_4{\cdot}CO_2H$	IX-546	164.20
5384	benzoic acid (*n*)(*p*)	.....	$C_3H_7{\cdot}C_6H_4{\cdot}CO_2H$	IX-545	164.20

† Properties for trans-; cis, m. p. −134.8°, b. p. 32.8°.

Propanoic acid 5351
Propanol 5368-9
Propanone 56
Propanselenol 5448
Propanthiol 5424-5
Propargyl aldehyde 5349
Propene 5459
Propenoic acid 149
Propenol 193
Propenyl anisole 511
Propenyl bromide (*iso*) 990
Propenyl carbinol (*iso*) 4059
Propenyl cyanide 1563
Propenyl guaiacol 1280, 3223
Propenyl trimethoxybenzene 584
Propesine 5373
Propine 225
Propionamide 5356

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5340	col. lq.	$1.005^{20°}_{4°}$	.....	124-5	.....	s.	s.
5341	col. lq.	$0.972^{20°}_{4°}$	−17	114-5	s.	∞	∞
5342	lq.	$1.52^{20°}$	.....	88-90	.....	.....	.....
5343	lq.	$1.045^{5°}$	.....	65	.....	.....	.....
5344	lq.	$2.018^{0°}$	.....	115	.....	.....	s.
5345	col. lq.	$0.935^{\frac{1}{3}\frac{5}{5}°}$	−99	37	i.	∞ ; ∞ act.	∞ ; ∞ bz.
5346	lq.	$0.918^{9°}$	−137.4	22.65	i.	.....	.....
5347	col. pd.	.....	85-7	.....	i.	s.	s.
5348	col. lq.	$1.139^{\frac{1}{1}\frac{5}{5}°}$	9±	102^{200mm}	s.	s.	s.
5349	oil	.....	.....	59-61	v. s.	.....	.....
5350	col. lq.	$0.986^{2\frac{5}{4}°}$	.....	$84\text{-}6^{11mm}$	s.	.....	.....
5351	col. lq.	$0.992^{20°}_{4°}$	−22	141.1	∞	∞	∞ ; ∞ chl.
5352	col. lq.	$0.807^{20°}_{4°}$	−81	49.5^{740mm}	$20^{20°}$	∞	∞
5353	lq.	$0.926^{20°}_{4°}$	21(40?)	130-2	.....	.....	.....
5354	nd./bz. + lg.	.....	88-90	.....	v. s.	v. s. h. bz.	.....
5355	pl./aq.	.....	154	less s. bz. than α	.....	.....	.....
5356	rhb. pl.	$1.042^{20°}_{4°}$	79-80	213	v. s.	v. s.	v. s.
5357	col. lq.	$1.012^{20°}_{4°}$	−45	168.8^{780mm}	d.	d.	.....
5358	lf./al.	1.175	104-5	.....	$0.4^{24°}$	s.; s. h. aq.	s.
5359	lq.	$1.521^{\frac{16.4}{4}°}$	.....	103-4	d.	d.	s.
5360	col. lq.	$1.065^{20°}_{4°}$	−94	80	d.	d.	s.
5361	col. lq.	$0.972^{15°}$	.....	44	d.	d.	.....
5362	lq.	.....	.....	127-8	d.	d.	.....
5363	col. lq.	$0.783^{2\frac{1}{4}°}$	−91.9	97.1	s.	∞	∞
5364	mn. pl./et. or lg.	.....	47-8	266^{712mm}	i.	s.	s.
5365	col. lq.	$0.886^{20°}_{4°}$	−92.5	101.6	$1.6^{16°}$	∞	∞
5366	col. lq.	$0.874^{20°}_{20°}$	−73.4	88.4	$3^{20°}$	∞	∞
5367	col. lq.	.....	.....	185-7	v. sl. s.	s.	s.
5368	col. lq.	$0.804^{20°}_{4°}$	−127	97.8	∞	∞	∞
5369	col. lq.	$0.789^{20°}_{4°}$	−85.8	82.5	∞	∞	∞
5370	col. cr./aq.	.....	137-8	.....	sl. s.	s.	s.
5371	col. lq.	$0.718^{20°}_{20°}$	−83	$49\text{-}50^{761mm}$	∞	∞	∞
5372	col. lq.	$0.694^{\frac{1}{4}\frac{6}{6}°}$	−101	33-4	∞	∞	∞
5373	col. pr.	.....	74-6	.....	v. sl. s.	s.; s. chl.	s.; s. bz.
5374	lq.	$0.949^{18°}$	.....	222	i.	v. s.	v. s.
5375	lq.	0.953	<−20	225^{761mm}	i.	.....	.....
5376	col. nd./al.	.....	125	.....	v. s.	v. s.	i.
5377	lq.	$0.978^{20°}_{4°}$	.....	236-7	i.	s.	s.
5378	col. lq.	$0.862^{20°}_{4°}$	−99.2	159.5	i.	∞	∞
5379	col. lq.	$0.862^{20°}_{4°}$	−96.9	152.5	i.	∞	∞
5380	col. lq.	$1.021^{\frac{25}{25}°}$	−51.6	231	i.	s.	s.
5381	col. lq.	$1.010^{\frac{25}{25}°}$	.....	218.5	i.	s.	s.
5382	lf./aq. al.	.....	58	272^{739mm}	sl. s. h.	s.	.....
5383	pr./aq.	.....	51	.....	sl. s. h.	s.	s.; s. bz.
5384	pr./h. aq.	.....	140-1	.....	sl. s. h.	s.	s.; s. bz.

Propionanilide 5358
Propionyl bromide 5359
Propionyl chloride 5360
Propionyl fluoride 5361
Propionyl iodide 5362

Propionyl phenol 3810-1
Propiophenone 3129
Proponal 2776
Propyl-, cf. also dipropyl-.
Propyl acetone 4164

Propyl-acetylene 5086
Propyl-acetylene (*iso*) 4168
Propyl adipate 2771

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5385	**Propyl** benzoic acid (*iso*) (*p*)	cuminic acid	$(CH_3)_2CH\cdot C_6H_4\cdot CO_2H$	IX-546	164.20
5386	benzoic amide (*iso*)(*p*)	cuminic amide	$(CH_3)_2CH\cdot C_6H_4\cdot CO\cdot NH_2$	IX-547	163.21
5387	*o*-benzoylbenzoate (*n*)	.....	$C_6H_5\cdot CO\cdot C_6H_4\cdot CO_2\cdot CH_2\cdot C_2H_5$	.....	268.30
5388	bromide (*n*)	1-bromopropane	$CH_3\cdot CH_2\cdot CH_2Br$	I-108	123.00
5389	bromide (*iso*)	2-bromopropane	$CH_3\cdot CHBr\cdot CH_3$	I-108	123.00
5390	bromopropenyl barbituric acid	nostal; noctal	$(C_3H_7)(CH_3\cdot CBr:CH):C_4H_2O_3N_2$	.....	289.14
5391	*iso*-butyl ketone (*n*)	.....	$C_2H_5\cdot CH_2\cdot CO\cdot C_4H_9$	I-706	128.21
5392	*n*-butyrate (*n*)	.....	$C_3H_7\cdot CO_2\cdot C_3H_7$	II-271	130.18
5393	*iso*-butyrate (*n*)	.....	$(CH_3)_2CHCO_2C_3H_7$	II-291	130.18
5394	*iso*-butyrate (*iso*)	.....	$C_2H_5\cdot CH_2\cdot CO_2\cdot CH:(CH_3)_2$	II-271	130.18
5395	*iso*-butyrate (*iso*)	.....	$C_3H_7\cdot CO_2\cdot C_3H_7$	II-291	130.18
5396	caproate (*n*)	.....	$C_5H_{11}\cdot CO_2\cdot CH_2\cdot C_2H_5$	II-323	158.23
5397	caprylate (*n*)	.....	$C_7H_{15}\cdot CO_2\cdot CH_2\cdot C_2H_5$	II-348	186.29
5398	carbamate (*n*)	.....	$NH_2\cdot CO_2\cdot CH_2\cdot C_2H_5$	III-28	103.12
5399	carbonate, ortho-	.....	$C(OCH_2\cdot C_2H_5)_4$	III-6	248.35
5400	chloride (*n*)	1-chloropropane	$CH_3\cdot CH_2\cdot CH_2Cl$	I-104	78.54
5401	chloride (*iso*)	2-chloropropane	$CH_3\cdot CHCl\cdot CH_3$	I-105	78.54
5402	chloroformate (*n*)	*n*-Pr chloro-carbonate	$Cl\cdot CO_2\cdot CH_2\cdot C_2H_5$	III-11	122.55
5403	chloroformate (*iso*)	*iso*-Pr chlorocarb.	$Cl\cdot CO_2\cdot CH(CH_3)_2$	III-12	122.55
5404	*iso*-cyanide (*n*)	*n*-propyl carbylamine	$C_2H_5\cdot CH_2\cdot N:C$	IV-141	69.10
5405	*iso*-cyanide (*iso*)	*iso*-Pr carbylamine	$(CH_3)_2CH\cdot N:C$	IV-154	69.10
5406	fluoride (*n*)	1-fluoropropane	$CH_3\cdot CH_2\cdot CH_2F$	I-104	62.09
5407	fluoride (*iso*)	2-fluoropropane	$CH_3\cdot CHF\cdot CH_3$	I-104	62.09
5408	formate (*n*)	.....	$H\cdot CO_2\cdot CH_2\cdot C_2H_5$	II-21	88.10
5409	formate (*iso*)	.....	$H\cdot CO_2\cdot CH(CH_3)_2$	II-21	88.10
5410	formate, ortho-(*n*)	.....	$H\cdot C(O\cdot CH_2\cdot C_2H_5)_3$	II-21	190.28
5411	furoate (*n*)	.....	$C_4H_3O\cdot CO_2\cdot C_3H_7$	XVIII-275	154.16
5412	*β*-furylacrylate (*n*)	.....	$C_4H_3O\cdot CH:CH\cdot CO_2\cdot CH_2\cdot C_2H_5$	.....	180.20
5413	glycolate (*iso*)	.....	$HOCH_2\cdot CO_2\cdot C_3H_7$	.....	118.13
5414	*n*-hexyl ketone (*n*)	decanone-4	$C_3H_7\cdot CO\cdot C_6H_{13}$	I-711	156.26
5415	*p*-hydroxybenzoate	(*n*); nipasol	$HOC_6H_4CO_2\cdot C_3H_7$	X-160	180.20
5416	hydroxylamine (*β*)	.....	$C_2H_5\cdot CH_2\cdot NHOH$	IV-537	75.11
5417	iodide (*n*)	1-iodopropane	$CH_3\cdot CH_2\cdot CH_2I$	I-113	169.99
5418	iodide (*iso*)	2-iodopropane	$CH_3\cdot CHI\cdot CH_3$	I-114	169.99
5419	lactate (*n*)	.....	$C_2H_4(OH)CO_2C_3H_7$	III-265	132.16
5420	lactate (*iso*)	.....	$C_2H_4(OH)CO_2C_3H_7$	III-282	132.16
5421	levulinate (*n*)	.....	$C_4H_7O\cdot CO_2C_3H_7$	III-675	158.19
5422	malonic acid (*n*)	.....	$C_3H_7\cdot CH(CO_2H)_2$	II-657	146.14
5423	malonic acid (*iso*)	.....	$C_3H_7\cdot CH(CO_2H)_2$	II-669	146.14
5424	mercaptan (*n*)	propanthiol-1	$CH_3\cdot CH_2\cdot CH_2\cdot SH$	I-359	76.15
5425	mercaptan (*iso*)	propanthiol-2	$(CH_3)_2CH\cdot SH$	I-367	76.15
5426	*α*-naphthylamine (*n*)	.....	$C_{10}H_7\cdot NH\cdot CH_2\cdot C_2H_5$	XII-1224	185.26
5427	nitrate (*n*)	.....	$CH_3\cdot CH_2\cdot CH_2\cdot O\cdot NO_2$	I-355	105.09
5428	nitrite (*n*)	.....	$CH_3\cdot CH_2\cdot CH_2\cdot O\cdot NO$	I-355	89.09

Propyl-benzyl alcohol (*iso*) 1571
Propyl-bromobutyramide 4580
Propyl carbinol (*n*) 1034
Propyl carbinol (*iso*) 1036
Propyl carbonate 2780
Propyl carbylamine 5404-5
Propyl chlorocarbonate 5402-3
Propyl cyanide 1175-6
Propyl dibromosuccinate 2781
Propyl disulfide 2782
Propyl ether 2783-5
Propyl-ethylene 498-9
Propyl maleate 2788
Propyl malonate 2789
Propyl mustard oil 5450

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5385	tri.	1.162	116-7	subl.	v. sl. s. c.	s.; s. conc. H_2SO_4	s.
5386	nd. or pl.	.....	155	.....	sl. s. h.	∞	sl. s.
5387	col. lq.	.....	.....	$223\text{-}5^{15mm}$	i.	s.	s.
5388	col. lq.	$1.353^{20°}_{4°}$	−109.9	70.8	$0.25^{20°}$	∞	∞
5389	col. lq.	$1.310^{20°}_{4°}$	−89	60	$0.32^{20°}$	∞; ∞ chl.	∞; ∞ bz.
5390	col. cr.	.....	178	.....	sl. s.	s.	sl. s.
5391	lq.	$0.813^{22°}_{0°}$	.....	155^{750mm}	i.; s. alk.	s.; s. act.	s.; sl. s. chl.
5392	col. lq.	$0.879^{15°}$	−95.2	142.7	v. sl. s.	∞	∞
5393	col. lq.	$0.884^{0°}_{4°}$	.....	134-5	.....	.....	.....
5394	col. lq.	$0.865^{13°}$	.....	128	.....	.....	.....
5395	col. lq.	$0.869^{0°}_{4°}$	.....	120.8	.....	.....	.....
5396	col. lq.	$0.884^{0°}_{0°}$	.....	185.5	.....	.....	.....
5397	col. lq.	$0.880^{0°}_{0°}$	.....	224.7	.....	.....	.....
5398	pr.	.....	60-1	200	v. s.	v. s.	v. s.
5399	col. lq.	$0.911^{8°}$	.....	224.2	.....	.....	.....
5400	col. lq.	$0.890^{20°}_{4°}$	−122.8	46.4	$0.27^{20°}$	∞	∞
5401	col. lq.	$0.859^{20°}$	−117	36.5	$0.31^{20°}$	∞	∞
5402	col. lq.	$1.090^{20°}_{4°}$	.....	$114\text{-}5^{768mm}$	i.; sl. d.	i.; sl. d.	∞; ∞ bz.
5403	col. lq.	.....	.....	$103\text{-}5^{721mm}$	i.	v. s.	v. s.
5404	lq.	.....	.....	99.5	i.	∞	∞
5405	lq.	$0.760^{0°}$	.....	87	i.	∞	∞
5406	gas	.....	.....	−3	.....	.....	.....
5407	gas	.....	.....	−11	.....	.....	.....
5408	col. lq.	$0.901^{20°}_{4°}$	−92.9	81.3	$2.22^{0°}$	∞	∞
5409	lq.	$0.873^{20°}_{4°}$	.....	$68\text{-}71^{751mm}$	.....	.....	.....
5410	col. lq.	$0.881^{20°}_{4°}$	.....	196-8	$2.1^{22°}$	.....	.....
5411	col. lq.	$1.075^{28°}_{4°}$	.....	211	v. sl. s.	s.	∞
5412	col. lq.	$1.074^{20°}_{4°}$	.....	119^{7mm}	i.	s.	.....
5413	col. lq.	.....	.....	161-2	s.	s.	s.
5414	lq.	$0.824^{21°}_{0°}$	−9	206-7	v. sl. s.	∞	∞
5415	col. pr./et.	.....	95-6	.....	$0.2^{80°}$	$100^{25°}$ Me al.	$50^{25°}$
5416	nd./et.	.....	46±	.....	v. s.	v. s.	sl. s. lg.
5417	lq.	$1.743^{20°}_{4°}$	−98.8	102.5	$0.11^{20°}$	∞	∞
5418	lq.	$1.705^{25°}_{25°}$	−90±	89.5	$0.14^{20°}$	∞; ∞ chl.	∞; ∞ bz.
5419	col. lq.	.....	.....	$122\text{-}3^{150mm}$	s.	s.	s.
5420	col. lq.	.....	.....	166-8	s.	s.	s.
5421	lq.	$0.990^{20°}_{4°}$	.....	221	.....	.....	.....
5422	pl./bz.	.....	96	d.	v. s.	v. s.	.....
5423	col. pr.	.....	87	d. 180	.....	v. s.	v. s.
5424	lq.	.....	−112	67-8	v. sl. s.	s.	s.
5425	lq.	>1	.....	58-60	sl. s.	∞	∞
5426	lt. yel. oil	.....	.....	$316\text{-}8^{771mm}$	i.	.....	.....
5427	lq.	$1.058^{20°}_{4°}$	.....	110.5	.....	s.	s.
5428	lq.	$0.935^{20°}_{4°}$	.....	57	.....	s.	s.

Propyl oxalate 2792-3
Propyl phthalate 2794-5
Propyl-piperidine, cf. alkd.
Propyl-*iso*-propyl carbinol 3536
Propyl succinate 2796-7
Propyl sulfate 2798
Propyl sulfide 2799-2800
Propyl sulfite 2801
Propyl sulfone 2802-3
Propyl tartrate 2804-5
Propyl-toluene (*n*) 4351-2
Propyl-toluene (*iso*) 1622-4
Propylene bromide 1864
Propylene chloride 2051
Propylene iodide 2397

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Propyl				
5429	nitroamine (*n*)	.....	$C_2H_5{\cdot}CH_2{\cdot}NH{\cdot}NO_2$	IV-570	104.11
5430	phenol (*o*)(*n*)	.....	$C_2H_5{\cdot}CH_2{\cdot}C_6H_4{\cdot}OH$	VI-499	136.19
5431	phenol (*m*)(*n*)	.....	$C_2H_5{\cdot}CH_2{\cdot}C_6H_4{\cdot}OH$	VI-499	136.19
5432	phenol (*p*)(*n*)	.....	$C_2H_5{\cdot}CH_2{\cdot}C_6H_4{\cdot}OH$	VI-500	136.19
5433	phenol (*o*)(*iso*)	*o*-cumenol	$(CH_3)_2CH{\cdot}C_6H_4{\cdot}OH$	VI-504	136.19
5434	phenol (*m*)(*iso*)	*m*-hydroxy-cumene	$(CH_3)_2CH{\cdot}C_6H_4{\cdot}OH$	VI-505	136.19
5435	phenol (*p*)(*iso*)	*p*-hydroxy-cumene	$(CH_3)_2CH{\cdot}C_6H_4{\cdot}OH$	VI-505	136.19
5436	phenyl carbinol (*n*)	.....	$C_3H_7{\cdot}CHOH{\cdot}C_6H_5$	VI-522	150.21
5437	phenyl carbinol (*iso*)	.....	$C_3H_7{\cdot}CHOH{\cdot}C_6H_5$	VI-523	150.21
5438	phenyl ether (*n*)	.....	$C_2H_5{\cdot}CH_2{\cdot}O{\cdot}C_6H_5$	VI-142	136.19
5439	phenyl ketone (*n*)	butyrophenone	$C_2H_5{\cdot}CH_2{\cdot}CO{\cdot}C_6H_5$	VII-313	148.20
5440	phenyl ketone (*iso*)	*iso*-butyrophenone	$(CH_3)_2CH{\cdot}CO{\cdot}C_6H_5$	VII-316	148.20
5441	propionate (*n*)	.....	$C_2H_5{\cdot}CO_2{\cdot}CH_2{\cdot}C_2H_5$	II-240	116.16
5442	propionate (*iso*)	.....	$C_2H_5{\cdot}CO_2{\cdot}CH(CH_3)_2$	II-241	116.16
5443	pyridine (2)(*α*)(*n*)	conyrine	$C_2H_5{\cdot}CH_2{\cdot}C_5H_4N$	XX-247	121.18
5444	pyridine (2)(*α*)(*iso*)	.....	$(CH_3)_2CH{\cdot}C_5H_4N$	XX-247	121.18
5445	pyridine (4)(*γ*)(*iso*)	.....	$(CH_3)_2CH{\cdot}C_5H_4N$	XX-248	121.18
5446	salicylate (*o*)(*n*)	.....	$HO{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_3H_7$	X-75	180.20
5447	salicylate (*o*)(*iso*)	.....	$HO{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_3H_7$	.....	180.20
5448	selenomercaptan	propanselenol-1	$CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}SeH$	I-360	123.05
5449	succinic acid (*n*)	.....	$C_3H_7{\cdot}C_2H_3(CO_2H)_2$	II-675	160.17
5450	*iso*-thiocyanate (*n*)	*n*-propyl mustard oil	$CH_3{\cdot}CH_2{\cdot}CH_2{\cdot}N{:}CS$	IV-145	101.16
5451	thiocyanate (*iso*)	.....	$(CH_3)_2CH{\cdot}S{\cdot}CN$	.....	101.16
5452	*p*-toluene sulfonate	(*n*)	$CH_3C_6H_4SO_3C_3H_7$	.....	214.27
5453	urea (*n*)	.....	$C_3H_7{\cdot}NH{\cdot}CO{\cdot}NH_2$	IV-142	102.14
5454	urethane (*n*)	.....	$C_3H_7{\cdot}NH{\cdot}CO_2{\cdot}C_2H_5$	IV-143	131.17
5455	*n*-valerate (*n*)	.....	$C_4H_9CO_2{\cdot}C_3H_7$	II-301	144.21
5456	*iso*-valerate (*n*)	.....	$C_4H_9CO_2{\cdot}CH_2{\cdot}C_2H_5$	II-312	144.21
5457	*iso*-valerate (*iso*)	.....	$C_4H_9CO_2{\cdot}CH(CH_3)_2$	II-312	144.21
5458	**Propylal** (*n*)	methylene diPr ether	$CH_2(OCH_2{\cdot}C_2H_5)_2$	I-575	132.20
5459	**Propylene**	propene	$CH_3{\cdot}CH{:}CH_2$	I-196	42.08
5460	bromohydrin (*prim*)	*β*-Br-propyl alcohol	$CH_3{\cdot}CHBr{\cdot}CH_2OH$	*I-181	139.00
5461	chlorohydrin (*prim*)	2-chloro-propanol-1	$CH_3{\cdot}CHCl{\cdot}CH_2OH$	I-356	94.54
5462	chlorohydrin (*sec*)	1-chloro-propanol-2	$CH_3{\cdot}CHOH{\cdot}CH_2Cl$	I-363	94.54
5463	cyanide	.....	$CH_3{\cdot}CH(CN){\cdot}CH_2{\cdot}CN$	II-640	94.11
5464	diamine (*dl*)	1,2-diamino-propane	$CH_3{\cdot}CH(NH_2){\cdot}CH_2{\cdot}NH_2$	IV-257	74.13
5465	glycol (*α*)	propandiol-1,2	$CH_3{\cdot}CHOH{\cdot}CH_2OH$	I-472	76.09
5466	glycol acetate, di-	.....	$(CH_3CO_2)_2CH_2{\cdot}CH(CH_3)$	II-142	160.17
5467	glycol acetate, mono-(*α*)	.....	$CH_3CO_2{\cdot}CH_2{\cdot}CHOH{\cdot}CH_3$	II-142	118.13
5468	oxide (1,2)	.....	$CH_3{\cdot}CH{\cdot}CH_2{\cdot}O$ (ring)	XVII-6	58.08
5469	oxide (1,3)	trimethylene oxide	$CH_2{\cdot}CH_2{\cdot}CH_2{\cdot}O$ (ring)	XVII-6	58.08
5470	**Prostigmine bromide**	(1,3)	$Br(CH_3)_3N{\cdot}C_6H_4{\cdot}O_2C{\cdot}N(CH_3)_2$	.....	303.20

Propylidene dibromide 1863
Propylidene dichloride 2050
Propylidene dichloride (*iso*) 2053
Propyne 225
Propynoic acid 5348
Propynol 5341
Protagon 3960
Protocatechuic acid 2319
Protocatechuic aldehyde 2311
Protocatechuic aldehyde ethyl ether 3188
Protocotoin 5326
Protopine, cf. alkd.
Protoveratrine, cf. alkd.
Prulaurasin, cf. glcde.
Prussic acid 3715

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5429	col. lq.	$1.104^{15°}$	−22	$128\text{-}9^{40mm}$	sl. s.	∞	∞
5430	lq.	$1.015^{0°}$	.....	221-6	v. sl. s.	s.	s.
5431	lq.	.....	26	228	v. sl. s.	s.	.....
5432	cr.	$1.009^{0°}$	21-2	230-2	v. sl. s.	s.	.....
5433	lq.	$1.012^{20°}$	15-6	214-5	v. sl. s.	∞	∞
5434	cr.	.....	26	228	v. sl. s.	.....	.....
5435	nd.	$0.990^{20°}$	61	228.2-9.2	v. sl. s.	$316^{25°}$	$350^{25°}$
5436	oil	$1.021^{\frac{18}{4}°}$	.....	$168\text{-}70^{100mm}$	.....	.....	.....
5437	oil	$0.987^{\frac{13.7}{4}°}$	.....	218-21	.....	.....	.....
5438	col. lq.	$0.953^{\frac{15}{15}°}$	.....	189-90	.....	.....	.....
5439	lq.	$0.990^{\frac{18}{4}°}$	11	231^{727mm}	i.	∞	∞
5440	lq.	$0.985^{\frac{20}{20}°}$	.....	220^{746mm}	i.	s.	s.
5441	col. lq.	$0.883^{\frac{20}{4}°}$	−76	122-3	0.5	∞	∞
5442	col. lq.	$0.893^{0°}$	.....	$109\text{-}11^{750mm}$	.....	.....	.....
5443	lq.	<1	.....	165-8	.....	.....	.....
5444	lq.	$0.934^{0°}$	.....	158-9	sl. s.	.....	.....
5445	lq.	$0.944^{0°}$	.....	177-8	.....	sl. s.	.....
5446	col. lq.	$1.099^{15°}$	.....	238-40	v. sl. s.	∞	∞
5447	col. lq.	$1.010^{25°}$	.....	$120\text{-}2^{18mm}$	.....	.....	.....
5448	oil	$1.302^{\frac{20}{4}°}$	.....	84	.....	.....	.....
5449	col. cr.	.....	92-3	.....	s.	2.8 c. chl.	.....
5450	lq.	$0.978^{\frac{16}{4}°}$	.....	152.7^{743mm}	.....	.....	.....
5451	lq.	$0.963^{20°}$	.....	$152\text{-}3^{754mm}$	i.	∞	∞
5452	col. lq.	.....	.....	$164\text{-}6^{10mm}$	i.	s.	s.
5453	cr.	.....	107	.....	s.	.....	.....
5454	lq.	.....	.....	192-3	.....	.....	.....
5455	lq.	$0.885^{0°}$	.....	167.5	i.	∞	∞
5456	col. lq.	$0.863^{\frac{20}{4}°}$	.....	155.9	i.	∞ ; ∞ chl.	∞
5457	col. lq.	$0.854^{17°}$	.....	142^{756mm}	.....	.....	.....
5458	lq.	$0.834^{20°}$	.....	137-8	.....	.....	.....
5459	col. gas	(A)1.498 $0.609^{-\frac{4.7}{4}°}$	−185	-48^{749mm}	44.6 cc.	1200 cc.	500 cc. ac.
5460	lq.	.....	.....	$52\text{-}3^{16mm}$	.....	.....	.....
5461	col. lq.	$1.103^{20°}$	.....	133-4	s.	s.	s.
5462	col. lq.	$1.115^{\frac{20}{20}°}$	.....	$126\text{-}7^{762mm}$	∞	∞	.....
5463	col. lq.	.....	12	252-4	.....	.....	.....
5464	col. lq.	$0.878^{15°}$	.....	119-20	∞	.....	.....
5465	col. oil	$1.040^{19.4°}$	.....	188-9	∞	∞	8
5466	col. lq.	.....	.....	186^{758mm}	10	.....	.....
5467	col. lq.	$1.055^{20°}$	.....	182-3	s.	.....	.....
5468	col. lq.	$0.831^{\frac{20}{20}°}$	.....	35	$33^{30°}$	∞	∞
5469	lq.	.....	.....	50	∞	.....	.....
5470	wh. cr. pd.	.....	176 d.	.....	v. s.	.....	.....

PS (puking stuff) gas 4697
Pseudoaconitine, cf. alkd.
Pseudochlorogenin 1478
Pseudocinchonine, cf. alkd.
Pseudocumene 6254
Pseudocumidine 6250
Pseudocumene 6254
Pseudocumenol 6265
Pseudoephedrine 2878
Pseudomorphine, cf. alkd.
Pseudopelletierine, cf. alkd.
Pseudopunicine, cf. alkd.
Pseudosarsasapogenin 5602
Pseudotropine, cf. alkd.
Pukateine, cf. alkd.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5471	**Pulegol** (*iso*)(*d*)	.....	$C_{10}H_{17}OH$	VI-65	154.24
5472	**Pulegone**	.....	$C_{10}H_{16}O$	VII-81	152.23
5473	**Purine**	.....	$C_5H_4N_4$	XXVI-354	120.11
5474	**Putrescine**	.....	$NH_2{\cdot}(CH_2)_4{\cdot}NH_2$	IV-264	88.15
5475	hydrochloride	.....	$C_4H_{12}N_2{\cdot}2HCl$	IV-264	161.08
5476	**Pyrantin**	*p*-ethoxyphenyl-succinimide	$C_2H_5O{\cdot}C_6H_4{\cdot}N(COCH_2)_2$	XXI-377	219.23
5477	**Pyrazine**	1,4-diazine	N:CH·CH:N·CH:CH (ring)	XXIII-91	80.09
5478	**Pyrazole**	.....	N:CH·CH:CH·NH (ring)	XXIII-39	68.08
5479	**Pyrazoline**	.....	N:CH·CH_2·CH_2·NH (ring)	XXIII-28	70.09
5480	**Pyrazolone** (5)	1,2-pentadiazenone	CO·CH_2·CH:N·NH (ring)	XXIV-13	84.08
5481	**Pyrene**	.....	$C_{16}H_{10}$	V-693	202.24
5482	**Pyridazine**	1,2-diazine	N:CH·CH:CH·CH:N (ring)	XXIII-89	80.09
5483	**Pyridine**	.....	C_5H_5N	XX-181	79.10
5484	hydrochloride	.....	$C_5H_5N{\cdot}HCl$	XX-189	115.56
5485	hydrochloride	.....	$C_5H_5N{\cdot}2HCl$	XX-189	152.03
5486	carboxylic acid (2)	picolinic acid (2)(α)	$C_5H_4N{\cdot}CO_2H$	XXII-33	123.11
5487	carboxylic HCl (2)	α-picolinic HCl	$C_5H_4N{\cdot}CO_2H{\cdot}HCl$	XXII-34	159.57
5488	carboxylic acid (3)	nicotinic acid (3)(β)	$C_5H_4N{\cdot}CO_2H$	XXII-38	123.11
5489	carboxylic HCl (3)	nicotinic HCl	$C_5H_4N{\cdot}CO_2H{\cdot}HCl$	XXII-39	159.57
5490	carboxylic HNO_3	nicotinic nitrate	$C_5H_4N{\cdot}CO_2H{\cdot}HNO_3{\cdot}H_2O$	XXII-39	204.14
5491	3-carboxylic acid flavianate	nicotinic flavianate	$C_6H_5O_2N{\cdot}C_{10}H_6O_8N_2S$	.....	437.33
5492	3-carboxylic acid picrate	nicotinic acid picrate	$C_6H_5O_2N{\cdot}C_6H_3O_7N_3$	*XXII-503	352.22
5493	3-carboxylic amide	nicotin(ic)amide	$C_5H_4N{\cdot}CONH_2$	XXII-40	122.12
5494	3-carboxylic amide flavianate	nicotinamide flavianate	$C_6H_6ON_2{\cdot}C_{10}H_6O_8N_2S$	.....	436.35
5495	3-carboxylic amide picrate	nicotinamide picrate	$C_6H_6ON_2{\cdot}C_6H_3O_7N_3$	.....	351.23
5496	carboxylic acid (4)	*iso*-nicotinic acid (4)	$C_5H_4N{\cdot}CO_2H$	XXII-45	123.11
5497	dicarboxylic acid (2,3)	quinolinic acid	$C_5H_3N(CO_2H)_2$	XXII-150	167.12
5498	dicarboxylic acid (2,4)	lutidinic acid (2,4)	$C_5H_3N(CO_2H)_2{\cdot}H_2O$	XXII-153	185.13
5499	dicarboxylic acid (2,5)	*iso*-cinchomeronic acid	$C_5H_3N(CO_2H)_2{\cdot}H_2O$	XXII-153	185.13
5500	dicarboxylic acid (2,6)	dipicolinic acid	$C_5H_3N(CO_2H)_2{\cdot}1\frac{1}{2}H_2O$	XXII-154	194.14
5501	dicarboxylic acid (3,4)	cinchomeronic acid	$C_5H_3N(CO_2H)_2$	XXII-155	167.12
5502	dicarboxylic acid (3,5)	dinicotinic acid	$C_5H_3N(CO_2H)_2$	XXII-160	167.12
5503	pentacarboxylic acid	.....	$C_5N(CO_2H)_5{\cdot}2H_2O$	XXII-190	335.18
5504	pentacarboxylic acid	.....	$C_5N(CO_2H)_5{\cdot}3H_2O$	XXII-190	353.20
5505	sulfonic acid (3)	.....	$C_5H_4N{\cdot}SO_3H$	XXII-387	159.16

Puking stuff gas 4697
Pulegomenthol 4025
Pulsatilla camphor 510
Punicine, cf. alkd.
Purpurin 6213-4
Purpuroxanthin 2298
Purpuroxanthin carboxylic acid 2305
Pyracetosalyl 566
Pyramidon 363
Pyrantone-A 1663
Pyridone 3812-4
Pyridyl-methyl-pyrrolidine, cf. alkd.
Pyridyl-piperidine, cf. alkd.
Pyro alcohol 4100

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5471	col. lq.	$0.911^{\frac{20}{4}}$°	.....	86-9^{10mm}	v. sl. s.	.....	.....
5472	col. lq.	$0.932^{\frac{20}{20}}$°	.....	224^{754mm}	i.	∞	∞
5473	cr./al.	.....	217	d.	s.	s. h.	s. toluene
5474	cr.	.....	27-8	158-60	v. s.	.....	.....
5475	nd./aq.	$0.877^{\frac{25}{4}}$°	>290	.....	v. s.	i. Me al.	.....
5476	pr./al.	.....	155-8	.....	0.08$^{17°}$; 1.2$^{100°}$	s. h.	i.
5477	pr./aq.	$1.031^{\frac{81}{4}}$°	52-3	118^{768mm}	∞	s.	s.; s. HCl
5478	nd./et.	.....	70	186-8	s.	s.	s.; s. bz.
5479	lq.	.....	.....	144	∞	∞	sl. s.
5480	nd./ toluene	.....	165	subl. d.	s.	v. s.	v. sl. s.
5481	lt. yel. pr.	.....	149-50	>360	i.	3.1 h. abs.	v. s.
5482	lq.	$1.107^{\frac{20}{4}}$°	−8	208	∞; s. HCl	s.; i. lg.	s.; s. bz.
5483	col. lq.	$0.982^{\frac{20}{4}}$°	−42	115-6*	∞	∞	s.
5484	hyg. pl./al.	.....	82	218-9	s.	s.	i.; s. chl.
5485	pr.	.....	46-7	d. > 55	.....	.....	i.
5486	nd./al.	.....	137-9	d. $-CO_2$	v. s.	v. s.	v. sl. s.
5487	rhb.	.....	210-25 d.	.....	.....	.....	.....
5488	nd./al.	.....	235.2	subl.	s. h.	s. h.	v. sl. s.
5489	pr./aq.	.....	274-5	.....	.....	s.	.....
5490	lf. or pr./ aq.	.....	192-4	.....	.....	.....	.....
5491	yel. pl./al.	.....	249-50	.....	s. h.	sl. s. abs.	i.
5492	pa. yel. pl. or nd./aq.	.....	225-7 d.	.....	s. h.	sl. s. abs.	i.
5493	col. nd./bz.	.....	133	.....	100	66.6	v. sl. s.
5494	pa. yel. cr./ 75% al.	.....	269-70 d.	.....	s.	sl. s. abs.	i.
5495	yel. pl. or nd.	.....	193	.....	s. h.	sl. s. abs.	i.
5496	nd./aq.	.....	317**	d.	s. h.	sl. s. h.	v. sl. s.
5497	col. mn./ aq.	.....	d. 110 (slow)	d. > 190 (rapid)	0.67°; s. h.	sl. s.; s. alk.	0.02; i. bz.
5498	pl./aq.	0.942	248-50	.....	v. s. h.	s. h.	i.
5499	cr./aq.	.....	236-7 (anh.)	subl. d.	sl. s. h.; s. h. HCl	v. sl. s.	v. sl. s.
5500	nd./aq.	.....	226 d. (anh.)	.....	sl. s. c.	v. sl. s.	v. sl. s.
5501	cr./HCl	.....	258-9 d.	subl. d.	sl. s. h.	sl. s.	i.; i. chl.
5502	cr.	.....	323 d.	subl. sl. d.	v. sl. s.	v. sl. s.	v. sl. s.; s. HCl
5503	cr./et.	.....	$-H_2O$, 100	d.	s.	.....	v. sl. s.
5504	cr./aq.	.....	d. 220 (anh.)	.....	s.	.....	v. sl. s.
5505	nd. or lf.	.....	d.	.....	v. s.	v. sl. s.	i.

* Liquid + $3H_2O$, b. p. 92-3°.
** Sealed tube.
Pyrocatechin 2312
Pyrocatechol 2312
Pyrocatechol ethyl ether 2927
Pyrocatechuic acid 2312
Pyrodin 111
Pyrogallic acid 6216
Pyrogallol 6216
Pyrogallol carboxylic acid 6220, 6223
Pyroligneous spirit 4100
Pyromellitic acid 682
Pyromucic acid 3340
Pyromuc(ic)amide 3341
Pyromucic anhydride 3343

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5506	**Pyridine** tricarboxylic acid (2,3,4)	α-carbocinchomeronic acid	$C_5H_2N(CO_2H)_3 \cdot 1\frac{1}{2}H_2O$	XXII-182	238.15
5507	tricarboxylic acid (2,4,5)	berberonic acid	$C_5H_2N(CO_2H)_3 \cdot 2H_2O$	XXII-185	247.16
5508	tricarboxylic acid (2,4,6)	trimesitinic acid	$C_5H_2N(CO_2H)_3 \cdot 2H_2O$	XXII-185	247.16
5509	tricarboxylic acid (3,4,5)	β-carbocinchomeronic acid	$C_5H_2N(CO_2H)_3 \cdot 3H_2O$	XXII-186	265.18
5510	**Pyridoxin**	2-Me-3-OH-4,5-di-(hydroxymethyl)-pyridine	$C_8H_{11}O_3N$	.....	169.18
5511	hydrochloride	.....	$C_8H_{11}O_3N \cdot HCl$	.....	205.64
5512	3-methyl ether	.....	$CH_3O \cdot C_8H_{10}O_2N$	.....	183.20
5513	**Pyrimidine**	*m*-diazine (1,3)		XXIII-89	80.09
5514	**Pyrocoll**	.....	$C_4H_3 \cdot N:(CO)_2:N \cdot C_4H_3$	XXIV-403	186.16
5515	**Pyrogallol** dimethyl ether (1,3;2)	2,6-diMeO-phenol	$(CH_3O)_2C_6H_3 \cdot OH$	VI-1081	154.16
5516	triacetate (1,2,3)	lenigallol	$C_6H_3(O_2CCH_3)_3$	VI-1083	252.22
5517	trimethyl ether	(1,2,3)	$C_6H_3(OCH_3)_3$	VI-1081	168.19
5518	**Pyrone** (1,4)	.....	$C_5H_4O_2$	XVII-271	96.08
5519	**Pyronine**	.....	$C_{17}H_{19}ON_2 \cdot Cl$	XVIII-596	302.80
5520	**Pyrotartaric acid** (*dl*)	methyl succinic acid	$HO_2C(CH_3)CH \cdot CH_2 \cdot CO_2H$	II-636	132.11
5521	**Pyrrole**	.....	$(\cdot CH:CH)_2:NH$	XX-159	67.09
5522	carboxylic acid (α)	(2)	$C_4H_3NH(CO_2H)$	XXII-22	111.10
5523	**Pyrrolidine**	tetrahydropyrrole	$(CH_2)_4:NH$	XX-4	71.12
5524	**Pyrroline**	dihydropyrrole		XX-133	69.10
5525	**Pyruvic** acid	pyro-racemic acid	$CH_3 \cdot CO \cdot CO_2H$	III-608	88.06
5526	amide	.....	$CH_3 \cdot CO \cdot CO \cdot NH_2$	III-620	87.08
5527	nitrile	acetyl cyanide	$CH_3 \cdot CO \cdot CN$	III-620	69.06
5528	**Quinaldine** carboxylic acid (3)	2-Me-quinoline-3-carboxylic acid	$CH_3 \cdot C_9H_5N \cdot CO_2H$	XXII-83	187.19
5529	4-carboxylic acid	aniluvitonic acid	$CH_3 \cdot C_9H_5N \cdot CO_2H \cdot aq.$	XXII-85	187.19
5530	5-carboxylic acid	(2;5)	$CH_3 \cdot C_9H_5N \cdot CO_2H$	XXII-86	187.19
5531	6-carboxylic acid	(2;6)	$CH_3 \cdot C_9H_5N \cdot CO_2H$	XXII-87	187.19
5532	8-carboxylic acid	(2;8	$CH_3 \cdot C_9H_5N \cdot CO_2H \cdot 1\frac{1}{2}H_2O$	XXII-87	214.21
5533	**Quinaldinic acid**	quinoline-2-carboxylic acid	$C_9H_6N \cdot CO_2H \cdot 2H_2O$	XXII-71	209.20
5534	**Quinazoline**	.....		XXIII-175	130.14
5535	**Quinhydrone**	.....	$C_6H_4O_2 \cdot C_6H_4(OH)_2$	VII-617	218.20
5536	**Quinic acid** (*l*)	.....	$(HO)_4C_6H_7 \cdot CO_2H$	X-535	192.17
5537	**Quininic acid** (6;4)	6-MeO-cinchoninic acid	$CH_3O \cdot C_9H_5N \cdot CO_2H$	XXII-234	203.19
5538	**Quinoline**	leucoline	C_9H_7N	XX-339	129.15
5539	ethiodide	.....	$C_9H_7N \cdot (C_2H_5I)$	XX-353	285.13
5540	**Quinoline** (*iso*)	.....	C_9H_7N	XX-380	129.15

Pyromucyl chloride 3344
Pyroracemic acid 5525
Pyroracemic aldoxime 4873
Pyrosal 566
Pyrotritaric acid 6396
Pyroxanthin 2258
Pyrrodiazole 6080
Pyrrolidine carboxylic acid 5335
Pyrrolidone 3936
Quebrachine, cf. alkd.
Quercetin 5807
Quercetin methyl ether 5556
Quercimelin, cf. glcde.
Quercitol 1608
Quercetrin, cf. glcde.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5506	rhb./aq.	.....	249-50 d. (anh.)	$-H_2O$, 115-20	18°; s. h.	sl. s.	i.; i. bz.
5507	tri.	.....	243	.....	s. aq. a.	sl. s. h.	i.; i. bz.
5508	pl./aq. H_2SO_4	.....	227 d. (anh.)	subl. d.	v. sl. s.	sl. s.	sl. s.
5509	pl. or lf.	.....	d. 261 (anh.)	$-H_2O$, 115	s. h.	.....	.....
5510	col. nd.	.....	160 d.	subl. in vac.	s.; s. act.	s.; sl. s. $CHCl_3$	sl. s.
5511	col. pr.	.....	209-10 d.	subl. in vac.	22	1.1	sl. s.; sl. s. act.
5512	cr./chl. lg.	.....	103-5	.....	s.	s.	s.
5513	cr.	.....	20-2	123-4	∞	s.	s.
5514	yel. mn.	.....	268-9*	subl.	i.; s. c. H_2SO_4	v. sl. s. c.	v. sl. s.; s. ac.
5515	mn./aq.	.....	55-6	262.7	$1.8^{13^{\circ}}$	s.	s.
5516	wh. cr. pd.	.....	164-5	....	i.	s.	d. aq. alk.
5517	rhb.	$1.099^{\frac{75^{\circ}}{75}}$	47	241	s. bz.	v. s.	v. s.
5518	cr.	$1.190^{40.3^{\circ}}$	32.5	215-7	v. sl. s.	s.	v. s.
5519	gn. pd.	.....	.....	.....	s.	sl. s.	i.
5520	tri.	1.411	111-2	.....	$66^{20^{\circ}}$	v. s.	v. s.
5521	lq.	$0.948^{\frac{20^{\circ}}{4}}$	.....	131	i.; i. alk.	s.; s. bz.	s.
5522	mn.	.....	192 sl. d.	d. 208.5	s.	s.	s.
5523	lq.	$0.852^{22.5^{\circ}}$	.....	87.5-8.5	∞	∞; ∞ chl.	∞
5524	lq.	$0.910^{\frac{20^{\circ}}{4}}$	.....	90-1	v. s.	∞	∞
5525	col. lq.	$1.267^{\frac{20^{\circ}}{4}}$	13.6 ±	165 sl. d.	∞	∞	∞
5526	pl./al.	.....	124-5	subl. 100	v. s.	s.	sl. s. c. bz.
5527	lq.	.....	.....	93	.....	.....	.....
5528	nd./al. or bz.	.....	235-8 d.	.....	i.	v. sl. s.	v. sl. s.
5529	yel. nd./aq.	.....	244-6 d.	subl. d.	sl. s.; s. h. ac.	sl. s.; i. h. chl.; s. a.	sl. s.; i. pet.
5530	nd./al.	.....	285 d.	subl. d.	v. sl. s.	s.; s. h. a.	i.; i. bz.
5531	nd./al.	.....	259-61	subl. d.	v. sl. s. h.	s. h.	.....
5532	nd./aq.	.....	151	.....	v. s. h.	s.; s. a.	s. alk.
5533	nd./aq.	.....	156 (anh.)	$-H_2O$, 100	s. h.; s. alk.	s.	s. h. bz.
5534	pl./pet.	.....	48.0-8.5	243^{773mm}	v. s.	s.	s.
5535	red brn. rhb.	$1.401^{20^{\circ}}$	171	subl. sl. d.	s. h.; s. NH_4OH	s.	s.; d. chl.
5536	mn./aq.	1.637	162-3	d.	$40^{9^{\circ}}$	s.; s. ac.	v. sl. s.
5537	yel. pr./aq. HCl	.....	280 d.	.....	v. sl. s. c.; s. alk.	1.2 h. abs.; s. a.	v. sl. s.; v. sl. s. bz.
5538	hyg. lq.	$1.095^{20^{\circ}}$	−15	237.1^{747mm}	6	∞	∞; s. CS_2
5539	yel. mn./al.	.....	159-60	.....	$301^{25^{\circ}}$	$1.8^{25^{\circ}}$ chl.	i.; s. al.
5540	pl.	$1.099^{\frac{21^{\circ}}{4}}$	24.6	240.5^{763mm}	sl. s.	.....	s. a.

* Sealed tube.

Quercitrinic acid, cf. glcde.
Quinaldic acid 5533
Quinaldine 4367
Quinaldine ethiodide 4368
Quinalizarin 5801
Quinanisole 4083
Quinazine 5548
Quinicine, cf. alkd.
Quinidine, cf. alkd.
Quinine, cf. alkd.
Quinizarin 2299
Quinizarin amide 327
Quinoform, cf. alkd.
Quinol 2314
Quinoline blue 1580
Quinoline carboxylic acid 5533
Quinolinic acid 5497

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5541	**Quinone** (*o*)	*o*-benzoquinone	$CH{\cdot}(CH)_3{\cdot}CO{\cdot}CO$	VII-600	108.09
5542	**Quinone** (*p*)	quinone	$CO{:}(CH{:}CH)_2{:}CO$	VII-609	108.09
5543	chlorimide (1,4)	.....	$O{:}C_6H_4{:}N{\cdot}Cl$	VII-619	141.56
5544	dichlordiimide (*p*)	.....	$Cl{\cdot}N{:}C_6H_4{:}N{\cdot}Cl$	VII-621	175.02
5545	dioxime (*p*)	.....	$HO{\cdot}N{:}C_6H_4{:}N{\cdot}OH$	VII-627	138.12
5546	monoxime (*p*)	*p*-nitrosophenol tautomer	$O{:}C_6H_4{:}N{\cdot}OH$ or $HO{\cdot}C_6H_4{\cdot}NO$	VII-622	123.11
5547	monoxime Na	(sodium salt)	$NaO{\cdot}C_6H_4{\cdot}NO{\cdot}2H_2O$	VII-624	145.10
5548	**Quinoxaline**	quinazine	$C_6H_4{\cdot}N{:}CH{\cdot}CH{:}N$	XXIII-176	130.14
5549	**Raffinose**	melitose	$C_{18}H_{32}O_{16}{\cdot}5H_2O$	.....	594.52
5550	**Resacetophenone**	2,4-diOH-aceto-phenone	$(HO)_2C_6H_3{\cdot}COCH_3$	VIII-266	152.14
5551	**Resazurin**	"azoresorcin"	$C_{12}H_7O_4N$	XXVII-128	229.18
5552	**Resorcinol** diacetate	(1,3)	$C_6H_4(O_2C{\cdot}CH_3)_2$	VI-816	194.18
5553	dibenzoate	(1,3)	$C_6H_4(O_2C{\cdot}C_6H_5)_2$	IX-131	318.31
5554	**Resorufin**	9-OH-iso-phenoxazone	$HO{\cdot}C_{12}H_6ON{:}O$	XXVII-128	213.18
5555	**Retene**	1-Me-7-isoPr-phenanthrene	$C_{18}H_{18}$	V-683	234.32
5556	**Rhamnetin**	quercetin-7-Me-ether	$C_{16}H_{12}O_7$	XVIII-245	316.26
5557	**Rhamnitol**	rhamnite	$CH_3{\cdot}C_5H_{11}O_5$	I-532	166.17
5558	**Rhamnose** (*β*)	isodulcite	$C_6H_{12}O_5{\cdot}H_2O$	I-870	182.17
5559	phenylhydrazone	.....	$C_6H_{12}O_4{:}N{\cdot}NHC_6H_5$	XV-216	254.28
5560	**Rhodanine**	rhodanic acid	$S{\cdot}CH_2{\cdot}CO{\cdot}NH{\cdot}CS$	XXVII-242	133.18
5561	**Rhodeose**	.....	$C_5H_{11}O_4{\cdot}CHO$	I-876	164.16
5562	**Rhodoxanthin**	.....	$C_{40}H_{50}O_2$	XXX-101	562.80
5563	**Riboflavin**	vitamin B_2 or G	$C_{17}H_{20}O_6N_4$	.....	376.36
5564	**Ribose** (*d*)	.....	$C_4H_9O_4{\cdot}CHO$	I-859	150.13
5565	phenylhydrazone (*l*)	.....	$C_5H_{10}O_4{:}N{\cdot}NHC_6H_5$	XV-215	240.25
5566	**Ricinelaidic** acid	.....	$C_{18}H_{34}O_3$	III-388	298.45
5567	sodium salt†	.....	$C_{17}H_{33}O{\cdot}CO_2Na$	.....	320.44
5568	**Ricinoleic acid**	.....	$C_{18}H_{34}O_3$	III-385	298.45
5569	**Ricinstearolic acid**	.....	$C_6H_{13}CHOHCH_2C{:}C{\cdot}C_7H_{14}CO_2H$	III-391	296.44
5570	**Rosaniline** (3-Me; 4,4′,4″-NH_2)	fuchsine carbinol base	$(CH_3{\cdot}C_6H_3NH_2){\cdot}COH(C_6H_4NH_2)_2$	XIII-763	319.39
5571	hydrochloride	fuchsine	$C_{20}H_{20}N_3Cl{\cdot}aq.$	XIII-765	337.84
5572	**Rosinduline**	.....	$HN{:}C_{10}H_5{:}NC_6H_4N{\cdot}C_6H_5$	XXV-348	321.36
5573	**Rosolic acid**‡	4,4′-diOH-3-Me-fuchsone	$C_{20}H_{16}O_3$	VIII-365	304.33

† Usually a mixture of salts of fatty acids from castor oil. ‡ See also No. 593.

Quinone-imide-oxime 4875
Quinophan 5234
Quinophenol 3825
Quinosol 3827
Quinotol 1386
Quinotoxine, cf. alkd.
R acid 4491
Racemic acid 5690
Ratanhin 4405
Redoxon 586
Resazoin 5551
Resorcin yellow 2308
Resorcine 2313
Resorcinol 2313
Resorcinol blue 3938
Resorcinol diethyl ether 2092
Resorcinol dimethyl ether 2407
Resorcinol ethyl ether 2928
Resorcinol methyl ether 4080
Resorcinol monacetate 114
Resorcinol phthalein 3250
Resorcinol phthalin 3254
Resorcyl aldehyde (*β*) 2310
Resorcylic acid 2316, 2318, 2320

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5541	red pr.	.....	d. 60-70	.....	v. s. act.	i. pet.	sl. s.
5542	yel. mn./ aq.	$1.318^{20°}_{4}$	115.7	subl.	v. sl. s. c.	s.; s. h. lg.	s.
5543	yel. lq.	.....	85-6	expl.	s. h.	s.	s.; s. a.
5544	nd./aq.	.....	126 d.	.....	v. sl. s. h.	v. s. h.	v. s.
5545	col. or yel.	.....	d. 240 ±	.....	v. sl. s. aq. NH_4OH	s. conc. NH_4OH	.....
5546	lt. yel. rhb.	.....	124-6	d. 144	s. h.	v. s.	v. s.
5547	red nd./al.	.....	$-2H_2O$, 100	.....	v. s.	s.; s. act.	i.
5548	cr.	$1.133^{18°}_{4}$	29-30	225-6	s. c.; sl. s. h.	∞	∞; ∞ bz.
5549	cr./aq.	$1.465^{0°}$	87 partly; 118-9 (anh.)	$-H_2O$, 110	$14.3^{20°}$; ∞ h.	$0.1^{20°}$	.....
5550	col. cr.	$1.18^{141°}$	144-6	d.	i.; s. pyr.	s. h.; s. ac.	i.; i. bz.
5551	gn. red/ac.	.....	d.	.....	i.	sl. s.	i.; i. alk.
5552	lq.	.....	.....	278 sl. d.	.....	.....	.....
5553	pl./al.	.....	117	.....	.....	$5^{18°}$ abs.	.....
5554	brn./HCl	.....	.....	....	i.; s. alk.	v. sl. s.	i.
5555	lf./al.	$1.13^{16°}$	98-9	390-4	i.; s. bz.	69 h.; s. CS_2	v. s. h.
5556	yel. n.d/al.	.....	>300	.....	v. sl. s. h.	s. h.	s. alk.
5557	tri.	.....	121	.....	v. s.; sl. s. act.	v. s.; sl. s. chl.	v. sl. s.
5558	col. mn.	$1.471^{20°}_{4}$	126	.....	$60.8^{21°}$	54 Me al.	i.
5559	col. lf.	.....	159	.....	$1.25^{15°}$	.....	i.
5560	pa. yel. pr./al.	.....	168-70 d.	.....	$0.2^{25°}$; s. h.; s. alk.	v. s.; s. NH_4OH	v. s.
5561	nd.	.....	144	.....	v. s.	v. sl. s.	.....
5562	b. bl. lf./ bz. Me al.	.....	219	.....	i.; sl. s. bz.	v. sl. s.; sl. s. chl.	s. pyr.; i. pet.
5563	or. yel. nd.	.....	286 d.	.....	$0.3^{25°}$	i. abs.	i.; s. pyr.
5564	pl./abs. al.	.....	87	.....	s.	sl. s.	.....
5565	col. cr.	.....	154-5 sl. d.	.....	v. s.	.....	.....
5566	nd./al.	.....	53	$240\text{-}2^{10mm}$	.....	v. s.	v. sl. s. pet.
5567	wh. yel. pd.	.....	.....	.....	s.	s.	.....
5568	lq.	$0.954^{16°}$	4-5	$226\text{-}8^{10mm}$	i.	∞; ∞ chl.	∞
5569	nd./al.	.....	53	260^{10mm}	.....	s.	s.
5570	col. nd./aq.	.....	186 d.	.....	v. sl. s.; s. a.	sl. s.	i.
5571	gn. red	1.22	d. > 200	.....	0.3	s.	i.; s. HCl
5572	brn. nd./ et.	.....	198-9	.....	i.	s.	s.; s. bz.
5573	red lf.	.....	308-10 d.	d.	$0.12^{25°}$	v. s. h.	sl. s.; s. alk.

Rhamnin, cf. glcde.
Rhamnite 5557
Rhamnocitrin (β) 5556
Rhamnoxanthin, cf. glcde.
Rheadin, cf. alkd.
Rheic acid 2306
Rhein 2306
Rho acid 553
Rhodalline 221
Rhodamine-B 5766
Rhodanic acid 5560
Rhodeoretin, cf. glcde.
Rhodinal 1518
Rhodinol 1519
Rhodol 4117
Rhoeadine, cf. alkd.
Rhubard yellow 2306
Ricidine, cf. alkd.
Ricinine, cf. alkd.
Robinin, cf. glcde.
Rodinal 349
Rongalite-C 3295
Rosolic acid (p) 593
Rubeanic acid 2821
Ruberythric acid, cf. glcde.
Rubiadin glucoside, cf. glcde.
Rubianic acid, cf. glcde.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5574	**Rotenone**	.....	$C_{23}H_{22}O_6$	.....	394.41
5575	**Rufigallic acid**	1,2,3,5,6,7-hexa-OH-anthraquinone	$C_{14}H_2O_2(OH)_6$	VIII-567	304.20
5576	**Sabinene**	.....	$C_{10}H_{16}$	V-143	136.23
5577	**Saccharic acid** (*d* or *l*)	.....	$(CHOH)_4(CO_2H)_2$	III-577	210.14
5578	***iso*-Saccharic acid**	.....	$(CHOH{\cdot}CH{\cdot}CO_2H)_2O$	.....	192.12
5579	**Saccharin**	*o*-benzoyl sulfimide	$C_6H_4{\cdot}CO{\cdot}NH{\cdot}SO_2$ | ——— |	XXVII-168	183.18
5580	soluble	(sodium salt)†	$C_7H_4O_3NSNa{\cdot}2H_2O$	XXVII-170	241.20
5581	**Safrole**	3,4-methylenedioxy-allylbenzene	$CH_2O_2:C_6H_3{\cdot}CH_2{\cdot}CH:CH_2$	XIX-39	162.18
5582	***iso*-Safrole**	3,4-methylenedioxy-propenylbenzene	$CH_2O_2:C_6H_3{\cdot}CH:CH{\cdot}CH_3$	XIX-35	162.18
5583	**Salicyl**-acetic acid	.....	$C_6H_4(OCH_2CO_2H){\cdot}CO_2H$	X-69	196.15
5584	aldehyde triacetate	acetylsalicylaldehyde diacetate	$C_6H_4CH:(O_2CCH_3)_2{\cdot}O_2C{\cdot}CH_3$	VIII-45	266.24
5585	salicylic acid	disalicylic acid; salysal; diplosal	$HO{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_6H_4{\cdot}CO_2H$	X-84	258.22
5586	**Salicylidene**-acetamide	.....	$HO{\cdot}C_6H_4{\cdot}CH:N{\cdot}CO{\cdot}CH_3$	VIII-47	163.17
5587	benzamide	.....	$HO{\cdot}C_6H_4{\cdot}CH:N{\cdot}CO{\cdot}C_6H_5$	IX-212	225.24
5588	*p*-phenetidine	malakin	$HO{\cdot}C_6H_4{\cdot}CH:N{\cdot}C_6H_4{\cdot}OC_2H_5$	XIII-458	241.28
5589	2-thiohydantoin	5-(2-hydroxybenzal)-2-thiohydantoin	$HO{\cdot}C_6H_4{\cdot}CH:C_3H_2ON_2S$	*XXV-502	220.24
5590	**Salipyrine**	antipyrene salicylate	$C_{18}H_{18}O_4N_2$	XXIV-32	326.34
5591	**Salyrgan**	mersalyl	$C_{13}H_{16}O_6NHgNa$	.....	505.87
5592	**Salvarsan** (1-As;3-NH_2;4-OH)	arsphenamine; "606"	$(:As{\cdot}C_6H_3(OH)NH_2{\cdot}HCl)_2{\cdot}2H_2O$	*XVI-507	475.01
5593	**Salvarsan** (neo)	neoarsphenamine; novarsenobenzol	$NH_2(OH)C_6H_3As:As{\cdot}C_6H_3(OH)NH{\cdot}CH_2OSONa$‡	*XVI-508	466.13
5594	**Santalic acid**	.....	$C_{15}H_{14}O_5$	.....	274.26
5595	**Santalol** (α)	arheol	$C_{15}H_{24}O$	VI-558	220.34
5596	**Santylyl salicylate**	santyl	$HO{\cdot}C_6H_4{\cdot}CO_2{\cdot}C_{15}H_{23}$	X-80	340.44
5597	**Santonic acid**	.....	$C_{15}H_{20}O_4$	X-804	264.31
5598	**Santonin**	santoninic anhydride	$C_{15}H_{18}O_3$	XVII-499	246.29
5599	**Santoninic acid**	.....	$C_{15}H_{20}O_4$	X-962	264.31
5600	**Sarcosine**	*N*-methyl glycine	$CH_3NH{\cdot}CH_2{\cdot}CO_2H$	IV-345	89.09
5601	hydrochloride	.....	$C_3H_7O_2N{\cdot}HCl$	IV-345	125.56
5602	**Sarsasapogenin,** pseudo	pseudo-smilagenin	$C_{27}H_{44}O_3$	.....	416.62
5603	**Schonberg's reagent**	benzylimido-di-(4-methoxyphenyl) methane	$(CH_3O{\cdot}C_6H_4)_2C:N{\cdot}CH_2{\cdot}C_6H_5$	.....	331.40

† Usually with 5% H_2O. ‡ Contains also solvent and inorganic salts.

Rubiazol 5337
Rufiopin 5799
Rufol 2293
Rumpff acid 4512
Rutaecarpine, cf. alkd.
Rutin, cf. glcde.
Rutylidene 6382
S acid 339, 344
Sα acid 4533
Sacchar(in)ol 5579
Saccharinose 5579
Safranone 670
Salamid 3738
Salazolon 5590
Salicin, cf. glcde.
Salicoyl-phenol 2323-5
Salicoyl-resorcinol 6225
Salicyl-acetophenone 3763
Salicyl alcohol 3750
Salicyl aldehyde 3733
Salicyl-aldehyde ethyl ether 2914

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5574	pl./al.	.....	163	.....	i.; s. chl.	sl. s.; s. act.	sl. s.; v. s. pet.
5575	red cr.	.....	subl. sl. d.	.....	i.; s. H_2SO_4	v. sl. s.; s. alk.	v. sl. s.
5576	lq.	$0.848^{\frac{15}{15}°}$	.....	164-5	i.	∞	∞
5577	syrup	.....	d. lactone	.....	v. s.	v. s.	i.
5578	rhb.	.....	185	d.	s.	s.	v. sl. s.
5579	mn./act.	.....	225-8 sl. d.	subl. 300 in vac.	$0.4^{25°}$; sl. s. h.	3.1 c.; sl. s. chl.	1.05 c.; s. alk. carb.
5580	col. pd.	.....	.....	.....	83	2.2	.....
5581	col. mn.	$1.100^{\frac{20}{4}°}$	11.2	233-4	i.	s.	∞; ∞ chl.
5582	col. lq.	$1.122^{\frac{20}{4}°}$	6-7	252-3	i.	∞	∞; ∞ bz.
5583	nd./aq.	.....	191-2	.....	s. h.	s.; s. act.	s.; s. ac.
5584	nd. or pl./al.	.....	103-4	.....	i.	s. h.; s. CCl_4	s.; s. bz.
5585	col. cr./bz. or chl.	.....	148-9	d.	i.; $1^{25°}$ bz.	$45^{25°}$; $66^{25°}$ act.	$28^{25°}$; v. s. CCl_4
5586	yel. pd.	.....	d. > 150	.....	i.; i. alk. carb.	i. alk.	s. conc. H_2SO_4
5587	yel. pd.	.....	d. 190	.....	v. s. act.*	s.; s. alk.	i.; v. sl. s. bz.
5588	pa. yel. cr./al.	.....	91-2	.....	i.	s. h.	s.; s. bz
5589	nd./ac.	.....	251-3	.....	.....	.....	.....
5590	cr. pd.	.....	91-2	.....	$0.5^{15°}$; $4^{100°}$	s.; v. s. chl.	sl. s.
5591	delq. wh.	.....	.....	.....	100	35	i.
5592	yel. pd.	.....	.....	.....	s.	sl. s.	v. sl. s.
5593	yel. pd.	.....	.....	.....	s.; d. by heat, air, light.	sl. s.; v. s. gly.	i.; i. chl.; sl. s. act.
5594	red pr.	.....	104	.....	i.; s. alk.	∞ abs.	s.
5595	col. oil	$0.977^{\frac{25}{25}°}$	.....	300±	i.	s.	.....
5596	yel. oil	1.07	.....	126.6^{20mm}	i.	s.	s.
5597	col. rhb./aq.	$1.251^{\frac{20}{4}°}$	170-2	285^{15mm}	$0.56^{17°}$	s.	s.; s. chl.
5598	col. pr.	1.187	169-70	.....	$0.02^{17.5°}$; $0.4^{100°}$	$2.3^{22.5°}$; $37^{80°}$	$1.3^{17.5°}$; $2.4^{40°}$
5599	rhb. pl./al.	.....	$-H_2O$, 120	.....	s. h.	s.; s. chl.	sl. s.
5600	rhb.	.....	210-5 d.	.....	v. s.	sl. s.	.....
5601	nd./al.	.....	170-2	.....	v. s.	v. sl. s.	v. sl. s.
5602	nd./act.	.....	171-3	.....	sl. s.	s.	s.; s. ac.
5603	pa. yel. cr./abs. al.	.....	93	.....	i.; sl. s. pet.	s. h.	sl. s.

* Also a modification insoluble in act.

Salicyl-aldehyde glucose, cf. glcde.
Salicyl-aldoxime 3736
Salicyl-amide 3738
Salicyl-anilide 3741
Salicyl-phenol 2323-5
Salicylic acid 3742
Salicylic methyl ether 4067
Salicylic nitrile 3748
Salicylic phenyl ether 5133
Salicylic sulfonic acid 5681
Salicylide 3747
Salicyl(oyl)-resorcinol 6225
Saliformin 3602
Saligenin 3750
Saligenin methyl ether 4072
Saligenol 3750
Salimenthol 4031
Salinigrin, cf. glcde.
Salipyrazolon 5590
Salit 866
Salmester 4078
Salocoll 5117
Salol 5235

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5604	**Scopoletin**	7-OH-6-MeO-coumarin	$C_{10}H_8O_4$	XVIII-99	192.16
5605	**Sebacic** acid	decandioic acid	$(CH_2)_8(CO_2H)_2$	II-718	202.24
5606	nitrile	.....	$(CH_2)_8(CN)_2$	II-720	164.24
5607	**Seleno**-phenol	.....	$C_6H_5{\cdot}SeH$	VI-345	157.07
5608	urea	.....	$NH_2{\cdot}CSe{\cdot}NH_2$	III-227	123.02
5609	**Semicarbazide**	.....	$NH_2{\cdot}NH{\cdot}CO{\cdot}NH_2$	III-98	75.07
5610	hydrochloride	.....	$NH_2CON_2H_3{\cdot}HCl$	III-100	111.54
5611	**Serine** (*dl*)	.....	$HO{\cdot}CH_2{\cdot}CHNH_2{\cdot}CO_2H$	IV-512	105.09
5612	**Serine** (*d* or *l*)	.....	$C_3H_7O_3N$	IV-505	105.09
5613	***iso*-Serine** (*dl*)	.....	$NH_2{\cdot}CH_2{\cdot}CHOH{\cdot}CO_2H$	IV-503	105.09
5614	***iso*-Serine** (*d* or *l*)	.....	$C_3H_7O_3N$	IV-503	105.09
5615	**Silico**-acetic acid	.....	$CH_3{\cdot}SiO{\cdot}OH$	IV-629	76.10
5616	benzoic acid	.....	$C_6H_5{\cdot}SiO{\cdot}OH$	XVI-911	138.17
5617	**Silicon** methyl	.....	$(CH_3)_4Si$	IV-625	88.20
5618	phenyl trichloride	.....	$C_6H_5{\cdot}SiCl_3$	.....	211.53
5619	tetraethyl	siliconononane	$(C_2H_5)_4Si$	IV-625	144.30
5620	**Silver**† fulminate	.....	$Ag_2C_2O_2N_2$	I-722	299.80
5621	**Sodium**† acetanilide	.....	$CH_3CON(Na){\cdot}C_6H_5$	XII-237	157.15
5622	ethyl	.....	$C_2H_5{\cdot}Na$	*IV-618	52.06
5623	glycerolate	.....	$NaC_3H_7O_3$	I-511	114.08
5624	mercaptide	.....	$C_2H_5{\cdot}S{\cdot}Na$	I-341	84.12
5625	**Sorbic acid**	hexadienoic acid	$CH_3(CH{:}CH)_2CO_2H$	II-483	112.12
5626	**Sozoiodolic** acid	2,6-diiodophenol-4-sulfonic acid	$I_2(OH)C_6H_2{\cdot}SO_3H{\cdot}3H_2O$	XI-245	480.04
5627	Na salt	sozoiodol-sodium	$C_6H_3O_4I_2SNa{\cdot}2H_2O$	XI-245	484.01
5628	Hg salt	.....	$C_6H_2O_4I_2SHg$	*XI-56	624.59
5629	Zn salt	.....	$(C_6H_3O_4I_2S)_2Zn{\cdot}6H_2O$	XI-245	1023.44
5630	**Starch**‡	.....	$(C_6H_{10}O_5)_x$	.....	(162.14)
5631	**Stearic** acid	octadecanoic acid	$CH_3(CH_2)_{16}CO_2H$	II-377	284.47
5632	ammonium **salt**	amm. stearate	$C_{17}H_{35}CO_2NH_4$	*II-171	301.50
5633	aldehyde	octadecanal	$CH_3(CH_2)_{16}CHO$	I-718	268.47
5634	amide	stearamide	$C_{17}H_{35}{\cdot}CO{\cdot}NH_2$	II-384	283.48
5635	anhydride	.....	$(C_{17}H_{35}CO)_2O$	II-384	550.92
5636	anilide	stearanilide	$C_{17}H_{35}CO{\cdot}NHC_6H_5$	XII-257	359.58
5637	chloride	stearyl chloride	$C_{17}H_{35}{\cdot}CO{\cdot}Cl$	II-384	302.92
5638	nitrile	heptadecyl cyanide	$C_{17}H_{35}{\cdot}CN$	II-384	265.47
5639	**Stearolic acid**	octadecynoic acid	$C_8H_{17}C{\vdots}C(CH_2)_7{\cdot}CO_2H$	II-495	280.44
5640	**Stearone**	.....	$C_{35}H_{70}O$	I-720	506.91
5641	**Stearoxylic acid**	.....	$CH_3(CH_2)_7(CO)_2{\cdot}(CH_2)_7CO_2H$	III-761	312.44
5642	**Stilbene** (*trans*)	diPh-ethylene	$C_6H_5{\cdot}CH{:}CH{\cdot}C_6H_5$	V-630	180.24
5643	**Stilbene** (*cis*)	diPh-ethylene	$C_6H_5{\cdot}CH{:}CH{\cdot}C_6H_5$	.....	180.24
5644	**Stovaine**§	benzoyl-EtdiMe-amino-*iso*-propanol HCl	$C_6H_5CO_2C(C_2H_5){\cdot}(CH_3)CH_2N(CH_3)_2{\cdot}HCl$	IX-175	271.78
5645	**Strophanthidin**	.....	$C_{23}H_{32}O_6{\cdot}2H_2O$	.....	440.52
5646	**Styrene**	phenyl-ethylene	$C_6H_5{\cdot}CH{:}CH_2$	V-474	104.14

† See also inorganic compounds.
‡ See also No. 3443.
§ Free base, liquid, b. p. 14^{25mm}, s. organic solvents.

Salt of amber 5653
Salysal 5585
Sandoptal 1038
Santoninic anhydride 5598
Santyl 5596
Saponin, cf. glcde.
Saporubrin, cf. glcde.
Sapotoxin, cf. glcde.
Sarcine, cf. alkd.
Sarcolactic acid 3939
Sarsasaponin, cf. glcde.
Satrapol 4117
Saxin 5579
Scammonin, cf. glcde.
Schaeffer acid 4498, 4507
Schollkopf's acid 4543
Scopolamine, cf. alkd.
Secaline, cf. alkd.
Sedatine 565
Sedormid 217
Selenium diphenyl 2742

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5604	nd. or pr.	.....	204	subl.	v. sl. s.	s. h.; i. bz.	s. h. ac.
5605	col. lf.	.....	134.5	294.5^{100mm}	0.1 c.; 2 h.	v. s.	v. s.
5606	col. lq.	.....	.....	$199\text{-}200^{15mm}$	.....	.....	.....
5607	oil	$1.487^{15°}$	.....	183.6	v. sl. s.	v. s. CCl_4	v. s.
5608	pr./aq.	.....	200 ± d.	.....	$10^{19°}$	$3^{18°}$	$0.6^{18°}$
5609	pr./al.	.....	96	.....	v. s.	v. s.	i.
5610	pr./aq. al.	.....	173 d.	.....	v. s.	i. abs.	i.
5611	pr./aq.	.....	246 d.	.....	$4^{20°}$	i.	i.
5612	col. pr.	.....	228 d.	.....	$33^{25°}$	i.	.....
5613	mn.	.....	248	.....	$1.5^{20°}$	s. h. aq.	.....
5614	col. cr./aq.	.....	199-200 d.	.....	$25^{00°}$	.....	.....
5615	amor. pd.	.....	.....	.....	i.	i. h. aq. Na_2CO_3	s. conc. KOH
5616	glass/et.	.....	92	.....	i.	s. KOH	s.
5617	lq.	$0.648^{19°}_{4}$	ign. in air	$26\text{-}7^{761mm}$	i. H_2SO_4	.....	.....
5618	lq.	.....	.....	197	d.	d.; s. chl.	s.
5619	col. lq.	$0.768^{22°}_{4}$	.....	152-4	i.	.....	.....
5620	wh. nd./aq.	.....	.....	expl.	$0.02^{30°}$	s.	i. HNO_3
5621	cr. pd.	.....	.....	.....	d. h.	.....	.....
5622	wh. pd.	.....	ign. in air	.....	d.	i. bz.	.....
5623	wh. pd.	.....	d. 245	.....	d.	s.	.....
5624	cr./al.	.....	.....	.....	v. s.; d. h.	v. s.; d. h.	.....
5625	nd./aq.	.....	134.5	228 d.	s. h.	v. s.	v. s.
5626	col. mn. pr.	.....	120 (anh.); d. 190	$-3H_2O$, 100	s.	s.	s.
5627	col. cr.	.....	.....	.....	16	6	i.
5628	or. pd.	.....	.....	.....	$0.05^{20°}$	i.; 13.3 aq. 15% NaCl	i.; s. aq. KI
5629	col. nd.	.....	.....	.....	5	30	i.
5630	wh. amor.	$1.50^{21°}$	d.	.....	i.	i.	i.
5631	col. lf.	$0.847^{69.3°}$	69-70	291^{110mm}	i.; s. bz.; s. act.	$2^{20°}$; $100^{50°}$	s.; s. CS_2; s. CCl_4
5632	waxy	0.89	73-5	d.	v. sl. s.	s. h.	i.; i. bz.
5633	lf.	.....	63.5	$251\text{-}2^{100mm}$	.....	.....	s.
5634	col. cr.	.....	108-9	$250\text{-}1^{12}$ sl. d.	i.	s. h.	s. h.
5635	col. cr.	.....	72	.....	.....	.....	.....
5636	nd./al.	.....	94-5	153.5^{10mm}	i.; s. act.	s.; s. chl.	v. s.; s. bz.
5637	col. cr.	.....	23	215^{15} sl. d.	.....	.....	.....
5638	col. cr.	$0.818^{41°}_{4}$	41	274.5^{100mm}	i.	.....	.....
5639	pr./al.	.....	48	260	i.	s. h.	s.
5640	lf./lg.	$0.798^{89°}_{4}$	88.4	.....	i.	sl. s. h.	sl. s. h.
5641	yel. pl.	.....	86	.....	sl. s. lg.	s. h.	s.
5642	mn./al.	$0.970^{1.2.5°}_{1.3}$	124	306-7	i.	0.917^{0} abs.	7.914^{0}
5643	yel. oil	.....	1	145^{13mm}	.....	.....	.....
5644	nd./al.	.....	175	.....	50; 2 chl.	22 abs.	i.; i. act.
5645	lf./aq.	.....	170-5*	.....	sl. s.; s. bz.	s.; s. chl.	s.; i. pet.
5646	col. lq.	$0.903^{20°}_{4}$	−31	145-6	v. sl. s.	∞	∞

* Anhyd., m. p. 235°.

Selenium ethyl 2207
Selenium methyl 2553
Semi-naphthalidam 4573
Seminose 3619
Semi-oxamazide 5017
Sennite 4286
Sensitol red 5316
Sheibley's reagent 1967
Siliconanane 5619
Sinalbine, cf. glcde.
Sinapine, cf. alkd.
Sinigrin, cf. glcde.
Sinigroside, cf. glcde.
Six-O-six 5592
Skatole 4284
Skatole-acetic acid 3867
Skatole-carboxylic acid 3865
Smilacin, cf. glcde.
Smilagenin (pseudo) 5602
Sneezing gas 2712
Sobrerone 5320
Sodium acetone bisulfite 64
Solanidine, cf. alkd.
Solanine, cf. alkd.
Solid green base 5762
Solid violet 3353

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5647	**Styrene** dibromide	α,β-diBr-ethyl-benzene	$C_6H_5CHBr{\cdot}CH_2Br$	V-356	263.98
5648	oxide	phenylethylene oxide	$C_6H_5{\cdot}CH{\cdot}O{\cdot}CH_2$ (bridge)	XVII-49	120.14
5649	**Suberic** acid	octandioic acid	$(CH_2)_6(CO_2H)_2$	II-691	174.19
5650	aldehyde	octandial	$(CH_2)_6(CHO)_2$	I-795	142.19
5651	**Succinamic acid**	.....	$NH_2{\cdot}CO{\cdot}C_2H_4{\cdot}CO_2H$	II-613	117.10
5652	***iso*-Succinic acid**	methyl-malonic acid	$CH_3{\cdot}CH(CO_2H)_2$	II-627	118.09
5653	**Succinic** acid	butandioic acid	$(CH_2{\cdot}CO_2H)_2$	II-601	118.09
5654	sodium salt	sodium succinate	$C_4H_4O_4Na_2{\cdot}6H_2O$	*II-262	270.16
5655	aldehyde	succinic dialdehyde	$(CH_2{\cdot}CHO)_2$	I-767	86.09
5656	amide	succinamide	$(CH_2{\cdot}CO{\cdot}NH_2)_2$	II-614	116.12
5657	anhydride	.....	$(CH_2{\cdot}CO)_2O$	XVII-407	100.07
5658	chloride	succinyl chloride	$(CH_2{\cdot}COCl)_2$	II-613	154.99
5659	*N*-chloroimide	succinchlorimide	$(CH_2{\cdot}CO)_2N{\cdot}Cl$	XXI-380	133.54
5660	imide	succinimide	$(CH_2{\cdot}CO)_2NH$	XXI-369	99.09
5661	nitrile	ethylene dicyanide	$(CH_2{\cdot}CN)_2$	II-615	80.09
5662	peroxide	succinyl peroxide	$(HO_2C{\cdot}C_2H_4{\cdot}CO)_2O_2$	II-613	234.16
5663	**Sucrose**	cane sugar; beet sugar	$C_{12}H_{22}O_{11}$	.....	342.30
5664	**Sudan III**	benzene-azo-*p*-benzene-azo-β-naphthol	$C_6H_5{\cdot}N{:}N{\cdot}C_6H_4{\cdot}N{:}N{\cdot}C_{10}H_6OH$	XVI-171	352.38
5665	**Sulfa**-diazine	2-sulfanilamido-pyrimidine	$H_2N{\cdot}C_6H_4{\cdot}SO_2{\cdot}NH{\cdot}C_4H_3N_2$	.....	250.27
5666	guanidine	sulfanilyl-guanidine	$H_2N{\cdot}C_6H_4{\cdot}SO_2{\cdot}NH{\cdot}C(:NH){\cdot}NH_2$	.....	214.24
5667	pyrazine	2-sulfanilamido-pyrazine	$H_2N{\cdot}C_6H_4{\cdot}SO_2{\cdot}NH{\cdot}C_4H_3N_2$	.....	250.27
5668	pyridine	2-sulfanilamido-pyridine	$H_2N{\cdot}C_6H_4{\cdot}SO_2{\cdot}NH{\cdot}C_5H_4N$	.....	249.28
5669	pyridine sodium	.....	$C_{11}H_{10}O_2N_3SNa$	.....	271.27
5670	thiazole	2-sulfanilamido-thiazole	$H_2N{\cdot}C_6H_4{\cdot}SO_2{\cdot}NH{\cdot}C_3H_2NS$	.....	255.31
5671	**Sulfamino**-benzoic acid (*o*)	benzoic acid-(*o*)-sulfamide	$NH_2{\cdot}SO_2{\cdot}C_6H_4{\cdot}CO_2H$	XI-376	201.19
5672	benzoic acid (*m*)	.....	$NH_2{\cdot}SO_2{\cdot}C_6H_4{\cdot}CO_2H$	XI-386	201.19
5673	benzoic acid (*p*)	.....	$NH_2{\cdot}SO_2{\cdot}C_6H_4{\cdot}CO_2H$	XI-390	201.19
5674	**Sulfarsphenamine**	diNa-3,3'-diNH_2-4,4'-diOH-arseno-benzene-*N*-di-methylenesulfonate	$[NaSO_3{\cdot}CH_2{\cdot}HN(OH){\cdot}C_6H_3{\cdot}As{:}]_2$	*XVI-509	598.20
5675	**Sulfo**-acetic acid	.....	$HO_3S{\cdot}CH_2CO_2H{\cdot}H_2O$	IV-21	158.13
5676	benzoic acid (*o*)	.....	$HO_3S{\cdot}C_6H_4{\cdot}CO_2H{\cdot}3H_2O$	XI-369	256.23
5677	benzoic acid (*m*)	.....	$HO_3S{\cdot}C_6H_4{\cdot}CO_2H{\cdot}2H_2O$	XI-384	238.21
5678	benzoic acid (*p*)	.....	$HO_3S{\cdot}C_6H_4{\cdot}CO_2H{\cdot}3H_2O$	XI-389	256.23
5679	benzoic anhydride	(1,2)	$C_6H_4(CO)(SO_2){:}O$	XIX-110	184.16
5680	phenyl-3-methyl-5-pyrazolone	(1-*p*-sulfophenyl)	$HO_3S{\cdot}C_6H_4{\cdot}N{\cdot}C_4H_5ON{\cdot}H_2O$	XXIV-44	272.27

Soluble indigo 3858
Solvent-GC 3446
Sonneryl 2999
Sophoretin 5807
Sophorin, cf. glcde.
Sophorine, cf. alkd.
Sorbinose 3620
Sorbite 3611
Sorbitol 3611
Sorbitol hexaacetate 3612
Sorbose 3620
Sozoiodol 5627
Sparteine, cf. alkd.
Spasmine 1790
Spasmodine 789
Spirit blue 516
Spirocid 128
Spiroform 120
Spirosal 3466
Spruce turpentine 1624
Stachydrine, cf. alkd.
Starch, animal 3443
Starch gum 1661
Stearamide 5634
Stearanilide 5636
Stearin 3433
Stearyl alcohol 4939
Stearyl chloride 5637
Stovarsol 128
Stramid 527
Streptocid 527
Streptozon 5337

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5647	cr./al.	.....	74-5	139-41^{15mm}	i.; s. lg.	s.; s. bz.	v. s.
5648	lq.	$1.052^{\frac{16}{4}°}$	.....	191-2	.....	.....	s.
5649	nd./aq.	.....	140-4	279^{100mm}	$0.14^{16°}$	s.; i. chl.	$0.8^{15°}$
5650	oil	.....	.....	230-40 sl. d.	v. s.	.....	.....
5651	col. nd.	.....	157	.....	sl. s.	v. sl. s. abs.	i. bz.
5652	col. nd.	1.455	d. 120-35	.....	$66^{20°}$	v. s.	v. s.
5653	col. mn.	$1.562^{15°}$	189-90	235($-H_2O$)	$6.8^{20°}$; $12^{100°}$	$9.9^{15°}$	$1.2^{15°}$
5654	wh. pd.	.....	$-6H_2O$, 120	.....	2 c.	v. sl. s.	$87^{75°}$ aq.
5655	lq.	$1.069^{\frac{18}{4}°}$	.....	169-70 sl. d.	s.	s.	s.
5656	col. nd.	.....	242-3	.....	$0.5^{15°}$; $11^{100°}$	i. abs.	i.
5657	col. cr.	1.503	119.6	261	v. sl. s.	v. sl. s. pet.	sl. s.
5658	col. cr.	$1.395^{\frac{20}{4}°}$	17	192-3	d.	d.; s. bz.	i. pet.
5659	rhb./bz.	1.65	148	.....	s. d.	0.9	sl. s.
5660	cr./act.	$1.412^{16°}$	125-6	287-8	v. s.	s.; i. chl.	v. sl. s.
5661	col.	$0.985^{\frac{21}{4}°}$	54.5	265-7	v. s.	v. s.	sl. s.
5662	col. pl.	.....	128 d.	.....	33	s.; s. act.	sl. s.; i. bz.
5663	col. mn.	$1.588^{15°}$	170-86 d.	.....	*$179^{0°}$	0.9	i.
5664	brn. lf./ac.	.....	195	.....	i.; i. alk.; s. xylene	sl. s.; s. H_2SO_4	s.; s. oil; s. chl.
5665	col. mn./ aq.	.....	255-6	.....	$0.012^{37°}$	sl. s.	i.
5666	col. mn./ aq.	.....	189-90	.....	$0.19^{37°}$	sl. s.	i.
5667	col. cr.	.....	255-7 d.	.....	†$0.005^{17°}$	.....	.....
5668	col. pr./aq.	.....	191-2	.....	<0.03 c.; $0.05^{37°}$	25; v. s. aq. HCl	sl. s.; v. s. alk.
5669	col. cr./al.	.....	317 d.	.....	$63^{25°}$	11	.....
5670	brn./75% al.	.....	201-2	.....	$0.09^{37°}$	.....	.....
5671	rhb./al.	.....	165-7	.....	s.	s.	s.
5672	pl./aq.	.....	237-8	.....	v. sl. s. c.	s.	sl. s.
5673	pr./aq.	.....	d. 280	.....	sl. s. h.	v. sl. s. bz.	.....
5674	yel. pd.	.....	.....	.....	v. s.	v. sl. s.	.....
5675	hyg. cr.	.....	84-6	245 d.	s.	s.; i. chl.	i. abs.
5676	cr./aq.	.....	68-9‡	$-3H_2O$, 105	v. s.	v. s.	i.
5677	delq. cr.	.....	98‡	.....	s.	s.; i. bz.	anh. s.
5678	nd./aq.	.....	94	m. anh. 260	s.	s.	anh. s.
5679	col. cr./bz.	.....	128-9	184-6^{18mm}	s. h.	s. chl.	s.; s. bz.
5680	nd./aq.	.....	d. 320	$-H_2O$, 120	$0.5^{20°}$	v. sl. s. abs.	i.; v. s. alk.

* See also special table of solubility in water.
† Sodium salt very soluble in aq.
‡ Anhydrous crysts., *m. p.* 141°.

Strophanthin, cf. glcde.
Strychnine, cf. alkd.
Styphnic acid 6312
Stypticin, cf. alkd.
Styptol, cf. alkd.
Styracin 1508
Styracol 3485
Styrone 1507
Styryl carbinol 1507
Suberane 1596
Suberene 1598
Suberone 1597
Succinamide 5656
Succinimide 5660
Succin-chlorimide 5659
Succinyl chloride 5658
Succinyl peroxide 5662
Sucrol 5112

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Sulfo				
5681	salicylic acid (5)	.....	$HO_3S{\cdot}C_6H_3(OH)CO_2H$	XI-411	218.18
5682	salicylic Na	(Na acid salt)	$C_7H_5O_6SNa{\cdot}2H_2O$	XI-412	276.20
5683	**Sulfonal**	acetone diethyl-sulfone	$(CH_3)_2C(SO_2{\cdot}C_2H_5)_2$	I-662	228.32
5684	**Sylvestrine** (*d* or *l*)	.....	$C_{10}H_{16}$	V-125	136.23
5685	**Synthalin**	decamethylene-di-guanidine di-HCl	$[H_2N{\cdot}C(:NH)NH{\cdot}(CH_2)_5]_2{\cdot}2HCl$	.....	329.32
5686	**Syringic acid**	gallic acid-3,5-dimethyl ether	$HO(CH_3O)_2{\cdot}C_6H_2{\cdot}CO_2H$	X-480	198.17
5687	**Tannin**	digallic acid	$(HO)_3C_6H_2{\cdot}CO_2{\cdot}C_6H_2(OH)_2CO_2H$	.....	322.22
5688	**Tartaric** acid (meso)	*i*-tartaric acid	$(CHOH{\cdot}CO_2H)_2$	III-528	150.09
5689	Ca salt (meso)	Ca meso-tartrate	$C_4H_4O_6Ca{\cdot}3H_2O$	III-529	242.20
5690	acid (*racemic*) (*dl*)	"traubensaure"	$(CHOH{\cdot}CO_2H)_2{\cdot}H_2O$	III-522	168.10
5691	acid (*d* or *l*)	"weinsaure"	$(CHOH{\cdot}CO_2H)_2$	III-481	150.09
5692	amide (*d*)	tartramide	$(CHOH{\cdot}CONH_2)_2$	III-520	148.12
5693	**Tartramidic acid**	.....	$NH_2{\cdot}CO{\cdot}(CHOH)_2{\cdot}CO_2H$	III-520	149.10
5694	**Tartrazine**	hydrazine yellow	$C_{16}H_9O_9N_4S_2Na_3$	XXV-252	534.38
5695	**Tartronic acid**	hydroxymalonic acid	$HO{\cdot}CH(CO_2H)_2{\cdot}\frac{1}{2}H_2O$	III-415	129.07
5696	**Taurine**	.....	$NH_2{\cdot}CH_2{\cdot}CH_2{\cdot}SO_3H$	IV-528	125.14
5697	**Taurocholic acid**	cholaic acid	$C_{26}H_{45}O_7NS{\cdot}H_2O$	.....	533.70
5698	Na salt	.....	$C_{26}H_{44}O_7NSNa$	.....	537.68
5699	**Tephrosin**	hydroxy-deguelin	$C_{23}H_{22}O_7$	.....	410.41
5700	**Teraconic acid**	γ-diMe-itaconic acid	$(CH_3)_2C{:}C(CO_2H){\cdot}CH_2{\cdot}CO_2H$	II-786	158.15
5701	**Terebic acid**	terebinic acid	$(CH_3)_2C{\cdot}CH(CO_2H){\cdot}$	XVIII-377	158.15
5702	**Terpenylic acid** (*dl*)	terpenolic acid	$C_8H_{12}O_4{\cdot}H_2O$	XVIII-385	190.19
5703	**Terpin hydrate** (*cis*)	.....	$C_{10}H_{20}O_2{\cdot}H_2O$	VI-745	190.28
5704	**Terpinene** (α)	*p*-menthadiene (1,3)	$C_{10}H_{16}$	V-126	136.23
5705	**Terpinene** (β)	*p*-menthadiene (3,1)(7)	$C_{10}H_{16}$	V-132	136.23
5706	**Terpinenol-4** (*d*)	terpenol	$C_{10}H_{18}O$	VI-55	154.24
5707	**Terpineol** (α)(*d* or *l*)	.....	$C_{10}H_{18}O$	VI-56	154.24
5708	**Terpineol** (α)(*dl*)	.....	$C_{10}H_{18}O$	VI-58	154.24
5709	**Terpinolene**	*p*-menthadiene (1,4)(8)	$C_{10}H_{16}$	V-133	136.23
5710	**Terpinyl acetate** (α)	(*dl*)	$C_{10}H_{17}{\cdot}O_2C{\cdot}CH_3$	VI-60	196.28
5711	**Testerone** (*trans*)	.....	$C_{19}H_{28}O_2$	.....	288.41
5712	**Testerone** (*cis*)	.....	$C_{19}H_{28}O_2$	.....	288.41
5713	**Tetraamino-3,3′-dimethyl-diphenylmethane**	(4,6,4′,6′-tetraNH$_2$)	$[CH_3(NH_2)_2C_6H_2]_2{:}CH_2$	XIII-342	256.34
5714	**Tetrabromo-**aniline	(2,3,4,6)	$Br_4C_6H{\cdot}NH_2$	XII-668	408.76
5715	benzene (1,2,3,5)	.....	$Br_4C_6H_2$	V-214	393.74

Sudan-G 662 or 5664
Sugar 1602-3, 1608, 3616-20, 3947, 4007, 5549, 5558, 5561, 5663-4, 6054, 6480
Sugar, acid of 5006-7
Sulamidyl 527
Sulfaldehyde 5879-81
Sulfanilamide 527
Sulfanilamido-pyrazine 5667
Sulfanilamido-pyrimidine 5665
Sulfanilamido-thiazole 5670
Sulfanilic acid 525
β-Sulfanilic acid 559
Sulfanilic acid diazide 1771
Sulfanilyl-aminopyridine 5668

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5681	hyg.nd./aq.	.....	120d.(anh.)	.....	s.	s.	s.
5682	col. cr.	.....	.....	.....	3.3	i.	.....
5683	pr./al.	.....	127-8	300 sl. d.	$0.2^{15°}$	$1.5^{15°}$; s. bz.	$0.7^{15°}$; s. chl.
5684	lq.	$0.863^{\frac{20°}{4}}$	.....	176-7	.....	.....	.....
5685	cr./al. et.	.....	193	.....	s.	.....	.....
5686	nd./aq. or et.	.....	204-5	.....	v. sl. s.	s.; s. chl.	s.
5687	amor. pd.	.....	200 d.	.....	s.	sl. s. abs.	i. abs.
5688	cr.	$1.666^{\frac{20°}{4}}$	140	.....	$120^{15°}$	.....	.....
5689	cr./aq.	.....	$-3H_2O$, 170	.....	0.17 h.	0.03^{18} ac.	$0.09^{100°}$ ac.
5690	tri.	$1.697^{\frac{20°}{4}}$	205-6	$-H_2O$, 100	$20.6^{20°}$; $185^{100°}$	2	0.09
5691	mn.	$1.760^{\frac{20°}{4}}$	168-70	d.	$139^{20°}$; $343^{100°}$	$25^{15°}$ abs.	$0.4^{15°}$
5692	rhb.	.....	195 d.	.....	i. bz.	$0.04^{12°}$	i.
5693	rhb./aq.	.....	171-2	.....	.....	.....	.....
5694	or. yel. pd.	.....	.....	.....	v. s.	i.	.....
5695	col. pr./aq.	.....	d. 155-8; $-\frac{1}{2}H_2O$,60	subl. 110	v. s.	v. s.	i.; anh. s.
5696	.....	.....	>240 d.*	.....	$6.4^{12°}$	$0.004^{17°}$	i.
5697	delq. nd.	.....	125±, d.	.....	d. h.	s.	v. sl. s.
5698	yel. pd.	.....	.....	.....	v. s.	v. s. h.	sl. s.
5699	col. pr.	.....	198	.....	i.	s. act.	s.; s. chl.
5700	tri./et.	.....	160-1 d.	.....	v. s. h.	v. s.	sl. s.; v. sl. s. bz.
5701	mn./al.	$0.815^{\frac{24°}{4}}$	174-5	.....	s. h.	s.	$1.7^{10°}$
5702	col. cr./aq.	.....	56; 90 (anh.)	subl. 130	s. h.	.....	.....
5703	rhb.	.....	$-H_2O$ > 117	.....	$0.4^{15°}$; 3.3 h.	$10^{15°}$; 50 h.	$1^{15°}$; $0.5^{15°}$ chl.
5704	lq.	$0.834^{\frac{20°}{4}}$	.....	174-5	i.	∞	∞
5705	lq.	$0.838^{22°}$	.....	173-4	i.	∞	∞
5706	cr.	$0.936^{15°}$	38-40	$219\text{-}21^{760mm}$	i.	v. s.	v. s.
5707	col. cr.	$0.935^{15°}$	38-40	219-21	i.	v. s.	v. s.
5708	col. cr.	$0.935^{\frac{20°}{20°}}$	35	$218\text{-}9^{752mm}$	i.	v. s.	v. s.
5709	lq.	$0.854^{20°}$	.....	183-5	i.	∞	∞
5710	lq.	$0.966^{\frac{20°}{4}}$	<-50	220 d.	i.	20	.....
5711	col.nd./act.	.....	154-5	.....	i.	s.	s.
5712	cr.	.....	220-1	.....	i.	s.	s.
5713	lf./aq.	.....	203-4	.....	v. sl. s.	v. sl. s.	.....
5714	nd.	.....	116-7	.....	.....	v. s.	v. s.
5715	nd./al.	.....	98.5	329	i.	s. h.	v.s.; v. s. bz.

* The sulfonimide, m. p. 88°.

Sulfanilyl-guanidine 5666
Sulfarsenol 5674
Sulfenazoxine 679
Sulfenthal 5127
Sulfhydryl-benzoic acid 5918
Sulfo-anthraquinone 559
Sulfo-benzide 2750
Sulfo-cyanic acid 5897
Sulfon-ethylmethane 6326
Sulfon-methane 5683
Sulfur yellow-S 3241
Sulfuric ether 2911
Superpalite 6159
Suprarenine 157

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Tetrabromo				
5716	benzene (1,2,4,5)	.....	$Br_4C_6H_2$	V-214	393.74
5717	*o*-cresol	.....	$Br_4C_6(OH)\cdot CH_3$	VI-362	423.77
5718	*m*-cresol-sulfonphthalein	brom cresol green	$C_{21}H_{14}O_5Br_4S$	.....	698.05
5719	ethane (1,1,2,2) (*sym*)	acetylene tetrabromide	$Br_2CH\cdot CHBr_2$	I-94	345.70
5720	ethane (1,1,1,2)	(*uns*)	$Br_3C\cdot CH_2Br$	I-94	345.70
5721	ethylene	ethylene tetraBr	$Br_2C{:}CBr_2$	I-192	343.68
5722	phenolphthalein	(3',5',3'',5'')	$C_{20}H_{10}O_4Br_4$	XVIII-149	633.94
5723	phenolphthalein	(sodium salt)	$C_{20}H_8O_4Br_4Na_2$	.....	677.92
5724	phenolsulfonphthalein	brom phenol blue	$C_{19}H_{10}O_5Br_4S$	*XIX-649	669.99
5725	phthalic anhydride	.....	$C_6Br_4\cdot CO\cdot O\cdot CO$ (ring)	XVII-485	463.74
5726	quinone	bromanil	$O{:}C_6Br_4{:}O$	VII-642	423.72
5727	**Tetrabutylammonium iodide** (*n*)	.....	$(C_4H_9)_4N\cdot I$	IV-157	369.38
5728	**Tetrachloro**-acetone	(*sym*)	$(Cl_2CH)_2CO\cdot 4H_2O$	I-656	267.94
5729	acetone (*sym*)	.....	$(Cl_2CH)_2CO$	I-656	195.87
5730	aniline (2,3,4,5)	.....	$Cl_4C_6H\cdot NH_2$	XII-630	230.92
5731	aniline (2,3,5,6)	.....	$Cl_4C_6H\cdot NH_2$	.....	230.92
5732	aniline (2,3,4,6)	.....	$Cl_4C_6H\cdot NH_2$	XII-630	230.92
5733	benzene (1,2,3,4)	.....	$Cl_4C_6H_2$	V-204	215.90
5734	benzene (1,2,3,5)	.....	$Cl_4C_6H_2$	V-204	215.90
5735	benzene (1,2,4,5)	.....	$Cl_4C_6H_2$	V-205	215.90
5736	1,2-dibromoethane	(1,1,2,2)	$Cl_2BrC\cdot CBrCl_2$	I-93	325.68
5737	1,1-dibromoethane	(1,2,2,2)	$Cl_3C\cdot CClBr_2$	I-93	325.68
5738	diphenyl (2,4,2',4')	.....	$(C_6H_3Cl_2)_2$	V-579	292.00
5739	ethane (*sym*)	acetylene tetraCl	$Cl_2CH\cdot CHCl_2$	I-86	167.86
5740	ethane (*uns*)	(1,1,1,2-tetraCl)	$Cl_3C\cdot CH_2Cl$	I-86	167.86
5741	ethylene	ethylene tetraCl	$Cl_2C{:}CCl_2$	I-187	165.85
5742	hydroquinone	.....	$(HO)_2C_6Cl_4$	VI-851	247.90
5743	phenol (2,3,4,6)	.....	$HO\cdot C_6HCl_4$	VI-193	231.90
5744	phenolphthalein	(4,5,6,7)	$C_{20}H_{10}O_4Cl_4$	XVIII-148	456.11
5745	*o*-phthalic acid	.....	$Cl_4C_6(CO_2H)_2\cdot\frac{1}{2}H_2O$	IX-819	312.93
5746	quinone	chloranil	$O{:}C_6Cl_4{:}O$	VII-636	245.89
5747	**Tetracosane** (*n*)	.....	$CH_3\cdot(CH_2)_{22}\cdot CH_3$	I-175	338.64
5748	**Tetradecane** (*n*)	.....	$CH_3\cdot(CH_2)_{12}\cdot CH_3$	I-171	193.38
5749	**Tetradecyl** acetate	(*n*)	$CH_3CO_2\cdot C_{14}H_{29}$	II-136	256.42
5750	alcohol (*n*)	tetradecanol-1	$CH_3(CH_2)_{12}CH_2OH$	I-428	214.38
5751	**Tetradecylene** (α)	tetradecene-1	$CH_3(CH_2)_{11}CH{:}CH_2$	I-226	196.36
5752	**Tetradecyne-2**	.....	$CH_3(CH_2)_{10}C{:}C\cdot CH_3$	I-262	194.35
5753	**Tetraethanolammonium hydroxide**	.....	$(HO\cdot CH_2CH_2)_4NOH$	IV-274	211.26
5754	**Tetraethylammonium** bromide	.....	$(C_2H_5)_4NBr$	IV-104	210.16
5755	chloride	.....	$(C_2H_5)_4NCl\cdot 4H_2O$	IV-104	165.71

Surinamin 4405
Sylvane 4245
Sylvic acid 1
Syringin, cf. glcde.
Tamasol-J 1031
Tampicin, cf. glcde.
Tanacetone 5936
Tannic acid, cf. glcde.
Tartramide 5692
Tartronyl urea 1686
Telepathine, cf. alkd.
Tellurium ethyl 2219
Tellurium methyl 2566
Terebinic acid 5701
Terephthalic, cf. also phthalic.
Terephthalic acid 5277
Terephthalyl dichloride 5286
Terpane 3579
Terpenol 5706

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5716	mn./CS_2	$3.027^{20°}$	178-80	.....	i.	.....	.....
5717	nd./ac.	.....	207-8	.....	sl. s. ac.	s.; s. alk.	s.
5718	lt. yel. pd.	.....	.....	.....	sl. s.	s.; s. alk.	i.
5719	col. lq.	$2.964^{20°}_{4°}$	−1.0	151^{54mm}	i.; ∞ ac.	∞; ∞ chl.	∞; ∞ aniline
5720	col. lq.	$2.875^{20°}_{4°}$	0	$103.5^{13.5mm}$	.....	s.	.....
5721	cr. pl.	.....	56-7	226-7	.....	.....	.....
5722	col. nd./al.	.....	280-5 d.	.....	i.; s. alk.	v. sl. s.	s.
5723	b. pd.	.....	.....	.....	v. s.	sl. s.	i.
5724	cr./ac. act.	.....	270-1 d.	.....	0.07	sl. s.	i.; s. alk.
5725	cr./ac. + xylene	.....	275-80	.....	v. sl. s. ac.	v. sl. s. bz.	s. $PhNO_2$
5726	yel. mn./bz.	.....	300	subl.	i.	s. h.	sl. s.
5727	lf.	.....	144-5	.....	v. s.	s.	.....
5728	tri.	.....	48-9	.....	.....	.....	.....
5729	lq.	.....	.....	180-2 sl. d.	v. s. bz.	v. s.	v. s.
5730	nd./al.	.....	118-20	.....	s. bz.	s.; s. ac.	s.
5731	cr.	.....	90	.....	i.	s.	.....
5732	nd./lg.	.....	88	.....	s. CS_2	s.	s. lg.
5733	nd.	.....	46-7	254^{761mm}	i.	sl. s.	v. s.
5734	nd./al.	.....	54-5	246	i.	sl. s. c.	v. s. CS_2
5735	nd./et.	$1.858^{22°}$	138-40	240-6	i.	sl. s. h.	s. bz.
5736	rhb.	2.713	200-5 d.	.....	.....	.....	.....
5737	rhb.	2.794	subl.	.....	.....	s. h.	s.
5738	cr.	.....	83	.....	i.	v. s. h.	sl. s. lg.
5739	col. lq.	$1.600^{20°}_{4°}$	−36	146.3	i.	∞	∞
5740	lq.	$1.588^{20°}_{4°}$	.....	129-30	i.	∞	∞
5741	col. lq.	$1.624^{15°}_{4°}$	−19	120.8	i.	∞; ∞ chl.	∞; ∞ bz.
5742	mn.	.....	234-6	subl.	i.; s. act.	$20^{25°}$	$20^{25°}$
5743	nd./lg.	$1.6^{80°}_{4°}$	69-70	164^{23mm}	v. sl. s.	v. s.	v. s.
5744	pl./Me al.	.....	>300	.....	i.; s. alk.	s.; i. chl.	s.; i. bz.
5745	cr./aq.	.....	d. $-1\frac{1}{2}H_2O$*	.....	$0.6^{14°}$; $3.0^{99°}$	s.	s.; v. s. act.
5746	yel.mn./bz.	.....	290**	subl.	80°; i. bz.$^{25°}$	i. c.; sl. s. h.	i. c.; sl. s. CCl_4
5747	cr.	$0.779^{51°}_{4°}$	51.1	324	.....	.....	s.
5748	col. lq.	$0.765^{20°}_{4°}$	5.5	252.5	i.	v. s.	v. s.
5749	col. cr.	.....	12-3	$176-7^{15mm}$	.....	.....	.....
5750	cr.	$0.824^{38°}_{4°}$	38	$167-70^{15mm}$	<0.02	sl. s.	s.
5751	lq.	$0.775^{15°}_{4°}$	−12	127^{15mm}	.....	.....	.....
5752	cr.	$0.800^{15°}_{4°}$	6.5	134^{15mm}	.....	.....	.....
5753	.....	.....	.....	.....	∞	.....	.....
5754	cr./abs. al.	.....	.....	.....	.....	v. s.	s. chl.
5755	mn.	$1.112^{25°}_{4°}$	37.5	.....	$141^{25°}$	$8.2^{25°}$ chl.	.....

* Anhydride, m. p. 255°.
** Sealed tube.
Terpenolic acid 5702
Terphenyl 2705
Tetbrothalein 5722
Tetraacetyl-glucosyl chloride 44
Tetraanhydro-berberine, cf. alkd.
Tetrabase 5834
Tebrabromo-fluorescein 2875-6
Tetrabromo-methane 1242
Tetracaine 5032
Tetrachloro-methane 1243
Tetradecanol 4451
Tetradecanoic acid 4450
Tetradecanol 5750

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5756	**Tetraethylammonium** hydroxide	.....	$(C_2H_5)_4NOH$	IV-103	147.26
5757	iodide	.....	$(C_2H_5)_4NI$	IV-104	257.17
5758	**Tetraethyl**-benzene	(1,2,4,5)	$(C_2H_5)_4C_6H_2$	V-455	190.32
5759	benzene (1,2,3,4)	.....	$(C_2H_5)_4C_6H_2$	V-455	190.32
5760	diaminobenzophenone	(4,4′)	$[(C_2H_5)_2N{\cdot}C_6H_4]_2CO$	XIV-98	324.45
5761	diaminodiphenylmethane	(4,4′)	$[(C_2H_5)_2N{\cdot}C_6H_4]_2CH_2$	XIII-242	310.47
5762	diaminotriphenyl carbinol	brilliant green base	$[(C_2H_5)_2N{\cdot}C_6H_4]_2{\cdot}C(OH){\cdot}C_6H_5$	XIII-746	402.56
5763	diaminotriphenyl carbinol sulfate	brilliant green dye salt	$(C_{27}H_{33}N_2){\cdot}HSO_4$	XIII-746	482.62
5764	ethanetetracarboxylate (*sym*)	.....	$[(C_2H_5O_2C)_2CH]_2$	II-858	318.32
5765	propanetetracarboxylate	($\alpha,\alpha,\beta,\gamma$)	$(CH_2{\cdot}CH{\cdot}CH){\cdot}(CO_2{\cdot}C_2H_5)_4$	II-859	332.34
5766	rhodamine	rhodamine B	$C_{28}H_{31}O_3N_2Cl$	XIX-346	479.00
5767	urea	.....	$[(C_2H_5)_2N]_2CO$	IV-120	172.27
5768	**Tetraethylene** glycol	.....	$(\cdot CH_2OCH_2\cdot)_3{:}(\cdot CH_2OH)_2$	I-468	194.22
5769	glycol dimethyl ether	diMeO-tetraglycol	$(CH_3O{\cdot}CH_2{\cdot}CH_2{\cdot}O{\cdot}CH_2{\cdot}CH_2)_2O$	.....	222.28
5770	pentamine	.....	$NH_2{\cdot}(CH_2CH_2NH)_3{\cdot}CH_2{\cdot}CH_2{\cdot}NH_2$	.....	189.30
5771	**Tetraglycol dichloride**	.....	$(Cl{\cdot}CH_2{\cdot}CH_2{\cdot}O{\cdot}CH_2{\cdot}CH_2)_2O$	.....	231.12
5772	**Tetrahydro**-benzoic acid (Δ_1)	.....	$CH_2(CH_2)_3CH{:}C{\cdot}CO_2H$	IX-41	126.15
5773	furan	tetramethylene oxide	$CH_2(CH_2)_2CH_2{\cdot}O$	XVII-10	72.10
5774	furfuryl acetate	.....	$CH_3CO_2{\cdot}CH_2{\cdot}C_4H_7O$	.....	144.17
5775	furfuryl alcohol	.....	$C_4H_7O{\cdot}CH_2OH$	.....	102.13
5776	furfuryl benzoate	.....	$C_6H_5CO_2{\cdot}CH_2{\cdot}C_4H_7O$	.....	206.23
5777	furfuryl butyrate	.....	$C_3H_7CO_2{\cdot}CH_2{\cdot}C_4H_7O$	.....	172.22
5778	furfuryl *n*-caproate	.....	$C_5H_{11}CO_2{\cdot}CH_2{\cdot}C_4H_7O$	.....	200.27
5779	furfuryl lactate	.....	$CH_3{\cdot}CHOH{\cdot}CO_2{\cdot}CH_2{\cdot}C_4H_7O$	.....	174.19
5780	furfuryl laurate	.....	$C_{11}H_{23}CO_2{\cdot}CH_2{\cdot}C_4H_7O$	.....	284.43
5781	furfuryl maleate	.....	$(:CH{\cdot}CO_2{\cdot}CH_2{\cdot}C_4H_7O)_2$	.....	284.30
5782	furfuryl palmitate	.....	$C_{15}H_{31}CO_2{\cdot}CH_2{\cdot}C_4H_7O$	.....	340.53
5783	furfuryl propionate	.....	$C_2H_5CO_2{\cdot}CH_2{\cdot}C_4H_7O$	.....	158.19
5784	furfuryl salicylate	.....	$HO{\cdot}C_6H_4CO_2{\cdot}CH_2{\cdot}C_4H_7O$	.....	222.23
5785	furfuryl succinate	.....	$(\cdot CH_2{\cdot}CO_2{\cdot}CH_2{\cdot}C_4H_7O)_2$	.....	286.32
5786	naphthalene (1,2,3,4)	tetralin	$C_6H_4CH_2(CH_2)_2CH_2$	V-491	132.20

Tetradecanone 3182
Tetradecene 5751
Tetraethyl germanium 3357
Tetraethyl lead 3957
Tetraethyl silicon 5619
Tetraethyl tin 5950
Tetrafluoro-methane 1244
Tetrahydro-benzene 1609

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5756	only in solns.*	.....	*	d.	s.	.....	.....
5757	col. cr./aq.	$1.559^{4°}$	>200	.....	$45^{25°}$	$1.6^{25°}$ chl.	i.; s. al.
5758	lq.	$0.888^{\frac{16}{4}°}$	13	250	i.	s. abs.	v. s.
5759	lq.	$0.887^{\frac{20}{4}°}$	11.6	248	i.	s. abs.	v. s.
5760	lf./al.	.....	95-6	.....	.....	.....	.....
5761	cr./al.	.....	41-2	253^{10mm}	.....	.....	.....
5762	red brn.	.....	.....	.....	v. sl. s.	s.	s. aq. a.
5763	rhb. gold nd.	.....	.....	.....	v. s.	v. s.	.....
5764	tet. pr.	$1.064^{79.5°}$	76	305 d.	.....	.....	.....
5765	oil	$1.118^{\frac{20}{4}°}$	.....	$200\text{-}11^{14mm}$	.....	.....	.....
5766	lf./HCl	.....	.....	.....	v. s.	v. s.	sl. s. alk.
5767	lq.	$0.886^{\frac{20}{4}°}$	.....	210-5	i.	s. a.	i. alk.
5768	lq.	$1.125^{\frac{20}{20}°}$	.....	327-8	∞	.....	.....
5769	lq.	$1.013^{\frac{20}{20}°}$	.....	275.8	∞	.....	.....
5770	lq.	$0.999^{\frac{20}{20}°}$	.....	333	∞	.....	.....
5771	lq.	$1.186^{\frac{20}{20}°}$	.....	114^{2mm}	sl. s.	.....	.....
5772	cr.	$1.072^{\frac{47}{4}°}$	29	240-3	$0.7^{20°}$	.....	.....
5773	col. lq.	$0.888^{\frac{21}{4}°}$	−65	65-6	s.	s.	s.
5774	col. lq.	$1.062^{\frac{25}{4}°}$	.....	$192\text{-}4^{740mm}$	sl. s.	s.	s.
5775	col. lq.	$1.050^{\frac{20}{4}°}$	.....	$177\text{-}8^{743mm}$	∞	∞	∞
5776	lq.	$1.137^{\frac{20}{0}°}$	.....	$300\text{-}2^{750mm}$	.....	.....	.....
5777	lq.	$1.012^{\frac{20}{0}°}$	.....	225-7	.....	.....	.....
5778	col. lq.	.....	.....	$141\text{-}3^{19mm}$	i.	s.	s.
5779	yel. lq.	.....	.....	$146\text{-}9^{18mm}$	s.	s.	s.
5780	pa. yel. lq.	.....	.....	$184\text{-}6^{6mm}$	i.	s.	s.
5781	yel. viscous lq.	.....	.....	$190\text{-}3^{2mm}$	sl. s.	s.	s.
5782	pa. yel. lq.	.....	.....	$195\text{-}8^{1.5mm}$	i.	s.	s.
5783	lq.	$1.044^{\frac{20}{4}°}$	.....	$204\text{-}7^{756mm}$	.....	.....	.....
5784	pa. yel. lq.	.....	.....	$131\text{-}3^{2mm}$	i.	s.	s.
5785	pa. yel. lq.	.....	.....	$219\text{-}21^{9mm}$	i.	s.	s.
5786	col. lq.	$0.973^{\frac{18}{4}°}$	−31	$206\text{-}7^{764mm}$	i.; ∞ bz.	s.; ∞ act.	s.

* Crysts. + $4H_2O$, m. p. 49-50°; + $6H_2O$, m. p. 55°.

Tetrahydro-nicotinic acid, cf. alkd.
Tetrahydro-pyrrole 5523
Tetrahydro-toluene 4207-8
Tetrahydroxy-flavanone 2891
Tetraiodo-fluorescein 2896
Tetraiodo-methane 1245

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Tetrahydro				
5787	α-naphthol (*ac.*)	.....	$C_6H_4{\cdot}CHOH{\cdot}$ $\vert\_\_\_\_\_$ $(CH_2)_2{\cdot}CH_2$ $\_\_\_\_\vert$	.....	148.20
5788	α-naphthol (*ar.*)	.....	$(CH_2)_4{:}C_6H_3OH$	VI-578	148.20
5789	β-naphthol (*ac.*)	.....	$C_6H_4(CH_2)_2CHOHCH_2$ $\vert\_\_\_\_\_\vert$	VI-579	148.20
5790	β-naphthol (*ar.*)	.....	$(CH_2)_4{:}C_6H_3OH$	VI-579	148.20
5791	β-naphthoylaceto-nitrile (*ar.*)	.....	$(CH_2)_4{:}C_6H_3{\cdot}CO{\cdot}$ $CH_2{\cdot}CN$	.....	199.24
5792	α-naphthylamine (*ac.*)	.....	$C_6H_4{\cdot}CH(NH_2){\cdot}$ $\vert\_\_\_\_\_$ $(CH_2)_2{\cdot}CH_2$ $\_\_\_\_\vert$	XII-1200	147.21
5793	α-naphthylamine	(*ar.*)	$(CH_2)_4{:}C_6H_3{\cdot}NH_2$	XII-1197	147.21
5794	β-naphthylamine (*ac.*)(*dl*)	.....	$C_6H_4CH_2CH(NH_2){\cdot}$ $\vert\_\_\_\_\_$ $CH_2{\cdot}CH_2$ $\_\_\_\_\vert$	XII-1200	147.21
5795	β-naphthylamine	(*ar.*)	$(CH_2)_4{:}C_6H_3{\cdot}NH_2$	XII-1198	147.21
5796	*o*-phthalic acid (Δ_1)	.....	$C_8H_{10}O_4$	IX-770	170.16
5797	quinoline (1,2,3,4)	.....	$C_9H_{10}NH$	XX-262	133.19
5798	quinone (*p*)	.....	$OC{:}(CH_2)_4{:}CO$	VII-556	112.12
5799	**Tetrahydroxy-**anthraquinone	rufiopin (1,2,5,6)	$C_{14}H_4O_2(OH)_4$	VIII-549	272.20
5800	anthraquinone (1,3,5,7)	anthrachryson	$C_{14}H_4O_2(OH)_4{\cdot}2H_2O$	VIII-551	308.24
5801	anthraquinone (1,2,5,8)	quinalizarin; alizarin bordeaux	$C_{14}H_4O_2(OH)_4$	VIII-549	272.20
5802	benzene (1,2,4,5)	.....	$(HO)_4C_6H_2$	VI-1155	142.11
5803	benzene (1,2,3,5)	.....	$(HO)_4C_6H_2$	VI-1154	142.11
5804	3,6-diaminoben-zene HCl	(1,2,4,5)	$(HO)_4C_6(NH_2)_2{\cdot}2HCl$	XIII-842	245.07
5805	flavone (3,7,3′,4′)	fisetin	$(HO)_2C_9H_3O_2{\cdot}C_6H_3{:}$ $(OH)_2$	XVIII-221	286.23
5806	flavanol (5,7,2′,4′)	morin; 3,5,7,2′,4′-pentaOH-flavone	$C_{15}H_{10}O_7{\cdot}2H_2O$	XVIII-239	338.26
5807	flavanol (5,7,3′,4′)	quercetin	$C_{15}H_{10}O_7{\cdot}2H_2O$	XVIII-242	338.26
5808	quinone	.....	$(HO)_4C_6O_2$	VIII-534	172.09
5809	**Tetraiodo-**benzene	(1,2,3,4)	$I_4C_6H_2$	V-229	581.76
5810	benzene (1,2,3,5)	.....	$I_4C_6H_2$	V-229	581.76
5811	benzene (1,2,4,5)	.....	$I_4C_6H_2$	V-229	581.76
5812	ethylene	periodo-ethene	$I_2C{:}CI_2$	I-195	531.70
5813	phenolphthalein	nosophen; iodophen	$C_{20}H_{10}O_4I_4$	XVIII-151	821.96
5814	phenolphthalein	(Na salt); iodeikon	$C_{20}H_8O_4I_4Na_2{\cdot}3H_2O$	XVIII-151	919.99
5815	phenolsulfon-phthalein	.....	$C_{19}H_{10}O_5I_4S$	.....	858.01
5816	phthalic anhydride	.....	$I_4C_6{:}(CO)_2O$	XVII-486	651.76
5817	pyrrole	iodol	I_4C_4NH	XX-168	570.74

Tetralin 5786
Tetralite 5873
Tetramethyl-alloxantin 232
Tetramethyl-aniline 5818
Tetramethyl-diaminobenzophenone 4436
Tetramethyl-diaminodiphenyl carbinol 4435
Tetramethyl-diaminotriphenyl methane 3964
Tetramethyl-ethylene 3658

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5787	col. lq.	1.090	.....	140^{17mm}	.....	.....	.....
5788	mn.	.....	68.5-9.0	$264\text{-}5^{705mm}$	sl. s. h.	v. s.	v. s.
5789	oil	$1.071^{\frac{20}{4}°}$	.....	264^{716mm}	v. sl. s.	v. s.	v. s.
5790	nd./lg.	.....	58-9	275-6	v. sl. s.	v. s.	v. s.
5791	pa. yel. cr.	.....	98-100	.....	i.	sl. s.	s.
5792	oil	.....	.....	246.5^{714mm}	s. h.	s.	s.
5793	oil	$1.067^{\frac{15}{15}°}$	.....	275^{12mm}	v. sl. s.	s.	s.
5794	lq.	$1.034^{\frac{15}{15}°}$	.....	250^{710} sl. d.	sl. s. h.	s.	s.
5795	nd./lg.	$1.029^{\frac{22}{4}°}$	38	$275\text{-}7^{713mm}$	.....	s.	s.
5796	lf.	.....	120(−H_2O)	.....	v. s.	.....	.....
5797	cr.	$1.070^{4°}$	20±	251	s.	∞	∞
5798	mn./aq.	.....	78	subl. 100	s.	s.	s.
5799	yel. red	.....	subl. d.	.....	sl. s. h.; s. H_2SO_4	s.; s. h. ac.	v. sl. s.
5800	yel. nd.	.....	>360	−H_2O, 150	i.; i. CS_2	sl. s.; s. ac.	v. sl. s.
5801	red nd./ $PhNO_2$	.....	>275	subl.	s. alk.; s. H_2SO_4	.....	.....
5802	lf./ac.	.....	215-20	.....	v. s.; sl. s. HCl	v. s.	v. s.
5803	nd./aq.	.....	165	.....	v. s.	v. s.	i. chl., bz.
5804	nd.	.....	.....	.....	v. s.	i. HCl	.....
5805	yel. nd.	.....	>360 d.	.....	i. c.; s. alk.	s.; s. act.; sl. s. pet.	sl. s.; sl. s. bz., chl.
5806	yel. nd./al.	.....	285 (anh.)	.....	$0.03^{20°}$; $0.1^{100°}$	s.; i. CS_2	sl. s.; s. alk.
5807	yel. nd.	.....	313-4 (anh.)	.....	i. c.; v. sl. s. h.	0.4 c.; 5.5 h.	v. sl. s.; s. alk.
5808	b. bl.	.....	.....	.....	v. s. h.	v. s.	sl. s.
5809	pr./CS_2	.....	136	subl.	s. chl.	s.	s.
5810	pr./et.	.....	148	subl.	v. s. h. ac.	sl. s.	sl. s.
5811	nd./et.	.....	254	subl. in vac.	v. s. CS_2	v. sl. s.	v. sl. s.
5812	yel. mn.	$2.983^{20°}$	187-92	subl. in vac.	v. s. CS_2	v. sl. s. c.	s. ac., bz.
5813	amor. pd.	.....	d. 220±	.....	i.; s. alk.	sl. s.	s.; s. chl.
5814	pa. b. hyg.	.....	d. by CO_2	.....	14	sl. s.	.....
5815	col. amor.	.....	.....	.....	i.	i.	i.
5816	yel. cr./ac.	.....	320-5	subl.	s. PhOH	s. $PhNO_2$	i.
5817	yel./aq. al.	.....	d. 140-50	.....	0.02	$5.8^{15°}$; s. h.	50

Tetramethyl-ethylene glycol 5312
Tetramethyl-hydracrylic acid 3762
Tetramethyl lead 3958
Tetramethyl-*p*-leucaniline 5844
Tetramethyl-methane 5085
Tetramethyl-piperidone 6056
Tetramethyl-*iso*-propyl alcohol 3531
Tetramethyl silicon 5617

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5818	**Tetramethyl-**aminobenzene	2,3,4,5-tetramethyl-aniline	$(CH_3)_4C_6H{\cdot}NH_2$	XII-1175	149.23
5819	aminobenzene	(2,3,5,6); duridine	$(CH_3)_4C_6H{\cdot}NH_2$	XII-1177	149.23
5820	aminobenzene	(2,3,4,6); ***iso***-duridine	$(CH_3)_4C_6H{\cdot}NH_2$	XII-1175	149.23
5821	ammonium bromide	.....	$(CH_3)_4N{\cdot}Br$	IV-51	154.06
5822	ammonium chloride	.....	$(CH_3)_4N{\cdot}Cl$	IV-51	109.60
5823	ammonium hydroxide	.....	$(CH_3)_4NOH{\cdot}5H_2O$	IV-50	181.23
5824	amm. hydroxide	.....	$(CH_3)_4NOH{\cdot}3H_2O$	IV-50	145.20
5825	amm. hydroxide	.....	$(CH_3)_4NOH{\cdot}H_2O$	IV-50	109.17
5826	ammonium iodide	.....	$(CH_3)_4N{\cdot}I$	IV-51	201.06
5827	benzene (1,2,3,4)	prehnitol	$(CH_3)_4C_6H_2$	V-430	134.21
5828	benzene (1,2,3,5)	isodurene	$(CH_3)_4C_6H_2$	V-430	134.21
5829	benzene (1,2,4,5)	durene	$(CH_3)_4C_6H_2$	V-431	134.21
5830	benzidine	.....	$[(CH_3)_2N{\cdot}C_6H_4{\cdot}]_2$	XIII-221	240.34
5831	benzoquinone	duroquinone	$(CH_3)_4C_6O_2$	VII-669	164.20
5832	diaminobutane(α,δ)	.....	$[(CH_3)_2N{\cdot}CH_2CH_2{\cdot}]_2$	IV-265	144.26
5833	diaminodiphenyl-amine (*p*)	Bindschedler's green leuco base	$[(CH_3)_2N{\cdot}C_6H_4]_2NH$	XIII-112	255.35
5834	diaminodiphenyl methane (*p,p'*)	Michler's hydride	$[(CH_3)_2N{\cdot}C_6H_4]_2CH_2$	XIII-239	254.36
5835	diamino-4''-hydroxy-triphenyl-methane	(4,4')	$[(CH_3)_2N{\cdot}C_6H_4]_2CH{\cdot}C_6H_4{\cdot}OH$	XIII-737	346.45
5836	diamino-4''-dimethoxy-triphenylmethane	(4,4')	$[(CH_3)_2N{\cdot}C_6H_4]_2CH{\cdot}C_6H_4{\cdot}OCH_3$	XIII-737	360.48
5837	diamino-4''-methyl-triphenylmethane	(4,4')	$[(CH_3)_2N{\cdot}C_6H_4]_2CH{\cdot}C_6H_4{\cdot}CH_3$	XIII-282	344.48
5838	diamino-3''-nitro-triphenylmethane	(4,4')	$[(CH_3)_2N{\cdot}C_6H_4]_2CH{\cdot}C_6H_4{\cdot}NO_2$	XIII-279	375.45
5839	*p*-phenylene-diamine	.....	$(CH_3)_2N{\cdot}C_6H_4{\cdot}N(CH_3)_2$	XIII-74	164.24
5840	*p*-phenylene-diamine	(HCl); Wurster's reagent	$C_{10}H_{16}N_2{\cdot}2HCl$	XIII-74	237.17
5841	pyromellitate	(1,2,4,5)	$C_6H_2(CO_2CH_3)_4$	IX-998	310.25
5842	succinic acid	.....	$[(CH_3)_2C{\cdot}CO_2H]_2$	II-706	174.19
5843	thiouram disulfide	.....	$[(CH_3)_2N{\cdot}CS{\cdot}S{\cdot}]_2$	IV-76	240.41
5844	triaminotriphenyl-methane	tetramethyl-*p*-leucaniline	$[(CH_3)_2N{\cdot}C_6H_4]_2CH{\cdot}C_6H_4{\cdot}NH_2$	XIII-314	345.47
5845	urea	.....	$[(CH_3)_2N]_2CO$	IV-74	116.16
5846	**Tetranitro-**diphenol	(3,x,3',x;4,4')	$[(NO_2)_2C_6H_2{\cdot}OH]_2$	VI-992	366.20
5847	diphenyl (2,4,2',4')	.....	$C_{12}H_6(NO_2)_4$	V-585	334.20
5848	diphenyl (3,4,3',4')	.....	$C_{12}H_6(NO_2)_4$	V-585	334.20
5849	diphenyl (2,6,2',6')	.....	$C_{12}H_6(NO_2)_4$	*V-274	334.20
5850	diphenyldisulfide	(2,2',4,4')	$[(NO_2)_2C_6H_3{\cdot}S{\cdot}]_2$	VI-344	398.32
5851	diphenyl ether	(2,4,2',4')	$[C_6H_3(NO_2)_2]_2O$	VI-255	350.20
5852	diphenylmethane	(2,4,2',4')	$C_{13}H_6(NO_2)_4$	V-596	348.23
5853	methane	.....	$C(NO_2)_4$	I-80	196.04

Tetramethyl thionine 4426
Tetramethyl tin 5951
Tetramethylene 1595
Tetramethylene-diamine 5474
Tetramethylene dibromide 1823
Tetramethylene dichloride 1973
Tetramethylene dicyanide 155
Tetramethylene diiodide 2389

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5818	lf./bz.	.....	70	259-60	sl. s. h.	s.	s.; s. pet.
5819	pr./h. aq.	.....	75	261-2	v. sl. s. c.	s.	s.
5820	cr.	$0.978^{24°}$	23-4	253-5	.....	.....	.....
5821	cr.	1.56	d. > 230	subl. > 360	$55^{15°}$	sl. s. abs.	i.; s. SO_2
5822	col. cr.	1.169	.....	.....	s.	s.	i.
5823	hyg. nd.	.....	62-3	d.	$151^{0°}$	$\infty^{63°}$ aq.	.....
5824	.....	.....	59-60	.....	.....	.....	.....
5825	.....	.....	d. 130-5	.....	.....	.....	.....
5826	col. pr.	1.84	d. > 230	.....	sl. s. c.	0.1 h.	i.; s. SO_2
5827	lq.	$0.901^{\frac{20°}{4°}}$	−4	204	.....	.....	.....
5828	lq.	$0.891^{\frac{20°}{4°}}$	−24	195-7	i.	s.	.....
5829	mn.	$0.838^{\frac{81°}{4°}}$	79-80	193-5	i.; s. bz.	s.	s.
5830	nd./bz. pet.	.....	193-4	>360	s. h. bz.	v. sl. s.	sl. s.
5831	yel. nd./lg.	.....	111	subl. 100	i.; s. bz.	v. s.	v. s.
5832	col. lq.	$0.804^{\frac{19°}{4°}}$	.....	169	∞	s.	s.
5833	pl.	.....	119	.....	.....	s.	.....
5834	lf./al.	.....	90-1; subl.	300	i.; s. bz.	s. h.; s. ac.	s.; s. chl.
5835	cr./al.	.....	163-5	.....	i.; s. dil. alk.	v. sl. s. lg.	s. bz.
5836	nd./al.	.....	105-6	.....	v. s. lg.; v. s. chl.	s.; v. s. CS_2	v. s.
5837	nd./al.	.....	94-5	.....	i.	s.	s.
5838	yel. pr./al.	.....	152	.....	i.; s. bz.	sl. s.; sl. s. lg.	sl. s.
5839	lf./aq. al.	.....	51	260	sl. s. h.	v. s.; v. s. lg.	v. s.; v. s. chl.
5840	cr.	.....	.....	.....	s.	.....	.....
5841	lf./Me al.	.....	141.5	.....	.....	sl. s. h.	.....
5842	cr.	.....	190-200 d.	.....	$0.48^{13.5°}$	s.	s.; i. lg.
5843	cr./al. chl.	$1.29^{\frac{20°}{4°}}$	146	.....	i.; s. chl.	v. sl. s.	v. sl. s.
5844	cr./al.	.....	151-2	.....	.....	sl. s.	.....
5845	lq.	$0.972^{15°}$	.....	177.5	.....	v. s.	v. s.
5846	yel. nd.	.....	220-5	.....	i.	s.	.....
5847	yel. pr./bz.	.....	165-6	d.	s. bz.; s. ac.	sl. s.	sl. s.
5848	yel. pr.	.....	186	.....	s. bz.	v. sl. s. lg.	s. ac.
5849	yel. nd./ac.	.....	217-8	.....	.....	.....	.....
5850	yel. nd.	.....	expl. > 280	.....	i.; s. pyr.	i.; s. $PhNO_2$	i.; s. $PhNH_2$
5851	cr.	.....	195±	.....	i.; s. h. bz.	v. sl. s.	sl. s.
5852	lt. yel./ac.	.....	172	.....	sl. s. bz.	i.	i.
5853	col. lq.	$1.650^{\frac{13°}{4°}}$	13	125.7 sl. d.	i.	v. s.	v. s.

Tetramethylene-glycol diacetate 2224
Tetramethylene oxide 5773
Tetranitro-chrysazine 1491
Tetraphenyl lead 3959
Tetraphenyl-pyrazine 234
Tetraphenyl tin 5952
Thebaine, cf. alkd.
Theelin 2903

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Tetranitro				
5854	naphthalene (γ)	(1,3,5,8)	$C_{10}H_4(NO_2)_4$	V-564	308.16
5855	naphthalene (β)	(1,3,6,8)	$C_{10}H_4(NO_2)_4$	V-564	308.16
5856	naphthalene (α)	(1,5,x,x)	$C_{10}H_4(NO_2)_4$	V-564	308.16
5857	phenol (2,3,4,6)	.....	$HO{\cdot}C_6H(NO_2)_4$	VI-292	274.11
5858	phenolsulfon-phthalein	.....	$C_{19}H_{10}O_{13}N_4S$	*XIX-650	534.36
5859	**Tetraphenyl-**arsonium bromide	.....	$(C_6H_5)_4AsBr{\cdot}2H_2O$	.....	499.26
5860	ethane (*sym*)	.....	$[(C_6H_5)_2CH{\cdot}]_2$	V-739	334.44
5861	ethylene	.....	$(C_6H_5)_2C{:}C(C_6H_5)_2$	V-743	332.42
5862	guanidine	.....	$HN{:}C[N(C_6H_5)_2]_2$	XII-430	363.44
5863	hydrazine	.....	$(C_6H_5)_2N{\cdot}N(C_6H_5)_2$	XV-125	336.42
5864	methane	.....	$(C_6H_5)_4C$	V-739	320.41
5865	urea	.....	$[(C_6H_5)_2N]_2CO$	XII-429	364.43
5866	**Tetrapropyl-**ammonium iodide (*n*)	.....	$(C_2H_5{\cdot}CH_2)_4NI$	IV-140	313.27
5867	benzene (*iso*)	(1,2,4,5)	$[(CH_3)_2CH]_4C_6H_2$	.....	246.42
5868	**Tetratriacontane** (*n*)	.....	$CH_3(CH_2)_{32}CH_3$	I-177	478.90
5869	**Tetrazine** (1,2,4,5)	.....	$(:N{\cdot}CH{\cdot}N)_2$	XXVI-353	82.07
5870	**Tetrazole**	.....	$CH{:}N{\cdot}NH{\cdot}N{:}N$ $\vert\_\_\_\_\_\vert$	XXVI-346	70.06
5871	**Tetrolic acid**	butynoic acid	$CH_3{\cdot}C{\vdots}C{\cdot}CO_2H$	II-479	84.07
5872	**Tetronal**	pentane-3,3-di-ethyl-sulfone	$(C_2H_5)_2C(SO_2C_2H_5)_2$	I-681	256.37
5873	**Tetryl** (2,4,6)	tri-NO_2-phenyl-methylnitramine	$(NO_2)_3C_6H_2{\cdot}$ $N(CH_3)NO_2$	XII-770	287.15
5874	**Thallin**	6-methoxy-tetra-hydroquinoline	$CH_3O{\cdot}C_9H_{10}N$	XXI-61	163.21
5875	**Thialdine**	.....	$(CH_3)_3C_3H_4S_2N$	XXVII-461	163.29
5876	**Thiamin chloride**	vitamin B_1	$C_{12}H_{17}ON_4ClS{\cdot}HCl$	.....	337.27
5877	**Thianthrene**	diphenylene disul-fide	$(C_6H_4)_2S_2$	XIX-45	216.30
5878	**Thiazole**	.....	C_3H_3NS	XXVII-15	85.12
5879	**Thio-**acetaldehyde (α)	sulfaldehyde	$(CH_3{\cdot}CHS)_3$	XIX-387	180.34
5880	acetaldehyde (β)	sulfaldehyde	$(CH_3{\cdot}CHS)_3$	XIX-387	180.34
5881	acetaldehyde (γ)	sulfaldehyde	$(CH_3{\cdot}CHS)_3$	.....	180.34
5882	acetamide	aceto-thioamide	$CH_3{\cdot}CS{\cdot}NH_2$	II-232	75.13
5883	acetanilide	.....	$C_6H_5{\cdot}NH{\cdot}CS{\cdot}CH_3$	XII-245	151.22
5884	acetdimethylamide	.....	$CH_3{\cdot}CS{\cdot}N(CH_3)_2$	*IV-329	103.18
5885	acetic acid	.....	$CH_3{\cdot}CO{\cdot}SH$	II-230	76.11
5886	aniline (4,4′)	diNH_2-diPH-sulfide	$(NH_2{\cdot}C_6H_4)_2S$	XIII-535	216.29
5887	barbituric acid	malonyl thiourea	$C_4H_4O_2N_2S$	XXIV-476	144.15
5888	benzaldehyde (α)	.....	$(C_6H_5{\cdot}CHS)_3$	XIX-396	366.53
5889	benzaldehyde (β)	.....	$(C_6H_5{\cdot}CHS)_3$	XIX-397	366.53
5890	benzanilide	.....	$C_6H_5{\cdot}NH{\cdot}CS{\cdot}C_6H_5$	XII-269	213.29
5891	benzoic acid	.....	$C_6H_5{\cdot}CO{\cdot}SH$	IX-419	138.18
5892	carbanilide	diphenyl thiourea	$(C_6H_5{\cdot}NH)_2CS$	XII-394	228.30
5893	chrome	.....	$C_{12}H_{14}ON_4S$	.....	262.32
5894	cresol (o)	o-tolyl mercaptan	$CH_3{\cdot}C_6H_4{\cdot}SH$	VI-370	124.19
5895	cresol (m)	m-tolyl mercaptan	$CH_3{\cdot}C_6H_4{\cdot}SH$	VI-388	124.19
5896	cresol (p)	p-tolyl mercaptan	$CH_3{\cdot}C_6H_4{\cdot}SH$	VI-416	124.19

Theelol 2902
Theine, cf. alkd.
Theobromine, cf. alkd.
Theocine, cf. alkd.
Theophylline, cf. alkd.
Thevetin, cf. glcde.
Thienyl alcohol 5924
Thio-, cf. also sulfo-.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5854	yel./act.	.....	194-5	.....	s. HNO_3	sl. s.	s. act.
5855	nd./al.	.....	203	expl.	i.	.....	.....
5856	lt. yel./chl.	.....	259	expl.	i.	v. sl. s.	.....
5857	lt. yel./chl.	.....	140	expl.	d. h.	v. sl. s. bz.	v. sl. s. lg.
5858	yel. nd./ ac. act.	.....	>200	.....	s.	s.	i.
5859	col. cr.	.....	281-4 (anh.)	$-2H_2O$ > 100	1.6	s.	sl. s. act.
5860	rhb.	1.182	209-11	379-83	14 h. bz.	0.8 h.	5 h. ac.
5861	tri. or mn.	.....	221-3	415-25	s. h. bz.	sl. s.	sl. s.
5862	rhb./lg.	.....	130-1	.....	i.; v. s. bz.	v. s.	v. s.
5863	rhb./al. chl.	.....	147-9	.....	s. bz.	v. sl. s. h.	s. act.
5864	rhb./bz.	.....	285	431	i. lg.	s. h. bz.	i.; i. ac.
5865	rhb.	1.222	183	.....	i.	s. h.	.....
5866	rhb.	$1.314^{25°}_{4°}$	d. 280±	.....	$18.6^{25°}$	$55^{25°}$ chl.	.....
5867	col. lq.	.....	.....	260	i.	$1^{25°}$	$85^{25°}$
5868	cr.	lq. $0.781^{73°}$	$\alpha 73; \beta 77$	$255^{1.0mm}$	.....	.....	.....
5869	red pr.	.....	99	.....	s.	s.	s.
5870	lf./al.	.....	155	subl.	s.; s. ac.	s.; sl. s. bz.	sl. s.
5871	pl./et.	.....	77-8	203	v. s.	v. s.	v. s.
5872	pl./aq.	.....	85	.....	0.22 c.	$5.4^{15°}$ abs.	$10^{15°}$
5873	yel. mn./al.	$1.57^{19°}$	129	expl. 187	i.; s. bz.	s. h.	s.; s. ac.
5874	pr.	.....	42-3	283^{735mm}	sl. s. c.	v. s.; v. s. bz.	v. s.
5875	mn.	$1.191^{18°}$	43	d.	v. sl. s.	s.	v. s.
5876	hyg. pr.	.....	252 sl. d.	.....	100	0.1	i.; i. bz.
5877	mn./al.	$1.706^{18°}_{4°}$	158-60	364-6	i.	0.25 c.	s. h.
5878	lq.	$1.200^{17°}_{4°}$	.....	116.8	sl. s.	s.	s.
5879	cr./al.	.....	101	246-7	i.; s. bz.	$3.86^{25°}$	$15.6^{25°}$
5880	cr./al.	.....	125-6	246-7	i.; s. chl.	$3.97^{25°}$	$13.7^{25°}$
5881	cr.	.....	81	100	.....	.....	.....
5882	mn.	.....	109-10	.....	v. s.	s.	sl. s.
5883	nd./aq.	.....	75-6	d.	i.	i. a.	s. alk.
5884	col. cr.	.....	114-6	.....	sl. s.	s.	v. s.
5885	yel. lq.	$1.074^{10°}$	<-17	93	s.	∞	∞
5886	nd./aq.	.....	108	.....	sl. s. h.	s.	s.; s. h. bz.
5887	lf./aq.	.....	235 d.	.....	sl. s.	s.; s. alk.	s. alk. carb.
5888	nd./bz. al.	.....	166-7	.....	i.	$0.2^{25°}$	$1.1^{25°}$
5889	nd./bz.	.....	225-6 d.	.....	s. h. ac.	$0.04^{25°}$	$0.4^{25°}$
5890	yel. pr./al.	.....	101-2	.....	i.	s.	v. s.
5891	yel. oil	.....	24	d.	i.	v. s.	∞
5892	rhb./al.	$1.3^{24°}$	154	d.	i.	v. s.	v. s.
5893	yel. pr./chl.	.....	227-8*	.....	s.	sl. s.	sl. s.
5894	lf.	.....	15	194.3	i.	s.	s.
5895	lq.	$1.052^{12°}_{4°}$	<-20	195.4	i.	s.	s.
5896	lf./al.	.....	43-4	195	i.	sl. s.	v. s.

* HCl salt, m. p. 217-21°.

Thio-allyl ether 1684
Thio-benzyl alcohol 816
Thio-carbamide 5920
Thio-carbonyl chloride 5916
Thio-cresol methyl ether 4402

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5897	**Thio** cyanic acid	sulfocyanic acid	HS·CN	III-143	59.09
5898	cyanic acid, per-	3,5-dimercapto-1,2,4-thiodiazol	CS·NH·CS·NH·S (ring)	XXVII-665	150.23
5899	cyanuric acid	.....	$C_3H_3N_3S_3$	XXVI-259	177.26
5900	diglycol (β)	β,β'diOH-diEt sulfide	$(HO{\cdot}CH_2CH_2)_2S$	I-470	122.18
5901	formamide	.....	$H{\cdot}CS{\cdot}NH_2$	II-95	61.10
5902	formanilide	.....	$C_6H_5{\cdot}NH{\cdot}CH{:}S$	XII-233	137.19
5903	glycerol (1)	.....	$HS{\cdot}CH_2{\cdot}C_2H_3(OH)_2$	I-519	108.15
5904	glycol, mono-	ethanol-1-thiol-2	$HO{\cdot}CH_2{\cdot}CH_2{\cdot}SH$	I-470	78.13
5905	glycolic acid	.....	$HS{\cdot}CH_2{\cdot}CO_2H$	III-245	92.11
5906	glycolic-β-amino-naphthalide	thionalide	$C_{10}H_7{\cdot}NH{\cdot}CO{\cdot}CH_2{\cdot}SH$	.....	217.28
5907	hydantoin	glycolyl thiourea	$C_3H_4ON_2S$	XXIV-260	116.14
5908	hydracrylic acid	.....	$HS{\cdot}CH_2CH_2CO_2H$	III-299	106.14
5909	hydroquinone, mono-	(1,4)	$HS{\cdot}C_6H_4{\cdot}OH$	VI-859	126.17
5910	lactic acid	.....	$CH_3{\cdot}CH(SH){\cdot}CO_2H$	III-289	106.14
5911	malic acid (*dl*)	mercaptosuccinic	$(HS{\cdot}C_2H_3)(CO_2H)_2$	III-439	150.15
5912	naphthene	benzothiophene	C_8H_6S	XVII-59	134.19
5913	naphthol (α)	α-naphthyl mercaptan	$C_{10}H_7{\cdot}SH$	VI-621	160.22
5914	naphthol (β)	β-naphthyl mercaptan	$C_{10}H_7{\cdot}SH$	VI-657	160.22
5915	phenol	phenyl mercaptan	$C_6H_5{\cdot}SH$	VI-294	110.17
5916	phosgene	thiocarbonyl chloride	$Cl_2C{:}S$	III-134	114.98
5917	propionamide	.....	$C_2H_5{\cdot}CS{\cdot}NH_2$	II-264	89.15
5918	salicylic acid (o)	sulfhydryl benzoic	$HS{\cdot}C_6H_4{\cdot}CO_2H$	X-125	154.18
5919	semicarbazide	.....	$NH_2{\cdot}CS{\cdot}NH{\cdot}NH_2$	III-195	91.13
5920	urea	thiocarbamide	$NH_2{\cdot}CS{\cdot}NH_2$	III-180	76.12
5921	urethane	ethyl thiourethane	$NH_2{\cdot}CO{\cdot}SC_2H_5$	III-138	105.15
5922	**Thionin**	Lauth's violet	$C_{12}H_9N_3S$	XXVII-391	227.28
5923	**Thiophene**	.....	C_4H_4S	XVII-29	84.13
5924	alcohol (α)	thienyl alcohol	$C_4H_3S{\cdot}CH_2OH$	XVII-113	114.16
5925	aldehyde (α)(2)	.....	$C_4H_3S{\cdot}CHO$	XVII-285	112.14
5926	carboxylic acid (α)	(1,2)	$C_4H_3S{\cdot}CO_2H$	XVIII-289	128.14
5927	carboxylic acid (β)	(1,3)	$C_4H_3S{\cdot}CO_2H$	XVIII-292	128.14
5928	**Thioxene** (o)	2,5-diMe-thiophene	$(CH_3)_2C_4H_2S$	XVII-41	112.18
5929	**Thioxene** (o)	2,3-diMe-thiophene	$(CH_3)_2C_4H_2S$	XVII-40	112.18
5930	**Thioxene** (m)	2,4-diMe-thiophene	$(CH_3)_2C_4H_2S$	XVII-41	112.18
5931	**Thioxene** (m)	3,4-diMe-thiophene	$(CH_3)_2C_4H_2S$	XVII-42	112.18
5932	**Threonine** (*dl*)	α-amino-β-hydroxy-butyric acid	$CH_3{\cdot}CHOH{\cdot}CH{:}(NH_2)CO_2H$	.....	119.12
5933	**Threonine** (*d*–)	.....	$C_4H_9O_3N$	IV-514	119.12
5934	**Threonine,** allo-	(*dl*)	$C_4H_9O_3N$	.....	119.12
5935	**Thujone** (α)	.....	$C_{10}H_{16}O$	VII-93	152.23
5936	**Thujone** (β)	tanacetone	$C_{10}H_{16}O$	VII-93	152.23
5937	**Thymohydro-quinone**	.....	$C_{10}H_{14}O_2$	VI-945	166.21
5938	**Thymol**	5-Me-2-isoPr-phenol	$(CH_3)(C_3H_7)C_6H_3OH$	VI-532	150.21
5939	chloride	(3,6;1,4)	$(CH_3)(C_3H_7)C_6H_2{:}(OH)Cl$	VI-539	184.66
5940	iodide	4-iodothymol	$C_{10}H_{13}OI$	VI-541	276.12
5941	phthalein	.....	$C_{28}H_{30}O_4$	*XVIII-381	430.52

Thio-diphenylamine 5138
Thio-histidine betaine 2890
Thio-phenetole 3132
Thio-phenine 378
Thio-phenylacetamide 5240
Thio-sinamine 221
Thio-trimethylacetamide 6275
Thiols, cf. mercaptans.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5897	col. lq.	.....	5±	d.	∞, d.	v. s.	v. s.
5898	not known; salts only	.....	.....	.....	.....	.....	.....
5899	cr.	.....	d. 200	.....	sl. s. h.	sl. s.	sl. s.
5900	syrup	.....	.....	164-6^{20mm}	∞	s. chl.	.....
5901	col. cr.	.....	28-9	.....	s.; i. bz.	s.; s. act.	s.; s. CS_2
5902	nd./aq.	.....	138	.....	i. aq. HCl	s.	v. s.
5903	yel. lq.	$1.295^{14.4°}$	.....	d.	v. sl. s.	∞	i.
5904	lq.	.....	.....	55-6^{9mm}	v. sl. s.	v. s.	.....
5905	col. lq.	$1.325^{20°}$	-16.5	123^{29mm}	.....	.....	.....
5906	col. nd.	.....	111-2	.....	.....	s.	s.
5907	nd./aq.	.....	d. 200±	.....	sl. s.	i.	i.
5908	col. cr.	$1.218^{21°}$	16.8	111-2^{15mm}	∞	∞	∞
5909	cr.	.....	32-4	166-8^{45mm}	s.	s. H_2SO_4	.....
5910	oil	.....	10±	98-9^{14mm}	∞	∞	∞
5911	col. cr.	.....	149-50	.....	s.; s. act.	s.; sl. s. bz.	sl. s.
5912	lf.	$1.165^{20°}_{4}$	31-2	220-1	.....	.....	.....
5913	lq.	$1.155^{23°}_{4}$	.....	208.5^{200mm}	sl. s.	v. s.	v. s.
5914	cr./al.	.....	81	286-8	v. sl. s.	v. s.	v. s.
5915	col. lq.	$1.074^{23°}_{4}$	.....	168-9	v. sl. s.	v. s.; ∞ bz.	∞; s. CS_2
5916	red lq.	$1.509^{15°}$	.....	73.5	d.	d.	s.
5917	lf./bz.	.....	41-3	.....	v. sl. s.	v. sl. s.	v. sl. s.
5918	lt. yel. nd.	.....	164	subl.	sl. s. h.	s.	s. ac.
5919	nd./aq.	.....	181-3 d.	.....	s.	s.	.....
5920	rhb./al.	$1.405^{20°}_{4}$	180-2	d.	9 c.	s.	sl. s.
5921	lf.	.....	108-9	subl. sl. d.	s. h.	s.	sl. s.
5922	brn. bl. lf.	.....	.....	.....	i. c.; i. lg.	sl. s.; s. chl.	sl. s.
5923	col. lq.	$1.070^{15°}_{4}$	-30	84	i.; s. bz.	s.	s. H_2SO_4
5924	lq.	.....	.....	207	.....	.....	.....
5925	oil	$1.215^{21°}$	.....	198	.....	.....	s.
5926	nd./aq.	.....	126.5	260 sl. d.	v. s. h.	v. s.	s.; sl. s. lg.
5927	mn. nd.	.....	136	subl.	$0.43^{25°}$	.....	.....
5928	lq.	$0.976^{17.5°}$	.....	136.5-7.5	i.	s.	s.
5929	lq.	$0.994^{21°}$	.....	136-7	.....	.....	.....
5930	lq.	$0.996^{20°}$	.....	137-8	i.	s.	s.
5931	lq.	$1.008^{23°}_{23°}$	.....	144-6	.....	.....	.....
5932	col. cr.	.....	228-9 d.	.....	$20^{25°}$	.....	.....
5933	hex. pl.	.....	225-7 d.	.....	s.	.....	.....
5934	col. cr.	.....	250-2	.....	s. h.	.....	.....
5935	col. lq.	0.912	.....	200-1	i.	s.	.....
5936	col. lq.	$0.916^{20°}_{4}$	.....	201-3	i.	s.	.....
5937	pr.	.....	140-3	290	s. h.	v. s.	v. s.
5938	cr./act.	$0.972^{25°}_{25°}$	51.5	232-3^{752mm}	$0.09^{19°}$; $0.11^{100°}$	v. s.; v. s. chl.	v. s.; s. alk.
5939	col. pl./lg.	.....	59-61	.....	0.1; s. dil. alk.	222; 60 bz.	83
5940	nd.	.....	68-9	.....	sl. s. h.	sl. s.	s.; s. chl.
5941	col. nd./al.	.....	245-6 d.	.....	i.; s. H_2SO_4	s.; s. act.	s. dil. alk.

Thionalid 5906
Thujin, cf. glcde.
Thymine 4413
Thymiode 5940
Thymiodol 5940
Thymodin 5940
Thymol-hexahydride 4024

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5942	**Thymol** sulfonic acid (α)	(3,6;1,4)	$(CH_3)(C_3H_7)C_6H_2$: $(OH)SO_3H \cdot H_2O$	.....	248.29
5943	**Thymoquinone**	.....	$O:C_6H_2(CH_3)\cdot(C_3H_7):O$	VII-662	164.20
5944	**Thymotic acid** (o)	(1,4;3,2)	$(CH_3)(C_3H_7)C_6H_2$: $(OH)CO_2H$	X-280	194.22
5945	**Thymyl**-acetate	acetyl thymol	$C_{10}H_{13}\cdot O_2C\cdot CH_3$	VI-537	192.25
5946	amine (1,3;4)	.....	$CH_3(NH_2)C_6H_3\cdot C_3H_7$	XII-1171	149.23
5947	**Thyroxine** (l)	.....	$C_{15}H_{11}O_4NI_4$	*XIV-671	776.93
5948	**Tin** chloride triphenyl	triphenyltin chloride	$(C_6H_5)_3SnCl$	*XVI-540	385.46
5949	diethyl	diethyl tin	$(C_2H_5)_2Sn$	IV-631	176.82
5950	tetraethyl	tetraethyl tin	$(C_2H_5)_4Sn$	IV-632	234.94
5951	tetramethyl	tetramethyl tin	$(CH_3)_4Sn$	IV-632	178.84
5952	tetraphenyl	tetraphenyl tin	$(C_6H_5)_4Sn$	XVI-914	427.10
5953	triethyl	triethyl tin	$[(C_2H_5)_3Sn\cdot]_2$	IV-638	411.76
5954	**Tolane**	diphenyl-acetylene	$C_6H_5\cdot C:C\cdot C_6H_5$	V-656	178.22
5955	**Tolidine** (o)	3,3'-diMe-benzidine	$(CH_3\cdot C_6H_3\cdot NH_2)_2$	XIII-256	212.28
5956	hydrochloride	.....	$C_{14}H_{16}N_2\cdot 2HCl$	XIII-257	285.21
5957	sulfate	.....	$C_{14}H_{16}N_2\cdot H_2SO_4$	XIII-257	310.36
5958	disulfonic acid	(3,4;6)	$[(CH_3)(NH_2)C_6H_2\cdot SO_3H]_2\cdot 1\frac{1}{2}H_2O$	XIV-796	399.43
5959	**Tolidine** (m)	2,2'-diMe-benzidine	$(CH_3\cdot C_6H_3\cdot NH_2)_2$	XIII-255	212.28
5960	**Toluene**	methyl-benzene	$CH_3\cdot C_6H_5$	V-280	92.13
5961	azo-1-naphthyl-amine-2 (o)	(2,1;1',2'); yellow OB	$CH_3\cdot C_6H_4\cdot N:N\cdot C_{10}H_6\cdot NH_2$	XVI-373	261.31
5962	disulfonic acid	(2,4)	$CH_3\cdot C_6H_3(SO_3H)_2$	XI-204	252.25
5963	disulfonic Na	(2,4); (Na salt)	$C_7H_6O_6S_2Na_2\cdot 7H_2O$	XI-204	422.34
5964	sulfinic acid (p)	.....	$CH_3\cdot C_6H_4\cdot SO_2H$	XI-9	156.19
5965	sulfinic Na (p)	(sodium salt)	$C_7H_7O_2SNa\cdot 2H_2O$	XI-9	214.22
5966	sulfonic acid (o)	.....	$CH_3\cdot C_6H_4\cdot SO_3H\cdot 2H_2O$	XI-83	208.23
5967	sulfonic acid (m)	.....	$CH_3\cdot C_6H_4\cdot SO_3H\cdot aq.$	XI-94	172.19
5968	sulfonic acid (p)	.....	$CH_3\cdot C_6H_4\cdot SO_3H\cdot H_2O$	XI-97	190.21
5969	sulfonic Na (p)	(sodium salt)	$C_7H_7O_3SNa\cdot 2H_2O$	XI-97	230.22
5970	**Toluenesulfonyl**-amide (o)	toluenesulfonamide	$CH_3\cdot C_6H_4\cdot SO_2\cdot NH_2$	XI-86	171.21
5971	amide (p)	.....	$CH_3\cdot C_6H_4\cdot SO_2\cdot NH_2$	XI-104	171.21
5972	anilide (p)	toluene-sul-fonanilide	$CH_3\cdot C_6H_4\cdot SO_2\cdot NH\cdot C_6H_5$	XII-567	247.30
5973	*n*-butylamide (p)	.....	$CH_3\cdot C_6H_4\cdot SO_2\cdot NH\cdot C_4H_9$	.....	227.31
5974	chloride (o)	toluene sulfon-chloride	$CH_3\cdot C_6H_4\cdot SO_2Cl$	XI-86	190.64
5975	chloride (p)	.....	$CH_3\cdot C_6H_4\cdot SO_2Cl$	XI-103	190.64
5976	di-*n*-butylamide	(p)	$CH_3\cdot C_6H_4\cdot SO_2\cdot N:(C_4H_9)_2$	.....	283.42
5977	dimethylamide (p)	.....	$CH_3\cdot C_6H_4\cdot SO_2\cdot N:(CH_3)_2$	.....	199.26
5978	ethylamide (p)	.....	$CH_3\cdot C_6H_4\cdot SO_2\cdot NH\cdot C_2H_5$	XI-105	199.26
5979	methylamide	.....	$CH_3\cdot C_6H_4\cdot SO_2\cdot NH\cdot CH_3$	XI-105	185.24
5980	methylanilide	.....	$CH_3\cdot C_6H_4\cdot SO_2\cdot N:(CH_3)(C_6H_5)$	XII-575	261.33

Tiglic acid 2426
Tiglic aldehyde 2427
T N T 6316
Tobias' acid 4505, 4549
Tolamine 1290
Tolazine 4334
Toliminazole 4137
Tolualdehyde 5985-7
Toluamide 5988-90
Tolubenzyl acetate 6481

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5942	col. pl.	.....	115-6	.....	v. s.	.....	.....
5943	yel. tri.	.....	46-7	232	v. sl. s.	s.	s.
5944	mn./aq.	.....	127	subl.	0.01 c.	s.	s.; s. bz.
5945	lq.	$1.009^{0°}$	.....	245^{757mm}	i.; ∞ chl.	∞; ∞ bz.	∞
5946	oil	.....	.....	230	v. sl. s.	s.	s.
5947	col. nd.	.....	232 d.	.....	i.; s. alk.	i.	i.
5948	col. cr./al.	.....	112-3	$240^{13.5mm}$	i.	s.	s.
5949	yel. oil	$1.558^{15°}$	.....	d.	i.	s.	s.
5950	col. lq.	$1.199^{20°}_{4°}$	−112	181	i.	.....	s.
5951	lq.	$1.291^{25°}_{4°}$	.....	78	i.	.....	.....
5952	tet. pr./chl.	$1.490^{0°}_{4°}$	226	>420	i.; s. pyr.	v. sl. s.	v. sl. s.
5953	lq.	$1.412^{0°}$	.....	265-70	i.	i. aq. al.	s. bz.
5954	mn. pr.	.....	60-2	300	i.	v. s. h.	v. s.
5955	lf.	.....	128-9	.....	v. sl. s.	s.	s.; s. ac.
5956	scales	.....	d. > 340	.....	$0.912^{0°}$	.....	.....
5957	gray	.....	d.	.....	0.1c.; d.h.	v. sl. s.	s. dil. a.
5958	nd.	.....	$-H_2O$, 150	.....	$0.21^{8°}$ (anh.)	i.; i. ac.	i.
5959	pr./aq.	.....	107-8	.....	sl. s. h.	v. s.	v. s.
5960	col. lq.	$0.866^{20°}_{4°}$	−95	110.8	i.; s. act.	∞ abs.	∞
5961	yel. pd.	.....	122-5	.....	i.; s. oil	s.; s. CCl_4	s.; s. bz.
5962	syrup	.....	.....	.....	s.	.....	.....
5963	pr.	.....	.....	.....	s.	.....	.....
5964	cr./aq.	.....	85-90	.....	sl. s.	v. s.; s. h. bz.	v. s.
5965	cr.	.....	.....	.....	s.	.....	.....
5966	delq. cr.	.....	*	128.8^{25mm}	sl. s.	s.	.....
5967	syrup	.....	.....	.....	sl. s.	s.	.....
5968	mn.	.....	104-5	$146-7^{25mm}$	0.3	s.	.....
5969	lf.	.....	.....	.....	s.	.....	.....
5970	tet. pr.	.....	156	.....	$0.11^{9°}$	$3.57^{5°}$	.....
5971	mn.	.....	137	.....	$0.2^{9°}$	$7.4^{5°}$	.....
5972	tri./aq. al. or bz.	.....	103	.....	.....	v. s.	.....
5973	col. rhb.	.....	41-2.5	.....	i.	s.	v. s.
5974	oil	$1.344^{17°}$	10	126^{10mm}	i.	.....	.....
5975	tri.	.....	69	134.5^{10mm}	i.	s.	s.; s. bz.
5976	pa. yel. lq.	.....	.....	$233-4^{20mm}$	i.	s.	s.
5977	col. cr.	.....	81-2	.....	i.	sl. s.	v. s.
5978	cr./lg.; pl./aq. al.	.....	61-3	.....	.....	.....	.....
5979	pl./aq. al.	.....	77-8	.....	v. sl. s.	v. s.	.....
5980	mn. pl./ EtOAc	.....	93-4	.....	.....	v. s.	v. s.

* Stable < 100°; forms *p*-isomer 140-50°.

Tolubenzyl alcohol 6016-8
Tolubenzyl-amine 6482-4
Toluene-azo-toluidine 309-12
Toluene hexahydride 4199
Toluene tetrahydride 4207-8
Toluhydroquinone 2372

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
5981	**Toluenesulfonyl** *p*-toluidide (*p*)	.....	$CH_3{\cdot}C_6H_4{\cdot}SO_2{\cdot}NH{\cdot}C_6H_4{\cdot}CH_3$	XII-981	261.33
5982	**Toluic** acid† (*o*)	2-Me-benzoic acid	$CH_3{\cdot}C_6H_4{\cdot}CO_2H$	IX-462	136.14
5983	acid (*m*)	3-Me-benzoic acid	$CH_3{\cdot}C_6H_4{\cdot}CO_2H$	IX-475	136.14
5984	acid (*p*)	4-Me-benzoic acid	$CH_3{\cdot}C_6H_4{\cdot}CO_2H$	IX-483	136.14
5985	aldehyde (*o*)	*o*-toluylaldehyde	$CH_3{\cdot}C_6H_4{\cdot}CHO$	VII-295	120.14
5986	aldehyde (*m*)	*m*-Me-benzaldehyde	$CH_3{\cdot}C_6H_4{\cdot}CHO$	VII-296	120.14
5987	aldehyde (*p*)	4-Me-benzaldehyde	$CH_3{\cdot}C_6H_4{\cdot}CHO$	VII-297	120.14
5988	amide (*o*)	*o*-toluamide	$CH_3{\cdot}C_6H_4{\cdot}CO{\cdot}NH_2$	IX-465	135.16
5989	amide (*m*)	*m*-toluamide	$CH_3{\cdot}C_6H_4{\cdot}CO{\cdot}NH_2$	IX-477	135.16
5990	amide (*p*)	4-toluamide	$CH_3{\cdot}C_6H_4{\cdot}CO{\cdot}NH_2$	IX-486	135.16
5991	anhydride (*o*)	.....	$(CH_3{\cdot}C_6H_4{\cdot}CO)_2O$	IX-464	254.27
5992	nitrile (*o*)	*o*-tolunitrile	$CH_3{\cdot}C_6H_4{\cdot}CN$	IX-466	117.14
5993	nitrile (*m*)	3-tolyl cyanide	$CH_3{\cdot}C_6H_4{\cdot}CN$	IX-477	117.14
5994	nitrile (*p*)	4-tolunitrile	$CH_3{\cdot}C_6H_4{\cdot}CN$	IX-489	117.14
5995	**Toluidine** (*o*)	2-methyl aniline	$CH_3{\cdot}C_6H_4{\cdot}NH_2$	XII-772	107.15
5996	hydrochloride	.....	$CH_3{\cdot}C_6H_4{\cdot}NH_2{\cdot}HCl$	XII-782	143.62
5997	**Toluidine** (*m*)	3-methyl aniline	$CH_3{\cdot}C_6H_4{\cdot}NH_2$	XII-853	107.15
5998	hydrochloride	.....	$CH_3{\cdot}C_6H_4{\cdot}NH_2{\cdot}HCl$	XII-856	143.62
5999	**Toluidine** (*p*)	4-methyl aniline	$CH_3{\cdot}C_6H_4{\cdot}NH_2$	XII-880	107.15
6000	hydrochloride	.....	$CH_3{\cdot}C_6H_4{\cdot}NH_2{\cdot}HCl$	XII-896	143.62
6001	**Toluquinone**	*o*-Me-*p*-benzoquinone	$O{:}C_6H_3(CH_3){:}O$	VII-645	122.12
6002	**Toluyl-*o*-benzoic acid** (*p*)	(1,4;1′,2′)	$CH_3{\cdot}C_6H_4{\cdot}CO{\cdot}C_6H_4{\cdot}CO_2H$	X-759	240.25
6003	**Toluylene** diamine	(1;3,4)(*o*)(*uns*)	$CH_3{\cdot}C_6H_3(NH_2)_2$	XIII-148	122.17
6004	diamine HCl	(1;3,4)	$C_7H_{10}N_2{\cdot}2HCl$	XIII-148	195.10
6005	diamine (1;2,4)	(*m*)(*uns*)	$CH_3{\cdot}C_6H_3(NH_2)_2$	XIII-124	122.17
6006	diamine HCl	(1;2,4)	$C_7H_{10}N_2{\cdot}2HCl$	XIII-129	195.10
6007	diamine (1;2,5)	(*p*)	$CH_3{\cdot}C_6H_3(NH_2)_2$	XIII-144	122.17
6008	diamine HCl	(1;2,5)	$C_7H_{10}N_2{\cdot}2HCl$	XIII-144	195.10
6009	diamine H_2SO_4	(1;2,5)	$C_7H_{10}N_2{\cdot}H_2SO_4$	XIII-144	220.24
6010	**Tolyl** acetic acid (*o*)	.....	$CH_3{\cdot}C_6H_4{\cdot}CH_2{\cdot}CO_2H$	IX-527	150.17
6011	acetic acid (*m*)	.....	$CH_3{\cdot}C_6H_4{\cdot}CH_2{\cdot}CO_2H$	IX-528	150.17
6012	acetic acid (*p*)	.....	$CH_3{\cdot}C_6H_4{\cdot}CH_2{\cdot}CO_2H$	IX-530	150.17
6013	benzoate (*o*)	*o*-cresyl benzoate	$C_6H_5CO_2{\cdot}C_6H_4{\cdot}CH_3$	IX-119	212.24
6014	benzoate (*m*)	*m*-cresyl benzoate	$C_6H_5CO_2{\cdot}C_6H_4{\cdot}CH_3$	IX-120	212.24
6015	benzoate (*p*)	*p*-cresyl benzoate	$C_6H_5CO_2{\cdot}C_6H_4{\cdot}CH_3$	IX-120	212.24
6016	carbinol (*o*)	*o*-tolubenzyl alcohol	$CH_3{\cdot}C_6H_4{\cdot}CH_2OH$	VI-484	122.16
6017	carbinol (*m*)	*m*-xylyl alcohol	$CH_3{\cdot}C_6H_4{\cdot}CH_2OH$	VI-494	122.16
6018	carbinol (*p*)	.....	$CH_3{\cdot}C_6H_4{\cdot}CH_2OH$	VI-498	122.16
6019	***iso*-cyanate** (*o*)	*o*-tolylcarbonimide	$CH_3{\cdot}C_6H_4{\cdot}N{:}CO$	XII-812	133.14
6020	***iso*-cyanate** (*m*)	*m*-tolylcarbonimide	$CH_3{\cdot}C_6H_4{\cdot}N{:}CO$	XII-864	133.14
6021	***iso*-cyanate** (*p*)	*p*-tolylcarbonimide	$CH_3{\cdot}C_6H_4{\cdot}N{:}CO$	XII-955	133.14
6022	hydrazine (*o*)	.....	$CH_3{\cdot}C_6H_4{\cdot}NH{\cdot}NH_2$	XV-496	122.17
6023	hydrazine HCl (*o*)	.....	$C_7H_{10}N_2{\cdot}HCl{\cdot}H_2O$	XV-496	176.65
6024	hydrazine (*m*)	.....	$CH_3{\cdot}C_6H_4{\cdot}NH{\cdot}NH_2$	XV-506	122.17
6025	hydrazine HCl (*m*)	.....	$C_7H_{10}N_2{\cdot}HCl$	XV-506	158.63
6026	hydrazine (*p*)	.....	$CH_3{\cdot}C_6H_4{\cdot}NH{\cdot}NH_2$	XV-510	122.17
6027	hydrazine HCl (*p*)	.....	$C_7H_{10}N_2{\cdot}HCl$	.....	158.63
6028	hydroxylamine	(*o*)(*β*)	$CH_3{\cdot}C_6H_4{\cdot}NHOH$	XV-13	123.15

† See also No. 5142.

Toluidine sulfonic acid 379-83
Tolunitrile 5992-4
Toluol 5960
Toluphenazine 4334
Toluquinoline 4372, 4374-5
Toluquinone oxime 4881
Toluylaldehyde 5139, 5985-7
Toluylene red 4585

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
5981	col. tri./ac.	.....	117-8	.....	.....	v. s. h.	.....
5982	cr./aq.	$1.062^{\frac{11}{4}5°}$	104-5	259^{751mm}	s. h.	v. s.	s. chl.
5983	pr./aq.	$1.054^{\frac{11}{4}2°}$	110-1	263	$0.09^{15°}$; $1.6^{100°}$	v. s.	v. s.
5984	cr./aq.	.....	179-80	274-5	v. sl. s. h.	v. s.	v. s.
5985	lq.	$1.039^{\frac{20°}{4}}$	.....	196-9	sl. s.	∞	∞
5986	lq.	$1.019^{\frac{20°}{4}}$	.....	199	sl. s.	∞	∞
5987	lq.	$1.019^{\frac{16.7°}{4}}$	.....	204-5	sl. s.	∞	∞
5988	nd./aq.	.....	147	.....	v. s. h.	v. s.	s.
5989	nd./et.	.....	97	.....	v. sl. s. bz.	s.	v. sl. s.
5990	nd./aq.	.....	165	.....	s. h.	s.	s.
5991	cr./et.	.....	39	>325	.....	.....	.....
5992	col. lq.	$0.998^{\frac{18°}{18}}$	−13	205.2	i.	∞	∞
5993	col. lq.	$0.976^{15°}$	−23	210^{773mm}	0.09 c.	1.7 h. aq.	.....
5994	nd./al.	$0.981^{\frac{30°}{30}}$	29.5	217.6	i.	v. s.	v. s.
5995	col. lq.	$0.999^{\frac{20°}{4}}$	−16.3 (−24.4)	199.7	$1.5^{25°}$; s. dil. a.	∞	∞
5996	mn. pr.	.....	218-20	242	s.	sl. s.	.....
5997	col. lq.	$0.989^{20°}_{4}$	−31.5	203.3	sl. s.	∞	∞
5998	lf./aq.	.....	228	250	$96.3^{12°}$	$61.9^{99°}$	.....
5999	cr.	$0.973^{\frac{50°}{50}}$; $1.046^{\frac{20°}{4}}$	44-5	200.3	$0.74^{21°}$; $1.1^{32°}$	v. s.; s. dil. a.	v. s.; s. CS_2
6000	nd./ac. et.	.....	243	257.5	$22.9^{11°}$	$25^{17°}$	i.; i. bz.
6001	yel. nd.	.....	68-9	subl.	sl. s. c.	v. s.	v. s.
6002	nd./ toluene	.....	139-40	d.	v. sl. s. h.; s. act.	v. s.	v. s.
6003	lf./lg.	.....	89-90	265	s. c.	.....	.....
6004	nd.	.....	.....	.....	v. s.	.....	.....
6005	rhb.	.....	99	283-5	s. h.	s.	s.
6006	nd.	.....	.....	.....	s.	.....	.....
6007	pl./bz.	.....	64	273-4	s.; s. h. bz.	s.	s.
6008	lf.	.....	.....	.....	s.	.....	.....
6009	pd.	.....	.....	.....	$0.8^{11°}$	.....	.....
6010	nd./aq.	.....	88-9	.....	s. h.	.....	.....
6011	nd.	.....	60.5-1.5	.....	s. h.	.....	.....
6012	nd./aq.	.....	92-4	265-7	s. h.	s.	s.; s. bz.
6013	lq.	.....	.....	307	i.	.....	s.
6014	cr.	.....	54-5	313-4	i.	.....	.....
6015	pl./et. al.	.....	71-2	315-6	i.	.....	.....
6016	nd.	$1.023^{40°}$	34-6	223^{750mm}	1 c.	v. s. abs.	v. s.
6017	lq.	$0.916^{17°}$	<−20	217	5 c.	s.	s.
6018	nd.	.....	60°	217	sl. s.	s.	s.
6019	lq.	.....	.....	184-7	i.; d. h.	d. h.	s.
6020	pa. yel. lq.	.....	.....	195-8	i.	s.	s.
6021	lq.	.....	.....	187^{751mm}	.....	.....	.....
6022	nd.	.....	56-9	.....	sl. s. lg.	v. s.	v. s.
6023	pl.	.....	.....	.....	s.	s.	.....
6024	oil	.....	.....	240-4	i.	s.	s.; s. chl.
6025	nd.	.....	.....	.....	s.	s.	.....
6026	rhb.	.....	65-6	240-4 sl. d.	sl. s.	v. s.; s. bz.	v. s.
6027	tan pl.	.....	.....	.....	s.	sl.	i.
6028	col./bz. et.	.....	44	.....	sl. s. lg.	s.	s.

Tolyl-, cf. also cresyl-.
Tolyl-acetamide 26-8
Tolyl acetate 1552-3
Tolyl-benzamide 775-7
Tolyl bromide 999-1001
Tolyl-carbonimide 6019-21
Tolyl chloride 1466-8
Tolyl cyanide 5992-4
Tolyl-diphenyl-methane 2756-7

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
6029	**Tolyl** hydroxylamine	(*m*)(*β*)	$CH_3 \cdot C_6H_4 \cdot NHOH$	XV-14	123.15
6030	hydroxylamine	(*p*)(*β*)	$CH_3 \cdot C_6H_4 \cdot NHOH$	XV-15	123.15
6031	*α*-naphthylamine	(*o*)(*N*)	$C_{10}H_7 \cdot NH \cdot C_6H_4 \cdot CH_3$	XII-1225	233.30
6032	*α*-naphthylamine	(*p*)(*N*)	$C_{10}H_7 \cdot NH \cdot C_6H_4 \cdot CH_3$	XII-1225	233.30
6033	*β*-naphthylamine	(*o*)(*N*)	$C_{10}H_7 \cdot NH \cdot C_6H_4 \cdot CH_3$	XII-1277	233.30
6034	*β*-naphthylamine	(*p*)(*N*)	$C_{10}H_7 \cdot NH \cdot C_6H_4 \cdot CH_3$	XII-1277	233.30
6035	pyrrole (*o*)(*N*)	.....	$C_4H_4N \cdot C_6H_4 \cdot CH_3$	XX-164	157.21
6036	pyrrole (*m*)(*N*)	.....	$C_4H_4N \cdot C_6H_4 \cdot CH_3$	.....	157.21
6037	pyrrole (*p*)(*N*)	.....	$C_4H_4N \cdot C_6H_4 \cdot CH_3$	XX-164	157.21
6038	salicylate (*o*)	(1,2;1′,2′)	$HO \cdot C_6H_4 \cdot CO_2 \cdot C_6H_4 \cdot CH_3$	.....	228.24
6039	salicylate (*m*)	(1,2;1′,3′)	$HO \cdot C_6H_4 \cdot CO_2 \cdot C_6H_4 \cdot CH_3$	.....	228.24
6040	salicylate (*p*)	.....	$HO \cdot C_6H_4 \cdot CO_2 \cdot C_6H_4 \cdot CH_3$	.....	228.24
6041	*iso*-thiocyanate (*o*)	*o*-tolyl mustard oil	$CH_3 \cdot C_6H_4 \cdot N:CS$	XII-813	149.20
6042	*iso*-thiocyanate (*m*)	*m*-tolyl mustard oil	$CH_3 \cdot C_6H_4 \cdot N:CS$	XII-865	149.20
6043	*iso*-thiocyanate (*p*)	*p*-tolyl mustard oil	$CH_3 \cdot C_6H_4 \cdot N:CS$	XII-956	149.20
6044	thiosemicarbazide	(*o*)	$CH_3 \cdot C_6H_4 \cdot NH \cdot CS \cdot NH \cdot NH_2$	XII-952	181.25
6045	thiourea (*o*)	.....	$CH_3 \cdot C_6H_4 \cdot NH \cdot CS \cdot NH_2$	XII-806	166.24
6046	thiourea (*m*)	.....	$CH_3 \cdot C_6H_4 \cdot NH \cdot CS \cdot NH_2$	XII-863	166.24
6047	thiourea (*p*)	.....	$CH_3 \cdot C_6H_4 \cdot NH \cdot CS \cdot NH_2$	XII-947	166.24
6048	urea (*o*)	.....	$CH_3 \cdot C_6H_4 \cdot NH \cdot CO \cdot NH_2$	XII-801	150.18
6049	urea (*m*)	.....	$CH_3 \cdot C_6H_4 \cdot NH \cdot CO \cdot NH_2$	XII-862	150.18
6050	urea (*p*)	.....	$CH_3 \cdot C_6H_4 \cdot NH \cdot CO \cdot NH_2$	XII-940	150.18
6051	**Tolylene** cyanide (*o*)	xylylene dicyanide	$C_6H_4(CH_2 \cdot CN)_2$	IX-874	156.18
6052	cyanide (*m*)	xylylene dicyanide	$C_6H_4(CH_2 \cdot CN)_2$	IX-875	156.18
6053	cyanide (*p*)	xylylene dicyanide	$C_6H_4(CH_2 \cdot CN)_2$	IX-875	156.18
6054	**Trehalose**	mycose	$C_{12}H_{22}O_{11} \cdot 2H_2O$	XXXI-378	378.33
6055	**Triacetamide**	.....	$(CH_3CO)_3N$	II-181	143.14
6056	**Triacetonamine hydrate**	tetramethyl-piperidone (*γ*)	$C_9H_{17}ON \cdot H_2O$	XXI-249	173.25
6057	**Triacontane** (*n*)	.....	$CH_3(CH_2)_{28}CH_3$	I-176	422.80
6058	**Triamino-**azobenzene	(2,4,3′); Bismarck brown	$NH_2 \cdot C_6H_4 \cdot N:N \cdot C_6H_3(NH_2)_2$	XVI-386	227.26
6059	benzene (1,2,3)	.....	$(NH_2)_3C_6H_3$	XIII-294	123.16
6060	benzene (1,2,4)	.....	$(NH_2)_3C_6H_3$	XIII-294	123.16
6061	benzene HCl	(1,2,4)	$(NH_2)_3C_6H_3 \cdot 2HCl$	XIII-295	196.09
6062	benzene (1,3,5)	(free base unknown)	$(NH_2)_3C_6H_3$	XIII-299	123.16
6063	benzene HCl	(1,3,5)	$(NH_2)_3C_6H_3 \cdot 3HCl$	XIII-299	232.55
6064	benzoic acid (2,3,5)	.....	$(NH_2)_3C_6H_2 \cdot CO_2H$	XIV-485	167.17

Tolyl iodide 3905-7
Tolyl-mercaptan 5894-6
Tolyl-mercuric chloride 4039
Tolyl-mustard oil 6041-3
Tolyl phosphate 6351-3
Tolyl phosphite 6354-5
Tolyl thiophosphate 6356-8
Tolylene alcohol 6497-9

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
6029	lf./bz. pet.	.....	68.5	.....	sl. s. h.	s.	s.; sl. s. lg.
6030	lf./bz.	.....	93-4	.....	1 c.; 5 h.	v. s.	s.; sl. s. bz.
6031	nd./lg.	.....	94-5	.....	i.; v. s. bz.	v. s.	v. s.
6032	pr./al.	.....	78-9	236^{15mm}	s. bz.	s. h.	s.; sl. s. h. pet.
6033	cr./lg.	.....	95-6	400-5	v. s. bz.; v. s. lg.	v. s.; v. s. chl.	v. s.; v. s. act.
6034	lf./al.	.....	102-3	.....	sl. s. lg.	sl. s. c.	s. bz.
6035	col. oil	.....	.....	246	v. sl. s. h.	v. s.	v. s. bz.
6036	yel. lq.	.....	.....	$149\text{-}51^{41mm}$	i.	s.	s.
6037	lf./aq. al.	.....	82	252^{729mm}	v. sl. s. h.	v. s.	v. s. pet.
6038	col. cr.	.....	35	.....	i.	s.	s.
6039	col. cr.	.....	74	.....	i.	s.	s.
6040	col. cr.	.....	39	.....	i.	s.	s.
6041	col. lq.	$1.104_{25}^{25°}$	.....	239	i.	v. s.	∞
6042	lq.	.....	<-20	244^{732mm}	.....	.....	.....
6043	nd./et.	$1.087_{25}^{25°}$	26	237	d. h.	d. h.	s.
6044	lf./bz.	.....	145-6	.....	i.	s.	s.; i. lg.
6045	cr./aq.	.....	151-2	.....	v. s. h.	v. s.	v. sl. s.
6046	pr./al.	.....	110-1	.....	s. h.	s.	s.
6047	pl./al.	.....	188	.....	v. sl. s. c.	s. h.	.....
6048	lf./al.	.....	190-2	.....	$0.25^{45°}$; s. h.	s.	s.
6049	lf./aq.	.....	142-3	.....	.....	.....	.....
6050	nd./aq.	.....	180-1	.....	$0.3^{45°}$	s.	$0.06^{23°}$
6051	cr./et.	.....	59-60	.....	.....	s.	s.
6052	cr.	.....	28-9	$305\text{-}10^{300mm}$ sl. d.	i.	s.	s.; s. chl.
6053	nd./aq.	.....	98	.....	sl. s. h.	s.	s.; s. chl.
6054	rhb./al.	.....	97*	$-2H_2O >$ 130°	s. h.	sl. s. h.	i.
6055	nd./et.	.....	78-9	.....	.....	.....	s.
6056	pl./aq.	.....	59; 35 (anh.)	205 sl. d.	s.	s.	s.
6057	cr.	lq. $0.780^{65.9°}$	65.9	$235^{1.0mm}$	s. bz.	sl. s.	s.
6058	or. mn./aq.	.....	143.5	.....	i.	s.	s.
6059	cr.	.....	103 ±	336	v. s.	v. s.	v. s.
6060	lf./chl.	.....	<100	340 ±	v. s.	v. s.	sl. s.; sl. s. chl.
6061	nd.	.....	225	.....	s.	v. sl. s.	sl. s. HCl
6062	.....	.....	.....	.....	.....	.....	.....
6063	col. cr.	.....	.....	.....	s.; d. h.	sl. s.	i.
6064	cr./aq.	.....	.....	.....	s. h.	v. sl. s. h.	i.

* Anhydrous, m. p. 210°.
Toxilic acid 3995
"Traubensaure" 5690
Triacetin 3418
Triacetyl-hydroquinone 3775
Triacetyl-pyrogallol 5516

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
6065	**Triamino** benzoic acid (3,4,5)	.....	$(NH_2)_3C_6H_2{\cdot}CO_2H{\cdot}\frac{1}{2}H_2O$	XIV-455	176.17
6066	benzoic acid HCl	(2,4,6)	$(NH_2)_3C_6H_2{\cdot}CO_2H{\cdot}3HCl$	XIV-455	276.56
6067	chlorobenzene HCl	(2,4,6)	$(NH_2)_3C_6H_2Cl{\cdot}3HCl$	.....	267.00
6068	phenol (2,4,6)	.....	$(NH_2)_3C_6H_2{\cdot}OH$	XIII-569	139.16
6069	toluene (2,4,6)	.....	$(NH_2)_3C_6H_2{\cdot}CH_3$	XIII-303	137.18
6070	toluene HCl	(2,4,6)	$(NH_2)_3C_6H_2CH_3{\cdot}3HCl$	XIII-303	246.58
6071	triphenylmethane (*o,p',p''*)	*o*-leucoaniline	$(NH_2{\cdot}C_6H_4)_3CH$	XIII-311	289.37
6072	triphenylmethane (*m,p',p''*)	pseudo-leucoaniline	$(NH_2{\cdot}C_6H_4)_3CH$	XIII-312	289.37
6073	triphenylmethane (*p,p',p''*)	*p*-leucoaniline	$(NH_2{\cdot}C_6H_4)_3CH$	XIII-313	289.37
6074	**Triamyl**-amine (*n*)	.....	$(C_5H_{11})_3N$	*IV-378	227.42
6075	amine (*iso*)	.....	$(C_5H_{11})_3N$	IV-183	227.42
6076	amine (*d*)	.....	$[C_2H_5{\cdot}CH(CH_3){\cdot}CH_2]_3N$	IV-179	227.42
6077	borate (*n*)	*n*-amyl borate	$(C_5H_{11})_3BO_3$	.....	272.23
6078	**Triazo**-acetic acid	.....	$(N{:}N){:}N{\cdot}CH_2{\cdot}CO_2H$	II-229	101.07
6079	benzene	phenyl azide	$C_6H_5{\cdot}N_3$	V-276	119.12
6080	**Triazole**	pyrrodiazole	$CH{:}N{\cdot}NH{\cdot}CH{:}N$ (ring)	XXVI-13	69.07
6081	**Tribenzamide**	.....	$(C_6H_5CO)_3N$	IX-214	329.34
6082	**Tribenzoyl** methane (*α*)	.....	$(C_6H_5CO)_2C{:}C(OH){\cdot}C_6H_5$	VII-877	328.35
6083	methane (*β*)	.....	$(C_6H_5CO)_3CH$	VII-877	328.35
6084	**Tribenzyl**-amine	.....	$(C_6H_5{\cdot}CH_2)_3N$	XII-1038	287.39
6085	citrate	benzyl citrate	$(C_6H_5CH_2)_3C_6H_5O_7$	.....	462.48
6086	**Tribromo**-acetamide	.....	$Br_3C{\cdot}CO{\cdot}NH_2$	II-221	295.79
6087	acetanilide (2,4,6)	.....	$Br_3C_6H_2{\cdot}NH{\cdot}COCH_3$	XII-665	371.88
6088	acetic acid	.....	$Br_3C{\cdot}CO_2H$	II-220	296.78
6089	aniline (2,3,4)	.....	$Br_3C_6H_2{\cdot}NH_2$	XII-662	329.85
6090	aniline (2,3,5)	.....	$Br_3C_6H_2{\cdot}NH_2$	XII-662	329.85
6091	aniline (2,4,5)	.....	$Br_3C_6H_2{\cdot}NH_2$	XII-662	329.85
6092	aniline (2,4,6)	.....	$Br_3C_6H_2{\cdot}NH_2$	XII-663	329.85
6093	aniline (3,4,5)	.....	$Br_3C_6H_2{\cdot}NH_2$	XII-668	329.85
6094	anisole (2,4,6)	.....	$Br_3C_6H_2{\cdot}OCH_3$	VI-205	344.86
6095	benzene (1,2,4)	(*uns*)	$Br_3C_6H_3$	V-213	314.83
6096	benzene (1,2,3)	(*vic*)	$Br_3C_6H_3$	V-213	314.83
6097	benzene (1,3,5)	(*sym*)	$Br_3C_6H_3$	V-213	314.83
6098	benzoic acid (2,4,6)	.....	$Br_3C_6H_2{\cdot}CO_2H$	IX-360	358.84
6099	benzoic acid (3,4,5)	.....	$Br_3C_6H_2{\cdot}CO_2H$	IX-361	358.84
6100	butane (1,2,3)	.....	$CH_3(CHBr)_2CH_2Br$	I-121	294.84
6101	butane	1,2,3-triBr-2-Me-propane	$(CH_2Br)_2{:}CBr{\cdot}CH_3$	I-128	294.84
6102	***tert*-butyl alcohol**	acetone-bromoform	$(CH_3)_2C(OH){\cdot}CBr_3$	*I-193	310.84
6103	ethane (1,1,2)	vinyl tribromide	$Br{\cdot}CH_2{\cdot}CHBr_2$	I-93	266.79
6104	ethyl alcohol	avertin	$Br_3C{\cdot}CH_2OH$	.....	282.79
6105	ethylene	ethylene tribromide	$Br{\cdot}CH{:}CBr_2$	I-191	264.78
6106	mesitylene	(2,4,6;1,3,5)	$Br_3C_6(CH_3)_3$	V-409	356.91
6107	*β*-naphthol	(1,3,6;2)	$Br_3C_{10}H_4{\cdot}OH$	VI-652	380.89
6108	phenol (2,4,6)	(*sym*)	$Br_3C_6H_2{\cdot}OH$	VI-203	330.83

Triamino-diphenyl 262
Triamino-triazine 4020
Triamino-triphenyl carbinol 5038
Triarachin 3419
Tribenzal-diamine 3700
Tribenzoin 3420

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
6065	nd./aq.	.....	$-H_2O$, > 100	.....	s. h.	i.	i.
6066	pr./aq.	.....	.....	.....	s.	sl. s.	i.
6067	brn. pd.	.....	.....	.....	s.	sl. s.	i.
6068	unstable	.....	.....	257	.....	.....	.....
6069	oil	.....	.....	.....	.....	.....	.....
6070	nd.	.....	.....	.....	s.; d. h.	.....	.....
6071	cr./al.	.....	165	.....	.....	.....	.....
6072	nd./et. lg.*	.....	150*	.....	v. sl. s. lg.	s.	sl. s.
6073	lf./aq.	.....	148	.....	sl. s. c.	s. abs.	s. bz.
6074	lq.	.....	.....	240-5	.....	.....	.....
6075	col. lq.	$0.786^{20°}_{4°}$	.....	265-7	.....	.....	.....
6076	col. lq.	$0.796^{13°}$	.....	230-7	i.	v. s.	∞
6077	col. lq.	.....	.....	130-2^{26mm}	.....	.....	.....
6078	col. hyg.	$1.354^{33°}$	16 ±; expl.	93^{3mm}	.....	.....	.....
6079	yel. oil	$1.088^{20°}_{20°}$	expl.	73.5^{24mm}	i.	sl. s.	sl. s.
6080	nd./et.	.....	120-1	260	v. s.	v. s.	sl. s.
6081	nd./al.	.....	207-8	subl.	s. h. bz.	i. c.	v. sl. s.
6082	cr. ppt.	.....	210-20	subl.	0.5/3 cc. chl.	s.	s. act.
6083	nd./al.	.....	226-31	.....	0.5 c. act. 0.2 chl.	0.01 c.	i. 10% Na_2CO_3
6084	mn./et.	$0.991^{25°}_{4°}$	92-3	380-90	v. sl. s.	s. h.	s.
6085	col. pl.	.....	.....	.....	i.	sl. s.	i.
6086	mn.	.....	121-2	.....	v. sl. s. bz.	s. h.	s. h.
6087	nd./al.	.....	232	.....	.....	.....	.....
6088	cr.	.....	135	245 d.	v. s.; d. h.	v. s.	v. s.
6089	lf./aq. al.	.....	100.6	.....	sl. s.	v. s.	v. s. bz.
6090	nd./al.	.....	91	.....	.....	.....	.....
6091	nd./al.	.....	85-6	.....	v. s. bz.	v. s.	v. s.
6092	rhb./bz.	$2.35^{20°}_{20°}$	119-20	300	i.; s. chl.	v. s. h.	v. s.
6093	nd.	.....	118-9	.....	i.	s.	s.
6094	nd./al.	.....	87-8	.....	.....	$1^{15°}$	.....
6095	nd./al.	.....	44-5	275-6	i.; v. s. bz.	v. s. h.	v. s.
6096	col./al.	2.658	87-8	.....	.....	.....	.....
6097	nd./al.	.....	119-20	271^{765mm}	i.	sl. s. h.	s.
6098	pr./aq.	.....	187	.....	$0.35^{15°}$	$0.55^{100°}$ aq.	.....
6099	nd./aq. al.	.....	234-5	.....	v. sl. s. h.	s.	s. h.
6100	col. lq.	$2.190^{\frac{16°}{4°}}$	.....	110-3^{19mm}	.....	.....	.....
6101	col. lq.	$2.211^{\frac{14°}{4°}}$	.....	222-5	i.	.....	.....
6102	cr./aq. al.	.....	167-76	.....	sl. s.	s.	s.
6103	lq.	$2.579^{\frac{20°}{4°}}$	−26	187-8^{752mm}	.....	.....	.....
6104	col. cr.	.....	79-80	92-3^{10mm}	$2.54^{0°}$	s.	s.; s. bz.
6105	lq.	$2.708^{20.5°}$	.....	163-4	.....	.....	.....
6106	tri./al.	.....	223	.....	i.	v. sl. s. h.	s. bz.
6107	nd./ac.	.....	155	.....	.....	.....	.....
6108	nd./aq.	$2.55^{20°}_{20°}$	96	subl.	$0.01^{15°}$; $50^{25°}$ bz.	v. s.; v. s. act.	s.; $12^{25°}$ CCl_4

* Crysts./bz. + $1C_6H_6$, m. p. 145°.
Tribenzylene-benzene 6362
Tribromo-acetaldehyde 876
Tribromo-hydrin 6112
Tribromo-methane 1016
Tribromo-nitromethane 4688

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Tribromo				
6109	phenyl acetate	(1;2,4,6)	$CH_3CO_2 \cdot C_6H_2Br_3$	VI-205	372.87
6110	phenyl salicylate	(2,1;2',4',6'); tribromosalol	$HO \cdot C_6H_4 \cdot CO_2 \cdot C_6H_2Br_3$	X-78	450.93
6111	phenyl-*p*-toluene-sulfonate (2,4,6)	.....	$CH_3 \cdot C_6H_4 \cdot SO_3 \cdot C_6H_2Br_3$	.....	485.01
6112	propane (1,2,3)	glyceryl tribromo-hydrin	$(CH_2Br)_2:CHBr$	I-112	280.82
6113	quinaldine (ω)	.....	$C_9H_6N \cdot CBr_3$	.....	379.90
6114	resorcinol (2,4,6)	.....	$Br_3C_6H(OH)_2$	VI-822	346.83
6115	**Tributyl**-amine (*n*)	.....	$(C_4H_9)_3N$	IV-157	185.34
6116	amine (*iso*)	.....	$(C_4H_9)_3N$	IV-166	185.34
6117	borate (*n*)	*n*-butyl borate	$B(OC_4H_9)_3$	.....	230.16
6118	carbinol (*n*)	.....	$(C_4H_9)_3C \cdot OH$	.....	200.35
6119	citrate (*n*)	*n*-butyl citrate	$(C_4H_9)_3C_6H_5O_7$	.....	360.44
6120	phenyl phosphate (*p*; *tert*)	phosphen 7	$[(CH_3)_3C \cdot C_6H_4 \cdot O]_3PO$	.....	494.59
6121	phosphate (*n*)	*n*-butyl phosphate	$(C_4H_9O)_3PO$	.....	266.32
6122	**Tri-*iso*-butylene**	.....	$(CH_3)_2C:C[C(CH_3)_3]_2$	I-225	168.31
6123	**Tricarballylic acid**	.....	$(HO_2C \cdot CH_2)_2:CH \cdot CO_2H$	II-815	176.12
6124	**Trichloro**-acetal	.....	$Cl_3C \cdot CH(OC_2H_5)_2$	I-621	221.52
6125	acetal	.....	$Cl_3C \cdot CH(OC_2H_5)_2$	I-621	221.52
6126	acetamide	.....	$Cl_3C \cdot CO \cdot NH_2$	II-211	162.42
6127	acetanilide (2,4,6)	.....	$CH_3 \cdot CO \cdot NH \cdot C_6H_2Cl_3$	XII-628	238.51
6128	acetic acid	.....	$Cl_3C \cdot CO_2H$	II-206	163.40
6129	acetyl chloride	.....	$Cl_3C \cdot CO \cdot Cl$	II-210	181.85
6130	aniline (2,3,4)	.....	$Cl_3C_6H_2 \cdot NH_2$	XII-626	196.47
6131	aniline (2,4,5)	.....	$Cl_3C_6H_2 \cdot NH_2$	XII-627	196.47
6132	aniline (2,4,6)	.....	$Cl_3C_6H_2 \cdot NH_2$	XII-627	196.47
6133	aniline (3,4,5)	.....	$Cl_3C_6H_2 \cdot NH_2$	XII-630	196.47
6134	benzene (1,2,3)	(*vic*)	$Cl_3C_6H_3$	V-203	181.46
6135	benzene (1,2,4)	(*uns*)	$Cl_3C_6H_3$	V-203	181.46
6136	benzene (1,3,5)	(*sym*)	$Cl_3C_6H_3$	V-203	181.46
6137	benzoic acid (2,3,4)	.....	$Cl_3C_6H_2 \cdot CO_2H$	IX-345	225.47
6138	benzoic acid (2,3,5)	.....	$Cl_3C_6H_2 \cdot CO_2H$	IX-345	225.47
6139	benzoic acid (2,4,5)	.....	$Cl_3C_6H_2 \cdot CO_2H$	IX-345	225.47
6140	benzoic acid (2,4,6)	.....	$Cl_3C_6H_2 \cdot CO_2H$	IX-345	225.47
6141	benzoic acid (3,4,5)	.....	$Cl_3C_6H_2 \cdot CO_2H$	IX-346	225.47
6142	bromoethane	(1;2,2,2)	$BrCH_2 \cdot CCl_3$	I-90	212.32
6143	bromomethane	.....	$Br \cdot CCl_3$	I-67	198.30
6144	*tert*-butyl acetate	(β,β,β)	$CH_3CO_2 \cdot C \cdot (CH_3)_2CCl_3$	II-131	219.50
6145	*tert*-butyl alcohol	acetone chloroform	$Cl_3C \cdot COH:(CH_3)_2$	I-382	177.47
6146	*o*-cresol (4,5,6)	(4,5,6;2,1)	$Cl_3C_6H(OH) \cdot CH_3$	*VI-175	211.48
6147	*o*-cresol (3,5,6)	(3,5,6;2,1)	$Cl_3C_6H(OH) \cdot CH_3$	*VI-175	211.48
6148	*m*-cresol (2,4,6)	(2,4,6;3,1)	$Cl_3C_6H(OH) \cdot CH_3$	*VI-189	211.48
6149	*p*-cresol (2,3,6)	(2,3,6;4,1)	$Cl_3C_6H(OH) \cdot CH_3$	VI-404	211.48
6150	dibromoethane	(1,1;2,2,2)	$Br_2CH \cdot CCl_3$	I-93	291.23
6151	ethane (1,1,1)	methyl chloroform	$CH_3 \cdot CCl_3$	I-85	133.42
6152	ethane (1,1,2)	vinyl trichloride	$ClCH_2 \cdot CHCl_2$	I-85	133.42
6153	ethyl acetate	.....	$CH_3CO_2 \cdot CH_2 \cdot CCl_3$	II-128	191.45
6154	ethyl alcohol	.....	$Cl_3C \cdot CH_2OH$	I-338	149.42

Tribromo-salol 6110
Tributyrin 3421
Tricaprin 3422
Tricaproin 3423
Tricaprylin 3424
Trichloro-acetaldehyde 1281

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
6109	nd./al.	.....	82-3	290-300	.....	.....	.....
6110	wh. pd.	.....	189	.....	i.; s. chl.	sl. s.; s. act.	s. bz.; s. ac.
6111	col. cr.	.....	113-4	.....	i.	s.	s.
6112	cr.	$2.436^{23°}$	16-7	219-21	i.	s.	s.
6113	tan pl.	.....	127-8	.....	i.	i.	i.
6114	nd./aq.	.....	111	.....	sl. s. c.	s. h.	s.
6115	col. lq.	$0.778^{\frac{20}{20}°}$	.....	216.5[761mm]	i.	s.	∞
6116	col. lq.	$0.764^{\frac{25}{4}°}$	−22	188-91	i.	s.	∞
6117	col. lq.	.....	.....	103-6[8mm]	.....	.....	.....
6118	col. lq.	.....	.....	117-20[10mm]	i.	s.	s.
6119	col. lq.	$1.045^{\frac{20}{20}°}$	−20	233[17mm]	i.	∞	∞
6120	col. cr.	.....	102-5	300[5mm]	i.; ∞ bz.	$2^{25°}$	∞ CCl_4
6121	col. lq.	$0.976^{\frac{25}{25}°}$	<−80	289 d.	0.6	∞	∞
6122	col. lq.	$0.774^{0°}$	<−30	178-80[752mm]	i.	.....	.....
6123	pr./aq.	.....	165-6	d.	$41^{15°}$	v. s.	$1^{18°}$
6124	lq.	$1.266^{15°}$	.....	197	0.5	∞	∞
6125	solid	.....	83	230 d.	.....	.....	.....
6126	mn.	.....	141	238-9[746mm]	v. sl. s.	v. s.	v. s.
6127	nd.	.....	203-4	.....	s. 50% ac.	s.; v. sl. s. CS_2	v. sl. s.; v. sl. s. lg.
6128	cr.	$1.617^{\frac{46}{15}°}$	58(50±)	195.5[754mm]	v. s.	s.	s.
6129	col. lq.	$1.629^{16.2°}$	.....	118	d.	d.	.....
6130	nd./lg.	.....	67.5	292[774mm]	s. lg.	v. s.	.....
6131	nd./lg.	.....	96	270±	sl. s. lg.	s.; s. CS_2	s. 50% ac.
6132	nd./lg.	.....	77.5-8.5	262[746mm]	i. H_3PO_4	s.	s.
6133	nd./aq. al.	.....	100	.....	.....	.....	.....
6134	cr./al.	.....	52-3	218-9	i.	sl. s.	.....
6135	col. cr.	$1.446^{26°}$	17	213	i.	.....	.....
6136	nd.	.....	63.5	208.5[764mm]	i.	sl. s.	.....
6137	nd.	.....	186(129)	.....	sl. s.	s.	s.
6138	nd./aq.	.....	163	.....	v. sl. s. c.	s.	s.
6139	nd./aq.	.....	163-4	subl.	v. sl. s. c.	s. c. abs.	.....
6140	cr./aq.	.....	164	.....	sl. s.	s.	s.
6141	nd./aq. al.	.....	203	subl.	v. sl. s. c.	s.	s.
6142	lq.	1.884	.....	151-3	.....	.....	.....
6143	col. lq.	$2.055^{0°}_{4}$	−21	104.1	.....	.....	.....
6144	lq.	.....	.....	191	i.; v. s. act.	v. s.; v. s. chl.	v. s.; v. s. bz.
6145	col. cr.	.....	97*	167	0.8 c.	111	s.; s. chl.
6146	nd./pet.	.....	77	.....	sl. s.	s.; s. alk.	s.
6147	nd./ac.	.....	62	.....	i. pet.	s.; s. alk.	s.
6148	col. nd./aq.	.....	47	265	sl. s.	s.; s. alk.	s.; s. lg.
6149	nd./pet.	.....	66-7	.....	sl. s.	s.; s. alk.	s.
6150	lq.	$2.317^{0°}_{4}$	.....	93-5[14mm]	.....	.....	.....
6151	lq.	$1.325^{\frac{25.6}{4}°}$	.....	74.1	i.	∞	∞
6152	col. lq.	$1.441^{\frac{25.5}{4}°}$	−36.7	113.5	i.	∞	∞
6153	col. oil	$1.189^{15°}$	.....	170[747mm]	.....	.....	.....
6154	rhb. pl.	$1.550^{23.3°}$	17.8	151[737mm]	v. sl. s.	∞	∞

* Forms solid solution with H_2O, m. p. 75-97°.

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
6155	**Trichloro** ethylene	ethylene trichloride	$ClCH{:}CCl_2$	I-187	131.40
6156	hydroquinone	(2,3,5)	$(HO)_2C_6HCl_3$	VI-850	213.46
6157	iodomethane	.....	$Cl_3C{\cdot}I$	I-71	245.30
6158	lactic acid	.....	$Cl_3C{\cdot}CHOH{\cdot}CO_2H$	III-286	193.43
6159	methylchloro-formate	diphosgene	$Cl{\cdot}CO_2{\cdot}CCl_3$	III-18	197.85
6160	naphthalene (1,4,5)	(δ)	$C_{10}H_5Cl_3$	V-545	231.51
6161	naphthalene (1,4,6)	(ϵ)	$C_{10}H_5Cl_3$	V-546	231.51
6162	phenol (2,3,5)	.....	$Cl_3C_6H_2{\cdot}OH$	VI-190	197.46
6163	phenol (2,4,5)	.....	$Cl_3C_6H_2{\cdot}OH$	.....	197.46
6164	phenol (2,4,6)	omal	$Cl_3C_6H_2{\cdot}OH$	VI-190	197.46
6165	phenyl phosphate	(*o*); phosphen 8	$(Cl{\cdot}C_6H_4{\cdot}O)_3PO$	.....	429.63
6166	propane (1,2,3)	glyceryl trichloro-hydrin	$(ClCH_2)_2{:}CHCl$	I-106	147.44
6167	propane (1,1,2)	.....	$CH_3{\cdot}CHCl{\cdot}CHCl_2$	I-106	147.44
6168	***iso***-propyl alcohol	(1,1,1); isopral	$Cl_3C{\cdot}CHOH{\cdot}CH_3$	I-365	163.44
6169	quinone	.....	$O{:}C_6HCl_3{:}O$	VII-634	211.44
6170	tribromoethane	(1,2,2;1,1,2)	$Cl_2CBr{\cdot}CClBr_2$	I-94	370.14
6171	**Tricosane** (*n*)	.....	$CH_3(CH_2)_{21}CH_3$	I-175	324.61
6172	**Tricyanogen chloride**	cyanuric chloride	$C_3N_3Cl_3$	XXVI-35	184.43
6173	**Tridecane** (*n*)	.....	$CH_3(CH_2)_{11}CH_3$	I-171	184.35
6174	**Tridecyl alcohol** (*n*)	tridecanol-1	$CH_3(CH_2)_{11}CH_2OH$	I-428	200.35
6175	**Tridecylene**	.....	$C_{13}H_{26}$	I-225	182.34
6176	**Tridecylic** acid	tridecanoic acid	$CH_3(CH_2)_{11}{\cdot}CO_2H$	II-364	214.34
6177	aldoxime	.....	$C_{12}H_{25}{\cdot}CH{:}NOH$	I-715	213.35
6178	**Triethanol**-amine	.....	$N(CH_2{\cdot}CH_2{\cdot}OH)_3$	IV-285	149.19
6179	amine HCl	.....	$C_6H_{15}O_3N{\cdot}HCl$	IV-285	185.65
6180	**Triethylamine**	.....	$(C_2H_5)_3N$	IV-99	101.19
6181	hydrobromide	.....	$(C_2H_5)_3N{\cdot}HBr$	IV-101	182.11
6182	hydrochloride	.....	$(C_2H_5)_3N{\cdot}HCl$	IV-101	137.65
6183	**Triethyl** arsine	arsenic triethyl	$(C_2H_5)_3As$	IV-602	162.09
6184	benzene (1,3,5)	(*sym*)	$(C_2H_5)_3C_6H_3$	V-449	162.26
6185	benzene (1,2,4)	(*uns*)	$(C_2H_5)_3C_6H_3$	V-448	162.26
6186	borate	ethyl borate	$(C_2H_5O)_3B$	I-335	146.00
6187	citrate	ethyl citrate	$C_3H_5O(CO_2C_2H_5)_3$	III-568	276.28
6188	phosphate	ethyl phosphate	$(C_2H_5O)_3PO$	I-332	182.16
6189	phosphine	.....	$(C_2H_5)_3P$	IV-582	118.16
6190	phosphine oxide	.....	$(C_2H_5)_3PO$	IV-592	134.16
6191	phosphine sulfide	.....	$(C_2H_5)_3PS$	IV-592	150.22
6192	phosphite	ethyl phosphite	$(C_2H_5O)_3P$	I-330	166.16
6193	propionate, ortho-	Et orthopropionate	$C_2H_5{\cdot}C(OC_2H_5)_3$	II-240	176.25
6194	silicol	.....	$(C_2H_5)_3Si{\cdot}OH$	IV-627	132.25
6195	silicol ethyl ether	.....	$(C_2H_5)_3Si{\cdot}OC_2H_5$	IV-627	160.30
6196	silicon hydride	.....	$(C_2H_5)_3Si{\cdot}H$	IV-625	116.25
6197	silicon oxide	.....	$[(C_2H_5)_3Si]_2O$	IV-627	246.48
6198	stibine	antimony triethyl	$(C_2H_5)_3Sb$	IV-618	208.94
6199	**Triethylene** glycol	.....	$(HOCH_2CH_2OCH_2)_2$	I-468	150.17
6200	glycol diacetate	.....	$(CH_3CO_2{\cdot}CH_2{\cdot}CH_2{\cdot}O{\cdot}CH_2)_2$	II-141	234.24
6201	tetramine	.....	$(H_2N{\cdot}CH_2{\cdot}CH_2{\cdot}NH{\cdot}CH_2)_2$	IV-255	146.24
6202	**Trifluoro**-1-chloro-ethane	(1,2,2)	$F_2CH{\cdot}CHFCl$	I-83	118.49

Trichloro-hydroxy toluene 6146-9
Trichloro-lactic nitrile 1284
Trichloro-methane 1477
Trichloro-nitromethane 4697
Tricresol, mixt. of 1545-7
Tridecanoic acid 6176
Tridecanol 6174
Tridecanone 4408

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
6155	col. lq.	$1.466^{20°}_{20°}$	−73	87.2	$0.1^{25°}$	∞	∞
6156	pr./aq.	.....	134	subl.	$0.6^{15°}$	v. s.	v. s.
6157	lq.	$2.36^{17°}$	−19	42 d.	.....	.....	.....
6158	cr./et.	.....	124	$140\text{-}70^{45mm}$	v. s.	v. s.	s.; s. chl.
6159	lq.	$1.653^{14°}$	−57	127.5	.....	.....	.....
6160	nd.	.....	131	.....	.....	v. s. h.	.....
6161	nd./al.	.....	65-6	.....	.....	sl. s. h.	.....
6162	nd./aq. al.	.....	55	249-50	sl. s. h.	s.	s.; s. lg.
6163	col./pet.	.....	61-3	252	i.; s. CCl_4	s.; s. bz.	s.
6164	nd.	$1.490^{75°}_{4°}$	68-9	246	$0.09^{25°}$	v. s.	v. s.
6165	col. cr.	$1.38^{60°}_{4°}$	35	$255\text{-}65^{5mm}$	i.; ∞ bz.	v. s.	∞ CCl_4
6166	lq.	$1.391^{20°}_{4°}$	−14.7	158	<0.1	∞	∞
6167	oil	$1.372^{25°}$	<−20	140	i.	∞	∞
6168	col. mn.	.....	50-1	161.8^{773mm}	3	s.; s. KOH	s.
6169	yel. lf./aq.	.....	168-9	subl.	i. c.	v. s. h.	v. s.
6170	pr.	$2.44^{18°}$	178-80 d.	.....	.....	.....	.....
6171	lf.	$0.779^{47.7°}_{4°}$	47.7	234^{15mm}	.....	.....	.....
6172	mn./et.	1.32	145	190	d. h.; s. ac.	v. s. chl.	s. h. abs.
6173	col. lq.	$0.757^{20°}_{4°}$	−6.2	234	i.	v. s.	v. s.
6174	cr.	$0.822^{31°}_{4°}$	30.5	$155\text{-}6^{15mm}$	.....	.....	.....
6175	lq.	$0.845^{0°}$	.....	232.7	i.	s.	v. s.
6176	cr./al.	.....	41	$199\text{-}200^{24mm}$	i.	v. s.	v. s.
6177	nd./aq. al.	.....	80.5	.....	sl. s. bz.	sl. s.	v. s.; s. chl.
6178	col. lq.	$1.126^{20°}_{20°}$	20-1	$277\text{-}9^{150mm}$	∞	∞; s. chl.	sl. s.
6179	cr./al.	.....	177	.....	sl. s.	v. sl. s.	.....
6180	col. oil	$0.729^{20°}_{20°}$	−114.8	89.4	∞ < 19°	∞	∞
6181	hex./chl.	1.322	248	subl. > 225	$151^{25°}$	$23^{25°}$ chl.	i.; s. al.
6182	cr./al.	$1.069^{21°}_{4°}$	253-4	subl. > 245	$150^{28°}$	s.; s. chl.	i.
6183	col. lq.	$1.150^{20°}_{4°}$	.....	140^{736} sl. d.	i.	∞	∞
6184	lq.	$0.861^{20°}_{4°}$	.....	215	i.	s. abs.	s.
6185	lq.	$0.882^{17°}_{4°}$	.....	$217\text{-}8^{755mm}$	i.	s. abs.	s.
6186	lq.	$0.864^{20°}_{20°}$	.....	120	d.	.....	.....
6187	oil	$1.137^{20°}_{4°}$	.....	294 ±	i.	∞	∞
6188	col. lq.	$1.068^{20°}_{4°}$	.....	215-6	$100^{25°}$	s.	s.
6189	col. lq.	$0.800^{15°}_{4°}$	.....	127.5^{744mm}	i.	∞	∞
6190	col. nd.	.....	52-3(44)	242.8-3.0	∞; i. KOH	∞	sl. s.
6191	hex. pr.	.....	94	ign. 70	.....	.....	.....
6192	lq.	$0.969^{20°}_{4°}$	.....	$155\text{-}7^{760mm}$	i.	v. s.	v. s.
6193	col. lq.	$0.887^{20°}$	.....	161^{766mm}	.....	.....	.....
6194	lq.	$0.871^{0°}$	.....	154	i.	.....	.....
6195	lq.	$0.840^{0°}$	.....	153	i.	∞	∞
6196	lq.	$0.721^{15°}_{4°}$	.....	95-6	i.	i. H_2SO_4	.....
6197	lq.	$0.859^{0°}$	.....	231	i.	s. H_2SO_4	.....
6198	col. lq.	$1.324^{16°}$	<−29	158-9	.....	v. s.	v. s.
6199	col. hyg.	$1.125^{20°}_{20°}$	.....	290	∞; i. pet.	∞; ∞ bz.	v. sl. s.
6200	col. lq.	.....	.....	300	∞	∞	∞
6201	lq.	$0.982^{15°}$	12	266-7	v. s.	v. s.	.....
6202	col. lq.	$1.365^{0°}$	.....	17	.....	v. s.	.....

Tridecyl cyanide 4456
Triethyl aluminum 230
Triethyl bismuthine 855
Triethyl boron 871
Triethyl carbinol 3533
Triethyl tin 5953

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Trifluoro				
6203	2-chloroethylene	(1,1,2)	$F_2C{:}CFCl$	.....	116.48
6204	1,2-dibromoethane	(1,1,2)	$F_2BrC{\cdot}CHBrF$	I-92	241.86
6205	1,1,2-tribromo-ethane	(1,2,2)	$Br_2CF{\cdot}CBrF_2$	I-94	320.77
6206	1,1,2-trichloro-ethane	(1,2,2)	$Cl_2CF{\cdot}CClF_2$	.....	187.39
6207	**Triglycol dichloride**	.....	$Cl(CH_2{\cdot}CH_2{\cdot}O)_2{\cdot}CH_2{\cdot}CH_2{\cdot}Cl$	.....	187.07
6208	**Triglycyl** glycine	.....	$NH_2(CH_2CONH)_3{\cdot}CH_2{\cdot}CO_2H$	IV-377	246.22
6209	glycine ester	biuret base	$C_7H_{13}O_3N_4{\cdot}CO_2C_2H_5$	IV-377	274.28
6210	**Trihexylamine** (*n*)	.....	$(C_6H_{13})_3N$	IV-188	269.50
6211	**Trihydroxy**-aceto-phenone (2,3,4)	gallacetophenone; alizarin yellow C	$(HO)_3C_6H_2{\cdot}COCH_3$	VII-393	168.14
6212	anthraquinone	anthragallol (1,2,3)	$C_6H_4(CO)_2C_6H(OH)_3$	VIII-505	256.20
6213	anthraquinone	(1,2,4); purpurin	$C_6H_4(CO)_2C_6H(OH)_3$	VIII-509	256.20
6214	anthraquinone (1,2,6)	flavopurpurin	$HO{\cdot}C_6H_3(CO)_2C_6H_2{:}(OH)_2$	VIII-513	256.20
6215	anthraquinone (1,2,7)	anthrapurpurin	$HO{\cdot}C_6H_3(CO)_2C_6H_2{:}(OH)_2$	VIII-516	256.20
6216	benzene (1,2,3)(*v*)	pyrogallol	$(HO)_3C_6H_3$	VI-1071	126.11
6217	benzene (1,2,4) (*uns*)	hydroxy-hydro-quinone	$(HO)_3C_6H_3$	VI-1087	126.11
6218	benzene (1,3,5) (*sym*)	phloroglucinol	$(HO)_3C_6H_3{\cdot}2H_2O$	VI-1092	162.14
6219	benzene (1,3,5)	phloroglucinol	$(HO)_3C_6H_3$	VI-1092	126.11
6220	benzoic acid (2,3,4)	pyrogallol carboxylic acid	$(HO)_3C_6H_2{\cdot}CO_2H{\cdot}xH_2O$	X-464	170.12
6221	benzoic acid (2,4,5)	.....	$(HO)_3C_6H_2{\cdot}CO_2H{\cdot}\frac{1}{2}H_2O$	X-468	179.13
6222	benzoic acid (2,4,6)	phloroglucinol carboxylic acid	$(HO)_3C_6H_2{\cdot}CO_2H{\cdot}H_2O$	X-468	188.13
6223	benzoic acid (3,4,5)	gallic acid	$(HO)_3C_6H_2{\cdot}CO_2H{\cdot}H_2O$	X-470	188.13
6224	benzophenone (2,3,4)	alizarin yellow A	$C_6H_5{\cdot}CO{\cdot}C_6H_2(OH)_3{\cdot}H_2O$	VIII-417	248.23
6225	benzophenone (2,6,2')	salicyloyl-resorcinol	$(HO)_2C_6H_3{\cdot}CO{\cdot}C_6H_4OH$	VIII-422	230.21
6226	butyrophenone (2,3,4)	*n*-butyropyrogallol	$(HO)_3C_6H_2{\cdot}COC_3H_7{\cdot}H_2O$	VIII-399	214.21
6227	butyrophenone (*n*)	(2,4,6)	$(HO)_3C_6H_2{\cdot}COC_3H_7{\cdot}H_2O$	*VIII-691	214.21
6228	glutaric acid	(*d* or *l*)	$(CHOH)_3(CO_2H)_2$	III-553	180.11
6229	glutaric acid (*dl*)	.....	$(CHOH)_3(CO_2H)_2$	.....	180.11
6230	methyl-amino-methane	.....	$H_2N{\cdot}C(CH_2OH)_3$	IV-303	121.14
6231	pyridine (*sym*)	(2,4,6)	$(HO)_3C_5H_2N$	XXI-197	127.10
6232	**Triiodo**-acetic acid	.....	$I_3C{\cdot}CO_2H$	II-225	437.79
6233	benzene (1,2,3)	(*vic*)	$I_3C_6H_3$	V-228	455.84
6234	benzene (1,2,4)	(*uns*)	$I_3C_6H_3$	V-228	455.84
6235	benzene (1,3,5)	(*sym*)	$I_3C_6H_3$	V-228	455.84
6236	benzoic acid	(2,3,5)	$I_3C_6H_2{\cdot}CO_2H$	*IX-150	499.85

Trifluoro-methane 3287
Trigemin 364
Trigenolline, cf. alkd.
Trigonelline, cf. alkd.
Triheptylin 3425
Trihydroxy-ethylamine 6178

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
6203	gas	.....	−157.5	−27.9	d.	.....	.....
6204	col. lq.	$2.254^{14°}$	.....	76.5	.....	.....	.....
6205	lq.	$2.5677^{0°}$	d. 330	117	.....	.....	.....
6206	lq.	$1.42^{25°}$	−37	46.5^{740mm}	i.	∞	∞; ∞ bz.
6207	lq.	$1.197^{\frac{20}{20}°}$	.....	241	$1.9^{20°}$	.....	.....
6208	col. pd.	.....	d. > 220	.....	v. s. h.	v. sl. s.	.....
6209	pl./aq.	.....	d. 270	.....	v. s. c.	v. sl. s.	v. sl. s.
6210	col. lq.	.....	.....	260	v. sl. s.	v. s.	v. s.
6211	col. cr./aq.	.....	173	.....	0.2 c.; s. h.	s.	v. sl. s. bz.
6212	cr./al. ac.	.....	310 d.	subl. 290±	v. sl. s.	s.; s. H_2SO_4	s.
6213	red nd./al.	.....	256-7	.....	sl. s. h.	s.	s.
6214	yel. nd./al.	.....	>360	459 sl. d.	v. sl. s. h.	s.	sl. s.
6215	or. nd./al.	.....	369	462 sl. d.	sl. s. h.	v. s. h.	sl. s.
6216	nd.	$1.453^{4°}$	133-4	309	$40^{13°}$	s.; sl. s. bz.	s.
6217	mn./aq.	.....	140.5	.....	v. s.	v. s.	v. s.; sl. s. bz.
6218	rhb.	.....	117; $-2H_2O$, 110	subl. sl. d.	1 c.	v. s.	v. s.
6219	cr.	.....	209-19	subl.	.....	.....	.....
6220	nd./aq.	.....	206 d. (anh.)	subl. in CO_2	$0.13^{12.5°}$	s.	sl. s.
6221	nd./aq.	.....	217-8 d. (anh.)	$-\frac{1}{2}H_2O$, 105	s. h.	s.	.....
6222	.....	.....	.....	.....	sl. s. c.	s.	v. s.
6223	mn./aq.	1.694	235 d. (anh.)	$-H_2O$, 100	$1^{13°}$; $3.3^{100°}$	$28^{15°}$ abs.	$2.5^{15°}$; 20 act.
6224	yel. nd./ aq. al.	.....	140-1 (anh.)	.....	v. sl. s. c.	s.; s. alk.; sl. s. bz.	s.; s. H_2SO_4
6225	yel. pl./al.	.....	133-4	.....	v. sl. s. h.	s.; s. alk.	s. bz.
6226	yel. nd./aq.	.....	76-80; 100 (anh.)	.....	.....	.....	.....
6227	nd./aq.	.....	179-80 (anh.)	$-H_2O$, 110	sl. s.	v. s.	v. s.
6228	lf./al.	.....	128	.....	v. s.	s.	s. act.
6229	pl./act.	.....	154-5 d.	.....	v. s.	v. s.	s. act.
6230	nd./al.	.....	171-2	$219-20^{10mm}$	v. s.	$0.4^{20°}$	i.; v. sl. s. act.(d.)
6231	nd. or pd.	.....	220-30 d.	.....	sl. s.; d. h.	i.	i.
6232	yel. lf.	.....	150 d.	.....	s.	.....	.....
6233	nd./al.	.....	116	.....	i.	v. s.	v. s.
6234	nd./al.	.....	91.4	.....	i.	s.	s. chl.
6235	nd./ac.	.....	182-4	.....	i.	sl. s.	sl. s.
6236	pr./al.	.....	223-4	.....	i.; v. sl. s. bz.	s. h.	i.

Trihydroxy-methylanthraquinone 2874
Trihydroxy-toluene 4361
Trihydroxy-triphenylmethane 3963

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
6237	**Triiodo** ethane (1,1,1)	methyl iodoform	$CH_3 \cdot CI_3$	I-99	407.80
6238	phenol (2,4,6)	.....	$I_3C_6H_2 \cdot OH$	VI-211	471.84
6239	**Triketohydrindene hydrate**	ninhydrin	$C_6H_4(CO)_2:C(OH)_2$	*VII-475	178.14
6240	**Trimethoxy** benzoic acid (2,3,4)	.....	$(CH_3O)_3C_6H_2 \cdot CO_2H$	X-465	212.20
6241	benzoic acid (2,4,5)	asaronic acid	$(CH_3O)_3C_6H_2 \cdot CO_2H$	X-468	212.20
6242	benzoic acid (3,4,5)	gallic acid trimethyl ether	$(CH_3O)_3C_6H_2 \cdot CO_2H$	X-481	212.20
6243	**Trimethyl**acetaldehyde	pivalic aldehyde	$(CH_3)_3C \cdot CHO$	I-688	86.13
6244	acetaldehyde oxime	....	$(CH_3)_3C \cdot CH:NOH$	*I-354	101.15
6245	acetic acid	pivalic acid	$(CH_3)_3C \cdot CO_2H$	II-319	102.13
6246	acetonitrile	*tert*-butyl cyanide	$(CH_3)_3C \cdot CN$	II-320	83.13
6247	acetophenone (2,4,6)	acetomesitylene	$(CH_3)_3C_6H_2 \cdot COCH_3$	VII-332	162.22
6248	amine	.....	$(CH_3)_3N$	IV-43	59.11
6249	amine HCl	.....	$(CH_3)_3N \cdot HCl$	IV-46	95.58
6250	aniline (2,4,5)	pseudocumidine	$(CH_3)_3C_6H_2 \cdot NH_2$	XII-1150	135.20
6251	aniline (2,4,6)	mesidine	$(CH_3)_3C_6H_2 \cdot NH_2$	XII-1160	135.20
6252	arsine	arsenic trimethyl	$(CH_3)_3As$	IV-600	120.01
6253	benzene (1,2,3)	hemimellitene	$(CH_3)_3C_6H_3$	V-399	120.19
6254	benzene (1,2,4)	pseudocumene	$(CH_3)_3C_6H_3$	V-400	120.19
6255	benzene (1,3,5)	mesitylene	$(CH_3)_3C_6H_3$	V-406	120.19
6256	benzoic acid (2,3,5)	*γ-iso*-durylic acid	$(CH_3)_3C_6H_2 \cdot CO_2H$	IX-552	164.20
6257	benzoic acid (2,3,4)	prehnitylic acid	$(CH_3)_3C_6H_2 \cdot CO_2H$	IX-552	164.20
6258	benzoic acid (2,3,6)	.....	$(CH_3)_3C_6H_2 \cdot CO_2H$	IX-552	164.20
6259	benzoic acid (2,4,5)	durylic acid	$(CH_3)_3C_6H_2 \cdot CO_2H$	IX-554	164.20
6260	benzoic acid (3,4,5)	*α-iso*-durylic acid	$(CH_3)_3C_6H_2 \cdot CO_2H$	IX-554	164.20
6261	benzoic acid (2,4,6)	*β-iso*-durylic acid	$(CH_3)_3C_6H_2 \cdot CO_2H$	IX-553	164.20
6262	borate	methyl borate	$(CH_3O)_3B$	I-287	103.92
6263	citrate	.....	$C_3H_5O(CO_2CH_3)_3$	III-567	234.20
6264	methoxy-propenyl ammonium bromide	esmodil	$(CH_3)_3N(Br) \cdot CH_2 \cdot C(:CH_2) \cdot OCH_3$	.....	210.12
6265	phenol (2,4,5)	pseudocumenol	$(CH_3)_3C_6H_2 \cdot OH$	VI-509	136.19
6266	phenol (2,4,6)	mesitol	$(CH_3)_3C_6H_2 \cdot OH$	VI-518	136.19
6267	phenyl ammonium iodide	.....	$(CH_3)_3C_6H_5N \cdot I$	XII-159	263.13
6268	phosphate	methyl phosphate	$(CH_3O)_3PO$	I-286	140.08
6269	phosphine	.....	$(CH_3)_3P$	IV-580	76.08
6270	quinoline (2,3,4)	.....	$(CH_3)_3C_9H_4N$	XX-414	171.23
6271	quinoline (2,3,6)	.....	$(CH_3)_3C_9H_4N$	XX-414	171.23
6272	quinoline (2,4,6)	.....	$(CH_3)_3C_9H_4N \cdot aq.$	XX-414	171.23
6273	quinoline (2,6,8)	.....	$(CH_3)_3C_9H_4N$	XX-415	171.23
6274	stibine	antimony trimethyl	$(CH_3)_3Sb$	IV-617	166.86
6275	thioacetamide	.....	$(CH_3)_3C \cdot CS \cdot NH_2$	.....	117.21
6276	urea	.....	$(CH_3)_2N \cdot CO \cdot NHCH_3$	IV-74	102.14
6277	**Trimethylene**acetal	.....	$CH_3 \cdot CH \cdot O(CH_2)_3 \cdot O$	.....	102.13
6278	bromohydrin	α-bromohydrin	$Br \cdot (CH_2)_3 \cdot OH$	I-356	139.00

Triiodo-methane 3887
Triisobutylene 6122
Trilaurin 3426
Trimellitic acid 684
Trimesic acid 685
Trimesitinic acid 5508
Trimethyl aluminum 231
Trimethyl bismuthine 856
Trimethyl boron 872
Trimethyl butene 3556
Trimethyl carbinol 1037
Trimethyl-cyclohexenone 5269
Trimethyl-ethylene 502
Trimethyl-gallic acid 6242
Trimethyl-glycine 846

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
6237	yel. octahed.	.....	95 d.	.....	v. s. CS_2; v. s. bz.	v. sl. s.	v. s.; sl. s. lg.
6238	nd./aq. al.	.....	157-8	d.	s. act.	2	s.
6239	pr./aq.	.....	239-40 d.; sl. d. 139	.....	s. h.	s. alk.	v. sl. s.
6240	cr./et.	.....	97-9	.....	s.	.....	.....
6241	nd./al.	.....	144	300±	s. h.	s.; s. lg.	s. bz.
6242	mn./aq.	.....	169-70	$225\text{-}7^{710mm}$	v. sl. s.	v. s.	v. s.; s. chl.
6243	lq.	$0.793^{17°}$	3	74-5	.....	.....	.....
6244	cr.	.....	41	65^{20mm}	.....	.....	.....
6245	nd.	$0.905^{50°}$	35.5	163.8	$2.1^{20°}$	v. s.	v. s.
6246	cr.	.....	15-6	105-6	.....	.....	.....
6247	lq.	$0.975^{\frac{20°}{4°}}$	.....	240.5^{735mm}	.....	.....	.....
6248	col. gas	$0.662^{-5°}$	−124	3.2-3.8	$41^{19°}$	s.	s.
6249	cr./al.	.....	271-8 d.	.....	s.	s.	i.
6250	nd./aq.	.....	66-8	234-5	$0.12^{19°}$	.....	.....
6251	lq.	0.963	.....	229-30	.....	.....	.....
6252	col. lq.	$1.124^{22°}$	.....	52.8	sl. s.	.....	.....
6253	col. lq.	$0.894^{\frac{20°}{4°}}$	−25.5	176.1	i.	s.	s.
6254	col. lq.	$0.876^{\frac{20°}{4°}}$	−44.1	169.3	i.	s.	s.; s. bz.
6255	col. lq.	$0.865^{\frac{20°}{4°}}$	−44.8(−52)	164.8	i.	s.; ∞ bz.	∞
6256	pl./lg.	.....	127	.....	.....	.....	.....
6257	pr./al.	.....	167.5	.....	.....	.....	.....
6258	nd./aq.	.....	105-6	.....	.....	.....	.....
6259	nd./bz.	.....	149-50	.....	v. sl. s. h.	v. s.	v. s.; s. bz.
6260	nd./aq.	.....	215-6	.....	v. sl. s. h.	s.	s.
6261	cr./al.	.....	152-5	.....	s. chl.	s.	s.
6262	lq.	$0.915^{20°}$	burns with green flame	72	d.	.....	.....
6263	tri.	.....	78-9	283-7 sl. d.	.....	.....	.....
6264	wh. cr. pd.	.....	169	.....	s.	s.	.....
6265	nd.	.....	71-2	231-4	v. sl. s. c.	v. s.	v. s.
6266	nd.	.....	72	221	v. sl. s.	v. s.	v. s.
6267	lf./al.	.....	228-30 d.	subl.	s.	$2^{80°}$	i. chl.
6268	lq.	$1.197^{\frac{19.5°}{0°}}$	.....	197.2	$100^{25°}$	s.	s.
6269	col. lq.	<1	.....	40-2	i.	.....	s.
6270	cr.	.....	65±	285	.....	.....	s.
6271	cr./lg.	.....	86-7	285	sl. s. bz.	s.	v. s.
6272	hyg. cr.	.....	63-4	277-8	sl. s.	sl. s.	v. s.
6273	mn./lg.	.....	46	260^{719mm}	i.	v. s.	v. s.
6274	col. lq.	$1.523^{15°}$	.....	80.6	v. sl. s.	s.	s.
6275	cr.	.....	114-6	.....	.....	.....	.....
6276	mn.	1.19	75.5	232.5^{765mm}	v. s.	v. s.	s.
6277	col. lq.	.....	.....	109-11	s.	s.	s.
6278	lq.	$1.571^{\frac{20°}{4°}}$	.....	$98\text{-}112^{185mm}$	16.6 c.	.....	.....

Trimethyl-glycocoll, cf. alkd.
Trimethyl-methane 1022
Trimethyl-pentane 4946
Trimethyl-phenylmethane 1052
Trimethyl-pyridine 1526
Trimethyl-trimethylene glycol 4332
Trimethyl-trithiane 5879-81
Trimethyl-vinyl-ammonium hydroxide 4584
Trimethyl-xanthine, cf. alkd.
Trimethylene 1621

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
	Trimethylene				
6279	chlorobromide	3-Cl-1-Br-propane	$Cl{\cdot}(CH_2)_3{\cdot}Br$	I-109	157.45
6280	chlorohydrin	α-chlorohydrin	$Cl{\cdot}(CH_2)_3{\cdot}OH$	I-356	94.54
6281	diacetate	.....	$CH_2(CH_2O_2C{\cdot}CH_3)_2$	II-143	160.17
6282	diamine	.....	$NH_2(CH_2)_3NH_2$	IV-261	74.13
6283	dibutyrate	.....	$CH_2(CH_2{\cdot}O_2C{\cdot}C_3H_7)_2$	.....	216.27
6284	dimercaptan	propandithiol-1,3	$HS{\cdot}(CH_2)_3{\cdot}SH$	I-476	108.21
6285	formal	1,3-dioxane	$CH_2{\cdot}O{\cdot}(CH_2)_3{\cdot}O$ (ring)	XIX-2	88.10
6286	glycol	propandiol-1,3	$HO{\cdot}(CH_2)_3{\cdot}OH$	I-475	76.09
6287	iodohydrin	α-iodohydrin	$I{\cdot}(CH_2)_3{\cdot}OH$	I-358	186.01
6288	**Trinitro**-acetonitrile	.....	$(NO_2)_3C{\cdot}CN$	II-229	176.05
6289	aniline (2,4,6)	picramide	$(NO_2)_3C_6H_2{\cdot}NH_2$	XII-763	228.12
6290	anisole (2,4,6)	methyl picrate	$(NO_2)_3C_6H_2{\cdot}OCH_3$	VI-288	243.13
6291	benzaldehyde (2,4,6)	.....	$(NO_2)_3C_6H_2{\cdot}CHO$	VII-265	241.12
6292	benzene (1,2,3)	(*vic*)	$(NO_2)_3C_6H_3$	*V-140	213.11
6293	benzene (1,3,5)	(*sym*)	$(NO_2)_3C_6H_3$	V-271	213.11
6294	benzene (1,2,4)	(*uns*)	$(NO_2)_3C_6H_3$	V-271	213.11
6295	benzoic acid (2,4,6)	.....	$(NO_2)_3C_6H_2{\cdot}CO_2H$	IX-417	257.12
6296	*tert*-butyltoluene (2,4,6;1,3)	artificial musk	$(NO_2)_3C_6H{:}(CH_3){\cdot}C(CH_3)_3$	V-439	283.24
6297	*tert*-butylxylene (2,4,6;1,3;5)	musk xylene	$(NO_2)_3C_6(CH_3)_2{\cdot}C(CH_3)_3$	V-448	297.26
6298	*m*-cresol	(2,4,6;1,3)	$(NO_2)_3C_6H(CH_3){\cdot}OH$	VI-387	243.13
6299	ethane (1,1,1)	.....	$CH_3{\cdot}C(NO_2)_3$	I-103	165.07
6300	methane	nitroform	$(NO_2)_3CH$	I-79	151.04
6301	naphthalene (1,2,5)	δ-trinitronaphthalene	$(NO_2)_3C_{10}H_5$	V-563	263.16
6302	naphthalene (1,3,5)	α-trinitronaphthalene	$(NO_2)_3C_{10}H_5$	V-563	263.16
6303	naphthalene (1,3,8)	β-trinitronaphthalene	$(NO_2)_3C_{10}H_5$	V-563	263.16
6304	naphthalene (1,4,5)	γ-trinitronaphthalene	$(NO_2)_3C_{10}H_5$	V-563	263.16
6305	α-naphthol (2,4,5)	naphthopicric acid	$(NO_2)_3C_{10}H_4{\cdot}OH$	VI-619	279.16
6306	orcinol	(2,4,6;1,3,5)	$(NO_2)_3C_6(OH)_3CH_3$	VI-890	259.13
6307	phenol (γ)	(2,3,6)	$(NO_2)_3C_6H_2{\cdot}OH$	VI-265	229.11
6308	phenol (β)	(2,4,5)	$(NO_2)_3C_6H_2{\cdot}OH$	VI-265	229.11
6309	phenol (2,3,5)	.....	$(NO_2)_3C_6H_2{\cdot}OH$	VI-264	229.11
6310	phenol (2,4,6)	picric acid	$(NO_2)_3C_6H_2{\cdot}OH$	VI-265	229.11
6311	phenylhydrazine	(2,4,6)	$(NO_2)_3C_6H_2{\cdot}N_2H_3$	XV-493	243.14
6312	resorcinol (2,4,6)	styphnic acid	$(NO_2)_3C_6H(OH)_2$	VI-830	245.11
6313	toluene (β)	(2,3,4)	$(NO_2)_3C_6H_2{\cdot}CH_3$	*V-172	227.13
6314	toluene (ε)	(2,3,5)	$(NO_2)_3C_6H_2{\cdot}CH_3$	*V-172	227.13
6315	toluene (γ)	(2,4,5)	$(NO_2)_3C_6H_2{\cdot}CH_3$	V-347	227.13
6316	toluene (α)	(2,4,6); TNT	$(NO_2)_3C_6H_2{\cdot}CH_3$	V-347	227.13
6317	toluene (δ)	(3,4,5)	$(NO_2)_3C_6H_2{\cdot}CH_3$	*V-173	227.13
6318	trimethyl benzene (2,4,6; 1,3,5)	*eso*-trinitro-mesitylene	$(NO_2)_3C_6(CH_3)_3$	V-412	255.19
6319	trimethyl benzene (4,5,6;1,2,3)	trinitro-hemi-mellitene	$(NO_2)_3C_6(CH_3)_3$	V-400	255.19
6320	trimethyl benzene (3,4,6;1,2,4)	*eso*-trinitro-pseudocumene	$(NO_2)_3C_6(CH_3)_3$	V-405	255.19

Trimethylene dibromide 1865
Trimethylene dicarboxylic acid 6425
Trimethylene dichloride 2052
Trimethylene dicyanide 3377
Trimethylene dilodide 2399
Trimethylene-glycol methylene ether 6285
Trimethylene-methylene dioxide 6285
Trimethylene oxide 5469
Trimethylene-trianiline 512
Trimethylene trisulfide 3309

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
6279	col. lq.	$1.63^{8°}$	.....	142-3	i.	.....	.....
6280	lq.	$1.131^{20°}_{4}$	.....	160-2	50 c.	s.	s.
6281	col. lq.	$1.070^{19°}$	.....	209-10	10	.....	.....
6282	col. lq.	$0.884^{25°}_{4}$	.....	135-6^{738mm}	.....	∞	∞
6283	col. lq.	.....	.....	125-30^{8mm}	i.	s.	s.
6284	oil	.....	.....	169-70	v. sl. s.	∞ ; ∞ chl.	∞ ; ∞ bz.
6285	col. lq.	$1.034^{20°}_{4}$	−42	105-6	∞	∞	∞
6286	oil	$1.060^{20°}_{4}$	.....	214	∞	∞	.....
6287	lq.	$1.998^{20°}_{4}$	.....	225^{748mm}	v. sl. s.	s.	s.
6288	waxy	.....	41.5	expl. 220	d.	d.	s.
6289	yel. mn.	.....	188-90	expl.	i.	sl. s.	s. h. act.
6290	col. mn.	$1.408^{20°}$	68.4	.....	s. bz.	s. ac.	.....
6291	pl./bz.	.....	119	.....	.....	.....	.....
6292	lt. gn./al.	.....	127.5	.....	i.	10 h.	.....
6293	col. rhb.	$1.688^{20°}_{4}$	121(61)	d.	0.04 c.	$1.9^{17.5°}$	$1.5^{17.5°}$
6294	col. cr.	$1.73^{16°}$	61-2	.....	.....	$5.5^{15.5°}$	$7.1^{15.5°}$
6295	rhb./aq.	.....	210-20 d.	.....	.....	.....	.....
6296	lt. yel./al.	.....	96-7	.....	i.	s.	s.; s. bz.
6297	nd./al.	.....	110	.....	i.	sl. s.	s.
6298	yel. nd./aq.	.....	109.5	expl. 150	$0.22^{20°}$; $0.81^{100°}$	v. s.	v. s.
6299	cr.	.....	56	.....	v. sl. s.	s.; sl. s. lg.	s.
6300	col. cr.	.....	15; expl.	45-7^{22mm}	s.	.....	.....
6301	nd./al.	.....	112-3	.....	.....	s.	.....
6302	rhb./chl.	.....	122-3	.....	s. ac.	s.	s. chl.
6303	cr./al.	.....	218-9	.....	i.	$*0.05^{23°}$	v. sl. s.
6304	yel./chl.	.....	154	.....	$1.1^{18°}$ bz.	$*0.11^{19°}$	$0.4^{19°}$
6305	yel. nd./aq.	.....	190	expl.	sl. s. h.	sl. s.	0.3 c. ac.
6306	yel. nd.	.....	162-3	expl.	s. h.	i. aq. a.	v. s. h. bz.
6307	wh. nd.	.....	117-8	.....	s. h.	v. s.	v. s.
6308	wh. nd./aq.	.....	96	.....	s. h.	v. s.	v. s.
6309	yel. nd./aq.	.....	119-20	.....	s. ac.	s.	s. bz.
6310	yel. rhb.	$1.763^{20°}_{4}$	121.8	expl. > 300	$1.23^{20°}$	$6.23^{20°}$ abs.	$1.08^{13°}$ abs.
6311	yel. nd./al.	.....	186	d.	i.; s. ac.	s. h.; i. bz.	i.; i. chl.
6312	yel./act.	1.829	180	.....	$0.6^{14°}$	v. s.	v. s.
6313	cr.	$1.620^{20°}_{4}$	112	expl. 290-310	i.	sl. s. c.	s.
6314	yel. rhb.	.....	97.2	d. 335	.....	s.	i.
6315	yel. pl/act.	$1.620^{20°}_{4}$	104	expl. 290	i.	s. h.	v. s.
6316	cr./al.	1.654	81-2	expl. 280	0.15 h.	$1.5^{22°}$	v. s.
6317	cr.	.....	137.5	d. 313	.....	$1^{15°}$	.....
6318	tri./al.	.....	232	expl. 415	sl. s. act.	sl. s. h.	sl. s. h.
6319	pl./al.	.....	209	.....	.....	.....	.....
6320	pr.	.....	185	.....	.....	v. sl. s. h.	v. s. h. bz.

* From 85% alcohol.

Trimyristin 3427
Trinitro-chlorobenzene 5308
Trinitro-cyanomethane 6288
Trinitro-hemimellitene 6319
Trinitro-mesitylene 6318
Trinitro-phenyl-methylnitramine 5873
Trinitro-pseudocumene 6320

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
6321	**Trinitro** triphenyl carbinol	(4,4′,4″)	$(NO_2{\cdot}C_6H_4)_3C{\cdot}OH$	VI-720	395.32
6322	triphenyl methane	(4,4′,4″)	$(NO_2{\cdot}C_6H_4)_3CH$	V-707	379.32
6323	*m*-xylene (4,5,6)	.....	$(NO_2)_3C_6H(CH_3)_2$	V-381	241.16
6324	*m*-xylene (2,4,6)	.....	$(NO_2)_3C_6H(CH_3)_2$	V-381	241.16
6325	*p*-xylene (2,3,6)	*eso*-tri-NO_2-*p*-xylene	$(NO_2)_3C_6H(CH_3)_2$	V-389	241.16
6326	**Trional**	Me-Et ketone di-Et sulfone	$(C_2H_5)(CH_3)C{:}(SO_2C_2H_5)_2$	I-671	242.34
6327	**Triphenyl** acetic acid	.....	$(C_6H_5)_3C{\cdot}CO_2H$	IX-712	288.33
6328	amine	.....	$(C_6H_5)_3N$	XII-181	245.31
6329	benzene (1,3,5)	.....	$(C_6H_5)_3C_6H_3$	V-737	306.38
6330	bromomethane	.....	$(C_6H_5)_3C{\cdot}Br$	V-704	323.23
6331	carbinol	tritanol	$(C_6H_5)_3C{\cdot}OH$	VI-713	260.32
6332	carbinol methyl ether	methyl-trityl ether	$(C_6H_5)_3C{\cdot}OCH_3$	VI-716	274.34
6333	chloromethane	.....	$(C_6H_5)_3C{\cdot}Cl$	V-700	278.77
6334	guanidine (α)	.....	$C_6H_5N{:}C(NHC_6H_5)_2$	XII-451	287.35
6335	guanidine (β)	.....	$HN{:}C(NHC_6H_5)N{:}(C_6H_5)_2$	XII-430	287.35
6336	hydrazine	.....	$(C_6H_5)_2N{\cdot}NHC_6H_5$	XV-125	260.32
6337	methane	tritane	$(C_6H_5)_3C{\cdot}H$	V-698	244.32
6338	methane *o*-carboxylic acid	.....	$(C_6H_5)_2CH{\cdot}C_6H_4{\cdot}CO_2H$	IX-714	288.33
6339	methyl	trityl	$(C_6H_5)_3C{\cdot}{\cdot}{\cdot}{\cdot}$	V-715	243.31
6340	methyl peroxide	.....	$[(C_6H_5)_3C{\cdot}O{\cdot}]_2$	VI-716	518.62
6341	phenyl phosphate	phenyl phosphate	$(C_6H_5O)_3PO$	VI-179	326.28
6342	phosphine	.....	$(C_6H_5)_3P$	XVI-759	262.28
6343	phosphite	phenyl phosphite	$(C_6H_5O)_3P$	VI-177	310.28
6344	rosaniline sulfate	Poirrier's blue	$(C_{38}H_{32}N_3)_2SO_4$	XIII-768	1157.38
6345	*p*-rosaniline trisulfonic Na	methyl blue; brilliant cotton blue	$C_{37}H_{27}O_9N_3S_3Na_2$	.....	799.78
6346	thiophosphate	.....	$(C_6H_5O)_3PS$	VI-181	342.34
6347	**Tri-*iso*-propanolamine**	.....	$N(CH_2{\cdot}CHOH{\cdot}CH_3)_3$	.....	191.27
6348	**Tripropylamine** (*n*)	.....	$(C_2H_5{\cdot}CH_2)_3N$	IV-139	143.27
6349	**Trithio**-carbonic acid	.....	$HS{\cdot}CS{\cdot}SH$	III-221	110.21
6350	phenyl phosphate	.....	$(C_6H_5S)_3PO$	VI-182	374.46
6351	**Tritolyl** phosphate (*o*)	tricresyl phosphate	$(CH_3{\cdot}C_6H_4{\cdot}O)_3PO$	VI-358	368.36
6352	phosphate (*m*)	tricresyl phosphate	$(CH_3{\cdot}C_6H_4{\cdot}O)_3PO$	.....	368.36
6353	phosphate (*p*)	tricresyl phosphate	$(CH_3{\cdot}C_6H_4{\cdot}O)_3PO$	VI-401	368.36
6354	phosphite (*m*)	tricresyl phosphite	$(CH_3{\cdot}C_6H_4{\cdot}O)_3P$	VI-381	352.36
6355	phosphite (*p*)	tricresyl phosphite	$(CH_3{\cdot}C_6H_4{\cdot}O)_3P$	VI-401	352.36
6356	thiophosphate (*o*)	tricresyl thiophosphate	$(CH_3{\cdot}C_6H_4{\cdot}O)_3PS$	*VI-173	384.42
6357	thiophosphate (*m*)	.....	$(CH_3{\cdot}C_6H_4{\cdot}O)_3PS$	*VI-203	384.42
6358	thiophosphate (*p*)	.....	$(CH_3{\cdot}C_6H_4{\cdot}O)_3PS$	*VI-203	384.42
6359	**Tritriacontane**	.....	$C_{33}H_{68}$	I-177	464.87
6360	**Tri-*o*-xenyl phosphate**	tri-*o*-phenylphenyl phosphate	$(C_6H_5{\cdot}C_6H_4{\cdot}O)_3PO$	.....	554.56
6361	**Tropic acid** (*dl*)	.....	$C_6H_5{\cdot}CH(CH_2OH){\cdot}CO_2H$	X-261	166.17
6362	**Truxene** (α)	tribenzylene benzene	$C_{27}H_{18}$	V-752	342.41

Triolein 3430
Trioxane 3289
Trioxy-methylene 3289
Trioxy-purine 6393
Tripalmitin 3431
Triphenyl antimony 563
Triphenyl-arsine 580
Triphenyl-bismuthine 857
Triphenyl-bismuthine dichloride 858
Triphenyl-carbinol-*o*-carboxylic anhyd. 5292

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
6321	mn. or rhb.	.....	193(167)	.....	s. bz.; s. ac.	sl. s. h.	sl. s.
6322	cr./bz.	.....	212.5	.....	v. sl. s. bz.	v. sl. s. ac.	.....
6323	pr./al.	$1.494^{19°}$	125	.....	i.	$1.2^{20°}$	sl. s.
6324	yel./al. bz.	$1.604^{19°}$	182	.....	i.	$0.04^{20°}$	sl. s.
6325	col. mn./al.	$1.59^{19°}$	139-40	expl. 410	.....	.....	.....
6326	pl./al.	.....	76	.....	$0.3^{15°}$	$5.8^{5°}$ abs.	$6.6^{15°}$
6327	mn.	.....	264-5 sl. d.	.....	sl. s.	s.	v. sl. s. bz.
6328	mn.	$0.774^{0°}_{0°}$	126.5	365	i.; s. act.	sl. s.	s.
6329	rhb.	1.205	170-1	.....	v. s. bz.	s. abs.	s.
6330	lt. yel. cr.	.....	152	230^{15mm}	d.	v. s. CS_2	v. s. bz.
6331	cr./bz.	$1.188^{20°}_{4°}$	162.5	>360	v. s. bz.	v. s.	v. s.
6332	tri./Me al.	.....	87-8	.....	.....	.....	.....
6333	col. cr.	.....	112-3	$230\text{-}5^{20mm}$	d.	v. s. CS_2	v. s. bz.
6334	rhb./al.	.....	144-5	d.	i.	$4.6^{0°}$ abs.	.....
6335	pl.	.....	131	.....	sl. s. bz.	s.	s.
6336	nd./bz. pet.	.....	142	.....	i.	s.	v. s. bz.
6337	cr.	$1.014^{99°}_{4°}$	93.4	$358\text{-}9^{754mm}$	i.; $44°$ bz.	v. s. h.	v. s.
6338	nd./al.	.....	162	subl.	i.	s.	s.
6339	col. cr.	.....	145-7	d.	i.	sl. s. h.	v. s. chl.
6340	cr./CS_2	.....	185-6	.....	i.	i.	i.
6341	pr./al.	.....	49-50	245^{11mm}	i.	$155^{25°}$	v. s.
6342	mn./et.	1.194	79	>360*	i.; s. HCl	sl. s.	v. s.; s. bz.
6343	lq.	$1.184^{18°}_{18°}$	.....	360	i.; s. chl.	s.; s. bz.	s.
6344	b. pd.	.....	.....	.....	.....	.....	.....
6345	b. pd.	.....	.....	.....	s.	.....	.....
6346	pr./al.	$**1.23^{20°}_{4°}$	52-3	>360 d.	i.; s. chl.	s.; s. bz.	s.; s. act.
6347	col. pl.	$1.020^{20°}$	35±	.....	s.	s.	s.
6348	col. lq.	$0.757^{20°}_{4°}$	-93.5	156.5	v. sl. s.	∞	∞
6349	red oil	> 1	d.20-30	.....	i. d.	s.	s.
6350	mn./et.	.....	114-5	.....	i.	s.	s.; s. chl.
6351	lq.	.....	.....	410 sl. d.	i.; s. bz.	v. s.	v. s.
6352	col. lq.	.....	.....	$273\text{-}5^{17mm}$	i.	s.	s.
6353	nd./aq.	.....	77-8	.....	v. s. bz.	v. s.	v. s.
6354	col. lq.	.....	.....	$235\text{-}8^{7mm}$	.....	.....	.....
6355	pa. yel. lq.	.....	.....	$236\text{-}9^{7mm}$	.....	.....	.....
6356	col. nd./al.	.....	45-6	.....	i.	sl. s.	v. s.
6357	rhb. cr.	.....	33-4	.....	i.	sl. s.	v. s.
6358	nd./al.	.....	93-4	.....	i.; v. s. bz.	v. s. chl.	sl. s. lg.
6359	cr.	lq. $0.780^{71.8°}$	71.8	328^{15mm}	.....	.....	.....
6360	col. rhb.	.....	112-3	.....	i.	$i.^{25°}$	$8^{25°}$ bz.; $1^{25°}$ CCl_4
6361	nd./aq.	.....	117-8	d.	$2^{15°}$; s. h.	s.; sl. s. bz.	s.; i. CS_2
6362	pl./xylene	.....	365-8	.....	i.; s. aniline	i.; s. $PhNO_2$	i.

*In hydrogen atm.
** Supercooled liquid.

Triphenyl-dihydroglyoxalin 233
Triphenyl-imidazole 3978
Triphenyl-imidazoline 233
Triphenyl-methyl chloride 6333
Triphenyl-oxazole 698
Triphenyl-stibine 563
Triphenyl-stibine dichloride 564
Triphenyl-tin dichloride 5948
Tripropin 3433
Tripropionin 3433
Triptane 3519
Triquinoyl 1604
Tristearin 3433

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
6363	**Tryptamine**	aminoethyl-indole (ω)(2)	$NH{\cdot}C_6H_4{\cdot}CH{:}C{\cdot}$ | $CH_2{\cdot}CH_2{\cdot}NH_2$ |	.....	160.21
6364	hydrochloride	.....	$C_{10}H_{12}N_2{\cdot}HCl$	.....	196.68
6365	**Tryptophane** (*l*)	β-indolyl-α-alanine	$C_6H_4{\cdot}NH{\cdot}CH{:}C{\cdot}$ | $C_2H_3(NH_2)CO_2H$ |	XXII-546	204.22
6366	**Tutocaine**	*p*-aminobenzoyl-dimethylamino-1,2-dimethyl propanol HCl	$NH_2{\cdot}C_6H_4{\cdot}CO_2CH{:}$ $(CH_3){\cdot}CH(CH_3){\cdot}$ $CH_2{\cdot}N(CH_3)_2{\cdot}HCl$	.....	286.80
6367	**Tyrosine** (*l*)	β-(*p*-hydroxy-phenyl)-alanine	$HO{\cdot}C_6H_4{\cdot}C_2H_3(NH_2){\cdot}$ CO_2H	XIV-605	181.19
6368	**Uliron**	4-(4′-aminophenyl-sulfonamido)-phenylsulfondi-methylamide	$NH_2{\cdot}C_6H_4{\cdot}SO_2{\cdot}NH{\cdot}$ $C_6H_4{\cdot}SO_2N(CH_3)_2$	.....	355.42
6369	**Umbelliferone**	7-hydroxy-coumarin	$HO{\cdot}C_6H_3{\cdot}CH{:}CH{\cdot}CO{\cdot}O$ |	XVIII-27	162.14
6370	**Undecane** (*n*)	.....	$CH_3{\cdot}(CH_2)_9{\cdot}CH_3$	I-170	156.30
6371	**Undecyl** alcohol (*n*)	undecanol-1	$CH_3(CH_2)_9CH_2OH$	I-427	172.30
6372	alcohol (*n*)(*sec*)	undecanol-2	$C_9H_{19}{\cdot}CHOH{\cdot}CH_3$	I-427	172.30
6373	**Undecylene** (α)	undecene-1	$CH_3(CH_2)_8CH{:}CH_2$	I-225	154.29
6374	**Undecylene** (β)	undecene-2	$C_8H_{17}{\cdot}CH{:}CH{\cdot}CH_3$	I-225	154.29
6375	alcohol	undecene-1-ol-11	$CH_2{:}CH(CH_2)_9{\cdot}OH$	I-452	170.29
6376	**Undecylenic acid**	10-hendecenoic acid	$CH_2{:}CH(CH_2)_8CO_2H$	II-458	184.27
6377	**Undecylic** acid	undecanoic acid	$CH_3{\cdot}(CH_2)_9{\cdot}CO_2H$	II-358	186.29
6378	aldehyde	undecanal	$CH_3{\cdot}(CH_2)_9{\cdot}CHO$	I-712	170.29
6379	aldehyde oxime	.....	$CH_3(CH_2)_9CH{:}NOH$	I-713	185.30
6380	amide	.....	$CH_3(CH_2)_9CO{\cdot}NH_2$	II-358	185.30
6381	nitrile	decyl cyanide	$CH_3{\cdot}(CH_2)_9{\cdot}CN$	II-358	167.29
6382	**Undecyne-1**	rutylidene	$CH_3{\cdot}(CH_2)_8{\cdot}C{:}CH$	I-261	152.27
6383	**Uracil** (2,4)	2,6-dioxy-pyrimidine	$CH{:}CH{\cdot}CO{\cdot}NH{\cdot}$ | $CO{\cdot}NH$ |	XXIV-312	112.09
6384	**Uramil**	5-amino-barbituric acid	$(CONH)_2COCH{\cdot}NH_2$ |	XXV-492	143.10
6385	**Uraminobenzoic acid** (o)	.....	$NH_2{\cdot}CO{\cdot}NH{\cdot}C_6H_4{\cdot}$ CO_2H	.....	180.16
6386	**Urea**	carbamide	$NH_2{\cdot}CO{\cdot}NH_2$	III-42	60.06
6387	calcium chloride	afenil	$CaCl_2{\cdot}4CH_4ON_2$	*III-26	351.23
6388	hydrochloride	.....	$CO(NH_2)_2{\cdot}HCl$	III-54	96.52
6389	nitrate	acidogen nitrate	$CO(NH_2)_2{\cdot}HNO_3$	III-54	123.07
6390	oxalate	.....	$2CH_4ON_2{\cdot}C_2H_2O_4$	III-55	210.15
6391	oxalate	.....	$2CH_4ON_2{\cdot}C_2H_2O_4{\cdot}$ $2H_2O$	III-55	246.18
6392	**Urethane**	ethyl carbamate	$NH_2{\cdot}CO_2{\cdot}C_2H_5$	III-22	89.09
6393	**Uric acid**	2,6,8-trioxy-purine	$C_5H_4O_3N_4$	XXVI-513	168.11
6394	**Usnic acid** (*d*)	.....	$C_{18}H_{16}O_7$	XIX-316	344.31
6395	**Usnic acid** (*dl*)	.....	$C_{18}H_{16}O_7$	XIX-316	344.31

Tritane 6337
Tritanol 6331
Trithio-formaldehyde 3309
Trithio-methylene 3309
Trityl 6339

Triuretdiamidine 396
Trivalerin 3434-5
Tropacocaine, cf. alkd.
Tropaeolin-G 4056
Tropeolin-D 4328

Tropeolin-O 2308
Tropeolin-OO 4996
Tropeolin-OOO 4995
Tropine, cf. alkd.
Tropine mandelate, cf. alkd.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
6363	cr.	.....	120	.....	.....	.....	.....
6364	col. cr.	.....	255-8	.....	s.	sl. s.	i.
6365	hex., rhb. nd.	.....	289	.....	sl. s. c.; v. s. h.	i.; i. alk.	i.; i. chl.
6366	col. cr. pd.	.....	212-5	.....	25	2.5	.....
6367	nd./aq.	$1.456^{20°}$	>290 d. *314 d.	.....	$0.04^{17°}$; $0.65^{100°}$	$0.01^{17°}$; s. alk.	i.; s. a.
6368	col. cr. pd.	.....	193-5	.....	sl. s.; v. s. alk.	s.	s. act.
6369	nd./aq.	.....	224-7	subl.	1 h.	s.; s. HCl	sl. s.; s. ac.
6370	col. lq.	$0.741^{20°}_{4°}$	-25.6	194.5	i.	∞	∞
6371	lq.	0.833	19	131^{15mm}	<0.02	s.	.....
6372	lq.	$0.827^{20°}_{4°}$	12	228-9	i.	s.	.....
6373	col. lq.	$0.763^{20°}_{4°}$	.....	188-90	i.	∞	∞
6374	lq.	$0.774^{15°}_{15°}$	.....	192-3	i.	∞	∞
6375	lq.	$0.860^{0°}_{4°}$	-4	245^{756mm}	.....	.....	.....
6376	cr.	$0.907^{24°}_{4°}$	24.5	295 d.	i.	s.	s.; s. chl.
6377	col. cr.	.....	29-30	228^{160mm}	i.	s.	s.
6378	lq.	$0.825^{23°}_{4°}$	-4	$116-7^{18mm}$	.....	.....	.....
6379	nd./Me al.	.....	72(61)	.....	.....	v. s.	v. s.
6380	col. cr.	.....	103	.....	.....	.....	.....
6381	col. lq.	.....	.....	253-4	.....	.....	.....
6382	lq.	$0.867^{25°}_{4°}$	-33	210-5	i.	s.	s.
6383	nd./aq.	.....	338 d.	.....	s. h.; s. NH_4OH	i.	i.
6384	nd.	.....	>400	.....	sl. s. h.; s. alk.	s. c. H_2SO_4	i.; s. NH_3
6385	nd.	.....	152	d. 171-2	d. h.	s.; s. Me al.	s. act.
6386	col. pr.	$1.335^{20°}_{4°}$	132.7	d.	$100^{17°}$; ∞ h.	$20^{20°}$	sl. s.
6387	wh. hyg. pd.	.....	158-60	.....	v. s.	sl. s.	.....
6388	wh. hyg. lf.	.....	d. 145	.....	s.	.....	.....
6389	col. mn. pr.	.....	152 d.	.....	v. s. h.	s.	i. HNO_3
6390	mn. pr.	.....	170-1	d.	$4.4^{16°}$	$1.6^{16°}$	i.
6391	.....	.....	d. > 120	$-H_2O$, 120	.....	.....	.....
6392	col. lf.	$1.11^{20°}_{20°}$	49-50	184	v. s.	v. s.	v. s.
6393	cr.	$1.893^{20°}$	d.	.....	0.06 h.	i.; s. aq. LiOH	i.
6394	cr.	.....	203	d.	i.	v. sl. s.	sl. s.
6395	yel. pr.	.....	195-6	.....	i.	v. sl. s. c.	$0.3^{20°}$

* Heated rapidly.

Trypaflavine 5328
Tryparsamide 583
Turicine, cf. alkd.
Tussol 568
Tylcalsin 116
Tyllithin 117
Tylnatrin 119
Tyramine 3799
Ulexine, cf. alkd.
Ultraquinine, cf. alkd.
Umbellic acid 2333
Undecanal 6378
Undecanoic acid 6377
Undecanol 6371-2
Undecanone 3107, 4324
Undecene 6373-4
Undecenol 6375
Undecyl cyanide 3956
Ural 1288

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
6396	**Uvinic acid**	2,5-diMe-furfurane-3-carboxylic acid	$(CH_3)_2C_4HO{\cdot}CO_2H$	XVIII-297	140.13
6397	**Uvitic acid** (5;1,3)	5-methyl-isophthalic acid	$CH_3{\cdot}C_6H_3(CO_2H)_2$	IX-864	180.15
6398	**Uvitonic acid** (2;4,6)	*o*-picoline-*o*,*p*-dicarboxylic acid	$CH_3{\cdot}C_5H_2N(CO_2H)_2$	XXII-161	181.14
6399	**Valeric** acid (*n*)	pentanoic acid	$C_2H_5{\cdot}CH_2{\cdot}CH_2{\cdot}CO_2H$	II-299	102.13
6400	aldehyde (*n*)	pentanal	$C_2H_5{\cdot}CH_2{\cdot}CH_2{\cdot}CHO$	I-676	86.13
6401	aldehyde oxime	.....	$C_4H_9{\cdot}CH{:}NOH$	I-676	101.15
6402	amide (*n*)	.....	$CH_3(CH_2)_3CONH_2$	II-301	101.15
6403	anhydride (*n*)	.....	$(C_4H_9CO)_2O$	II-301	185.24
6404	chloride (*n*)	*n*-valeryl chloride	$CH_3{\cdot}(CH_2)_3{\cdot}COCl$	II-301	120.58
6405	nitrile (*n*)	*n*-butyl cyanide	$CH_3(CH_2)_3{\cdot}CN$	II-301	83.13
6406	***iso*-Valeric** acid	*β*-Me-butyric acid	$(CH_3)_2CH{\cdot}CH_2{\cdot}CO_2H$	II-309	102.13
6407	aldehyde	2-methyl-butanal-4	$(CH_3)_2CH{\cdot}CH_2{\cdot}CHO$	I-684	86.13
6408	aldehyde oxime	.....	$C_4H_9{\cdot}CH{:}NOH$	I-686	101.15
6409	amide	.....	$C_4H_9{\cdot}CO{\cdot}NH_2$	II-315	101.15
6410	anhydride	.....	$(C_4H_9CO)_2O$	II-314	186.24
6411	anilide	.....	$C_4H_9{\cdot}CO{\cdot}NHC_6H_5$	XII-254	177.24
6412	chloride	*iso*-valeryl chloride	$(CH_3)_2CH{\cdot}CH_2COCl$	II-315	120.58
6413	nitrile	*iso*-butyl cyanide	$(CH_3)_2CH{\cdot}CH_2{\cdot}CN$	II-315	83.13
6414	**Valeryl diethylamide** (*iso*)	valyl	$(CH_3)_2CH{\cdot}CH_2{\cdot}CO{\cdot}N(C_2H_5)_2$	.....	157.25
6415	**Valylene**	.....	$CH_2{:}C(CH_3){\cdot}C{:}CH$	I-263	66.10
6416	**Vanillalacetone** (1;3,4)	ferulic methyl ketone	$CH_3{\cdot}CO{\cdot}CH{:}CH{\cdot}C_6H_3(OCH_3)OH$	VIII-291	192.21
6417	**Vanillic acid** (3;4,1)	4-OH-3-MeO-benzoic acid	$(CH_3OC_6H_3(OH){\cdot}CO_2H$	X-392	168.14
6418	**Vanillin** (3;4,1)	4-OH-3-MeO-benzaldehyde	$(CH_3O)C_6H_3(OH){\cdot}CHO$	VIII-247	152.14
6419	ethyl ether	4-EtO-3-MeO-benzaldehyde	$(CH_3O)C_6H_3{:}(OC_2H_5)CHO$	VIII-256	180.20
6420	*p*-phenetidine ethyl carboxylate	(4,1;1′,3′,4′); eupyrin	$C_2H_5O{\cdot}C_6H_4{\cdot}N{:}CH{\cdot}C_6H_3(OCH_3)O{\cdot}CO_2{\cdot}C_2H_5$	.....	343.37
6421	***iso*-Vanillin**	3-OH-4-MeO-benzaldehyde	$(CH_3O)C_6H_3(OH){\cdot}CHO$	VIII-254	152.14
6422	**Vanillyl alcohol**	4-OH-3-MeO-benzyl alcohol	$(CH_3O)C_6H_3(OH){\cdot}CH_2OH$	VI-1113	154.16
6423	**Veratric** acid	3,4-dimethoxy-benzoic acid	$(CH_3O)_2C_6H_3{\cdot}CO_2H$	X-393	182.17
6424	aldehyde (3,4;1)	vanillin methyl ether	$(CH_3O)_2C_6H_3{\cdot}CHO$	VIII-255	166.17
6425	**Vinaconic acid**	ethylene malonic acid	$CH_2{\cdot}CH_2{\cdot}C(CO_2H)_2$ (ring)	IX-722	130.10
6426	**Vinyl** acetate	.....	$CH_3CO_2{\cdot}CH{:}CH_2$	*II-63	86.09
6427	acetic acid	butenoic acid	$CH_2{:}CH{\cdot}CH_2{\cdot}CO_2H$	II-407	86.09
6428	acrylic acid (*β*)	.....	$CH_2{:}(CH)_2{:}CH{\cdot}CO_2H$	II-481	98.10
6429	alcohol	ethenol	$CH_2{:}CH{\cdot}OH$	I-601	44.05
6430	amine†	.....	$CH_2{:}CH{\cdot}NH_2$	IV-203	43.07
6431	anisole (*o*)	*o*-methoxy styrene	$CH_2{:}CH{\cdot}C_6H_4{\cdot}OCH_3$	VI-560	134.17
6432	anisole (*m*)	*m*-methoxy styrene	$CH_2{:}CH{\cdot}C_6H_4{\cdot}OCH_3$	VI-561	134.17
6433	anisole (*p*)	*p*-methoxy styrene	$CH_2{:}CH{\cdot}C_6H_4{\cdot}OCH_3$	VI-561	134.17
6434	bromide	bromo-ethylene	$CH_2{:}CH{\cdot}Br$	I-188	106.96

† This product is actually ethylene imine, $CH_2{\cdot}CH_2{\cdot}NH$.

Uraline 1288
Uralium 1288
Uranin 3251
Urazine 2851
Urea chloride 1229
Ureido-hydantoin, cf. alkd.
Ureous acid, cf. alkd.
Urotropine 3599
Uroxin 188
Ursin, cf. glcde.
Ursol-D 5260
Ursol-P 349
Vacciniin, cf. glcde.

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
6396	cr./aq.	.....	135	subl.	0.25 h.	s.	v. s.
6397	nd./aq.	.....	290-1	subl.	sl. s. h.	s.	s.
6398	cr. pd.	.....	274-82 d.	.....	i. c.; s. a.	s. h. aniline	v. sl. s. h. bz.
6399	col. lq.	$0.939^{\frac{20}{4}\circ}$	−34.5(−59)	187	$3.3^{16\circ}$	∞	∞
6400	lq.	$0.819^{11\circ}$	.....	103.4	v. sl. s.	s.	s.
6401	cr.	.....	52	.....	.....	.....	.....
6402	mn. pl.	1.023	106	.....	v. s.	v. s.	v. s.
6403	lq.	$0.922^{\frac{17}{4}\circ}$	.....	218^{754mm}	d. h.	.....	.....
6404	col. lq.	$1.016^{15\circ}$	.....	127-8	d.	d.	.....
6405	col. lq.	$0.957^{\frac{15}{4}\circ}$	.....	$141\text{-}2^{763mm}$	i.	s.	s.
6406	col. lq.	$0.931^{\frac{20}{20}\circ}$	−37.6	176	$4.2^{20\circ}$	∞ ; ∞ chl.	∞
6407	col. lq.	$0.803^{17\circ}$	−51	92.5	sl. s.	s.	s.
6408	oil	$0.893^{\frac{20}{4}\circ}$	.....	161.3^{759mm}	.....	.....	.....
6409	mn.	$0.965^{\frac{20}{4}\circ}$	135-7	232	s.	s.	s.
6410	col. lq.	$0.929^{\frac{27}{4}\circ}$	.....	215	.....	.....	.....
6411	nd./lg.	1.078	113-4	.....	sl. s. h.	s.	s.
6412	col. lq.	$0.989^{\frac{20}{4}\circ}$	.....	$114\text{-}5^{726mm}$	d.	d.	s.
6413	col. lq.	$0.807^{\frac{20}{20}\circ}$	.....	$126\text{-}8^{714mm}$	.....	.....	.....
6414	col. lq.	.....	.....	210	4	s.	s.
6415	col. lq.	.....	.....	50	.....	.....	.....
6416	yel. nd./ aq. al.	.....	129-30	.....	v. sl. s.	s.; s. conc. H_2SO_4	s.; s. bz.
6417	nd./aq.	.....	207	subl.	$0.12^{14\circ}$; $2.5^{100\circ}$	v. s.	v. s.
6418	mn.	1.056	81-2	285(in CO_2)	$1^{14\circ}$; $5^{75\circ}$	v. s.; v. s. chl.	v. s.; v. s. CS_2
6419	mn.	.....	64-5	subl.	v. sl. s. h.	s.	s.
6420	yel. cr.	.....	87-8	.....	sl. s.	s. h.	s.; s. chl.
6421	mn.	$1.196^{\frac{20}{4}\circ}$	115-7	subl. sl. d.	s. h.	s.; sl. s. CS_2	s.
6422	mn./aq.	.....	115	d.	v. s. h.	v. s.	v. s.
6423	cr./aq.*	.....	180-1	subl.	$0.05^{14\circ}$; $0.6^{100\circ}$	v. s.	v. s.
6424	nd./et.	.....	44-7	280-5	sl. s. h.	s.	s.
6425	tri./et.	.....	175	210^{30mm}	v. s.	s.	.....
6426	col. lq.**	$0.932^{\frac{20}{4}\circ}$	<−60	72-3	i.	s.	s.
6427	col. lq.	$1.013^{\frac{15}{15}\circ}$	−39	163	s.	∞	∞
6428	hyg. pr./ et.	.....	80	d. 110-5	s. h.	s.	s.; sl. s. pet.
6429	not known;	acetalde-	hyde	des-	motrope	.....	.....	.....
6430	lq.	0.832	.....	56	.....	s.	.....
6431	lq.	$1.005^{\frac{17.2}{4}\circ}$	.....	195-200	i.	s.	s.
6432	lq.	.....	.....	$89\text{-}90^{14mm}$	i.	s.	s.
6433	lq.	$1.000^{\frac{18}{4}\circ}$	.....	$204\text{-}5^{756mm}$	i.	s.	s.
6434	lq.	$1.529^{\frac{11}{4}\circ}$	−138	5.8	i.	∞	∞

* Crysts. + $1H_2O$ < 50°.
** Polymerizes in light.
Valamin 497
Valdivin, cf. glode.
Valerone 1901
Valerophenone 1117-8
Valeryl chloride 6404, 6412
Valerylene 5087
Validol 4032
Valine 391-5
Valisan 863
Valyl 6414
Valzin 5112
Vanillal 3188
Vanillin methyl ether 6424

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
6435	**Vinyl** chloride	chloro-ethylene	$CH_2:CH\cdot Cl$	I-186	62.50
6436	ether	.....	$(CH_2:CH)_2O$	I-433	70.09
6437	ethyl alcohol	allyl carbinol	$C_3H_5\cdot CH_2OH$	I-441	72.10
6438	ethyl ether	ethyl-vinyl ether	$CH_2:CH\cdot O\cdot C_2H_5$	I-433	72.10
6439	fluoride	fluoro ethylene	$CH_2:CH\cdot F$	I-186	46.04
6440	glycolic acid	.....	$CH_2:CH\cdot CHOH\cdot CO_2H$	III-370	102.09
6441	guaiacol (1;3,4)	hesperetole	$CH_2:CH\cdot C_6H_3(OH)\cdot(OCH_3)$	VI-954	150.17
6442	iodide	iodoethylene	$CH_2:CH\cdot I$	I-192	153.96
6443	phenol (*o*)	*o*-hydroxy styrene	$CH_2:CH\cdot C_6H_4\cdot OH$	VI-560	120.14
6444	phenol (*m*)	*m*-hydroxy styrene	$CH_2:CH\cdot C_6H_4\cdot OH$	VI-561	120.14
6445	**Violuric** acid	nitroso-barbituric acid	$CO\cdot(NHCO)_2\cdot C:NOH$	XXIV-506	157.09
6446	sodium salt	.....	$C_4H_2O_4N_3Na$	XXIV-507	179.08
6447	**Xanthene**	2,2'-methylene-diphenyl ether	$C_6H_4\cdot CH_2\cdot C_6H_4\cdot O$	XVII-73	182.21
6448	**Xanthic acid**	xanthogenic acid	$C_2H_5O\cdot CS\cdot SH$	III-209	122.20
6449	**Xanthine**†	2,6-dioxy-purine	$C_5H_4O_2N_4$	XXVI-447	152.11
6450	**Xanthogenamide**	Et-thioncarbamate	$C_2H_5O\cdot CS\cdot NH_2$	III-137	105.15
6451	**Xanthone**	benzophenone oxide	$OC:(C_6H_4)_2O$	XVII-354	196.19
6452	**Xanthophyll**	lutein	$C_{40}H_{56}O_2$	XXX-95	568.85
6453	**Xanthydrol**	9-OH-xanthene	$HOCH:(C_6H_4)_2O$	XVII-129	198.21
6454	**Xylene** (*o*)	1,2-dimethylbenzene	$C_6H_4(CH_3)_2$	V-362	106.16
6455	sulfonic acid	(1,2;4)	$(CH_3)_2C_6H_3\cdot SO_3H\cdot 2H_2O$	XI-121	222.25
6456	sulfonic Na	(1,2;4)	$(CH_3)_2C_6H_3\cdot SO_3Na\cdot 5H_2O$	XI-121	298.29
6457	**Xylene** (*m*)	1,3-dimethylbenzene	$C_6H_4(CH_3)_2$	V-370	106.16
6458	sulfonic acid	(1,3;4)	$(CH_3)_2C_6H_3\cdot SO_3H\cdot 2H_2O$	XI-123	222.25
6459	sulfonic Na	(1,3;4)	$(CH_3)_2C_6H_3\cdot SO_3Na\cdot H_2O$	XI-123	226.23
6460	sulfonic Ca	(1,3;4)	$[(CH_3)_2C_6H_3\cdot SO_3]_2Ca$	.....	410.50
6461	sulfonyl chloride	(1,3;4)	$(CH_3)_2C_6H_3\cdot SO_2Cl$	XI-123	204.67
6462	**Xylene** (*p*)	1,4-dimethylbenzene	$C_6H_4(CH_3)_2$	V-382	106.16
6463	sulfonic acid	(1,4;2)	$(CH_3)_2C_6H_3\cdot SO_3H\cdot 2H_2O$	XI-127	222.25
6464	sulfonic Na	(1,4;2)	$(CH_3)_2C_6H_3\cdot SO_3Na\cdot H_2O$	XI-127	226.23
6465	**Xylenol** (*vic*)(*o*)	2,3-dimethyl phenol	$(CH_3)_2C_6H_3\cdot OH$	VI-480	122.16
6466	**Xylenol** (*uns*)(*o*)	3,4-dimethyl phenol	$(CH_3)_2C_6H_3\cdot OH$	VI-480	122.16
6467	**Xylenol** (*sym*)(*m*)	3,5-dimethyl phenol	$(CH_3)_2C_6H_3\cdot OH$	VI-492	122.16
6468	**Xylenol** (*vic*)(*m*)	2,6-dimethyl phenol	$(CH_3)_2C_6H_3\cdot OH$	VI-485	122.16
6469	**Xylenol** (*uns*)(*m*)	2,4-dimethyl phenol	$(CH_3)_2C_6H_3\cdot OH$	VI-486	122.16
6470	**Xylenol** (*p*)	2,5-dimethyl phenol	$(CH_3)_2C_6H_3\cdot OH$	VI-494	122.16
6471	**Xylidine** (*vic*)(*o*)	2,3-dimethyl aniline	$(CH_3)_2C_6H_3\cdot NH_2$	XII-1101	121.18
6472	**Xylidine** (*uns*)(*o*)	3,4-dimethyl aniline	$(CH_3)_2C_6H_3\cdot NH_2$	XII-1103	121.18
6473	**Xylidine** (*sym*)(*m*)	3,5-dimethyl aniline	$(CH_3)_2C_6H_3\cdot NH_2$	XII-1131	121.18
6474	**Xylidine** (*vic*)(*m*)	2,6-dimethyl aniline	$(CH_3)_2C_6H_3\cdot NH_2$	XII-1107	121.18
6475	**Xylidine** (*uns*)(*m*)	2,4-dimethyl aniline	$(CH_3)_2C_6H_3\cdot NH_2$	XII-1111	121.18
6476	acetate	.....	$C_6H_{11}N\cdot HC_2H_3O_2$	.....	181.23
6477	**Xylidine** (*p*)	2,5-dimethyl aniline	$(CH_3)_2C_6H_3\cdot NH_2$	XII-1135	121.18

† See also Alkaloid table.

Vanirome 3188
Vasicine, cf. alkd.
Veratridine, cf. alkd.
Veratrine, cf. alkd.
Veratrole 2406
Veratroylaconine, cf. alkd.
Veritol 4117
Veronal 2124
Vesipyrin 120
Vicianin, cf. glode.
Vicine, cf. alkd.
Victoria yellow 4056
Vinetine, cf. alkd.
Vinopyrin 5110

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
6435	gas	$0.908^{\frac{25}{25}°}$	−160	−12	sl. s.	s.	v. s.
6436	col. lq.	$0.773^{\frac{20}{25}°}$	.....	28.3	v. sl. s.	∞	∞
6437	lq.	$0.838^{\frac{17.5°}{4}}$	.....	113.5^{748mm}	s.	.....	.....
6438	lq.	$0.763^{\frac{4}{17.5°}}$	.....	35.5	v. sl. s.	s.	.....
6439	col. gas	.....	.....	−51	i.	$400^{20°}$ cc.	$550^{20°}$ cc. act.
6440	hyg. nd.	.....	33-40	$129\text{-}30^{12mm}$	v. s.	s.	s.; i. CS_2
6441	cr.	.....	57	.....	sl. s.	s.	s.
6442	lq.	$2.08^{0°}$	.....	56	.....	.....	.....
6443	nd.	$1.061^{\frac{19.2°}{4}}$	29	108^{15mm}	s. alk.	s.	s.
6444	oil	.....	.....	$114\text{-}6^{17mm}$	.....	.....	.....
6445	rhb.	.....	224 d.	$-H_2O$, 100	s. h.	s.	.....
6446	lf./al.	.....	100.5	315	sl. s.	.....	.....
6447	lf./al.	.....	100.5	315	sl. s.; s. H_2SO_4	sl. s. c.	s.; s. bz.
6448	oil	>1	−53	d. 24	v. sl. s.	.....	.....
6449	pd.	.....	d. > 150	.....	$0.26^{17°}$	$0.03^{17°}$	s. KOH
6450	mn.	.....	40-1	.....	$2.3^{20°}$	∞	∞
6451	nd./al.	.....	173-4	$349\text{-}50^{730mm}$	sl. s. h.; s. chl.	0.7 c.; 8.5 h.	sl. s.; sl. s. lg.; s. bz.
6452	brn. red	.....	190-3	.....	i.; s. chl.	sl. s. h.	sl. s.
6453	col./aq. al.	.....	122-3 d.	.....	v. sl. s.	s.	s. chl.
6454	col. lq.	$0.881^{\frac{20°}{4}}$	−25	144	i.	∞ abs.	∞
6455	pl./aq. H_2SO_4	.....	d.	.....	s.	.....	.....
6456	pr.	.....	.....	.....	s.	.....	.....
6457	col. lq.	$0.867^{\frac{17°}{4}}$	−47.4	139.3	i.	∞ abs.	∞
6458	cr./aq. H_2SO_4	.....	63-4	.....	s.	.....	.....
6459	pl.	.....	.....	.....	s.	.....	.....
6460	col. cr.	.....	.....	.....	s.	i.	i.
6461	cr.	.....	34	$135\text{-}6^{11mm}$	d. h.	d. h.	.....
6462	pl.	$0.861^{\frac{20°}{4}}$	13.2	138.5	i.	s.	v. s.
6463	col. lf./aq.	.....	86	$149^{0.1mm}$	s.	s. chl.	.....
6464	mn.pr./aq.	$1.522^{15°}$	.....	.....	s.	.....	.....
6465	nd./aq.	.....	75	218	s.	s.	.....
6466	cr./10% al.	$1.023^{\frac{17°}{15}}$	62.5	225^{757mm}	sl. s.	s.	∞
6467	nd./aq.	.....	68	219.5	sl. s.	s.	.....
6468	lf.	.....	48-9	212	s. h.	s.	.....
6469	nd.	$1.036^{\frac{20°}{4}}$	25-6	211.5^{766mm}	.....	.....	.....
6470	mn.	.....	74.5	211.5-3.5	.....	.....	.....
6471	lq.	$0.991^{15°}$	<−15	223	v. sl. s.	s.	s.
6472	pr./lg.	$1.076^{17.5°}$	49-50	224-6	v. sl. s. c.	s. pet.	.....
6473	oil	$0.972^{\frac{20°}{4}}$	.....	221-2	.....	.....	.....
6474	lq.	$0.980^{15°}$	.....	216-7	.....	.....	.....
6475	lq.	$0.978^{\frac{19.8°}{4}}$	.....	213-4	v. sl. s.	.....	.....
6476	cr.	.....	68	.....	.....	.....	.....
6477	oil	$0.979^{\frac{21°}{4}}$	15.5	215^{739mm}	v. sl. s.	.....	.....

Vinous alcohol 2946
Vinyl-acetic nitrile 204
Vinyl-benzene 5646
Vinyl cyanide 151
Vinyl tribromide 6103
Vinyl trichloride 6152
Vinyl-trimethylammonium hydroxide 4584
Vioform 1392
Violutin, cf. glcde.
Violutiside, cf. glcde.
Viridine, cf. alkd.
Vitamin-A 1252-4, 1570
Vitamin-B1 5876
Vitamin-B2 5563

No.	Name	Synonym	Formula	Beil. Ref.	Formula Weight
6478	**Xylitol**	pentanpentol	$C_5H_{12}O_5$	I-531	152.15
6479	**Xylorcinol** (*m*)	4,6-diMe-resorcinol	$(CH_3)_2C_6H_2(OH)_2$	VI-912	138.16
6480	***l*-Xylose** (+)	wood sugar	$C_4H_9O_4{\cdot}CHO$	I-865	150.13
6481	**Xylyl** acetate (*p*)	*p*-tolubenzyl acetate	$CH_3C_6H_4CH_2{\cdot}O_2C{\cdot}CH_3$	VI-498	164.20
6482	amine (*o*)	*o*-tolubenzylamine	$CH_3{\cdot}C_6H_4{\cdot}CH_2{\cdot}NH_2$	XII-1106	121.18
6483	amine (*m*)	.....	$CH_3{\cdot}C_6H_4{\cdot}CH_2{\cdot}NH_2$	XII-1134	121.18
6484	amine (*p*)	.....	$CH_3{\cdot}C_6H_4{\cdot}CH_2{\cdot}NH_2$	XII-1141	121.18
6485	bromide (*o*)	*ω*-bromo-*o*-xylene	$CH_3{\cdot}C_6H_4{\cdot}CH_2{\cdot}Br$	V-365	185.07
6486	bromide (*m*)	*ω*-bromo-*m*-xylene	$CH_3{\cdot}C_6H_4{\cdot}CH_2{\cdot}Br$	V-374	185.07
6487	bromide (*p*)	*ω*-bromo-*p*-xylene	$CH_3{\cdot}C_6H_4{\cdot}CH_2{\cdot}Br$	V-385	185.07
6488	chloride† (*o*)	*ω*-chloro-*o*-xylene	$CH_3{\cdot}C_6H_4{\cdot}CH_2{\cdot}Cl$	V-364	140.61
6489	chloride (*m*)	.....	$CH_3{\cdot}C_6H_4{\cdot}CH_2{\cdot}Cl$	V-373	140.61
6490	chloride (*p*)	.....	$CH_3{\cdot}C_6H_4{\cdot}CH_2{\cdot}Cl$	V-384	140.61
6491	**Xylylene** dibromide (*o*)	*ω,ω'*-diBr-*o*-xylene	$C_6H_4(CH_2Br)_2$	V-366	263.98
6492	dibromide (*m*)	.....	$C_6H_4(CH_2Br)_2$	V-374	263.98
6493	dibromide (*p*)	.....	$C_6H_4(CH_2Br)_2$	V-385	263.98
6494	dichloride (*o*)	*ω,ω'* diCl-*o*-xylene	$C_6H_4(CH_2Cl)_2$	V-364	175.06
6495	dichloride (*m*)	.....	$C_6H_4(CH_2Cl)_2$	V-373	175.06
6496	dichloride (*p*)	.....	$C_6H_4(CH_2Cl)_2$	V-384	175.06
6497	glycol (*o*)	phthal alcohol	$C_6H_4(CH_2OH)_2$	VI-910	138.16
6498	glycol (*m*)	.....	$C_6H_4(CH_2OH)_2$	VI-914	138.16
6499	glycol (*p*)	.....	$C_6H_4(CH_2OH)_2$	VI-919	138.16
6500	**Xylyl** hydrazine	(2,4;1)	$(CH_3)_2C_6H_3{\cdot}NHNH_2$	XV-549	136.19
6501	hydrazine (2,5;1)	diMe-Ph-hydrazine	$(CH_3)_2C_6H_3{\cdot}NHNH_2$	XV-552	136.19
6502	hydrazine (2,6;1)	diMe-Ph-hydrazine	$(CH_3)_2C_6H_3{\cdot}NHNH_2$	XV-548	136.19
6503	**Zinc** diethyl	zinc ethide	$(C_2H_5)_2Zn$	IV-672	123.50
6504	dimethyl	dimethyl zinc	$(CH_3)_2Zn$	IV-671	95.45
6505	dipropyl (*n*)	*n*-dipropyl zinc	$(C_2H_5{\cdot}CH_2)_2Zn$	IV-675	151.55
6506	di-*iso*-propyl	.....	$[(CH_3)_2CH]_2Zn$	IV-675	151.55
6507	**Zingerone**	3-MeO-4-OH-benzylacetone	$HO(CH_3O)C_6H_3{\cdot}CH_2{\cdot}CH_2{\cdot}COCH_3$	*VIII-623	194.22

† See also Nos. 1474-6.

Vitamin-B6 5510
Vitamin-C 586
Vitamin-D2 1187
Vitamin-G 5563
Vitamin-H 853
Vitamin-K 4342
Vomicine, cf. alkd.
Waldivin, cf. glcde.
War gases 1247; 1303; 1473; 1985; 4697
"Weinsaure" 5691
Westrosol 6155
White damp 1239
White tar 4458
Wintergreen oil 4380
Wood alcohol 4100
Wood naphtha 4100
Wood spirit 4100
Wood sugar 6480
Wrightine, cf. alkd.
Wurstor's reagent 5840
Xanthaline, cf. alkd.
Xanthenol 6453
Xanthogenic acid 6448
Xanthopuccine, cf. alkd.
Xanthopurpurin 2298

No.	Crystalline Form and Color	Specific Gravity	Melting Point °C.	Boiling Point °C.	Solubility in 100 Parts		
					Water	Alcohol	Ether
6478	syrup	.....	.....	.....	s.	.....	.....
6479	lf./chl.	.....	124-5	276-9	v. s.	v. s.	v. s.
6480	nd.	1.535^{0}	153-4	.....	$117^{20°}$	v. sl. s. c.	i.
6481	lq.	.....	.....	227	.....	.....	.....
6482	oil	$0.977^{\frac{19}{0}°}$	0	205.6^{745mm}	.....	.....	.....
6483	oil	$0.965^{\frac{20}{0}°}$	.....	205^{750mm}	i.	s.	s.
6484	lq.	$0.952^{\frac{20}{0}°}$	12.6-13.2	204^{739mm}	v. sl. s.	.....	.....
6485	pr.	$1.381^{23°}$	21	223-4	i.	s.	s.
6486	col. lq.	$1.371^{23°}$	.....	212-5 sl. d.	i.	s.	s.
6487	nd./al.	1.324	35	$218\text{-}20^{740mm}$	i.	v. s. chl.	v. s. h.
6488	col. lq.	.....	.....	195-203	i.	∞ abs.	∞
6489	lq.	$1.064^{20°}$	.....	195-6	i.	∞ abs.	∞
6490	oil	.....	.....	200-2	i.	∞ abs.	∞
6491	rhb.	$1.988^{0°}$	94.5	d.	16.6 pet.	s.	20
6492	mn./chl.	$1.959^{0°}$	76-7	$135\text{-}40^{20mm}$	33 pet.	v. s. chl.	v. s.
6493	mn./bz.	$2.012^{0°}$	145-7	245	.....	v. s. h. chl.	$2.7^{20°}$
6494	mn.?	$1.393^{0°}$	55	239-41	v. s. chl.	v. s.	v. s.
6495	cr.	$1.302^{20°}$	34.2	250-5	i.	.....	.....
6496	mn.	$1.417^{0°}$	100.5	240-5 d.	i.	.....	.....
6497	pl./et.	.....	64.2-4.8	.....	$>25^{18°}$	$>25^{18°}$	$25^{18°}$
6498	cr./bz.	lq. $1.161^{18°}$	46-7	$154\text{-}9^{13mm}$	v. s.	.....	s.
6499	nd.	.....	115-6	.....	sl. s.	v. s.	v. s.
6500	nd./et.	.....	85	d.	v. sl. s.	v. s.	s.
6501	col. nd.	.....	78	.....	i.	s.	s.
6502	nd./pet.	.....	46 ±	.....	s. lg.	.....	.....
6503	col. lq.	$1.182^{18°}$	−28	118	d.	d.	.....
6504	col. lq.	$1.386^{11°}$	−40	46	d.	d.	.....
6505	col. lq.	.....	.....	158-60	d.	d.	.....
6506	col. lq.	.....	.....	$94\text{-}8^{40mm}$	d.	d.	.....
6507	col. cr./ et. pet.	.....	40-1	.....	sl. s.	s. dil. alk.	s.; sl. s. pet.

Xanthorhamnin, cf. glcde.
Xenene 2695; cf. also diphenyl.
Xenyl-, cf. diphenylyl-.
Xenyl carbimide 2714
Xenyl chloride 1373-5
Xenyl mustard oil 2755
Xylene musk 6297
Xylic acid 2459
Xylohydroquinone 2379
Xylol 6454, 6457, 6462
Xyloquinone 2549-51
Xylorcin 2380
Xylyl alcohol 6016-8
Xylylene-dicyanide 6051-3
Yageine, cf. alkd.
Yajeine, cf. alkd.
Yara yara 4312
Yellow-AB 661
Yellow-OB 5961
Yohimbine, cf. alkd.
Zingiberon 6507
Zygadenine, cf. alkd.

PHYSICAL CONSTANTS

Compiled by F. E. SHEIBLEY, Ph.D.

Names of the compounds in the table below are arranged alphabetically. No compound is listed more than once in the table and each compound is given a number.

Synonyms. At the bottom of each page is an alphabetical listing of names for compounds which are to be found in the main body of the table but under a different name; the number following the name refers to the numerical place of this compound in the table; thus, *acetyl-benzoyl-aconine 3* indicates that this compound is the 3d compound in the table where it will be found listed under the name *aconitine*.

Appearance. In addition to the crystalline form and color, the solvent used in purification is often given; thus, "rhomb./al." indicates that rhombic crystals were obtained when the compound was crystallized from alcohol.

Optical Properties are given in the column headed "[α]"; only the directions of the specific rotations have been indicated, since the factors affecting the determination of this property are too variable to come within the scope of the table.

Color Reactions with Sulfuric Acid, where available, have been included as an

Abbreviations used in the table

a., acid
abs., absolute
ac. a., acetic acid
act., acetone
al., alcohol
alk., alkali (i. e. aqueous NaOH or KOH)
am. al., amyl alcohol
amor., amorphous
anh., anhydrous
aq., aqueous; water
bl., blue
B. P., boiling point
br., brown
bz., benzene, C_6H_6
c., cold
chl., chloroform, $CHCl_3$
colorl., colorless
cryst., crystals or crystalline
d, dextro-rotatory
d., decomposes or decomposition
deliq., deliquescent
dil., dilute
dk., dark
diss., dissociates
effl., efflorescent
et., ether $(C_2H_5)_2O$
Et, ethyl (C_2H_5)
EtOAc, ethyl acetate
gly., glycerol
grn., green
h., hot
hex., hexagonal
hyg., hygroscopic
i., insoluble
in., inactive
l, levo-rotatory
leaf., leaflets or leaves

No.	Name	[α]	Formula	Appearance	Melting Point °C.
1	**Aconine**	*d*	$C_{25}H_{41}O_9N$	hyg., amor.	132
2	salts	*l*	.....	hyg.	.....
3	**Aconitine**	*d*	$C_{34}H_{47}O_{11}N$	rhomb. pr./chl.	204
4	hydrobromide	*l*	$C_{34}H_{47}O_{11}N \cdot HBr \cdot 2\frac{1}{2}H_2O$	hex. tab./aq.	sint. 160
5	hydrobromide	...	$C_{34}H_{47}O_{11}N \cdot HBr \cdot \frac{1}{2}H_2O$	need./al.	206–7
6	hydrochloride	*l*	$C_{34}H_{47}O_{11}N \cdot HCl \cdot 3H_2O$	cryst.	149; 170*
7	**Adenine**	...	$C_5H_5N_5$	need. + $3H_2O$/aq.	360–5 d. subl. 220
8	**Agmatine**	...	$HN{:}C(NH_2) \cdot NH \cdot (CH_2)_4NH_2$	.....	.....

* Melting point of the anhydrous compound.

aid in the making of rapid preliminary examinations.

Solubilities expressed by numbers are given in parts by weight of solvent required to dissolve one part of the alkaloid at a temperature of approximately 25°C. Because of the wide discrepancies existing between many of these figures as found in the literature no claim to accuracy can be made, and the values stated are perhaps best considered as upper limits.

References. The information given in the table has been collected mainly from the following sources:

Henry: **Plant Alkaloids,** 3d edition. Published by J. and A. Churchill, London (1939).

Merck's Index, 5th edition. Published by Merck and Co., Inc., Rahway, N. J. (1940).

Heilbron: **Dictionary of Organic Compounds.** Published by Oxford University Press, New York (1934).

Beilstein: **Handbuch der Organischen Chemie,** 3d edition.

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lig., ligroin
liq., liquid
lt., light
lustr., lustrous
Me, methyl (CH_3)
MeOH, methyl alcohol
met., metallic
mon., monoclinic
need., needles
octahedrl., octahedral
org., orange
orthorhomb., orthorhombic
pa., pale
pet., petroleum ether
powd., powder
pr., prisms
pyr., pyridine
r., red
rhomb., rhombic
s., soluble
sint., sinters
sl., slight or slightly
subl., sublimes
tab., tabular
tricl., triclinic
trim., trimetric
v., very
v. s., very soluble
v. sl. s., very slightly soluble
wh., white
yel., yellow
∞, soluble in all proportions; i.e., miscible
>, greater than

No.	Reaction with H_2SO_4	Solubility Expressed in Parts of Solvent Required to Dissolve 1 Part Alkaloid					
		Water	Alcohol	Ether	Chloroform	Benzene	Others
1	.....	v. s.	v. s.	i.	s.	.....	i. pet.
2	.....	.....	.....	.....	.....	.....	.....
3	colorl. when pure	3300	23	47	3	6.2	.....
4	.....	s.	s.	.....	.....	.....	.....
5	.....	.....	.....	.....	.....	.....	.....
6	.....	s.	s.	.....	.....	.....	.....
7	.....	1086 c.; 40 h.	sl. s. h.	i.	i.	s. a.	s. h. NH_4OH
8	.....	.....	.....	.....	.....	.....	.....

No.	Name	[α]	Formula	Appearance	Melting Point °C.
9	sulfate	...	$C_5H_{14}N_4 \cdot H_2SO_4$	colorl. cryst./aq. MeOH	226–9
10	**Allantoin†.**	*in*	$C_4H_6O_3N_4$	need./h. aq.	235–6
11	**Anabasine**	*l*	$C_{10}H_{14}N_2$	colorl. liq.	B.P. 276
12	**Anhalonine**	*l*	$C_{12}H_{15}O_3N$	wh. need.	85
13	**Apomorphine**	...	$C_{17}H_{17}O_2N$	pr. + $1Et_2O$/et.	170 d.
14	hydrochloride	*l*	$C_{17}H_{17}O_2N \cdot HCl \cdot \frac{1}{2}H_2O$	pr./aq.	.....
15	**Apoquinine**	*l*	$C_{19}H_{22}O_2N_2$	need./et.	180–90 d.
16	**Arecoline**	*in*	$C_8H_{13}O_2N$	very alkaline oil	B.P. 209
17	hydrobromide	*in*	$C_8H_{13}O_2N \cdot HBr$	pr./al.	169–71
18	hydrochloride	...	$C_8H_{13}O_2N \cdot HCl$	cryst.	158·
19	**Aspidospermine**	*l*	$C_{22}H_{30}O_2N_2$	need./al. or pet.	208
20	**Atisine**	*l*	$C_{22}H_{33}O_2N$	wh., amor.	indefinite
21	hydrochloride	*d*	$C_{22}H_{33}O_2N \cdot HCl$	prisms	296
22	**Atropine**	*in*	$C_{17}H_{23}O_3N$	colorl. pr.	118, subl.
23	sulfate	*in*	$(C_{17}H_{23}O_3N)_2 \cdot H_2SO_4 \cdot H_2O$	need.	194*
24	**Bebeerine,** α	*l*	$C_{18}H_{19}O_3N$	pr./MeOH	214
25	**Bebeerine,** β	*d*	$C_{18}H_{19}O_3N$	yel., amor.	142–50
26	hydrochloride	...	$C_{18}H_{19}O_3N \cdot HCl$	need. or scales	259–60
27	**Benzoylecgonine**	*l*	$C_{16}H_{19}O_4N \cdot 4H_2O$	lustr. need./aq.	90–2; 193–5*
28	**Berberine**	*in*	$C_{20}H_{19}O_5N \cdot 6H_2O$	red-yel. need./aq.	145d.
29	bisulfate	...	$C_{20}H_{17}O_4N \cdot H_2SO_4$	yel. need.	.....
30	chloroform	...	$C_{20}H_{19}O_5N \cdot CHCl_3$	tricl. tab./chl.	179
31	hydrochloride	...	$C_{20}H_{17}O_4N \cdot HCl \cdot 2H_2O$	org. need. or yel. powd.	.....
32	nitrate	...	$C_{20}H_{17}O_4N \cdot HNO_3$	yel. need.	.....
33	**Betaine†**	*in*	$C_5H_{11}O_2N \cdot H_2O$	sweet deliq. cryst.; anh. at 100°	293*
34	hydrochloride	...	$C_5H_{11}O_2N \cdot HCl$	mon. cryst.	227–8 d.
35	**Brucine**	*l*	$C_{23}H_{26}O_4N_2 \cdot 4H_2O$	mon. pr./al.	105; 178*
36	hydrochloride	...	$C_{23}H_{26}O_4N_2 \cdot HCl$	wh. need.	.....
37	nitrate	...	$C_{23}H_{26}O_4N_2 \cdot HNO_3 \cdot 2H_2O$	wh. pr.	230 d.*
38	sulfate	...	$(C_{23}H_{26}O_4N_2)_2 \cdot H_2SO_4 \cdot 7H_2O$	long need.	.....
39	**Caffeine**	*in*	$C_8H_{10}O_2N_4 \cdot H_2O$	need./al.; anh. 100°	235*; subl. 178
40	citrate (true)	...	$C_8H_{10}O_2N_4 \cdot C_6H_8O_7$	mon.	.....
41	hydrochloride	...	$C_8H_{10}O_2N_4 \cdot HCl \cdot 2H_2O$	mon.	d. 80–100
42	mercurichloride	...	$C_8H_{10}O_2N_4 \cdot HgCl_2$	colorl. need.	246
43	sulfate	...	$C_8H_{10}O_2N_4 \cdot H_2SO_4$	wh. need.	.....
44	triiodide	...	$C_8H_{10}O_2N_4I_2 \cdot HI \cdot 1\frac{1}{2}H_2O$	long grn. met. pr.	171
45	**Canadine**	*l*	$C_{20}H_{21}O_4N$	silky need./al.	133–4
46	**Carpaine**	*d*	$C_{14}H_{25}O_2N$	pr./al.	121
47	**Carpiline**	*d*	$C_{16}H_{18}O_3N_2$	wh. cryst.	187
48	**Cephaeline**	*l*	$C_{28}H_{38}O_4N_2$	fine need./et.	107–8; 120–30*

* Melting point of the anhydrous compound.
† See also listing in the table Physical Constants of Organic Compounds.

Amino-butyl-guanidine 8
2-Amino-6-hydroxy-purine 115
6-Amino-purine 7
Anhaline 121

No.	Reaction with H_2SO_4	Solubility Expressed in Parts of Solvent Required to Dissolve 1 Part Alkaloid					
		Water	Alcohol	Ether	Chloroform	Benzene	Others
9	.....	s.	v. sl. s.	.....	.....	.....	.....
10	.....	132 c.; 30 h.	5000 abs.	i.	.....	.....	s. NaOH
11	.....	s.	s.	s.	.....	s.	.....
12	.....	s.	s.	s.	s.	.....	.....
13	colorl.	sl. s.	s.	sl. s.	v. s.	sl. s.	s. alk.
14	.....	39.5	38.2	1864	sl. s.	.....	.....
15	fluorescent dil.	s. h.	s.	sl. s.	v. s.	v. s.	s. KOH
16	.....	s.	s.	s.	s.	.....	.....
17	.....	1	8 c.; 2 h.	sl. s.	sl. s.	.....	.....
18	.....	s.	s.	.....	.....	.....	.....
19	colorl.	6000	48	106	s.	s.	s. dil. a.
20	.....	sl. s.	s.	s.	s.	s.	s. dil. a.
21	.....	v. s.	v. s.	i.	.....	.....	.....
22	colorl.	300	1.46	16.6	1.56	s.	s. dil. a.
23	colorl.	0.38	3.7	2140	620	.....	.....
24	br.→r. h.	i.	sl. s.	sl. s.	s.	.....	s. a., act.
25	.....	i.	sl. s.	.....	s.	s.	s. dil. a.
26	.....	s.	s.	.....	.....	.....	.....
27	.....	s. h.	s.	i.	.....	s. dil. a.	s. alk.
28	grn.→yel.	22	100	v. sl. s.	sl. s.	sl. s.	unstable
29	.....	100; s. h.	sl. s.	.....	.....	.....	.....
30	.....	.....	.....	.....	.....	.....	.....
31	.....	400; s. h.	s. h.	i.	i.	.....	.....
32	.....	sl. s.	.....	.....	.....	.....	.....
33	.....	s.	s.	sl. s.	.....	.....	.....
34	.....	1.7	15	i.	i.	.....	.....
35	dk. yel. h.; HNO_3→r.	320 c.; 150 h.	1.1	133	7.5	88	i. alk.
36	.....	s.	s.	.....	.....	.....	.....
37	.....	s.	s.	.....	.....	.....	.....
38	.....	75 c.; 10 h.	84	.....	254	.....	.....
39	+$K_2Cr_2O_7$ →grn.	45.6	53.2	375 c.; 339 h.	8 c.; 6.4 h.	88 c.; 18.9 h.	s. EtOAc sl. s. pet.
40	.....	s. d.	s. d.	.....	.....	.....	.....
41	.....	s. d.	s. d.	.....	.....	.....	.....
42	.....	260	.....	.....	.....	.....	.....
43	.....	s. d.	s. d.	.....	.....	.....	.....
44	.....	i.	s.	.....	sl. s.	.....	.....
45	.....	i.	s.	v. s.	v. s.	v. s.	.....
46	.....	sl. s.	9	33	s.	5.5	s. dil. a.
47	.....	s. h.	.....	sl. s.	s.	s.	.....
48	.....	i.	s.	sl. s.	s.	s.	s. alk.; s. dil. a.

Aphrodine 244
Apocupreine 15
Aticine 20
Atroscine 129
Banisterine 118
Baptitoxine 92
Barytine 138
Benzoyl-pseudotropine 235

No.	Name	[α]	Formula	Appearance	Melting Point °C.
49	**Cevadine**	*d*	$C_{32}H_{49}O_9N \cdot 2C_2H_5OH$	rhomb.; becomes anh. 130–40	205*
50	**Chelerythrine**	*in*	$C_{21}H_{19}O_5N \cdot C_2H_5OH$	pr. leaf./al.	207
51	**Chelidonine**	*d*	$C_{20}H_{19}O_5N \cdot H_2O$	mon. tab./dil. HCl	135–6*
52	**Cinchonamine**	*d*	$C_{19}H_{24}ON_2$	orthorhomb.need./al.	185
53	**Cinchonidine**	*l*	$C_{19}H_{22}ON_2$	trim. pr./al.	210.5
54	hydrochloride	*l*	$C_{19}H_{22}ON_2 \cdot HCl \cdot 2H_2O$	pyramids or pr.	242*
55	sulfate	*l*	$(C_{19}H_{22}ON_2)_2 \cdot H_2SO_4 \cdot 3H_2O$	mon. pr.	240 d.*
56	**Cinchonine**	*d*	$C_{19}H_{22}ON_2$	rhomb. pr./al.	264
57	bisulfate	...	$C_{19}H_{22}ON_2 \cdot H_2SO_4 \cdot 4H_2O$	octahedrl.	.....
58	hydrochloride	*d*	$C_{19}H_{22}ON_2 \cdot HCl \cdot 2H_2O$	mon.	217–8 d.*
59	sulfate	*d*	$(C_{19}H_{22}ON_2)_2 \cdot H_2SO_4 \cdot 2H_2O$	rhomb.	198.5*
60	**Cinchotine**	*d*	$C_{19}H_{24}ON_2$	pr. or scales	268–9
61	**Cinnamylcocaine**	*l*	$C_{19}H_{23}O_4N$	need./bz.	121
62	**Cocaine**	*l*	$C_{17}H_{21}O_4N$	mon.pr./al.;need./aq.	98
63	chromate	...	$C_{17}H_{21}O_4N \cdot H_2CrO_4 \cdot H_2O$	org. yel. leaf.	127
64	hydrochloride	*l*	$C_{17}H_{21}O_4N \cdot HCl$	short pr./al.	195
65	**Cocl aurine**	*l*	$C_{17}H_{19}O_3N$	bitter need.	221
66	**Codamine**	...	$C_{20}H_{25}O_4N$	pr./al.	121
67	**Codeine**	*l*	$C_{18}H_{21}O_3N \cdot H_2O$	rhomb. pr./aq.	155*
68	hydrochloride	*l*	$C_{18}H_{21}O_3N \cdot HCl \cdot 2H_2O$	need., pr./aq.	280 d.
69	phosphate	*l*	$C_{18}H_{21}O_3N \cdot H_3PO_4 \cdot 2H_2O$	need. or pr.	235 d.
70	sulfate	*l*	$(C_{18}H_{21}O_3N)_2 \cdot H_2SO_4 \cdot 5H_2O$	rhomb. pr.	278 d.
71	**Colchicine**	*l*	$C_{22}H_{25}O_6N$	yel. varnish; yel. need./EtOAc	143–7*; 155–7
72	chloroform	...	$C_{22}H_{25}O_6N \cdot CHCl_3$	need./chl.	d. 60–70
73	**Columbamine**	...	$C_{20}H_{21}O_5N$	free base unknown	.....
74	chloride	...	$C_{20}H_{20}O_4NCl \cdot 2\frac{1}{2}H_2O$	yel. need.	194
75	chloride	...	$C_{20}H_{20}O_4NCl \cdot 4H_2O$	br. pr.	184
76	**Conessine**	*d*	$C_{24}H_{40}N_2$	leaf. or need./act.	123–5
77	**Conhydrine**	*d*	$C_8H_{17}ON$	wh. cryst./et.	121; B.P. 226
78	**Coniine**	*d*	$C_3H_7 \cdot C_5H_{10}N$	colorl. liq.	−2; B.P. 166–7
79	hydrochloride	*d*	$C_8H_{17}N \cdot HCl$	rhombs/aq.	220
80	picrate	...	$C_8H_{17}N \cdot C_6H_3O_7N_3$	yel. need./h. aq.	75
81	**Corybulbine**	*l*	$C_{21}H_{25}O_4N$	light-sensitive crysts.	238
82	**Corycavine**	*in*	$C_{21}H_{21}O_5N$	rhomb. tab./al.	218–9

* Melting point of the anhydrous compound.

Chinicine 193
Chinidine 195
Chinotine 195
Choline sinapate 215
α-Chondodendrine 24
Cicutine 78
Cinchovatine 53
Cinnamoylcocaine 61

No.	Reaction with H_2SO_4	Solubility Expressed in Parts of Solvent Required to Dissolve 1 Part Alkaloid					
		Water	Alcohol	Ether	Chloroform	Benzene	Others
49	yel.→r.	sl. s.	10	12	s.	.....	s. CS_2
50	grn.→yel.	i.	sl. s.	sl. s.	v. s.	s. dil. a.	sl. s. act.
51	crimson with guaiacum	i.	v. s.	v. s.	s.	.....	s. am. al.
52	.....	v. sl. s.	30	100	s. h.	s. h.	s. dil. a.
53	no fluorescence	5000	20	200	s.	.....	s. dil. a.
54	.....	20	s.	300	v. s.	.....	.....
55	.....	63 c.; 20 h.	72 c.; 32 h.	v. sl. s.	923	.....	.....
56	.....	3670	48 c.; 20 h.	370	165	.....	s. am. al.
57	.....	0.4	0.8	.....	.....	.....	.....
58	.....	22 c.; 3.5 h.	1 c.	275	22	.....	.....
59	.....	60 c.; 30 h.	10 c.; 6 h.	3230	70	.....	.....
60	.....	1300	sl. s.	534	v. sl. s.	.....	.....
61	.....	i.	s.	s.	s.	s.	.....
62	colorl.	600	5	2.5	1.1	s.	s. act.
63	.....	sl. s.	.....	.....	.....	.....	.....
64	.....	0.4	2.6	i.	19	.....	s. act.
65	.....	sl. s.	v. s. h.	sl. s.	sl. s.	i.	s. alk.; s. dil. a.
66	.....	s. h.	s.	s.	s.	s.	s. dil. a.
67	h.→bl.	120	1.6 c.; 1 h.	12.5	0.66	10.4	68 NH_4OH
68	.....	20 c.; 1 h.	145	.....	.....	.....	.....
69	.....	2.25	261	1310	6700	.....	.....
70	.....	30 c.; 6.3 h.	1200	i.	i.	.....	.....
71	yel.→r. h.	22	s.	157	s.	88	i. pet.
72	.....	d. h.	.....	.....	.....	.....	.....
73	.....	.....	.....	.....	.....	.....	.....
74	.....	s.	s.	.....	.....	.....	.....
75	.....	s.	s.	.....	.....	.....	.....
76	.....	v. sl. s.	s.	s.	s.	.....	.....
77	.....	sl. s.	s.	s.	s.	.....	.....
78	colorl.	100	v. s.	v. s.	sl. s.	s.	sl. s. CS_2
79	.....	2	s.	.....	s.	.....	.....
80	.....	.....	s.	s.	.....	.....	.....
81	.....	v. sl. s.	s. h.	v. sl. s.	s.	s.	.....
82	.....	i.	v. sl. s.	.....	s.	s. dil. a.	i. alk.

Cinnamoylecgonine methyl ester 61
Coffearin 234
Conchinine 195
Conicine 78
Conquinine 195
Conydrine 77
Cordianine 10
Cornutine 107

No.	Name	[α]	Formula	Appearance	Melting Point °C.
83	**Corydaline**	*d*	$C_{22}H_{27}O_4N$	colorl. pr./al.	135
84	**Corytuberine**	*d*	$C_{19}H_{21}O_4N$	silky need./et.	240
85	**Cotarnine**	...	$C_{12}H_{15}O_4N$	need./bz.	132–3 d.
86	hydrochloride	...	$C_{12}H_{14}O_3NCl \cdot 2H_2O$	pa. yel. silky need.	197 d.
87	phthalate	...	$(C_{12}H_{14}O_3N)_2 \cdot C_6H_4(CO_2)_2$	yel. cryst. or powd.	103
88	**Cryptopine**	*in*	$C_{21}H_{23}O_5N$	pr./al. or bz.	220–1
89	**Cupreine**	*l*	$C_{19}H_{22}O_2N_2 \cdot 2H_2O$	pr./et.	198*
90	**Cuscohygrine**	*in*	$C_{13}H_{24}ON_2$	oil	B.P. 215^{50}
91	hydrate	...	$C_{13}H_{24}ON_2 \cdot 3\frac{1}{2}H_2O$	need.	40–1; 120–30**
92	**Cytisine**	*l*	$C_{11}H_{14}ON_2$	large rhomb. cryst.	152–3
93	**Delphinine**	*d*	$C_{33}H_{45}O_9N$	plates/al.	198–200
94	hydrochloride	...	$C_{33}H_{45}O_9N \cdot HCl$	need./MeOH + et.	208–10
95	**Diacetylmorphine**	...	$C_{21}H_{23}O_5N$	bitter cryst./MeOH	172
96	hydrochloride	*l*	$C_{21}H_{23}O_5N \cdot HCl \cdot H_2O$	cryst. powd.	230 d.
97	**Dilaudid**	...	$C_{17}H_{19}O_3N \cdot HCl$	cryst. powd.	.....
98	**Dionin**		$C_{19}H_{23}O_3N \cdot HCl \cdot H_2O$	wh. cryst. powd.	123 d.; 170 d.*
99	**Ecgonine**	*l*	$C_9H_{15}O_3N \cdot H_2O$	mon. pr./al.	198; 205*
100	hydrochloride	*l*	$C_9H_{15}O_3N \cdot HCl$	rhomb. or tricl. tab.	246
101	**Emetine**	*l*	$C_{29}H_{40}O_4N_2$	plates/al. or et.	74
102	hydrochloride	*d*	$C_{29}H_{40}O_4N_2 \cdot 2HCl \cdot 7H_2O$	woolly need./h. aq.; thick pr./c. satd. soln.	235–55; dry, d.
103	**Ephedrine** ‡	*l*	$C_{10}H_{15}ON$	unctuous, colorl. cryst.	40; B.P. 255
104	hydrochloride	*l*	$C_{10}H_{15}ON \cdot HCl$	need.	216 d.
105	sulfate	*l*	$(C_{10}H_{15}ON)_2 \cdot H_2SO_4$	wh. odorless cryst.	245 d.
106	**Ergotinine**	*d*	$C_{35}H_{39}O_5N_5$	long need./al.	239 d.
107	**Ergotoxine**	*l*	$C_{35}H_{41}O_6N_5$	pr./bz.	190–200
108	**Evodiamine**	*d*	$C_{19}H_{17}ON_3$	yel. leaf./al.	278
109	hydrate	*in*	$C_{19}H_{19}O_2N_3$	rhomb. leaf.	146–7
110	**Gelsemine**	*d*	$C_{20}H_{22}O_2N_2$	wh. cryst.	178
111	acetone	...	$C_{20}H_{22}O_2N_2 \cdot (CH_3)_2CO$	pr./act.	−act. at 120
112	hydrochloride	*d*	$C_{20}H_{22}O_2N_2 \cdot HCl$	pr./aq. al. or aq.	300
113	**Glaucine**	*d*	$C_{21}H_{25}O_4N$	yel. rhomb. pr.	119–20
114	**Gnoscopine**	*in*	$C_{22}H_{23}O_7N$	long need./MeOH	232 d.
115	**Guanine**	*in*	$C_5H_5ON_5$	wh. cryst. powd.	>360 d.
116	**Guvacine**	...	$C_6H_9O_2N \cdot H_2O$	short rods/dil. al.	285 d.

* Melting point of the anhydrous compound.
** Becomes anhydrous at 120–30°.
‡ See also listing in table Physical Properties of Organic Compounds.

Corynine 244 Diamorphine 95
Cuskhygrine 90 Dihydromorphinone hydrochloride 97
Daturine 22 2,6-Dihydroxy-purine 243 1,3-Dimethyl-xanthine 233
Dehydromorphine 188 Dimethoxy-strychnine 35 3,7-Dimethyl-xanthine 232

No.	Reaction with H_2SO_4	Solubility Expressed in Parts of Solvent Required to Dissolve 1 Part Alkaloid					
		Water	Alcohol	Ether	Chloroform	Benzene	Others
83	.....	i.	s. h.	v. s.	v. s.	s.	i. alk.
84	.....	s. h.	s.	i.	i.	i.	.....
85	.....	s. h.	s.	s.	.....	s. dil. a.	s. NH_4OH
86	.....	1	4	.....	.....	.....	.....
87	.....	v. s.	.....	.....	.....	.....	.....
88	violet→grn.→yel.	v. sl. s.	100 h.	v. sl. s.	sl. s.	v. sl. s.	s. h. pyr.
89	dil.→no fluorescence	i.	s.	sl. s.	sl. s.	sl. s.	s. alk.; i. NH_4OH
90	.....	∞	s.	s.	.....	s.	.....
91	.....	s.	s.	s.†	.....	s.†	.....
92	.....	s.	s.	i.	s.	s.	i. pet.
93	+malic a. →org.→bl.	50,000	20	10	15	.....	.....
94	.....	.....	.....	.....	.....	.....	.....
95	.....	1700	24	70	2.2	s.	s. dil. a.; s. alk.
96	.....	2	s.	i.	i.	.....	.....
97	.....	s.	s.	i.	.....	.....	.....
98	.....	7	1.4	i.	i.	.....	.....
99	.....	4	50	l.	i.	i.	s. EtOAc
100	.....	s.	sl. s.	.....	.....	.....	.....
101	.....	1000	s.	s.	s.	sl. s.	.....
102	.....	4	s.	s.	.....	.....	.....
103	.....	20	0.2	s.	s.	.....	s. oils
104	.....	3	12	i.	.....	.....	.....
105	.....	1.2	76	i.	.....	.....	.....
106	with et.→org.→bl.	sl. s.	200 c.; 52 h.	1020	s.	77 h.	26 act.
107	ditto	i.	s.	sl. s.	s.	s. h.	s. NaOH
108	.....	i.	sl. s.	sl. s.	sl. s.	i.	i. dil. a.
109	.....	.....	.....	.....	.....	.....	.....
110	colorl.→yel. br.→yel. grn.	sl. s.	s.	s.	s.	s.	s. dil. a.
111	.....	.....	.....	.....	.....	.....	.....
112	.....	s.	sl. s.	.....	.....	.....	.....
113	colorl.→bl. in time	s. h.	v. s.	s.	v. s.	sl. s.	sl. s. pet.
114	.....	i.	1500	.....	s. h.	sl. s.	i. alk.
115	.....	i.	v. sl. s.	v. sl. s.	s. a.	v. sl. s. NH_4OH	s. KOH
116	.....	s.	.....	i.	.....	.....	.....

† With separation of droplets of water.

Eserine 174
Ethyl-morphine-HCl 98
Eudermol 163
Feraconitine 185
Fumarine 183
Gelseminine 110
Glyoxyl-diureide 10
Guaranine 39
Gynesin 234

No.	Name	[α]	Formula	Appearance	Melting Point °C.
117	**Harmaline**	*in*	$C_{13}H_{14}ON_2$	pr./al. + bz.	250 d.
118	**Harmine**	*in*	$C_{13}H_{12}ON_2$	rhomb. pr./al.	257–9 d.
119	**Hemoatropine**	...	$C_{16}H_{21}O_3N$	deliq. pr./et.	99–100
120	hydrobromide	...	$C_{16}H_{21}O_3N \cdot HBr$	rhomb.	217–8 d.
121	**Hordenine**	*in*	$C_{10}H_{15}ON$	orthorhomb. pr.	117.8; subl. 140–50
122	sulfate	...	$(C_{10}H_{15}ON)_2 \cdot H_2SO_4 \cdot 2H_2O$	colorl. cryst.	208–10*
123	**Hydrastine**	*l*	$C_{21}H_{21}O_6N$	colorl. rhomb. pr./al.	132
124	hydrochloride	*d*	$C_{21}H_{21}O_6N \cdot HCl$	hyg. powd.	116
125	**Hydrastinine**	*in*	$C_{11}H_{13}O_3N$	need./lig.	116–7
126	hydrochloride	*in*	$C_{11}H_{12}O_2NCl$	yel. need.	212 d.
127	**Hydrocotarnine**	*in*	$C_{12}H_{15}O_3N \cdot \frac{1}{2}H_2O$	mon. pr./al.	55–6
128	**Hydroquinine**	*l*	$C_{20}H_{26}O_2N_2 \cdot 2H_2O$	need./chl. or et.	172*
129	**Hyoscine**	*l*	$C_{17}H_{21}O_4N$	syrup or cryst./et.	59
130	hydrobromide	*l*	$C_{17}H_{21}O_4N \cdot HBr \cdot 3H_2O$	rhomb. tab. or need./aq.	194–7*
131	**Hyoscyamine**	*l*	$C_{17}H_{23}O_3N$	silky need./aq. al.	106–8
132	hydrobromide	*l*	$C_{17}H_{23}O_3N \cdot HBr$	deliq. pr.	152
133	hydrochloride	...	$C_{17}H_{23}O_3N \cdot HCl$	wh. cryst.	149–51
134	sulfate	*l*	$(C_{17}H_{23}O_3N)_2 \cdot H_2SO_4 \cdot 2H_2O$	need./al.	206*
135	**Hypaphorine**	*d*	$C_{14}H_{18}O_2N_2 \cdot 2H_2O$	large mon. cryst./aq.	255*
136	**Hypoxanthine**	*in*	$C_5H_4ON_4$	minute need.	d. 150
137	**Japaconitine**	*d*	$C_{34}H_{47}O_{11}N$	need./al., et. or chl.	202–9
138	**Jervine**	*l*	$C_{26}H_{37}O_3N \cdot 2H_2O$	long grouped pr.	238–42
139	**Laudanine**	*in*	$C_{20}H_{25}O_4N$	pr./aq. al.	166–7
140	**Laudanosine**	*d*	$C_{21}H_{27}O_4N$	need./bz.	90
141	**Lobeline**	*l*	$C_{22}H_{27}O_2N$	broad colorl. need.	130–1
142	hydrochloride	*l*	$C_{22}H_{27}O_2N \cdot HCl$	wh. granular powd.	180
143	**Lupanine**	*d*	$C_{15}H_{24}ON_2$	need./pet.; very alkaline	40
144	hydrochloride	*d*	$C_{15}H_{24}ON_2 \cdot HCl \cdot 2H_2O$	.....	127–8; 250–2*
145	**Lupinine**	*l*	$C_{10}H_{19}ON$	rhomb. cryst./pet.	69–71
146	hydrochloride	*l*	$C_{10}H_{19}ON \cdot HCl$	rhomb. pr./aq. al.	212–3
147	**Lycorine**	*l*	$C_{16}H_{17}O_4N$	colorl. pr./al.	280 d.
148	**Mezcaline**	*in*	$C_{11}H_{17}O_3N$	colorl. alk. oil or cryst.	B.P. 180^{12}; 35–6
149	**Morphine**	*l*	$C_{17}H_{19}O_3N \cdot H_2O$	trim. pr./al.	254 d.*
150	acetate	*l*	$C_{17}H_{19}O_3N \cdot CH_3CO_2H \cdot 3H_2O$	cryst. powd./al.	200 d.

* Melting point of the anhydrous compound.

Herapathite 207 Hydro-berberine 45 Hydroxy-coniine 77 *dl*-Hyoscyamine 22
Heroin 95 Hydro-cinchonine 60 6-Hydroxy-purine 136 Iodoquinine sulfate 207
Hydra-ergotocin 244 Hydroxy-cinchonine 89 Hydroxy-stachydrine 238 Laburnine 92

No.	Reaction with H_2SO_4	Solubility Expressed in Parts of Solvent Required to Dissolve 1 Part Alkaloid					
		Water	Alcohol	Ether	Chloroform	Benzene	Others
117	.....	v. sl. s.	s. h.	sl. s.	.....	.....	s. dil. a.
118	yel. with grn. fluorescence	v. sl. s.	sl. s.	sl. s.	s.	.....	s. dil. a.
119	.....	sl. s.	s.	s.	s.	s.	s. dil. a.
120	.....	6	32	i.	625	.....	.....
121	.....	s.	v. s.	v. s.	s.	sl. s.	s. dil. a.; s. alk.
122	.....	s.	sl. s.	i.	.....	.....	.....
123	olive grn. with $(NH_4)_2MoO_4$	i.	170	175	1.4	15	.....
124	.....	s.	s.	v. sl. s.	sl. s.	.....	.....
125	.....	s. h.	s.	s.	s.	d.	s. a.
126	.....	v. s.	v. s.	300	286	.....	.....
127	yel.→r.h.	i.	v. s.	v. s.	v. s.	v. s.	i. alk.
128	dil.→fluorescence	v. sl. s.	s.	s.	s.	s. act.; i. pet.	s. NH_4OH
129	h.→bl.	sl. s.	s.	s.	s.	sl. s.	sl. s. pet.
130	.....	1.5	16	i.	750	.....	.....
131	colorl.	281	s.	49	1.5	132	s. dil. a.
132	.....	v. s.	2.5	1610	1.7	.....	.....
133	.....	s.	s.	.....	.....	.....	.....
134	.....	0.5	4.5	v. sl. s.	v. sl. s.	.....	.....
135	.....	v. s.	v. s.	.....	.....	.....	i.
136	.....	1370 c.; $69.5^{100°}$	900 h.	i.	.....	s. a.	s. alk.
137	.....	i.	s.	s.	s.	.....	i. pet.
138	yel.→grn. h.	i.	s.	sl. s.	s.	sl. s.	s. act.
139	red	v. sl. s.	s.	600	v. s.	v. s.	s. alk. carb.
140	rose red→red violet 150°	i.	s.	19	s.	s. h.	i. alk.
141	red-br.	v. sl. s.; d. h.	s. h.	s.	s.	s.	v. sl. s. pet.
142	.....	40	10	.....	v. s.	.....	.....
143	.....	s.	s.	s.	s.	.....	.....
144	.....	.....	.....	.....	.....	.....	.....
145	.....	s.	s.	s.	s.	s.	sl. s. pet.
146	.....	s.	.....	.....	.....	.....	.....
147	$+MoO_3$→grn.→bl.	i.	sl. s.	sl. s.	sl. s.	sl. s. EtOAc	s. a.
148	yel.→violet	s.	s.	i.	s.	s.	i. pet.
149	pink→grn. h.→br.	3533 c.; 1075 h.	170 c.; 80 h.	4450	1525	9000	475 EtOAc
150	.....	2.25	17.3	i.	710	.....	6.5 gly.

Lupinidine 220
Lycine 34
Macleyine 183
Mescaline 148
Methoxy-cinchonine 199
Methyl-benzoyl-ecgonine 62
Methyl-granatonine 190
Methyl-hydrocupreine 128
Methyl-6-methoxy-7,8-methylenedioxy-tetra-hydro-isoquinoline 12
O-Methyl-morphine 67
N-Methyl-proline-methylbetaine 222
Methyl-theobromine 39

No.	Name	[a]	Formula	Appearance	Melting Point °C.
151	hydrochloride	*l*	$C_{17}H_{19}ON \cdot HCl \cdot 3H_2O$	silky need./aq.	200 d.
152	sulfate	*l*	$(C_{17}H_{19}O_3N)_2 \cdot H_2SO_4 \cdot 5H_2O$	silky or cubic cryst./aq.	250 d.*
153	**Muscarine**	*d*	$C_8H_{19}O_3N$	deliq. cryst.	.....
154	**Nandinine**	*d*	$C_{19}H_{19}O_4N$	leaf.	145–6
155	**Narceine**	*in*	$C_{23}H_{27}O_8N \cdot 3H_2O$	need. or pr./aq.	145*
156	bisulfate	...	$C_{23}H_{27}O_8N \cdot H_2SO_4 \cdot 10H_2O$	cryst. powd.	d.→yel.
157	hydrochloride	...	$C_{23}H_{27}O_8N \cdot HCl \cdot 3H_2O$	cryst./HCl	192*
158	**Narcotine**	*l*	$C_{22}H_{23}O_7N$	long need./h. al.	176
159	hydrochloride	...	$C_{22}H_{23}O_7N \cdot HCl \cdot H_2O$	lustrous cryst.	197–8
160	**Nicotine**	*l*	$C_{10}H_{14}N_2$	colorl. oil	B.P. 246[730]
161	hydrochloride	*d*	$C_{10}H_{14}N_2 \cdot 2HCl$	deliq. cryst.	.....
162	picrate	...	$C_{10}H_{14}N_2 \cdot 2C_6H_3O_7N_3$	yel. need. or pr./al.	218
163	salicylate	*d*	$C_{10}H_{14}N_2 \cdot C_7H_6O_3$	wh. plates	117–8
164	tartrate	*d*	$C_{10}H_{14}N_2 \cdot 2C_4H_6O_6 \cdot 2H_2O$	reddish-wh. cryst.	88–90
165	**Oxyacanthine**	*d*	$C_{38}H_{38}O_6N_2$	need./al. or et.	216–7
166	nitrate	...	$C_{38}H_{38}O_6N_2 \cdot 2HNO_3 \cdot 4H_2O$	need.	195–200
167	**Papaveraldine**	...	$C_{20}H_{19}O_5N$	cryst./bz. or pet.	210
168	**Papaverine**	*in*	$C_{20}H_{21}O_4N$	rhomb. pr. or need./al.-et.	147–8
169	hydrochloride	...	$C_{20}H_{21}O_4N \cdot HCl$	mon. pl./aq.	220–1 d.
170	**Paraconline**	*in*	$C_8H_{15}N$	yel. liq.	B.P. 168–70
171	**Pelletierine**	*in*	$C_8H_{15}ON$	colorl. oil	B.P. 106[21]; 195[760]
172	**Pellotine**	...	$C_{13}H_{19}O_3N$	plates/al.	110–2
173	hydrochloride	...	$C_{13}H_{19}O_3N \cdot HCl$	wh. cryst.	.....
174	**Physostigmine**	*l*	$C_{15}H_{21}O_2N_3$	hyg. cryst. (2 forms)	86–7; 105–6
175	**Pilocarpidine**	*d*	$C_{10}H_{14}O_2N_2$	viscid oil	.....
176	nitrate	*d*	$C_{10}H_{14}O_2N_2 \cdot HNO_3$	pr./aq.	137
177	**Pilocarpine**	*d*	$C_{11}H_{16}O_2N_2$	colorl. oil or need.	34
178	hydrochloride	*d*	$C_{11}H_{16}O_2N_2 \cdot HCl$	pr. or need.	204–5
179	nitrate	*d*	$C_{11}H_{16}O_2N_2 \cdot HNO_3$	pr./al. or aq.	176–8
180	**Piperine**	*in*	$C_{17}H_{19}O_3N$	mon. need./al.	129–30
181	periodide	...	$(C_{17}H_{19}O_3N)_2 \cdot HI \cdot I_2$	steel bl. need.	145
182	**Porphyroxine**	*l*	$C_{19}H_{23}O_4N$	pr./lig.	134–5
183	**Protopine**	*in*	$C_{20}H_{19}O_5N$	mon. cryst./al.	207–8
184	**Protoveratrine**	...	$C_{32}H_{51}O_{11}N$	rectangular tab.	245–50 d.
185	**Pseudoaconitine**	*d*	$C_{36}H_{51}O_{12}N$	rhombs/chl. + et.	212–4
186	**Pseudoephedrine**	*d*	$C_{10}H_{15}ON$	rhomb. tab./et.	118–9
187	hydrochloride	...	$C_{10}H_{15}ON \cdot HCl$	need.	176
188	**Pseudomorphine**	*l*	$C_{34}H_{36}O_6N_2 \cdot 3H_2O$	crusts or need.	d. 327

* Melting point of the anhydrous compound.

Napelline 3
Narcissine 147
Narcosine 158
dl-Narcotine 114
Nepaline 185
Neriine 76
Nor-arecaidine 116
Opianin 158
Opin 182
Oxy-dimorphine 188

No.	Reaction with H_2SO_4	Solubility Expressed in Parts of Solvent Required to Dissolve 1 Part Alkaloid					
		Water	Alcohol	Ether	Chloroform	Benzene	Others
151	.....	17.2 c.; 0.5 h.	42	i.	i.	.....	19 gly.
152	.....	15.3	452	i.	i.	.....	.....
153	.....	v. s.	v. s.	sl. s.	sl. s.	.....	d.a.; stable alk.
154	.....	sl. s.	s.	s.	s.	s.	s. dil. a.
155	br.→r. h.	769 c.; 220 h.	945 c.; s. h.	i.	v. sl. s.,	i.; s. alk.	s. NH_4OH; s. dil. a.
156	.....	s.→basic salt	s. h.	s.	s.	.....	.....
157	.....	s. h.	s. h.	.....	.....	.....	s. MeOH
158	yel. grn.→ r. h.	3300	100	166	3	22	s. h. alk.
159	.....	diss.	s.	.....	s.	.....	.....
160	colorl.	s.	∞	∞	∞	.....	s. pet.
161	.....	s.	s.	.....	.....	.....	.....
162	.....	.....	.....	.....	.....	.....	low solubility
163	.....	s.	s.	.....	.....	.....	.....
164	.....	v. s.	v. s.	.....	.....	.....	.....
165	colorl.	i.	s.	s.	s.	s.	s. dil. a.
166	.....	sl. s.	.....	.....	.....	.....	.....
167	.....	i.	sl. s.	sl. s.	s.	s.	s. a.; sl. s. pet.
168	colorl.→ rose r. h.	i.	45 c.; 4 h.	250	s. h.	s. h.	13 pyr.
169	.....	37	s.	i.	s.	.....	.....
170	.....	v. sl. s.	∞	∞	.....	.....	.....
171	grn. with $K_2Cr_2O_7$	20	s.	s.	s.	s.	.....
172	yel.→r. with HNO_3	v. sl. s.	s.	s.	s.	.....	sl. s. pet.
173	.....	s.	.....	.....	.....	.....	.....
174	colorl.→yel.	sl. s.	s.	s.	s.	s.	.....
175	.....	s.	s.	.....	s.	.....	.....
176	.....	2	82	.....	.....	.....	.....
177	colorl.	v. s.	v. s.	sl. s.	v. s.	v. sl. s.	i. pet.; s. alk.
178	.....	0.3	3	i.	545	.....	.....
179	.....	4	60	i.	i.	.....	.....
180	dk. r.→ br. blk.	sl. s.	12	26	2.6	s.	i. pet.
181	.....	.....	s.	.....	v. s.	.....	.....
182	red	sl. s.	s.	s.	s.	s.	s. dil. a.
183	yel.→ violet→grn.	i.; sl.s. act.	900	1000	15	v. sl. s.	sl. s. NH_4OH
184	grn.→bl.→ violet	i.	s. h.	sl. s.	s.	i.	i. pet.
185	.....	v. sl. s.	s.	sl. s.	s.	.....	*l* salts
186	.....	sl. s.	s.	s.	s.	.....	.....
187	.....	s.	s.	.....	.....	.....	.....
188	+sucrose→ dk. grn.→ br.	i.	i.	i.	i.	s. alk.	s. h. NH_4OH; s. pyr.

Oxy-neurine HCl 34
6-Oxy-purine 136
Paramorphine 228
Peganine 239
1-Phenyl-2-methylamino-propanol 103
Pilosine 47
Pitayine 195
Proline-betaine 222
2-Propyl-piperidine 78
Pseudocinchonine 60

No.	Name	[α]	Formula	Appearance	Melting Point °C.
189	hydrochloride	*l*	$C_{34}H_{36}O_6N_2 \cdot 2HCl \cdot 2H_2O$	cryst. powd.	.....
190	**Pseudopelletierine**	*in*	$C_9H_{15}ON$	anh. prism. tab.	48; B.P. 246
191	**Pseudotropine**	*in*	$C_8H_{15}ON$	tab. or pr./et.	108
192	**Pukateine**	*l*	$C_{18}H_{17}O_3N$	cryst./et.	200
193	**Quinicine**	*d*	$C_{20}H_{24}O_2N_2$	yel. oil; hardens on standing	(60)
194	oxalate	*d*	$(C_{20}H_{24}O_2N_2)_2 \cdot H_2C_2O_4 \cdot 9H_2O$	pr./chl. or need./al.	149
195	**Quinidine**	*d*	$C_{20}H_{24}O_2N_2$	pr. + al./al.; tab. + et./et.	174–5*
196	bisulfate	...	$C_{20}H_{24}O_2N_2 \cdot H_2SO_4 \cdot 4H_2O$	hair-like need. or pr.	.....
197	hydrochloride	*d*	$C_{20}H_{24}O_2N_2 \cdot HCl \cdot H_2O$	asbestos-like pr.	258–9 d.*
198	sulfate	*d*	$(C_{20}H_{24}O_2N_2)_2 \cdot H_2SO_4 \cdot 2H_2O$	pr. or need./h. aq.	.....
199	**Quinine**	*l*	$C_{20}H_{24}O_2N_2$	wh. need. or powd.	175
200	arsenate	...	$3(C_{20}H_{24}O_2N_2) \cdot 2H_3AsO_4 \cdot 5H_2O$	wh. effl. cryst.	.....
201	bisulfate	*l*	$C_{20}H_{24}O_2N_2 \cdot H_2SO_4 \cdot 7H_2O$	pr./aq. or al.	160 d.*
202	formate	*l*	$C_{20}H_{24}O_2N_2 \cdot HCO_2H$	cryst. powd.; need.	109 d.
203	hydrate	*l*	$C_{20}H_{24}O_2N_2 \cdot 3H_2O$	efflorescent; anh. at 100°	57
204	hydrobromide	...	$C_{20}H_{24}O_2N_2 \cdot HBr \cdot H_2O$	hyg., silky need.	152–200
205	hydrochloride	*l*	$C_{20}H_{24}O_2N_2 \cdot HCl \cdot 2H_2O$	effl., silky need.	158–60*
206	hydrochloride, di-	*l*	$C_{20}H_{24}O_2N_2 \cdot 2HCl$	wh. powd. or need.	180–5
207	iodosulfate	...	$4C_{20}H_{24}O_2N_2 \cdot 3H_2SO_4 \cdot 2HI \cdot I_4 \cdot 6H_2O$	pl./al.; r. or grn. by reflected or transmitted light	$-H_2O$, 100
208	salicylate	...	$C_{20}H_{24}O_2N_2 \cdot C_7H_6O_3 \cdot H_2O$	need./aq.	195
209	sulfate	*l*	$(C_{20}H_{24}O_2N_2)_2 \cdot H_2SO_4 \cdot 7H_2O$	efflorescent need.	235*
210	sulfate	*l*	$(C_{20}H_{24}O_2N_2)_2 \cdot H_2SO_4 \cdot 2H_2O$	by drying in air	205
211	valerate	...	$C_{20}H_{24}O_2N_2 \cdot C_5H_{10}O_2 \cdot H_2O$	cryst. powd.	95
212	**Rhoeadine**	...	$C_{21}H_{21}O_6N$	small pr. or need.	245–7 d.
213	**Ricinine**	...	$C_8H_8O_2N_2$	pr. or tab./al. or aq.	201, subl.
214	**Rutaecarpine**	...	$C_{18}H_{13}ON_3$	yel. pl.; need./EtOAc	260–2
215	**Sinapine**	...	$C_{16}H_{25}O_6N$	free base unknown	.....
216	bisulfate	...	$C_{16}H_{24}O_5NHSO_4 \cdot 3H_2O$	leaf./al.	127*
217	thiocyanate	...	$C_{16}H_{24}O_5NSCN \cdot H_2O$	pale yel. need./aq.	178
218	**Solanidine**	*l*	$C_{26}H_{41}ON$	need./et. or al.	219
219	**Solanine**	*l*	$C_{44}H_{71}O_{15}N$	slender need./al.	244–54 d.

* Melting point of the anhydrous compound.

Pseudo-punicine 190
Punicine 171
°yridyl-*N*-methyl-pyrrolidine 160
*-(3-Pyridyl)-piperidine 11
Quebrachine 244
α-Quinidine 53
β-Quinine 195

No.	Reaction with H_2SO_4	Solubility Expressed in Parts of Solvent Required to Dissolve 1 Part Alkaloid					
		Water	Alcohol	Ether	Chloroform	Benzene	Others
189	.....	70	.....	.....	.....	.....	.....
190	$+CrO_3\rightarrow$ grn.	s.	s.	s.	s.	.....	sl. s. pet.
191	.....	v. s.	v. s.	sl. s.	s.	.....	very alkaline
192	org.→r. and violet h.	i.	s.	161	s.	s. pyr.	s. alk
193	no fluorescence	v. sl. s.	s.	s.	s.	.....	.....
194	.....	s. h.	s.	.....	s.	.....	.....
195	dil.→bl. fluorescence	2000 c.; 800 h.	26	22	2.3	s.	sl. s. lig.
196	.....	8; fluorescence	.....	.....	.....	.....	.....
197	.....	60 c.; v. s. h.	s.	sl. s.	s.	.....	.....
198	.....	100 c.; 15 h.	8	v. sl. s.	15	i.	.....
199	colorl.→lt. yel.→br. h.	1750	0.6	22.6	1.9	166 c.; 30 h.	s. CS_2; s. NH_4OH
200	.....	650 c.; 120 h.	200 c.; 50 h.	.....	.....	.....	s. dil. a.
201	.....	fluorescence; 9	19	1770	920	.....	18 gly.
202	.....	19	s.	v. sl. s.	s.	.....	.....
203	.....	1560 c.; 800 h.	0.6	1.4	1.6	70	212 gly.
204	dil.→fluorescence	40 c.; 3 h.	1	23	1	.....	9 gly.
205	ditto	16 c.; 0.5 h.	0.6	340	1	.....	9 gly.
206	.....	0.6	5	v. sl. s.	7	.....	.....
207	.....	1000 h.	800 c.; 50 h.	.....	.....	.....	60 h. ac. a.
208	.....	1500	14	114	38	.....	18 gly.
209	dil.→fluorescence	725 c.; 30 h.	60	sl. s.	1000	.....	24 gly.
210	.....	810 c.; 30 h.	96	sl. s.	sl. s.	.....	.....
211	.....	70 c.; 40 h.	2	10	.....	.....	.....
212	purple r.	1200	700	800	v. sl. s.	i.	s. a., d.
213	.....	s. h.; i. pet.	sl. s. c.; s. h.	sl. s.	s.	sl. s.	forms no salts
214	bright yel.	i.	sl. s.	s.	s.	s.	.....
215	.....	.....	.....	.....	.....	.....	.....
216	.....	s.	s. h.	i.	.....	.....	.....
217	.....	sl. s.	sl. s.	.....	.....	.....	.....
218	.....	v. sl. s. h.	s. h.	sl. s.	s.	.....	.....
219	yel.→rose →r.	i.	s. h.	i.	i.	i.	.....

Quinoform 202
Quinotoxine 193
Rheadin 212
Ricidine 213
Sarcine 136
Scopolamine 129
Secaline 106
Sophorine 92

No.	Name	[α]	Formula	Appearance	Melting Point °C.
220	**Sparteine**	*l*	$C_{15}H_{26}N_2$	colorl. oil	B.P. 325^{754} in H_2
221	bisulfate	...	$C_{15}H_{26}N_2 \cdot H_2SO_4 \cdot 5H_2O$	transparent cryst.	150–2*
222	**Stachydrine**	...	$C_7H_{13}O_2N \cdot H_2O$	deliq. cryst.	235 d*
223	oxalate	...	$C_7H_{13}O_2N \cdot H_2C_2O_4$	need.	105–7
224	**Strychnine**	*l*	$C_{21}H_{22}O_2N_2$	colorl. rhombs/al.	286–8; B.P. 270^5
225	hydrochloride	...	$C_{21}H_{22}O_2N_2 \cdot HCl \cdot 2H_2O$	efflorescent pr.	.....
226	nitrate	*l*	$C_{21}H_{22}O_2N_2 \cdot HNO_3$	shining need.	.....
227	sulfate	...	$(C_{21}H_{22}O_2N_2)_2 \cdot H_2SO_4 \cdot 5H_2O$	effl., mon. pr.	200 d.*
228	**Thebaine**	*l*	$C_{19}H_{21}O_3N$	leaf. or pr./al.	193
229	hydrochloride	*l*	$C_{19}H_{21}O_3N \cdot HCl \cdot H_2O$	large rhombs or yel. powd.	.....
230	***iso*-Thebaine**	*d*	$C_{19}H_{21}O_3N$	rhomb./al. or et.	203–4
231	sulfate	...	$(C_{19}H_{21}O_3N)_2 \cdot H_2SO_4$	.....	120–1 d.
232	**Theobromine**	*in*	$C_7H_8O_2N_4$	minute rhomb. cryst.; mon./h. aq.	330†; subl. 290
233	**Theophylline**	*in*	$C_7H_8O_2N_4 \cdot H_2O$	mon. tab. or need./h. aq.	269–72
234	**Trigonelline**	...	$C_7H_7O_2N \cdot H_2O$	hyg. pr./al.	218 d.*
235	**Tropacocaine**	*in*	$C_{15}H_{19}O_2N$	need. or plates	49
236	hydrochloride	...	$C_{15}H_{19}O_2N \cdot HCl$	need.; pl./aq. al.	283 d.
237	**Tropine**	*in*	$C_8H_{15}ON$	hyg. tab./abs. et.	63
238	**Turicine**	*d*	$C_7H_{13}O_3N \cdot H_2O$	sweet, effl. pr. or need./aq. al.	260 d.*
239	**Vasicine**	*l*	$C_{11}H_{12}ON_2$	need./al.	211–2
240	**Veratridine**	*in*	$C_{36}H_{51}O_{11}N$	amor.; yel.	180
241	**Vicine**	*l*	$C_{10}H_{16}O_7N_4 \cdot 2H_2O$	need.	239–42
242	**Vomicine**	*d*	$C_{22}H_{24}O_4N_2$	need./aq. al.	278–80
243	**Xanthine**	*in*	$C_5H_4O_2N_4 \cdot H_2O$	small pl.; anh. at 125°	>150 d.
244	**Yohimbine**	*d*	$C_{21}H_{26}O_3N_2$	need./aq. al.	247–8
245	hydrochloride	*d*	$C_{21}H_{26}O_3N_2 \cdot HCl$	plates	302
246	nitrate	...	.....	colorl. pr.	276
247	thiocyanate	...	.....	rectangular pr./h. aq.	233–4
248	**Zygadenine**	*l*	$C_{39}H_{63}O_{10}N$	need./bz.	200–1

* Melting point of the anhydrous compound.
† Sealed tube.

Stypticin 86
Styptol 87
Telepathine 118
Tetraanhydro-berberine 45
Tetrahydro-nicotinic acid 116
Theine 39
Theocine 233
Trigenolline 234
Trimethyl-glycocoll 33
1,3,7-Trimethyl-xanthine 39
Tropine mandelate 119
Ulexine 92

No.	Reaction with H_2SO_4	Solubility Expressed in Parts of Solvent Required to Dissolve 1 Part Alkaloid					
		Water	Alcohol	Ether	Chloroform	Benzene	Others
220	colorl.	328	s.	s.	s.	i.	.....
221	colorl.	1.1	2.4	i.	i.	.....	.....
222	.....	s.	s.	i.	i.	s. dil. a.	d. in air
223	.....	.....	i. c.	.....	.....	.....	.....
224	colorl.	6400 c.; 3100 h.	110 c.; 28 h.	55	6	150	173 PhMe
225	.....	35	60	i.	.....	.....	i. HCl
226	.....	42 c.; 10 h.	120	i.	156	.....	60 gly.
227	.....	31 c.; 7 h.	65	i.	325	.....	7 gly.
228	blood r.	i.	10	135	19	18	i. alk.
229	.....	12	s.	.....	.....	.....	.....
230	.....	.....	s.	sl. s.	s.	.....	.....
231	.....	.....	.....	.....	.....	.....	.....
232	.....	2000 c.; 150 h.	1775 c.; 260 h.	3125 h.	157 c.; 100 h.	100,000	s. alk.; 4700 h. CCl_4
233	.....	120 c.; s. h.	64	sl. s.	164	s. alk.	s. NH_4OH
234	.....	v. s.	s.	v. sl. s.	v. sl. s.	i.	neutral reaction
235	.....	i.	s.	s.	v. s.	v. s.	s. dil. NH_4OH
236	.....	s.	sl. s.	.....	.....	.....	.....
237	.....	v. s.	v. s.	s.	s.	s.	.....
238	.....	v. s.	sl. s.	.....	.....	.....	.....
239	colorl.	sl. s.	s.	sl. s.	s.	sl. s.	i. pet.; s. dil. a.
240	yel.	s.	.....	sl. s.	.....	.....	.....
241	yel.	sl. s.	i. abs.	.....	.....	s. dil. a.	s. MeOH
242	$+CrO_3 \rightarrow$ deep r.	.....	s. h.	sl. s.	s.	.....	s. act.
243	.....	14,400 c.; 1500 h.	2400	3000	.....	.....	s. alk.; s. a.
244	colorl. $+ K_2Cr_2O_7 \rightarrow$ dirty grn.	v. sl. s.	s.	sl. s.	s.	s. h.	.....
245	.....	120	400	.....	.....	.....	.....
246	.....	.....	.....	.....	.....	.....	.....
247	.....	.....	.....	.....	.....	.....	.....
248	or. $\rightarrow$ cherry r.	.....	s.	.....	s.	s.	.....

Ultraquinine 89
5-Ureido-hydantoin 10
Ureous acid 243
Veratrine, a mixture of 49,240 *et al.*
Veratrine (crystallized) 49
Veratroylaconine 185
Vinetine 165
Viridine 138
Wrightine 76
Xanthaline 167
Xanthopuccine 45
Yageine 118
Yajeine 118

PHYSICAL CONSTANTS

Compiled by F. E. SHEIBLEY, Ph.D.

Names of the compounds in the table below are arranged alphabetically.

Appearance. In addition to the crystalline form and color, the solvent used in purification is often given; thus, "rhomb./al." indicates that rhombic crystals were obtained when the compound was crystallized from alcohol.

Optical Properties. These are indicated by the symbols *d*, *l*, or *in.* following the name. Most of the optically active glucosides are levo-rotatory.

Solubilities. Most glucosides are soluble in cold or hot water. The solubilities given for alcohol refer to the ordinary alcohol of approximately 95% concentration. Solubilities expressed by numbers are given in parts by weight of solvent required to dissolve one part of the glucoside. Because of discrepancies existing between many of these figures as found in the literature no claim to accuracy can be made,

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Abbreviations used in the table

a., acid
abs., absolute
ac., a., acetic acid
act., acetone
al., alcohol
alk., alkali (i. e. aqueous NaOH or KOH)
amor., amorphous
anh., anhydrous
aq., aqueous; water
br., brown
bz., benzene, C_6H_6
c., cold
Chl., chloroform, $CHCl_3$
colorl., colorless
conc., concentrated
cryst., crystals or crystalline
crystn., crystallization
d., decomposes or decomposition
d, dextro-rotatory
dil., dilute
et., ether $(C_2H_5)_2O$
EtOAc, ethyl acetate
h., hot
hyd., hydrate
hyg., hygroscopic

No.	Name	Formula	Appearance	Melting Point °C.
1	Absinthin	$C_{30}H_{40}O_8$	glossy need. or yel. amor. powd.	68
2	Aesculin (*l*)	$C_{15}H_{16}O_9 \cdot 2H_2O$	pr./aq. or dil. al.	205 d.
3	Amygdalin (*l*)	$C_{20}H_{27}O_{11}N \cdot 3H_2O$	orthorhomb. pr./aq.; glossy scales $(+2H_2O)$/ 80% al.	214–6*
4	Antiarin	$C_{27}H_{42}O_{10} \cdot 4H_2O$	plates/aq.	220–5
5	Apiin (*l*)	$C_{26}H_{28}O_{14} \cdot H_2O$	glossy need. or yel. cryst. powd.	228
6	Arbutin (*l*)	$C_{12}H_{16}O_7 \cdot H_2O$	long silky need./aq.	195–200*
7	Baptisin (*l*)	$C_{28}H_{30}O_{14} \cdot 3H_2O$	thin wh. need./al. slowly becomes anh.	sint. 150; m. 249–51
8	Bryonin (*d*)	$C_{34}H_{50}O_9$	amor. bright yel. powd.	softens 208
9	Carminic acid	$C_{22}H_{20}O_{13}$	purplish-br. mass or bright r. powd.; r. pr.	d. 136

* Melting point of the anhydrous compound.

Abietin 15
Acocantherin 51
Arthanitin 22
Asebotin 55
Aurantiin 49

OF GLUCOSIDES

and the numerical values stated are perhaps best considered as upper limits.

Hydrolytic Products. By hydrolysis glucosides are split into a sugar (generally glucose) or a mixture of sugars, and a principle characteristic of the glucoside. The hydrolysis is usually effected with hot dilute sulfuric acid or hydrochloric acid, and less often with emulsin or baryta water.

References. The information given in the table has been collected mainly from the following sources:—

J. J. L. van Rijn: **Die Glykoside.** Published by Borntraeger, Berlin (1900).
Merck's Index, 5th edition. Published by Merck and Co., Inc., Rahway, N. J.
Beilstein: **Handbuch der Organischen Chemie,** 3d edition.

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i., insoluble
in, inactive
K_2CO_3, aq. soln. of
KOH, aq. soln. of
l, levo-rotatory
leaf., leaflets or leaves
m-, meta
m., melts
m.p., M.P., melting point
mon., monoclinic
need., needles
org., orange
orthorhomb., orthorhombic
pet., petroleum ether
powd., powder
pr., prisms
pyr., pyridine
r., red
rhomb., rhombic
s., soluble
sint., sinters
sl., slight or slightly
v., very
wh., white
yel., yellow
>, greater than

No.	Solubility Expressed in Parts of Solvent Required to Dissolve 1 Part Glucoside					Hydrolytic Products		
	Water	Alcohol	Ether	Chloro-form	Others	Principle	M.P. °C.	Sugar
1	sl. s.	s.	s.	s.	s. bz.; s. NaOH	resinous substance	.....	glucose
2	576 c ; s. h.†	24 h.	sl. s.	s. h.	v. s. dil. alk.	aesculetin	270 d.	glucose
3	12 c.; v. s. h.	720 c.; 9 h.	i.	.....	.....	hydrocyanic acid benzaldehyde	−12 −26	glucose
4	s.	s.	sl. s.	.....	.....	antiarigenin	180	antiarose
5	sl. s. c.; s. h.	s. h.	i.	.....	.....	apigenin	subl. 292–5	glucose + apiose
6	8 c.; 1 h.	13	i.	i.	i. CS_2	hydroquinone	170.3	glucose
7	sl. s. c.; s. h.	sl. s. dil.	v. sl. s.	v. sl. s.	s. glacia. ac. a.	baptigenin	296–8	glucose + *rhamnose*
8	s.	s.	i.	i.	.....	bryogenin (resinous)	.....	glucose
9	s.	s.	v. sl. s.	i.	s. alk.; s. conc. H_2SO_4	carmine red	.....	sugar

† Aqueous solutions fluoresce faint blue.

Avenein 35
Avornin 30
6-Benzoyl-*d*-glucose 79
6-Benzoyl-salicin 59

No.	Name	Formula	Appearance	Melting Point °C.
10	Cerberin (*l*)	$C_{27}H_{40}O_8$	glossy cryst./et.	191–2
11	α-Chinovin (*d*)	$C_{30}H_{48}O_8$	rosettes of small need./al.	.....
12	β-Chinovin (*d*)	$C_{30}H_{48}O_8$	scales/dil. al.	235 d.
13	Clavicepsin (*d*)	$C_{18}H_{34}O_{16}\cdot H_2O$	wh. cryst.	91; 198*
14	Colocynthin	$C_{56}H_{84}O_{23}$	microscopic pr.	.....
15	Coniferin (*l*)	$C_{16}H_{22}O_8\cdot 2H_2O$	wh. pointed satiny need.	185
16	Convallamarin (*l*)	$C_{23}H_{44}O_{12}$, mixture	wh., cryst. powd.	.....
17	Convallarin (*l*)	$C_{34}H_{62}O_{11}$, mixture	rectangular pr.	.....
18	Convolvulin (*l*)	$C_{54}H_{96}O_{27}$	wh. amor. powd.	155–8
19	Coriamyrtin (*d*)	$C_{15}H_{18}O_5$	mon. pr.	228–30
20	Crocin	$C_{44}H_{64}O_{26}\cdot H_2O$	br. red cryst.	186 d.
21	Curangin (*d*)	$C_{48}H_{77}O_{20}$	amor.	172
22	Cyclamin (*l*)	$C_{27}H_{38}O_{13}$	wh. amor. powd.; microscopic cryst.	236
23	Daphnin (*l*)	$C_{15}H_{16}O_9\cdot 2H_2O$	pr. or need./aq.	215 d.
24	Datiscin (*l*)	$C_{27}H_{30}O_{15}\cdot 4H_2O$	glossy need. or pl./aq.	192
25	Digitalin	$C_{36}H_{56}O_{14}$	wh. cryst. powd.	229
26	Digitonin (*l*)	$C_{55}H_{90}O_{29}$	wh. cryst. powd.	sint. 225; d. 235
27	Digitoxin**	$C_{41}H_{64}O_{13}$	wh. leaf.	255–6*
28	Digitoxin hydrate	$C_{41}H_{64}O_{13}\cdot 6H_2O$	leaf./al.	145
29	Euxanthic acid	$C_{19}H_{16}O_{10}\cdot H_2O$	straw yel. need.	155–8 d.
30	Frangulin (*l*)	$C_{21}H_{20}O_9\cdot H_2O$	org. need./aq. pyr.	246–9
31	Fraxin	$C_{16}H_{18}O_{10}$	need./al.	205
32	Fustin	$C_{36}H_{26}O_{14}$	wh. glossy need./aq.	217 d.
33	Gaultherin (*l*)	$C_{14}H_{18}O_8\cdot H_2O$	need. or pr./al.	179–80
34	Glucogallin (*l*)	$C_{13}H_{16}O_{10}$	wh.-yel. cryst.	193 d.
35	Glycovanillin (*l*)	$C_{14}H_{18}O_8\cdot 2H_2O$	wh. need./dil. al.	192
36	Glycyphyllin	$C_{21}H_{24}O_9\cdot 3H_2O$	long, thin, glossy pr./et.	175–80 d.
37	Gratiolin	$C_{43}H_{70}O_{15}$	fine, glossy need.	235–7 d.
38	α-Hederin (*l*)	$C_{41}H_{64}O_{11}$	wh. need.	256–7
39	Helicin ‡ (*l*)	$C_{13}H_{16}O_7\cdot \frac{3}{4}H_2O$	fine, radiating need./aq.	175 *; —aq. 100
40	Helleborein (*l*)	$C_{37}H_{56}O_{18}$	warts of fine need./al.	270

* Melting point of the anhydrous compound.
** Crystalline digitalin.
‡ Does not occur naturally but is obtained by oxidizing salicin.

Cuspidatin 58
Datiscosid 24
Digitalin, crystalline 27
Digitin 26
Esculin 2
Esculinic acid 2

No.	Solubility Expressed in Parts of Solvent Required to Dissolve 1 Part Glucoside					Hydrolytic Products		
	Water	Alcohol	Ether	Chloro-form	Others	Principle	M.P. °C.	Sugar
10	sl. s.	12	sl. s.	9	sl. s. CCl_4	cerberetin	85.5	glucose
11	i.	s. dil.	v. sl. s.	v. sl. s.	s. alk.	chinovic acid	d. 295	chinovose
12	.....	v. s.‡	i.	.....	i. EtOAc	chinovic acid	d. 295	chinovose
13	s.	sl. s.	i.	i.	i. bz.	*d*-mannitol	166	glucose
14	s.	s. h.	i.	.....	.....	colocynthein (resinous)	.....	glucose
15	200 c.; v. s. h.	sl. s.	i.	.....	.....	coniferyl alcohol†	73–4	glucose
16	s.	s. dil.	sl. s.	i.	.....	convallamaretin	.....	sugar
17	sl. s.	s.	i.	.....	.....	convallaretin	.....	sugar
18	sl. s.	s.	i.	sl. s.	s. EtOAc	methylethyl-acetic and other acids	.....	glucose, rhodeose
19	sl. s. c.	s. h.	s.	s.	.....	indefinite	.....	sugar
20	sl. s. c.; s. h.	sl. s. abs.	i.	.....	.....	crocetin	285	gentiobiose
21	v. sl. s.	s.	sl. s.	.....	s. aq. act.	curangaegenin	132	rhamnose + a little glucose
22	sl. s.	57	i.	i.	i. bz.	cyclamiretin	198	fructose, cyclose
23	sl. s. c.; s. h.	v. s. h.	i.	.....	s. alk.	daphnetin	253–6 d.	glucose
24	s.	s.	i.	.....	.....	datiscetin	276	rhamnose
25	1000	12	sl. s.	sl. s.	s. MeOH	digitaligenin	210–2	glucose, digitalose
26	sl. s.	s.	v. sl. s.	v. sl. s.	s. MeOH	digitogenin	softens 250	glucose, galactose
27	v. sl. s.	s.	v. sl. s.	s.	.....	digitoxigenin	230	digitoxose
28	.....	.....	.....	.....	.....	.....	.....	.....
29	s. h.	s. h.	v. sl. s.	.....	s. alk.	euxanthone	240	glycuronic acid
30	i.	sl. s. h.	i.	s. alk.	s. h. bz.	frangula-emodin	256–7	rhamnose
31	sl. s. c.; s. h.	s. h.	i.	.....	§	fraxetin	227	glucose
32	v. s. h.	v. s.	sl. s.	.....	s. alk.	fisetin	>360	rhamnose
33	slowly s.	s.	v. sl. s.	v. sl. s.	v. sl. s. act.	methyl salicylate	−8.3	glucose
34	s.	s.	sl. s.	i.	s. alk.	gallic acid	235 d.	glucose
35	s.	sl. s.	i.	.....	.. ....	vanillin	80	glucose
36	s. h.	s.	s.	i.	i. bz.	phloretin	180	isodulcite
37	s. h.	s.	i.	.....	.....	gratiogenin	198	glucose
38	i.	s.	i.	.....	s. ac. a.	hederagenin	331	arabinose, rhamnose
39	60 c.; v. s. h.	s.	sl. s.	.....	.....	salicylaldehyde	−7	glucose
40	v. s.	sl. s.	i.	.....	.....	helleboretin	>200	glucose, arabinose, ac. a.

‡Heat evolved; forms penta-alcoholate, m.p. 70–80°, which separates.
†By the action of emulsin; heating with dilute acids gives resinous material.
§Solutions fluoresce blue.

Franguloside 30
Fraxinin 31
Glucosido-methyl salicylate 33
Glucosido-salicylaldehyde 39
Gratus strophanthin 51
Helixin 38

No.	Name	Formula	Appearance	Melting Point °C.
41	Helleborin	$C_{28}H_{36}O_6$	lustrous need.	>250
42	Hesperidin	$C_{28}H_{34}O_{15}$	wh., micro. need./aq. MeOH	251–2; d. 254
43	Indican	$C_{14}H_{17}O_6N \cdot 3H_2O$	need./aq.	57–8; 176–8 *
44	Iridin	$C_{24}H_{26}O_{13}$	wh. need.→yel. in air	208
45	Jalapin (*l*)	$C_{34}H_{56}O_{16}$	colorl. amor. mass	131–50
46	Linamarin (*l*)	$C_{10}H_{17}O_6N$	need.	142–3
47	Maclayin	$C_{17}H_{32}O_{10}$	deliquescent cryst.	158–65
48	Murrayin	$C_{18}H_{22}O_{10}$	microscopic need.	170
49	Naringin (*l*)	$C_{27}H_{32}O_{14} \cdot 8H_2O$	need/aq.	82
50	Ononin	$C_{25}H_{26}O_{11}$	small pr., need. or plates	210
51	Ouabain (*l*)	$C_{29}H_{44}O_{12} \cdot 7H_2O$	transparent plates	185 *
52	Parillin (*l*)	$C_{26}H_{44}O_{10} \cdot 2\frac{1}{2}H_2O$	fine plates	177
53	Periplocin (*d*)	$C_{30}H_{48}O_{12}$	long, thin need.	205
54	Phillyrin	$C_{27}H_{34}O_{11}$	need. or plates	162
55	Phloridzin (*l*)	$C_{21}H_{24}O_{10} \cdot 2H_2O$	small, wh., silky need.	108 **
56	Picein (*l*)	$C_{14}H_{18}O_7 \cdot H_2O$	need./aq.	194 *
57	Picrocrocin (*l*)	$C_{16}H_{26}O_7$	pr./et.-chl.-MeOH mixt.	154–6
58	Polygonin	$C_{21}H_{20}O_{10}$	glossy, yel. need.	202–3
59	Populin (*l*)	$C_{20}H_{22}O_8 \cdot 2H_2O$	wh. cryst. powd. or very fine need./aq.	180 *
60	Prulaurasin (*l*)	$C_{14}H_{17}O_6N$	bitter need.	120–2
61	Quercitrin	$C_{21}H_{20}O_{11} \cdot 2H_2O$	pale yel. need. or plates	182–5; 250–2 *
62	Robinin	$C_{32}H_{40}O_{19} \cdot 7\frac{1}{2}H_2O$	yellowish need./aq.	195 *
63	Ruberythric acid	$C_{25}H_{26}O_{13}$	small, citron yel. need.; yel. pr./aq.	258–60
64	Rubiadin glucoside	$C_{21}H_{20}O_9$	yel. need./glacial ac. a.	270 d.
65	Rutin	$C_{27}H_{30}O_{16} \cdot 2H_2O$	bright yel. need./aq.	188–90
66	Salicin (*l*)	$C_{13}H_{18}O_7$	glossy need., plates or rhomb. pr./aq.	199–201, then remelts 230–40
67	Saponin	$C_{32}H_{52}O_{17}$	wh. amor. powd.	d. 195
68	Saporubrin (*l*)	$(C_{18}H_{28}O_{10})_4$	wh. amor. powd.	.....
69	Sapotoxin	$C_{17}H_{26}O_{10}$	wh. amor. powd.	.....
70	Sarsasaponin (*l*)	$C_{44}H_{76}O_{20} \cdot 7H_2O$	long need./al.	sint. 200; m. 248

* Melting point of the anhydrous compound.
** Melts at 108°, then solidifies at 130° and remelts at 170–1 d.

iso-Hesperidin 49
Indoxyl-β-glucoside 43
Kalmin 55
Laricin 15
Lilacin 74
Macleyin 47
dl-Mandelonitrile-glucoside 60
Melin 65
Methoxy-coniferin 74
Monotropitoside 33
Orizabin 45
Paviin 31

No.	Solubility Expressed in Parts of Solvent Required to Dissolve 1 Part Glucoside					Hydrolytic Products		
	Water	Alcohol	Ether	Chloroform	Others	Principle	M.P. °C.	Sugar
41	i.	sl. s.	sl. s.	s.	.....	helleborein	d. >140	glucose
42	v. sl. s.	sl. s.	i.	i.	v. s. dil. alk.	hesperetin	226	glucose, rhamnose
43	v. s.	v. s.	sl. s.	sl. s.	sl. s. bz.	indigo	390–2 d.	glucose
44	v. sl. s.	s. h.	i.	i.	sl. s. act.	irigenin	186	glucose
45	sl. s	s.	s. h.	s.	d. alk.	jalapinolic acid	67–9	sugars
46	v. s.	sl. s.	sl. s.	sl. s.	s. h. act.	hydrocyanic acid	−12	glucose, act.
47	.....	sl. s.	i.	i.	.....	maclayetin	209–10	glucose
48	s. h.	s.	i.	.....	s. alk.	murrayetin	110	glucose
49	sl. s. c.; s. h.	v. s.	i.	i.	v. s. h. ac. a.	naringenin	251	glucose, rhamnose
50	sl. s. h.	s. h.	i.	.....	s. h. KOH	formononetin	265	glucose
51	100 c.; 5 h.	20 c.; 8 h.	i.	i.	i. EtOAc	acocanthic acid lactone	.....	rhamnose
52	v. sl. s. c.; 20 h.	s.	i.	s.	i. pet.	parigenin	.....	sugars
53	125 c.	s.	v. sl. s.	v. sl. s.	i. bz.	periplogenin	185	glucose
54	s. h.	s.	i.	s. h.	.....	phillygenin	.....	glucose
55	1000 c.; s. h.	4	sl. s.	i.	.....	phloretin	262–4	glucose
56	sl. s.	s.	s.	i.	s. ac. a.	*p*-hydroxy-acetophenone	109	glucose
57	v. s.	v. s.	sl. s.	sl. s.	i. bz.	safranol	.....	glucose
58	sl. s. h.	sl. s. h.	i.	.....	.....	emodin	254	glucose
59	i. c.; sl. s. h.	sl. s. c.; s. h.	i.	s. dil. a.	s. dil. alk.	saligenin	87	glucose, benzoic a.
60	s.	s.	i.	.....	.....	*dl*-mandelonitrile	−10	glucose
61	i. c.; sl. s. h.	s.	sl. s.	.....	s. alk.	quercetin	313–4 *	rhamnose
62	s. h.	s. h.	i.	.....	s. alk.	caempferol	271	rhamnose
63	sl. s. c.; s. h.	v. sl. s. abs.	v. sl. s.	s. alk. →r.	i. bz.	alizarin	290	glucose; xylose
64	v. sl. s. h.	s.	s.	.....	i. K_2CO_3	rubiadin	290	glucose
65	s. h.	s. h.	i.	i.	s. alk.	quercetin	313–4 *	glucose, rhamnose
66	23 c.; 3 h.	72	i.	i.	s. alk.	saligenin	87	glucose
67	s. †	i.	i.	i.	i. bz.	sapogenin	257–60	sugar
68	v. s. †	s. dil.	i.	i.	i. bz.	sapogenin	257–60	glucose
69	s. †	s. dil.	i.	i.	s. alk.	sapotoxin-sapogenin	.....	sugar
70	v. s. †	s. h.	v. sl. s.	.....	.....	sarsasapogenin	197–8	glucose

† Aqueous solutions foam on shaking.

Phaseolunatin 46
Phillyroside 54
Phlorizin 55
Phyllyrin 54
Piceoside 56
Potassium myronate 72
Primulin 22
Quercimelin 61
Quercitrinic acid 61
Rhamnin 83
Rhamnoxanthin 30
Rhodeoretin 18
Rubianic acid 63
Salinigrin 56
Scammonin 45

No.	Name	Formula	Appearance	Melting Point °C.
71	Sinalbine (*l*)	$C_{30}H_{42}O_{15}N_2S_2 \cdot 5H_2O$	pale yel. need.	83–4; 139 *
72	Sinigrin (*l*)	$C_{10}H_{16}O_9NS_2K \cdot H_2O$	rhomb. pr./aq.; need./al.	127–9; 179 *
73	Strophanthin (*in*)	$C_{31}H_{48}O_{12}$	microcryst., hyg.	179
74	Syringin (*l*)	$C_{17}H_{24}O_9 \cdot H_2O$	rosettes of long need./aq.	192
75	Tampicin	$C_{34}H_{54}O_{14}$	amor., colorl. to yel.	130
76	Tannic acid (*d*)	$C_{76}H_{52}O_{46}$	yel. to br. amor. bulky powd. or spongy masses; shining scales	d. 210–5
77	Thevetin (*l*)	$C_{42}H_{66}O_{18} \cdot 3H_2O$	need./al.	210
78	Thujin	$C_{20}H_{22}O_{12}$	yel. microscopic tablets	.....
79	Vacciniin (*d*)	$C_6H_{11}O_6COC_6H_5 \cdot H_2O$	cryst./aq. act.	104–6
80	Valdivin (*in*)	$C_{36}H_{48}O_{20} \cdot 2H_2O$	hexagonal pr.	230 d.*
81	Vicianin (*l*)	$C_{19}H_{25}O_{10}N$	wh. need.	147–8
82	Violutin (*l*)	$C_{19}H_{26}O_{12}$	wh. cryst.	169–72
83	Xanthorhamnin (*d*)	$C_{34}H_{42}O_{20}$	yel. micro need. + EtOH/al.	−EtOH, at 120

* Melting point of anhydrous compound.

Sinigroside 72
Smilacin 52
Sophorin 65
Strophanthin Thoms 51

No.	Solubility Expressed in Parts of Solvent Required to Dissolve 1 Part Glucoside					Hydrolytic Products		
	Water	Alcohol	Ether	Chloroform	Others	Principle	M.P. °C.	Sugar
71	s.	sl. s.	i.	.....	i. CS_2	sinapine sulfate, and higher mustard oils	127 *	glucose
72	s.	sl. s. c.; i. abs.	i.	i.	i. bz.	allyl mustard oil	−80	glucose
73	43	s.	i.	i. CS_2	i. bz.	strophanthidin	170; 235 *	sugars; no glucose
74	s. h.	s. h.	i.	.....	.....	syringenin	.....	glucose
75	i.	s.	s.	.....	.....	tampicolic acid	.....	sugar
76	v. s.	sl. s.	v. sl. s.	v. sl. s.	v. sl. s. act.	gallic acid	235 d.*	glucose
77	s. h.	s.	sl. s.	sl. s.	s. EtOAc	thevetigenin	140	glucose
78	s. h.	s.	.....	.....	.....	thujetin	.....	glucose
79	s.	s.	i.	sl. s.	sl. s. bz.	benzoic acid	121.7	glucose
80	s. h.	s. dil.	i.	v. s.	.....	?	.....	sugar
81	s. h.	sl. s.	.....	i.	i. bz.	benzaldehyde hydrocyanic acid	−26 −12	vicianose
82	s.	s.	i.	.....	i. act.	methy.salicy.ate	−8.3	glucose; arabinose
83	v. s.; d.	s.	i.	i.	i. bz.	rhamnetin	>300	rhamnose

Ursin 6

Violutiside 82
Waldivin 80

CONSTANTS OF FATS,

See also table on *Composition and Use of Foods.*

Classification: Class SV, semi-drying vegetable oil; NVO, non-drying vegetable oil of the olive oil type; AF, animal fat; AW, animal wax; NVR, non-drying vegetable oil of the rape oil type; DV,

No.	Name	Class	Specific Gravity $\frac{15°}{15}$ C.
1	Acorn, *Quercus agrifolia*	SV	0.916
2	Almond, *Prunus amygdalus*	NVO	0.914–0.921
3	Apricot kernel, *Prunus Armeniaca*	NVO	0.915–0.926
4	Beef marrow, *Bos taurus*	AF	0.931–0.938
5	Beef tallow, *Bos taurus*	AF	0.895
6	Beechnut, *Fagus sylvatica F. Americana*	SV	0.922
7	Beeswax, *Apis mellifera*	AW	0.961–0.968
8	Black mustard, *Sinapis nigra*	NVR	0.915–0.919
9	Black walnut, *Juglans nigra*; (*cf. Walnut*)	DV	0.918–0.921
10	Bone fat, *Sevum ossis*	AF	0.914–0.916
11	Brazil nut, *Bertholletia excelsis*	SV	0.917–0.918
12	Butter fat, *Vaccae lactis adeps*	AF	0.907–0.912 $\frac{40°}{15}$
13	Candlenut, *Aleurites moluccana*	DV	0.925
14	Candlenut, *Aleurites triloba*	DV	0.927
15	Carnauba wax, *Corypha cerifera*	VW	0.995–0.999
16	Castor, *Ricinus communis*	NVC	0.960–0.967
17	Chaulmoogra, U. S. P. X Revision	SV	$0.950^{25°}$
18	Chaulmoogra, *Taraktogenos Kurzii*	SV	0.943–0.954
19	Cherry kernel, *Prunus cerasus*	NVO	0.918–0.929
20	Chicken fat, *Gallus domesticus*	AF	0.924
21	Chinese insect wax, *Coccus cerifera*	AW	0.809–0.811
22	Chinese vegetable tallow, *Stillingia sebifera*	VF	0.918–0.922
23	Coconut, *Cocos butyracea*; *C. nucifera*	VF	0.926
24	Cocoa (Cacao) butter, *Theobroma cacao*	VF	0.964–0.974
25	Cod liver, *Gadus morrhua*	MA	0.922–0.931
26	Corn (Maize), *Zea Mays*	SV	0.921–0.928
27	Cottonseed, *Gossypium* Species	SV	0.917–0.918 $\frac{25°}{25°}$
28	Cottonseed stearin, *Gossypium*	VF	$0.867–0.868^{100°}$
29	Croton, *Croton tiglium*	SV	0.942–0.944
30	Date kernel, *Phoenix dactylifera*	NVO	—
31	Deer fat, *Cervus elephus*	AF	0.962–0.967
32	Dolphin, *Delphinus globiceps*	MA	0.908–0.930
33	Goat's butter, *Capellae lactis adeps*	AF	0.917–0.935 $\frac{37.7°}{37.7}$
34	Goose fat, *Anser cinereus*	AF	0.923–0.930
35	Grape seed, *Vitis vinefera*	NVC	0.917–0.933
36	Hazelnut, *Corylus avellana*	NVO	0.917
37	Hemp seed, *Cannibis sativa*	DV	0.928–0.934
38	Herring, *Clupea harengus*	MA	0.920–0.939
39	Horse fat, *Equus caballus*	AF	0.919–0.933
40	Human fat	AF	0.9033
41	Japan wax, *Rhus succedaneum*	VF	0.970–0.980 $0.875^{100°}$
42	Lard oil, *Sus scrofa*	NA	0.913–0.915
43	Lard oil (fatty tissue), *Sus scrofa*	AF	0.934–0.938 $0.861\frac{100°}{15.5}$
44	Laurel (bayberry), *Laurus nobilis*	VF	$0.880^{100°}$
45	Linseed, *Linum usitatissimum*	DV	0.930–0.938
46	Menhaden, *Alosa manhaden—Brevortia tyrannus*	MA	0.923–0.933
47	Mutton tallow, *Ovis aries*	AF	0.937–0.953 $0.858\frac{100°}{15.5}$

OILS AND WAXES

drying vegetable oil; VW, vegetable wax; NVC, non-drying vegetable oil of the castor oil type; VF, vegetable fat; MA, marine animal or fish oil; NA, non-drying animal oil; Sp, sperm oil.

Solidification point °C.	Acid value	Saponification value	Iodine value	Reichert-Meissl value	No.
−10	.....	199.3	100.0	.....	1
−15 to −20	0.5–3.5	183.3–207.6	93–103.4	0.5	2
−19	3.5	191.4–198.2	100–108.7	0.2	3
29 to 31	1.6	196–199	39–55.4	2	4
31 to 38	0.25	196–200	35.4–42.3	0.25	5
−17	.....	191–196	97–111	.....	6
60.5 to 62	16.8–20.6	88–96	8.8–10.7	0.3–0.5	7
16	5.7–7.3	173–175	99–110	.....	8
turbid −12	8.6–9.0	190.1–191.5	141–142.7	.....	9
15 to 17	29.6–53	185–198	46–55.8	0.2–1.7	10
0 to 3	1.4	193	90–106	.....	11
20 to 23	0.45–35.4	210–230	26–38	17.0–34.5	12
<−18	2	189–195	163–164	1.2	13
.....	.....	202–204	139–143.8	.....	14
80 to 87	4–8	79–84	13.5	.....	15
turbid −12 solid −17 to −18	0.12–0.8	175–183	84	1.4	16
<25	.....	196–213	98–104	.....	17
20 to 25	0.79–21.5	196–213	97.6–110.4	.....	18
−19 to −20	1.1	193.3–195	110–114.3	.....	19
21 to 27	1.2	193–204.6	66–71.5	1.8	20
80 to 81	63	78–93	1.4	.....	21
24 to 34	2.4	179–206	23–40.5	0.2–0.9	22
14 to 22	2.5–10	253.4–262	6.2–10	6.6–7.5	23
21.5–23	1.1–1.9	192.8–195	32.8–41.7	0.3–1	24
−3	5.6	171–189	137–166	0.2	25
−10 to −20	1.37–2.02	187–193	111–128	4.3	26
+12 to −13	0.6–0.9	194–196	103–111.3	0.95	27
16 to 22	4–10	195	88.7–93.6	0.22	28
−8 to −18	27–30.9	193–215	108–109	12–13.6	29
18.1	.....	211	52.3	0.88	30
.....	0.8–5.3	194.5–200	26–36	0.68	31
+5 to −3	2–12	body 203.4 jaw 290	126.9 body 32.8 jaw	body 46.9 jaw 65.9	32
.....	.....	233–236	25–37	20.8–27.7	33
22 to 24	0.59	191–193	58–67	0.2–0.98	34
−10 to −17	0.75	171–191	94.3–135	0.46	35
−17 to −18	.....	191–197	87	0.99	36
−15 to −28	0.45	190–195	145–161.7	.....	37
.....	1.8–44	170–194	102–149	.....	38
20 to 45	0–2.4	195–200	75–86	1.6–2.1	39
15	.....	193–200	57–73	.....	40
40.5 to 46	11–12	206.6–237.5	4.9–12.8	.....	41
+4 to −2	0.1–2.5	193–198	62.5–79	0–0.2	42
27.1 to 29.9	0.5–0.8	195–203	47–66.5	0.5–0.8	43
25	26.3	198–199	68–80	1.6	44
−19 to −27	1–3.5	188–195	175–202	0.95	45
−5	3–11.6	189–192.9	148–185	1.2	46
32 to 41	1.7–14	195–196	48–61	.....	47

No.	Name	Class	Specific Gravity $\frac{15^\circ}{15}$ C.
48	Myrtle wax, *Myrica cerifera—M. Carolinensis*	VF	0.995–0.875$^{100^\circ}$
49	Neat's foot, *Bos taurus*	NA	0.913–0.918
50	Nutmeg (mace) butter, *Myristica officinalis*	VF	0.945–0.966
51	Olive, *Olea Europaea sativa*	NVO	0.9140–0.918
52	Palm, *Elaeis guineensis* (W. Africa)	VF	0.924; 0.858$^{100^\circ}$
53	Palm kernel, *Elaeis guineensis* (S. America)	VF	.....
54	Palm kernel, *Elaeis guineensis* (W. Africa)	VF	0.866–0.873$^{100^\circ}$
55	Peach kernel, *Amygdalus Persica*	NVO	0.918–0.925
56	Peanut, *Arachis hypogaea*	NVO	0.917–0.926
57	Perilla, *Perilla ocimoides*	DV	0.930–0.937
58	Pistachio nut, *Pistacia vera*	NVO	0.913–0.919
59	Plum kernel, *Prunus domestica* and *P. damascena*	NVO	0.912–0.913
60	Poppy seed, *Papaver somniferum*	DV	0.924–0.926
61	Porpoise—body oil, *Delphinus phocaena*	MA	0.926
62	Pumpkin seed, *Cucurbita pepo*	SV	0.923–0.925
63	Rabbit fat, *Lepus cuniculus*	AF	0.934–0.936 0.861$^{100^\circ}$
64	Rape seed, *Brassica campestris*	NVR	0.913–0.917
65	Safflower, *Carthamus tinctorius*	DV	0.925–0.928
66	Sardine, *Clupea pilchardus* and *C. scombrinus*	MA	0.920–0.934
67	Seal, *Phoca* species	MA	0.915–0.926
68	Sesame, *Sesamum indicum*	SV	0.919$^{25^\circ}$
69	Shark, *Selache (cetorhinus) maxima et al.*	MA	0.916–0.919
70	Soya, soy or soja bean, *Soja hispida; Dolichos hispida*	SV	0.924–0.927
71	Sperm, *Physeter macrocephalus*	Sp	0.878–0.884
72	Spermaceti, *Physeter macrocephalus*	AW	0.905–0.945 0.806–0.812$^{99^\circ}$
73	Sunflower, *Helianthus annuus*	DV	0.924–0.926
74	Tallow, *Oleum adipis bovis*	NA	0.914–0.919
75	Tallow, *Sevum*	AF	0.925–0.950
76	Tung,—China wood, *Aleurites fordii*	DV	0.939–0.949
77	Tung,—China wood, *Aleurites montana*	DV	0.939–0.949
78	Walnut, *Juglans regia* (cf. Black walnut)	DV	0.925–0.927
79	Whale, *Balaena mysticetus*	MA	0.917–0.924
80	White mustard seed, *Sinapis alba*	NVR	0.912–0.916
81	Wool fat, *Ovis aries*	AW	0.970–0.973

CONSTANTS OF FATS,

No.	Name	Index of Refraction at 25°C. or *40°C.	Hehner value	Acetyl value	Unsaponifiable matter
1	Acorn	.....	.....	.....	.....
2	Almond	1.4593–1.4646*	96.0	9.6	0.75
3	Apricot kernel	1.4636–1.4705	.....	12.2	.....
4	Beef marrow	.....	.....	.....	.....
5	Beef tallow	1.4552–1.4587*	96–96.5	2.7–8.6	.....
6	Beechnut	1.4698	95–96	.....	.....
7	Beeswax	1.4538–1.4566*	.....	15.2	52–55
8	Black mustard	1.4718	96	.....	3.3
9	Black walnut	.....	95.8	.....	.....
10	Bone fat	.....	91–95	11.3	0.5–1.8
11	Brazil nut	1.4671	.....	.....	.....
12	Butter fat	1.4555–1.4578*	87.6–89.6	1.9–8.6	0.3–0.6
13	Candlenut *Al. mol.*	1.4760–1.4790	95–96	9.8	0.5–9
14	Candlenut *Al. tri.*	1.4760–1.4790	.....	.....	.....

Solidification point °C.	Acid value	Saponification value	Iodine value	Reichert-Meissel value	No.
39 to 43	3–4.4	205.5–211.7	3.9–9.5	0.5	48
+ 10 to —2	0.1–0.6	193–199	57.5–75	0.9–1.2	49
41 to 42	17.2	154–178	40–81	1.1–4.2	50
turbid + 2 ppt. —6	0.3–1.0	185–196	79–88	0.6–1.5	51
35 to 42	10	200–205	49.2–58.9	0.9–1.9	52
27.4	0.33–0.55	220.2–231.4	25.5–31.6	.....	53
.....	.....	243–255	10.5–17.5	5–6.8	54
—20	1–1.5	191–193	92–99.7	.....	55
3	0.8	186–194	88–98	0.4	56
.....	.....	188–194	185–206	.....	57
—5 to —10	.....	191	83–87	.....	58
—5 to —8	0.55	191–193	100–103.6	.....	59
—16 to —18	2.5	193–195	128–141	0.6	60
—16	body 1.2 jaw 5.0	body 203.4 jaw 253–272	body 126.9 jaw 30.9–49.6	body 46.9 jaw 132	61
—15	.....	188–193	121–130	4.45	62
17 to 23	1.4–7.2	199–203	70–99.8	0.7–2.8	63
—10	0.36–1.0	168–179	94–105	0.0–7.9	64
—13 to —18	0.6	188–203	122–141	0.0–0.2	65
20 to 22	4–25	187.7–196	150–193	0.5–1	66
3	1.9–40	187.5–196.2	130–152	0.2	67
—4 to —6	9.8	188–193	103–117	1.1–1.2	68
.....	.....	157–164	115–139	.....	69
—10 to —16	0.3–1.8	189–193.5	122–134	0.5–2.8	70
15.5	13.2	120–137	80–84	0.6	71
42 to 47	0.5–2.8	126–135	3.8–9.5	.....	72
—17	11.2	188–193	129–136	0.5	73
2 to 7.5	0.2–0.25	193.5–199	56–60.5	0.3	74
.....	.....	193–198	35–45	0.5–1.0	75
<17	2	190–197	163–171	1.10	76
<17	2	190–197	163–171	0.35	77
—15 to —27	2.5	190.1–197	139–150	0.92	78
—2 to 0	1.9	160–202	90–146	14	79
—8 to —16	5.4	171–174	94–98.4	.....	80
38 to 40	59.8	82–130	17–29	5–8	81

OILS AND WAXES (Continued)

Maumené number	Insoluble fatty acids				No.
	Melting point °C.	Solidification point or Titer	Acid value	Iodine value	
.....	25	.....	.....	.....	1
51–54	13–14	9.5–11.5	196–207	93–96.5	2
42.5	2.3–4.5	.....	197	99.4–108	3
.....	44–46	.....	204.5	44–56	4
.....	42.5–44	37.9–46.2	197–202	41.3	5
64	23–24	17	.....	114	6
.....	.....	.....	.....	.....	7
43	16–17	13.4–13.7	187.1	109.6	8
.....	0	.....	.....	.....	9
.....	41–43	39–43	200	48–57	10
.....	28–30	31.1–32.2	.....	.....	11
.....	38–41	33–39	210–233	36–52	12
.....	20–21	.....	.....	.....	13
.....	.....	17.8	.....	.....	14

No.	Name	Index of Refraction at 25° C. or *40 °C.	Hehner value	Acetyl value	Unsaponifiable matter
15	Carnauba wax	1.4672–1.4701*	.....	55.2	54–55
16	Castor	1.4771	.....	146–150.5	0.6
17	Chaulmoogra, U.S.P. X Revision	.....	.....	.....	.....
18	Chaulmoogra, *Taraktogenos Kurzii*	1.4777–1.4779	.....	.....	2.4–2.6
19	Cherry kernel	1.4635	.....	.....	.....
20	Chicken fat	1.4580*	94.6	45	.....
21	Chinese insect wax	1.4566*	.....	.....	50
22	Chinese vegetable tallow	1.4470–1.4579*	95.3	.....	.....
23	Coconut	1.453	82.3–90.5	2.3–6.9	.....
24	Cocoa (Cacao) butter	1.4537–1.4580*	94–95	1.97	.....
25	Cod liver	1.4758–1.4783	95.3	1.15	0.54–2.68
26	Corn	1.4733	93–95	7.5–11.5	1.5–2.8
27	Cottonseed	1.4743–1.4752	95.7	21–25	1.1
28	Cottonseed stearin	1.4700–1.4725	96.5	.....	.....
29	Croton	1.4710*	89.0	19.8–38.6	0.6
30	Date kernel	1.4535–1.4633	95.2	.....	.....
31	Deer fat	.....	95.8	.....	0.52
32	Dolphin	1.4665	93.1	.....	2
33	Goat's butter	1.4499–1.4551*	.....	.....	.....
34	Goose fat	1.4583–1.4626	94.5–95.3	.....	.....
35	Grape seed	1.4713–1.4725	92	13.5–14.5	1.6
36	Hazelnut	1.4667	95.5	3.2	0.5
37	Hemp seed	1.4740–1.4745*	.....	.....	1.08
38	Herring	1.4665–1.4729	95–96	.....	1–2
39	Horse fat	1.4658–1.4702	95–98	.....	.....
40	Human fat	1.4593–1.4607*	94–96	.....	.....
41	Japan wax	1.4560–1.4591*	90–91	17.3–26.5	1.1–1.6
42	Lard oil	1.4607*	97	2.6	0.6
43	Lard oil (fatty tissue)	1.4609–1.4620	93–95	2.6	.....
44	Laurel (bayberry)	1.4783	.....	.....	.....
45	Linseed	1.4797–1.4802	94.5–95.5	.....	0.4–1.2
46	Menhaden	1.4787	.....	.....	0.6–1.43
47	Mutton tallow	1.4545–1.4585*	95.5	.....	.....
48	Myrtle wax	1.4511*	92–94	.....	.....
49	Neat's foot	1.4643–1.4685	94.8–95.9	7.7–9.3	0.12–0.65
50	Nutmeg	1.4700–1.4812*	.....	.....	.....
51	Olive	1.4657–1.4667	95	10.5	0.4–1.0
52	Palm	1.4603–1.4639*	94.5–97	15.7	.....
53	Palm kernel (S. America)	.....	.....	.....	.....
54	Palm kernel (W. Africa)	1.4492–1.4543*	91–91.5	7.6	.....
55	Peach kernel	1.4682–1.4701	94–96	6.5	.....
56	Peanut	1.4620–1.4653*	95	3.5	0.5–0.9
57	Perilla	1.4753*	95.8	.....	.....
58	Pistachio nut	1.4672	96	.....	.....
59	Plum kernel	1.4679–1.4702	95.2	.....	.....
60	Poppy seed	1.4739–1.4742	95.4	.....	0.43
61	Porpoise—body oil	1.4622–1.4625	body 85.5 jaw 68–72	.....	body 3.7 jaw 16–17
62	Pumpkin seed	1.4724–1.4739	96	.....	.....
63	Rabbit fat	1.4586*	99.5	.....	.....
64	Rape seed	1.4649–1.4659	94.5–96.3	14.75	1.48
65	Safflower	1.4769	95	16.1	.....
66	Sardine	1.4763–1.4852	93.3–96	21–22	0.98
67	Seal	1.4742–1.4762	93–96	33–34	0.3–1.0
68	Sesame	1.4704–1.4717	95	.....	0.9–1.3
69	Shark	1.4825	87–97	11.9	2.8–15.2
70	Soya	1.4723–1.4756	93–94.5	4.9	1.27–1.54

Maumené number	Insoluble fatty acids				No.
	Melting point °C.	Solidification point or Titer	Acid value	Iodine value	
.....	.....	.....	.....	.....	15
46–47	13	3	192	87–93	16
.....	.....	.....	.....	.....	17
.....	44–45	39.6	215	103	18
45	19–21	13–15	.....	104–114	19
.....	38–40	32–34	200.8	64.6	20
.....	92	.....	.....	.....	21
.....	39–57	45.2–47.2	202–208	30–55	22
21	24–27	21.2–25.2	258–273	8.4–9	23
.....	48–53	47.2–49.2	190–198	33–39	24
102–113	21.8–38	17.5–24.3	204–207	130–170	25
74–86	17–20	14–16	198.4	113–126	26
75–81	34.5	.....	202–208	111–115	27
.....	27–45	39.9–51	.....	94	28
.....	17–19	17–19	201	112	29
.....	.....	.....	.....	.....	30
.....	50–64	46–50	.....	.....	31
.....	.....	.....	.....	.....	32
.....	.....	.....	.....	.....	33
.....	36.6–40	31–34	202	65.3	34
53	23–25	18–20	187.4	99	35
36	22–25	19–20	201	91–98	36
97	17–21	15.6–16.6	.....	141	37
.....	30–32	.....	179	.....	38
46–54	31.3–53.4	33.7–45	203	72–87	39
.....	35.5	.....	.....	64	40
.....	53–56.5	54–55	214	.....	41
40–47	33–38.4	27–33	.....	.....	42
24–28	37–46.6	36–42.4	202	64.2	43
116	.....	15.1	.....	82	44
103–126	20–24	16–20.6	197	179–192	45
123–128	.....	.....	.....	.....	46
.....	33.5–49	40–48.5	210	34.8	47
.....	47–48	.....	231	.....	48
47–58.5	29–41	16–26.5	200.6	62–76	49
.....	42.5	36	.....	.....	50
35–52	26–30	16.9–26.4	193–198	86–90	51
.....	50	42.5–45.5	204–207	53	52
.....	.....	.....	.....	.....	53
.....	25–28.5	20–25.5	258–264	12	54
42.5	10–18	13–13.5	201–205	94–102	55
44–67	26–36	30.5–39	202	96–103	56
124	—5	.....	.....	200–211	57
44.5–45	17–20	13–14	.....	89–96	58
45	12.4–18	.....	.....	95.7–104	59
71–88	20.5	17–19	199	139	60
body 50	.....	.....	207	126	61
.....	26	26–28	197	134	62
.....	39–50	35–41	218	64	63
50–67	18.5–20	11.7–13.6	185	99–106	64
.....	11–17	7–12	199	148	65
.....	30–34.8	28.2	177–185	.....	66
.....	22–23	13–17	193	186–201	67
61–68.5	25–35	24	197–201	110–116	68
.....	21–22	.....	.....	.....	69
59–61	26.2–27.5	24	198	115–140	70

No.	Name	Index of Refraction at 25° C. or *40° C.	Hehner value	Acetyl value	Unsaponifiable matter
71	Sperm	1.4573	.....	4.5–6.4	37–41
72	Spermaceti	.....	.....	2.6	51.5
73	Sunflower	1.4659–1.4721	95	.....	0.31
74	Tallow (oil)	.....	.....	.....	.....
75	Tallow (sevum)	.....	95–96	.....	.....
76	Tung (*Al. ford.*)	1.515–1.520	96	.....	0.4–0.8
77	Tung (*Al. mont.*)	1.515–1.520	.....	.....	0.4–0.8
78	Walnut	1.4770	93.4–95.4	.....	.....
79	Whale	1.4679–1.4724	93–95	11–23	1–4
80	White mustard seed	1.4649*	96–97	.....	.....
81	Wool fat	1.4784–1.4822	91	23	39–44

Maumené number	Insoluble fatty acids				No.
	Melting point °C.	Solidification point or Titer	Acid value	Iodine value	
51	13.4	11.9	23.6	83–86	71
.....	.....	.....	.....	.....	72
60–75	22–24	18–19.8	202	124–134	73
.....	43–46	35–37.5	197–202	25–40	74
.....	.....	40–50	.....	.....	75
.....	31–44	.....	189–198	144–159	76
.....	.....	.....	.....	.....	77
103	15–20	14.3	200	150	78
85–92	14–27	10–24	.....	131	79
44–49	15–16	9–10	185.8	95	80
.....	41.8	.....	.....	17	81

For information concerning the properties of various commercial resins, see Circular No. 430 issued in May 1933 by the Educational Bureau of the American Paint and Varnish Manufacturers' Association.

Classification. The 3d column headed "Class," places each resin into one of the following groups:

I. Natural gum-resins of vegetable origin, which contain some resinous constituents in admixture with carbohydrate bodies, so that the resulting complex will yield some water-soluble constituents.

II. Natural resins of animal origin.

III. Natural resins of vegetable origin—largely mixtures of resin acids, alcohols and esters, with some resenes or hydrocarbon bodies. This class is divided into the following groups:

A. Oleo-resins and balsams—very fresh exudations containing volatile solvents which act as carriers.

B. New resins—same as IIIA—with the solvents gone completely.

C. Semi-fossil resins—the products of the action of the elements on new resins over a relatively short time. These resins are not entirely soluble unless melted

Name	Source	Class	Sp. Gr.
Gum Accroides Used to color spirit varnishes and nitrocellulose lacquers, and in sealing wax. Composition is 85% p-coumaric ester of xanthoresinotannol.	A species of *Xanthorroea* in Australia — Yellow variety Red variety	III. B III.B	....
Accra Copal	W. Africa	III. C	1.033
Amber Used in jewelry; it is the hardest and most highly fossilized resin. Composition is 28% succino-abietic acid, 70% esters of succinic acid and succino-resinol.	Baltic coast and Burma. Fossil resin from extinct conifers	III. D	1.052 (1.05–1.11)
Gum Ammoniacum Composition:—20-26% gum, 65-75% resin, balance water, ash, etc.	*Dorema Ammoniacum*, from Persia and Africa	I.	1.19–1.21
Red Angola Copal Commonly used in Europe; less in U. S. A.	Semi-fossil from Angola, W. Africa	III. C	1.066–1.068
White Angola Copal	W. Africa	III. C	1.055
Gum Arabic (Acacia) Used in adhesives and emulsions. Varieties:—gum senegal, kordofan.	Dried juice from bark of *Acacia senegal*	True gum	.....
Asafoetida Composition:-25% gum, 60% resin ester, 7% essential oil. U. S. P. requires ash to be under 10%. Used in treatment of heaves.	Species of *Ferula*	I.	.....
Batu An important variety of East India resin (*q.v.*).			

and partially depolymerized.

D. Fossil resins—those exposed for long periods of time. They are substantially insoluble.

IV. Treated natural resins including esters, etc.

V. Pure synthetics—resinous complexes made under controlled conditions.

The 4th column gives the **specific gravity**, the 5th gives the **softening point (S. P.)**, and the 6th gives the **melting point (M. P.)**. The next three columns give the **acid, saponification,** and **iodine numbers** in that order. Figures enclosed in parentheses indicate the extreme values reported by different investigators. The 10th and last column gives the solubility of the resins in various solvents. The figures 1 to 12 refer to the following solvents: 1-ethyl alcohol; 2-methyl alcohol; 3-ether; 4-benzene; 5-acetone; 6-amyl alcohol; 7-chloroform; 8-aniline; 9-benzaldehyde; 10-carbon tetrachloride; 11-turpentine; 12-amyl acetate. The letter "s." (soluble), indicates that over 90% of the resin is soluble in the solvents numbered there-after; "p. s." (partly soluble), indicates that from 41-90% of the resin will dissolve, while "i." (insoluble), indicates that 40% or less dissolves. The **ester number** is indicated by **E,** and the methoxyl number by **M.**

S. P., °C.	M. P., °C.	Acid No.	Sap. No.	Iod. No.	Solubility
.....	.....	64–88	98–176	156–192	s. 1
.....	.....	64–106	18–25	.....	.....
75	120 (106–156)	98 (46–129)	140 (133–168)	58 (58–62)	s. 6, 8, 12; p. s. 1, 3, 5, 7, 9: i. 2, 4, 10, 11.
175	300 (280–315)	15 (15–34)	115 (86–145)	62 E. = 71–91	v. sl. s. or i. 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12.
.....	.....	Resin:–57–135	Resin:– E. = 19–98	M. = 8.6–11.0	.....
90	>300 (305)	128 (128–143)	132 (132–162)	63–137 E. = 58–62	s. 5, 6, 8, 9, 12; p. s. 1, 3; i. 2, 4, 7, 10, 11.
45	95 (95–125)	127 (57–127)	160 (132–160)	130	s. 5, 6, 8, 9, 12; p. s. 1, 2, 3, 4, 7; i. 10, 11.
.....	.....	2–8	56–90	0.5	s. water.
.....	.....	Resin.– 11–82	Resin:– E. = 82–214	M. = 7–18	s. in 90% alcohol over 50%.

Name	Source	Class	Sp. Gr.
Benguela Copal An uncommon resin.	W. Africa	III. C	1.058 (1.035–1.062)
Gum Benzoin Composition:—69% cinnamic acid esters, 30% cinnamic acid, 1% or less of vanillin.	Sumatra and Siam *Styrax Benzoin*	III. A, B	1.063–1.092
Brazil Copal	S. America *Hymenae courbaril*	III. C	1.053
Cameron Copal	W. Africa	III. C	1.052
Canada Balsam Used in optometric work.	*Abies balsamea*	III. A	0.90
Colombia Copal	S. America	III. C	1.054
Congo Copal Composition:—89% resin acids, 8.5% resenes. It is the commonest fossil varnish resin, widely used because of its low price. Loango copal is a variety of Congo.	Belgain Congo	III. C	1.061
Copaiba Balsam Oleo resin, named, as are many others, from port of shipment. Used in medicine.	S. American species of *Copaiba*	III. A	0.916–0.995
Dammar A common resin, used in varnish and lacquer. It is dissolved in coal tar solvents and alcohol, which precipitate incompatible ingredients.	East Indian trees of *Shorea* variety	III. B	1.031 (1.031–1.123)
Demerara Copal Semi fossil gum. Not in common use.	British Guiana	III. D	1.047
Dragon's Blood Used as red coloring agent.	E. Indies (Sumatra) *Calamus draco*	III. A, B	1.25
East India A very common resin, widely used in the varnish industry. Composition:—12% resin acids, 78% resenes.	Species of *Dipterocarpus* in East Indies	III. B, C	.....
Gum Elemi Contains some essential oils, mixed with resins. Used in lacquers and spirit varnishes.	Mainly from the Philippines; *Canarium commune*	III. A, B	1.018–1.083

S. P., °C.	M. P., °C.	Acid No.	Sap. No.	Iod. No.	Solubility
65 (65–95)	165 (140–215)	123 (123–137)	157 (135–168)	61–85 E. = 50–64	s. 6, 8, 12; p. s. 1, 2, 3, 5, 7, 9; i. 4, 10, 11.
.....	<100	127–142 (98–142)	190–207 (148–207)	57–76 M. = 13–44	s. completely in 1.
50	100	123 (123–130)	133 (133–143)	123–134 E. = 1–5	s. 6, 8, 12; p. s. 1, 2, 3, 4, 5, 7, 9, 10, 11.
100 (96–110)	150 (110–150)	160 (129–160)	70 (70–168)	65–70	s. 8; p. s. 3, 6, 9, 12; i. 1, 2, 4, 5, 7, 10, 11.
.....	Liquid	88–106	105–116 E. = 4–10	Refr. Index = 1.532; M. = 0	.....
90	>300	119	156	.....	s. 6, 8, 12; p. s. 1, 3, 5, 7, 9; i. 2, 4, 10, 11.
90 (90–95)	195 (115–195)	132 (132–151)	132–179	58–59	s. 6, 8, 12; p. s. 1, 2, 3, 5, 9; i. 4, 7, 10, 11.
.....	.....	34–98	E. = 2–33	.....	.....
75	100 E. = 4–20 M. = 0	35 (21–35)	39 (31–47)	64–142	s. 3, 4, 7, 8, 9, 10, 11, 12; p. s. 1, 2, 5, 6.
90	180	98	102	.....	p. s. 3, 7, 9, 12; i. 1, 2, 4, 5, 8, 10, 11.
.....	100 E. = 142	11 M. = 25–34	153	54–98	s. 1, 3; p. s. 7, CS_2, petr. ether, ethyl acetate.
.....	.....	21	35	.....	s. coal tar hydrocarbons; i. 1, esters.
.....	soft	15–22 E. = 3–24	24–28 M. = 0–2.5	81–175	.....

Name	Source	Class	Sp. Gr.
Galbanum Composition:—64% alcohol-soluble resin, 27% gum, 9% essential oil. Used in medicine.	*Ferula galbaniflua*	I	1.109–1.133
Gamboge Composition:—65-75% resin, 20-25% gum. Used as a yellow coloring agent and as a purgative.	Siam. *Garcinia Hanburii*	I	.....
Guaiacum Used in medicine.	From wood of *Guajacum officinale* and *G. sanctum*	III. B	.....
Gurjun Balsam	Java and Cochin, China *Dipterocarpus*	III. A	0.960–0.966
Jalap Resin of, Used in medicine; purgative.	*Exogonium jalapa*	III. B	.....
Karaya Gum (Indian gum) Resembles tragacanth. Used in hair "wave set" and in foods.	India; Africa. *Sterculia urens*	I	1.461–1.480
Kauri, Bush Composition:—64.5% resin acids, 12% resenes.	A recent to semi-fossil variety of Kauri. It is the softest grade of Kauri on the market.	III. B, C	1.030–1.038
Kauri, Fossil Composition:—69% resin acids, 9.5% resenes. A common resin used for high grade varnishes.	*Agathis australis* (the New Zealand Kauri Pine)	III. C, D	1.053
Kissel Copal Said to make poor varnishes.	Africa	III. C	1.066
Gum Lac (Shellac) (Data given is for orange shellac.)	Secretion of *Coccus lacca*, the lac insect	II.	1.182 (1.113–1.214)
Madagascar Copal A hard fossil resin, used little because of its high price.	Fossil gum from Madagascar	III. D	1.056
Manila, Soft Used as a cheap shallac substitute in spirit varnishes.	E. Indies. Trees of *Hymenea* group	III. B	1.060
Manila, Hard The hardest grade used in the varnishes. A very common resin.	E. Indies	III. C	1.065
Mastic Formerly much used in lacquers and spirit varnishes. Not so popular now.	Evergreen shrubs in Mediterranean regions. *Pistacia lentiscus*	III. B	1.057 (1.04–1.07)
Mecca Balsam (Balm of Gilead) Used as a tonic in the Orient.	*Balsamodendron gileadense* in Arabia	III. A	.....

S.P., °C	M. P., °C.	Acid No.	Sap. No.	Iod. No.	Solubility
.....	.....	Resin:- 19–40	Resin:- E. = 55–91	.....	.....
.....	.....	79–100 E. = 57–67	148 M. = 0–2.4	71 (116)	s. 1; emulsifies in water.
.....	.....	23–44	M. = 74–84	.....	54–74% soluble in ether.
.....	Sticky liquid	.....	.....	.....	s. 4, 7, CS_2; p. s. 1.
.....	.....	12–13	E. = 120	M. = 0	.....
.....	.....	13–23	.....	.....	.....
50	125	82 (74–82)	87 (79–102)	74–170	s. 1, 6, 8, 9, 12; p. s. 2, 3, 4, 5, 7, i. 10, 11.
90	185	79 (63–79)	90 E. = 26–36	120 (120–164)	s. 6, 8, 9, 12; p. s. 1, 5, 7; i. 2, 3, 4, 10, 11.
65	110	70	118	.....	s. 8; p. s. 1, 3, 5, 7, 9, 12; i. 2, 4, 6, 10, 11.
95	150	61 (55–65) E. = 150	201 (200–212) Unsap. = 3.5	18 (15–18)	s. alcohols, borax solutions; p. s. 3, 5, 7, CS_2, ethyl acetate; i. 4, toluene, petr. ether.
130	300	66	78.5	126	p. s. 6, 8, 9, 12; i. 1. 2, 3, 4, 5, 7, 10, 11.
45	120	145 (136–150)	185 (185–196)	91–111	s. 1, 2, 5, 6, 8, 9, 12; p. s. 3, 4, 7; i. 10, 11.
80	190	73 E. = 44–50	87	90 (86–91)	s. 6, 8, 9; p. s. 1, 3, 5, 7; i. 2, 4, 10, 11.
80–93	95	63 (50–71)	79 (70–194)	64–159 E. = 23–29	s. 3, 4, 6, 7, 8, 9, 10, 11, 12; p. s. 1, 2, 5.
.....	.....	.....	.....	.....	.....

Name	Source	Class	Sp. G.
Myrrh (Bdellium is a variety.) Has 50-60% gum. Used in medicine.	Turkey, India, Arabia, Somaliland. Species of *Commiphora*	I.	.....
Peru Balsam Has 55-66% cinnamein. Used in medicine and perfumery.	Central America. Black liquid from *Toluifera pereirae*	III. A	1.14–1.151
Olibanum or **Frankincense** Used in perfumery.	*Boswellia Carterii*, etc. Somaliland and S. Australia	I.	.....
Pontianak Composition:—84.5% resin acids, 4% resenes. A recent to semi-fossil resin. Similar to, but harder and less odorous than soft manila. Used in spirit varnishes.	Borneo	III. B, C	1.037
Rosin or **Colophony** Largely abietic acid, $C_{20}H_{30}O_2$. Commonest and cheapest resin. Graded according to color. Used in paints, soap, paper, etc.	*Pinus* species. Mostly *Pinus palustris*. Gum obtained on distillation	III. B	1.045–1.086
Gum Sandarac Composition:—85% sandaracolic acid, 10% callitrolic acid. Common resin for use in spirit varnishes.	N. E. Africa. Small trees; *Callitris quadrivalvis*	III. B	1.073
Sierra Leone Copal The hardest of the recent resins.	W. Africa. *Guibourtia Copalifera*	III. B	1.072
Balsam Storax Used in medicine.	Levant and Greece. *Styrax officinalis*	III. A	.....
Balsam Tolu	S. America. *Toluifera balsamum*	III. A	.....
Gum Thus A soft, fresh oleoresin from slashed trees, yielding turpentine and rosin on distillation.	*Pinus* species	III. A	.....
Gum Tragacanth Swells in water—used in adhesives.	Asia Minor and Persia. *Astragalus gummifer*	Gum	.....
Venice Turpentine	European larch. *Larix europaea*	III. A	1.094–1.190
Zanzibar Copal Composition:—85% resin acids, 10% essential oils, 5% resenes. A common resin, little used only because of its high price. Soluble in oils after depolymerization.	Zanzibar and E. Africa. *Trachylobium verrucosum*	III. D	1.054–1.063

S. P., °C.	M. P. °C.	Acid No.	Sap No.	Iod. No.	Solubility
.....	M. = ca.13	Resin:– 42–70	Resin:– 159–216	Resin:– E. = 95–145	.....
.....	.....	.....	.....	.....	s. 1, 3.
.....	E. = 7–131	42–50	M. = 5–7	.....	.....
55	135	134	186	119–142	s. 1, 5, 6, 8, 9, 12; p. s. 2, 3, 7; i. 4, 10, 11.
70–80	120–135	155–175 E. = 8–23	167–194 M. = 0	80–220	s. nearly all organic solvents; p. s. 3, petr. ether.
.....	145	140 (154)	154 (142–174)	66–160 E. = 1–11 M. = 0	s. 1, 3, 6, 8, 12; p. s. 2, 5, 7, 9; i. 4, 10, 11.
60	130 (130–200)	110 (73–130)	123 (123–158)	63–133	s. 6, 8, 9, 12; p. s. 2, 3, 4, 5, 7; i. 1, 10, 11.
.....	.....	128–131	191–206	65	s. 3, 1 (hot).
.....	.....	.....	.....	.....	.....
.....	.....	108–145	140–161	E. = 3–60	.....
.....	.....	.....	.....	.....	.....
E. = 30–56	M. = 0	67–101	81–127	144	s. 1, 3, 4, 7, petr. ether.
150	300	93 (87–93)	93 (70–93)	115–123	p. s. 8, 12; i. 1, 2, 3, 4, 5, 6, 7, 9, 10, 11.

(Completed on following page.)

Aldehyde Resins—V. These resins result from the polymerization of acetaldehyde, crotonaldehyde, etc. They are marketed in Germany as substitutes for shellac.

Alkyd Resins—V. These resins are the reaction products of polyhydric alcohols (particularly glycerol) with polybasic acids (chiefly phthalic, although succinic, maleic, sebacic, etc. have been used), in the presence of some modifying acid. The reaction progresses through an esterification into a polymerization. Eventually a stage is reached where the complex becomes insoluble. The modifying acid (generally a fatty acid of one of the various oils) is added to increase the solubility and flexibility. In order that the reaction may proceed as far as possible, it is generally carried to the point of incipient gelation and dissolved in hot solvent. The resulting products are usually sold in the form of a solution for use in lacquer and oleoresinous varnishes. "Glyptal" resins are of this type.

Cumar Resins—V. These resins are manufactured by various distillers of coal tar by polymerization of cumarone and indene hydrocarbon fractions. They are neutral (acid No. =0) although impure grades contain saponifiable matter. They are soluble in nearly all organic solvents except the alcohols. They are graded according to hardness, which, in turn, increases with increasing melting point. The soft varieties (soft rubber grades) melt from 50 to 65°C., while the hardest varieties (varnish grades) have melting points ranging from 135 to 150°C. Specific gravity of 1.2 to 1.3, iodine number from 23 to 29, acid number from 0 to 20, and saponification number from 0 to 25 have been obtained. These resins decompose on heating to 300-400°C.

Ester Gum—IV. These products are rosin glycerides prepared by condensation of rosin with glycerol or other polyhydric alcohols. They are of two types, one high in acid and the other low in acid. The high acid types are used in spar varnishes and have acid numbers from 40 to 80, melting points from 100 to 110°C.; the low acid types are used in lacquers and have acid numbers from 2 to 10, melting points from 90 to 100°C. They are soluble in toluene, acetone, and esters. Solubility in mineral spirits or in alcohols depends on type and treatment.

Hardened Rosin—IV. Rosin is often brought into reaction with zinc oxide or lime to produce a hardened material of lower acidity for use in varnish. These resinates with the remaining free or unchanged rosin are soluble in the common solvents.

Modified Ester Gums—IV. To obtain increased hardness in ester gums, it is common practice to react glycerol and rosin with other acids or phenol-aldehyde complexes, thus forming a mixed glyceride. The modifying or hardening acid may be succinic, maleic, etc. The esters modified with phenol-formaldehyde (so-called Albertol Copals) are heat reactive with tung oil and produce very rapid drying varnishes. These modified with maleic anhydride have excellent solvent release.

Petroleum Hydrocarbons—V. The gasoline cracking stills yield some polymerizable hydrocarbons which are now being exploited as resins. **Phenol-Aldehyde Types—V.** These resins are condensation products of phenols with aldehydes, and vary widely in properties. They are all initially soluble in organic solvents; special types are oil soluble, and react with wood oil to produce fast-drying varnishes. All but one type are heat-convertible to insoluble gels or films. This is the commonest type of resin (Bakelite, "Durez", etc.) used in plastics; the resins are also widely used in varnishes. **Acrylate Resins—V.** These are polymers of acrylic and alkacrylic acid esters, yielding water-white, tough, soluble products used for plastics and coatings. "Lucite" is a methacrylate. **Styrol Resins—V.** Styrene polymers give resins possessing properties similar to acrylate and vinyl resins. **Vinyl Resins—V.** These are polymers of vinyl acetate or vinyl chloride, or copolymers of mixtures thereof. Their properties are similar to acrylate resins and they are used extensively in safety glass. "Vinylite" and "Vinyon" are vinyl resins. **Amine- or Amide- (Urea) Formaldehyde Resins—V.** These heat-convertible resins are obtained by the reactions of amines or amides with formaldehyde. Urea, melamine and related compounds give transparent, colorless resins which heat-convert with extraordinary rapidity. Some types can be dissolved in solvents. They are used extensively in plastics ("Beetle"), in fast-drying coatings, and in textile treatment. **Rubber Resins and Substitutes—IV and V.** Rubber is essentially poly-isoprene. Its conversion products, obtained by halogenation with or without other treatment, are used for special coatings ("Pliolite", "Tornesit"). Many synthetic rubbers and rubber substitutes are available; e.g., polychloroprene ("Neoprene"), polyisobutylene ("Vistanex"), etc.

SYNTHETIC RUBBERS

The following information on synthetic rubbers was taken from *Bu. of Standards Circular C 427, Synthetic Rubbers*, by Lawrence A. Wood (1940). This publication gives a bibliography of over 200 references covering the literature from 1930 to 1940. Synthetic rubbers show outstanding superiorities to natural rubber in resistance to the effects of liquids, especially petroleum products, and in resistance to deterioration by light, heat, oxygen, and ozone.

VARIETIES OF SYNTHETIC RUBBER

Abbreviations used in the table:

Type:
- B, Butadiene polymer.
- BC, Butadiene co-polymer.
- C, Chloroprene polymer.
- DB, Dimethylbutadiene polymer.
- IB, Isobutene polymer.
- PS, Organic polysulfide.
- PV, Plasticized vinyl chloride polymer.

Manufactured by:
- B, Bayer & Co., 1915-18, Germany.
- BC, Belgium Cracking Co., Belgium.
- BFG, B. F. Goodrich Co., U.S.A.
- DP, E. I. du Pont de Nemours and Co., U.S.A.
- GE, General Electric Co., U.S.A.
- IC, Imperial Chemical Industries, England.
- IG, I. G. Farbenindustrie, Germany.
- J, Japan.
- S, Stomil Co., Poland.
- SO, Standard Oil Co., U.S.A.
- SR, Soviet Russia.
- TC, Thiokol Corporation, U.S.A.
- UI, Umeno Institute, Japan.

Trade name	Type	Mfd. by	Remarks
Buna 85	B	IG	Mol. wt. *ca.* 85,000
Buna 115	B	IG	Mol. wt. *ca.* 115,000
Buna N *	BC	IG	Co-polymer with acrylonitrile; now called Perbunan
Buna S	BC	IG	Co-polymer with styrene
Buna SS	BC	IG	Co-polymer with styrene; more styrene than Buna S
Duprene *	C	DP	Now called Neoprene
Ethanite	PS	BC	Similar to Thiokol A
Flamenol	PV	GE	.....
Ker	B	S	.....
Korogel	PV	BFG	Highly plasticized Koroseal
Koroseal	PV	BFG	.....
Levulkan *	BC	IG	Now called Buna SS
Methyl rubber B	DB	B	Sodium used as catalyst
Methyl rubber H	DB	B	Cold polymerization
Methyl rubber W	DB	B	Hot polymerization
Neoprene	C	DP	.....
Mustone	C	UI	.....
Oppanol	IB	IG	.....
Perbunan	BC	IG	Co-polymer with acrylonitrile
Perbunan Extra	BC	IG	Higher nitrile content than Perbunan
Perduren	PS	IG	.....
Resinit *	PS	SR	.....
SKA	B	SR	From petroleum
SKB	B	SR	From alcohol
Sovoprene	C	SR	.....
Thiokol	PS	TC	.....
Thionite	PS	J	.....
Vistanex	IB	SO	.....
Vulcaplas	PS	IC	.....

*This term now commercially obsolete.

CHEMICAL STRUCTURES OF SYNTHETIC RUBBERS

Compound	Monomer	Polymer	Examples
Simple polymers:			
1,3-Butadiene	$CH_2{:}CH{\cdot}CH{:}CH_2$	$—CH_2{\cdot}CH{:}CH{\cdot}CH_2—$	Buna 85 and 115; SKA; SKB; Ker
2-Methyl-1,3-butadiene (isoprene)	$CH_2{:}C(CH_3)CH{:}CH_2$	$—CH_2{\cdot}C(CH_3){:}CH{\cdot}CH_2—$	Natural rubber
2,3-Dimethyl-1,3-butadiene	$CH_2{:}C(CH_3){\cdot}C(CH_3){:}CH_2$	$—CH_2{\cdot}C(CH_3){:}C(CH_3){\cdot}CH_2—$	Methyl rubber
2-Chloro-1,3-butadiene (chloroprene)	$CH_2{:}C(Cl){\cdot}CH{:}CH_2$	$—CH_2{\cdot}C(Cl){:}CH{\cdot}CH_2—$	Neoprene; Sovprene; Mustone
2-Methyl-1-propene (isobutene)	$(CH_3)_2C{:}CH_2$	$—C(CH_3)_2{\cdot}CH_2—$	Vistanex; Oppanol
Chloroethene (vinyl chloride)	$ClCH{:}CH_2$	$—CHCl{\cdot}CH_2—$	Plasticized materials; Koroseal; Korogel; Flamenol
Co-polymers:			
Butadiene + styrene	$CH_2{:}CH{\cdot}CH{:}CH_2 + C_6H_5CH{:}CH_2$	$—CH_2{\cdot}CH{:}CH{\cdot}(CH_2)_2{\cdot}CH(C_6H_5)—$	Buna S and Buna SS
Butadiene + acrylonitrile	$CH_2{:}CH{\cdot}CH{:}CH_2 + CH_2{:}CH{\cdot}CN$	$—CH_2{\cdot}CH{:}CH{\cdot}(CH_2)_2{\cdot}CH(CN)—$	Perbunan and Perbunan Extra
Polysulfides:			
Ethylene chloride + sodium tetrasulfide	$ClCH_2{\cdot}CH_2Cl + Na_2S_4$	$—CH_2{\cdot}CH_2{\cdot}S(:S){\cdot}S(:S)—$	Thiokol A
Dichloroethyl ether + sodium tetrasulfide	$(ClCH_2{\cdot}CH_2)_2O + Na_2S_4$	$—CH_2{\cdot}CH_2{\cdot}O{\cdot}CH_2{\cdot}CH_2{\cdot}S(:S){\cdot}S(:S)—$	Thiokol B; Perduren G

ELECTRICAL PROPERTIES OF SYNTHETIC RUBBERS

Abbreviations used in the table:
E, dielectric constant.
L, conductivity in mho/cm.
PF, power factor.

Name	*E*	*L*	*PF*
Neoprene[d,e]	7.5†	1×10^{-12}	300×10^{-4}†
Perbunan[e]	*ca.*15	*ca.* 1×10^{-7}	.....
Buna 85; 115, and S	2.9*	*ca.* 1×10^{-14}	7×10^{-4}*
Thiokol	4.6	.....	.....
Vistanex	2.3†§	$<20 \times 10^{-18}$	1.5×10^{-4}† 3.4×10^{-4}§
Vinyl chloride[a]	3.3†	0.1×10^{-12}	.....
Vinyl chloride[b]	5.7†	2.8×10^{-12}	.....
Vinyl chloride[c]	9.7†	323×10^{-12}	.....

(a) With 0% tricresyl phosphate as plasticizer.
(b) With 30% tricresyl phosphate as plasticizer.
(c) With 60% tricresyl phosphate as plasticizer.
(d) With only enough added ingredients to insure proper vulcanization.
(e) Polar groups—chlorine in Neoprene and Koroseal, nitrile in Perbunan—result in relatively high values of conductivity and dielectric constant. This is advantageous in the dissipation of undesired static charges.
* At 50 c/s.
† At 1000 c/s.
§ At 100,000 c/s.

PHYSICAL PROPERTIES OF SYNTHETIC RUBBERS

Abbreviations used in the table:
D, density, g./cc. at 20° to 25°C.
n_D^t, index of refraction at t°C. and D line wave length.
T, tensile strength in kg./sq. cm.
E, elongation in %.

Name	Unvulcanized				Vulcanized			
					Pure gum		Carbon-black	
	D	n_D^t	T	E	T	E	T	E
Natural rubber	0.91	1.5190^{25}	25	1,200	290	710	350	650
Buna 85	....	.....	...	.....	...	...	175	600
Buna 115	....	.....	...	.....	...	...	200	700
Buna S	....	.....	...	.....	...	...	280	650
Chloroprene, μ-polymer	1.23	1.5512^{20}	...	.....	...	...	...	...
Koroseal [a]	....	.....	400	2	†	†	†	†
Koroseal [b]	....	.....	270	170	†	†	†	†
Koroseal [c]	....	1.525^{20}	70	500	†	†	†	†
Methyl rubber	0.93	.....	...	.....	...	...	...	...
Methyl rubber W	....	.....	...	.....	30	510	170	530
Methyl rubber H	....	.....	...	.....	90	240	160	300
Neoprene	1.25	1.5580^{25}	30	1,100	300	820	290	760
Perbunan	0.96	1.5213^{25}	...	.....	150	900	320	600
Perbunan Extra	0.97	.....	...	.....	...	...	...	...
Perduren G	1.68	.....	...	.....	...	...	...	...
Perduren H	1.56	.....	...	.....	...	...	...	...
Perduren L	1.17	.....	...	.....	...	...	...	...
Thiokol A	1.60	.....	...	.....	...	...	60	370
Thiokol D	1.34	.....	7	570	35	750	120	610
Thiokol DX	1.39	.....	...	.....	...	...	...	...
Thiokol F	1.38	.....	...	.....	...	...	...	...
Vistanex HM (Oppanol B 200)	0.91	1.5089^{25}	60	1,000	†	†	†	†
Vistanex MM (Oppanol B 100)	....	.....	20	1,000	†	†	†	†
Vinyl chloride [a]	1.42	1.565^{40}	...	.....	...	...	...	...
Vinyl chloride [b]	1.33	.....	...	.....	...	...	...	...
Vinyl chloride [c]	1.25	.....	...	.....	...	...	...	...

(a) With 0% plasticizer.
(b) With 30% plasticizer.
(c) With 60% plasticizer.
† Not vulcanizable.

SWELLING OF VULCANIZED SYNTHETIC RUBBERS IN LIQUIDS

The first eight liquids are petroleum products, in the handling of which synthetic rubber has been found particularly useful. Unfortunately, the common names used for the liquids are insufficient to describe their chemical compositions, which may vary widely with place of origin and subsequent treatment. Since the swelling is determined largely by the chemical composition of the liquid, such a wide variation of values is obtained that the figures quoted for these products are less significant than those for the others. Neoprene, for example, may swell in different lubricating oils at 100°C. as much as 120% or as little as 12%. Correlation is found with a figure

which represents to some extent the ratio of aliphatic to aromatic constituents in the oil. Usually the tensile strength of a synthetic rubber shows less impairment than that of natural rubber, even when the amounts of swelling are not widely different. Synthetic compounds can be made which are greatly superior to natural rubber in that there is much less extraction of soluble material by liquids in contact with them.

The table below gives the volume increase, in %, after immersion for 8 weeks at room temperature.

Liquid	Natural rubber	Neoprene	Perbunan	Perbunan Extra	Thiokol A	Thiokol D	Thiokol DX, F
Light gasoline	160	...	20	20	0	...	...
Gasoline	230	8	40	...	0	3	3
Kerosene	...	60	...	...	0	2	2
Diesel oil	120	...	15	15	...	...	...
Fuel oil	...	...	...	...	0	10	10
Lubricating oil	...	40	−4	...	0	1	1
Paraffin oil	140	...	3	...	...	...	...
Transformer oil	150	...	5	...	...	...	...
Acetone	...	25	110	100	...	...	9
Benzene	370	160	210	140	7	150	90
Carbon tetrachloride	670	160	220	120	0	40	30
Ethyl ether	130	50	50	...	...	...	...
Linseed oil	100	...	20	...	...	1	1
Turpentine	300	90	50	30	0	...	...

PERMEABILITY OF SYNTHETIC RUBBERS

Buna S, Buna 85, and Buna 115 possess about the same permeabilities to air as natural rubber does, but Perbunan shows a permeability less than half as large.

The table below gives the diffusion of water in terms of grams of water vapor passing through 1 sq. cm. of material 1 cm. thick in one hour under a differential pressure of 1 mm. of mercury; i.e., $g \cdot hr^{-1} \cdot cm \cdot cm^{-2} \cdot (mm\ of\ Hg)^{-1}$.

The permeability of hydrogen is given in terms of cubic centimeters per minute passing through a membrane 1 cm. thick and 1 sq. cm. in area, when it separates air at atmospheric pressure from the gas at a pressure of 30 mm. of water above atmospheric; i.e., $cm^3 \cdot min^{-1} \cdot cm \cdot cm^{-2}$.

Name	$H_2O \times 10^8$	$H_2 \times 10^6$
Soft vulcanized rubber	6.66	....
Rubber	....	24
Ebonite	1.51	....
Neoprene, vulcanized	2.63	....
Neoprene	....	4.2
Thiokol A	0.22	....
Thiokol B	....	0.71
Thiokol D	....	1.51
Vinyl chloride, plasticized polymer	3.85	....

PLASTICS

From information contained in *Plastics in the National Defense*, by Robert J. Moore, Bakelite Corporation; *Trans. Am. Inst. Chem. Engrs.* 37, *521 (1941)*. Reprinted with permission.

Plastics are amorphous substances and, unlike crystalline compounds, do not possess physical properties which can be regarded as true constants. Moreover, many commercial plastics are variable mixtures of substances with formulations made to meet certain conditions of use. It is for these reasons that tables of physical properties can not be presented in the same manner as tables of physical properties of crystalline compounds. For concise information as to composition, properties and trade names reference can be made to "*Modern Plastics Catalog*," published by Breskin Publishing Corp., 122 E. 42nd St., New York.

To illustrate the kinds of properties generally required of a plastic material and the numerical values of these properties the following list is given for a widely used "high impact" phenolic molding material. Determinations of the values were made according to *A.S.T.M. Standard Tests.*

Specific gravity	1.37–1.40
Weight per cubic inch	0.79–0.81 oz. (22.4–22.9 g.)
Tensile strength	6800–7200
Compressive strength	20,000–30,000
Impact strength*	25–30 ft.-lbs. for an inch sq.
Flexural strength (transverse)	10,000–13,000
Modulus of elasticity (by flexure)	$0.70–1.00 \times 10^6$
Distortion under heat (2.5 kgm. load)	130°C.
Specific heat	0.30–0.35
Thermal conductivity**	$3–4 \times 10^{-6}$
Coefficient of heat expansion	45×10^{-6}
Dielectric strength†	300–400
" " ‡	200–300
Volume resistivity at 30°C.	$0.5–1.0 \times 10^5$ megohms/cc.
Power factor (10^3 cycles)	0.08–0.20 (8%–20%)
" " (10^6 cycles)	0.05–0.10 (5%–10%)
Dielectric constant (10^3 cycles)	4.5–6.0
" " (10^6 cycles)	4.5–6.0
Water absorption#	*ca.* 1.0%
" " ##	*ca.* 3.3%
Standard colors	black, brown and tan
Colors made to order	a limited range

* *Energy to break test piece* $/bd^2$ where b = width, and d = thickness measured in the direction of force application.
** Calories per cm^2 per sec. per °C. per cm.
† Instantaneous 60 cycles.
‡ Step 60 cycles.
Disc 2 inches diameter by ¼ inch thick for 24 hrs.
Disc 2 inches diameter by ¼ inch thick for 144 hrs.

EXPLANATION OF TABLES I AND II

In the two tables which follow, the plastics have been classified into 13 types and designated by the letters from *A* to *M*.

TYPES OF PLASTICS

A Phenolic, general purpose
B Phenolic, low-loss
C Phenolic, heat-resistant
D Phenolic, acid- and alkali-resistant
E Phenolic, shock-resistant
F Phenolic, transparent
G Urea
H Polystyrene
I Cellulose acetate
J Aceto-butyrate
K Ethyl cellulose
L Methyl methacrylate
M Vinyl (no filler)

The values in the following two tables are all relative values and make possible a comparison between types. Thus, from Table I a comparison of type *B* with type *F* for the property of toughness is to be interpreted in the sense that *F* shows 4 times the toughness as does *B*.

In Table II, relative values are given with *number one as the best* for the given condition. Thus, type *J* is rated *1* (i.e., *first* or *best*) for toughness whereas type *B* (11) is *eleventh* or *poorest* of all the types. Table II is intended to assist a designer in making a selection of material to meet certain conditions. *Example*—Which plastic is most suitable for an automobile distributor head? *Answer*—Toughness is a property to be desired and from the table it is found that *E* is the most suitable thermoplastic material. Flexural and tensile strength are not highly important nor is the matter of color. Cold flow must be considered. Here all the phenolic materials appear to be suitable. In the next group of properties only water resistance need be considered and here *H* is first, *M* is second, and *B* and *C* are tied for third place. In the next group of properties are dimensional change on aging and heat resistance. For aging will be found the following types in their order of suitability: (1st) *C;* (2d) *B;* (3d) *H* and *M;* (4th) *A*. For heat resistance the order is: (1st) *C;* (2d) *A;* (3d) *B;* (4th) *J*. Of the remaining properties dielectric strength and moldability around inserts are the most important. For dielectric strength the order of suitability is: (1st) *H*, *K*, and *M;* (2d) *G;* (3d) *B*. For moldability around inserts the phenolics *A* to *F* have an advantage over all the others. Thus it is evident that, all properties considered, the phenolics *A* to *F* have an advantage over all the others. Which of the phenolics is to be selected is a matter of cost. The general-purpose material *A* is the cheapest not only in the price per pound but also because of its lower density. While *A* may not be the best material for the job yet it is amply suitable and therefore is commonly used in the manufacture of distributor heads.

TABLE I. PROPERTIES OF PLASTICS

Properties	Types of Plastics												
	A	B	C	D	E	F	G	H	I	J	K	L	M
Toughness**	1.5	1	2	1.5	30	4	3	4	22*	37*	27	4.5	9
Flexural Strength	26	26	22	17	33	33	33	30	17	19	30	33	33
Tensile Strength	26	19	17	17	22.5	26	31	19	13	12	21	24.5	28
Color Stability	†	†	†	†	†	†	#	#	#	#	#	#	#
Cold Flow §	4	4	4	4	4	..	4–70	20–220	20–640	..	..	10–550	10–320
Heat Resistance ‡	44	32	57.5	32	32	32	19	21	22	25	22	16	17.5
Thermal Conductivity [b]	7	33	33	7	8	7	11.5	3	10	13	10	7	7
Water Absorption [a]	8–11.5	1	1	2	10–16	2	16–32	*b*	23–45	13–18	20	6.5–8	0.3
Resistance to Alk. Weak	F	F	F	VG	F	VG	F	E	F	F	VG	VG	E
Resistance to Alk. Strong	P	P	P	P	VP	P	P	E	VP	P	VG	VG	E
Resistance to Acid Weak	F	..	F	VG	F	F	F	E	F	F	F	VG	E
Resistance to Acid Strong	G	..	P	G	P	G	P	E	P	P	P	G	E
Density [d]	22–25	30.5	32	20.5	22.5	21	23–24	16	21–22	20	18.5	19.5	22
Dielectric Strength [e]	42–63	67	35	42	35	42–56	70	91	49	..	91	70	91
Relative Loss Factor 60~ [f]	4675	172	..	..	..	375	625	1	300	68	38	188	313
Relative Loss Factor 100~	1560	88	..	..	..	375	350	1	450	68	38	248	293
Relative Loss Factor 10^6~	413	44	..	..	..	375	350	1	375	68	38	83	293
Resistivity [g]	13	10^4	2	..	1	120	2000	10^8	100	..	10^5	..	10^4

* Charpy. ** Impact strength. † Recommended for dark shades only. # All shades possible.

§ Relative % decrease in height of ½ inch cube, 24 hrs., 120°F., 1000 lbs. load; values show minimum-maximum ranges according to formulations.

‡ Values are for continuous heat and show highest useful temperature rating; special formulations may vary ratings on permanently thermoplastic materials.

[a] The higher the rating the better the heat conduction.

[b] Immersion A.S.T.M.; values show minimum-maximum ranges of water absorption according to formulations. Of all the thermoplastics, the polystyrenes and the copolymer vinyls rank first in water resistance; *e.g.*, water absorption of copolymer vinyl is less than 0.1% for 24 hrs. immersion.

[c] *E*, excellent; *VG*, very good; *G*, good to other than strong oxidizing acids; *F*, fair; *P*, poor; *VP*, very poor.

[d] Weight per unit volume; values show minimum-maximum ranges according to formulations.

[e] A.S.T.M. ½ inch instantaneous; values show minimum-maximum ranges according to formulations.

[f] Assuming polystyrene, which shows the lowest loss, to have unit value. This rating is arbitrary since frequencies change relative losses.

[g] Assuming phenolic shock-resistant, which is the lowest, to have unit value and considering its excellent resistivity the ratings for the higher ones are fantastic. All are good insulators for direct current.

TABLE II. PLASTICS COMPARATOR

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The numerical value indicates the relative value of a given plastic starting with *number one as the best* for the given condition.

Properties	Types of Plastics												
	A	B	C	D	E	F	G	H	I	J	K	L	M
Toughness *	10	11	9	10	2	7	8	7	4	1	3	6	5
Flexural Strength	3	3	4	6	1	1	1	2	6	5	2	1	1
Tensile Strength	3	7	8	8	5	3	1	7	9	10	6	4	2
Color Stability	7	7	7	7	7	7	1	4	3	3	6	2	5
Cold Flow	1	1	1	1	1	1	2	4	8	6	7	5	3
Water Resistance	6	3	3	4	7	4	9	1	11	8	10	5	2
Acid Resistance	3	4	4	2	4	3	4	1	4	4	4	2	1
Alkali Resistance	4	4	4	3	5	3	4	1	6	4	2	2	1
Solvent Resistance	1	1	1	1	1	1	1	3†	3†	3†	3†	3†	2†
Dimensional Change on Aging	4	2	1	5	6	5	7	3	9‡	8‡	8‡	8‡	3‡
Heat Resistance	2	3	1	3	3	3	7	6	5	4	5	9	8
Flammability**	3	1	1	2	4	2	5	6	6	6	6	6	6
Heat Insulation	2	7	7	2	3	2	5	1	4	6	4	2	2
Density	8	12	13	5	10	6	11	1	7	4	2	3	9
Hardness	5	3	2	4	5	4	1	6	9§	8§	8§	7§	7§
Loss Factor	10	4	..	..	..	7	9	1	8	3	2	5	6
Resistivity	7	3	8	..	9	5	4	1	6	..	2	..	3
Dielectric Strength	4	3	8	7	8	6	2	1	5	..	1	2	1
Moldability Around Inserts	2	2	2	3	1	3	4	6	5	5	5	6	5

* Impact strength.

** Inverse ratio of the time the piece continues to burn after removal from gas flame.

† Soluble in specific types of solvents.

‡ Depends upon the type of plasticizer and content of plasticizer.

§ Varies according to percentage and type of plasticizer.

COMMON OR TRADE NAMES OF CHEMICALS WITH THEIR CHEMICAL SYNONYMS AND FORMULAS

See also the tables: *Properties of Minerals, Physical Constants of Inorganic Compounds, Physical Constants of Organic Compounds, Composition and Physical Properties of Alloys,* and *Commonly Used Ceramic Materials.*

Common or Trade Name	Chemical Synonym	Formula
A acid	1, 7-Dihydroxy-naphthalene-3, 6-disulfonic acid	$C_{10}H_8O_8S_2$
Acenaphthenequinone	7, 8-Diketo-acenaphthene	$C_{12}H_6O_2$
3-Acenaphthol	3-Hydroxy-acenaphthene	$C_{12}H_{10}O$
Acerdol	Calcium permanganate	$Ca(MnO_4)_2 \cdot 4H_2O$
Acetosol	Acetylene tetrachloride	$Cl_2CH \cdot CHCl_2$
Acetylenogen	Calcium carbide	CaC_2
Acetyl-H acid	8-Acetamido-1-naphthol-3, 6-disulfonic acid	$C_{12}H_{11}O_8NS_2$
Acetylith	Calcium carbide	CaC_2
Acrylic liquid	Methyl methacrylate	$CH_2:C(CH_3)CO_2CH_3$
Actol	Silver lactate	$AgC_3H_5O_3 \cdot H_2O$
Adalin	Bromo-diethylacetyl urea	$(C_2H_5)_2CBr \cdot CO \cdot NHCONH_2$
Adorin	Formaldehyde	HCHO
Adronol acetate	Cyclohexanol acetate	$CH_3CO_2C_6H_{11}$
Aerngo	Copper acetate	$Cu(C_2H_3O_2)_2 \cdot 6H_2O$
Agnin, or agnolin	Anhydrous lanolin	.....
Air saltpeter	cf. Saltpeter	.....
Aldoform	Formaldehyde	HCHO
Alembroth	cf. Sal alembroth	.....
Alen's α-acid	cf. Freund's acid	.....
Alizarin assistant	cf. Turkey red oil	.....
Alum Alum flour Alum meal	Potassium aluminum sulfate	$K_2Al_2(SO_4)_4 \cdot 24H_2O$
Alumina	Aluminum oxide	Al_2O_3
Alumino-ferric	Mixed sodium and aluminum sulfates	.....
Alundum	Fused alumina	Al_2O_3
American ashes	Crude potassium carbonate	K_2CO_3
Amide powder	An explosive powder	40% KNO_3, 38% NH_4NO_3, 22% C
4-Amino-chrysoidine	2, 4, 4'-Triamino-azo-benzene	$C_{12}H_{13}N_5$
Aminoform	cf. Hexamin	.....
Amino-naphthol-δ	1-Amino-7-naphthol	$C_{10}H_9ON$
Amino-naphthol-disulfonic acid K	cf. K acid	.....
Amino-naphthol-disulfonic acid RR or 2R	cf. 2R acid	.....
Amino-naphthol-disulfonic acid SS	1-Amino-8-naphthol-2, 4-disulfonic acid	$C_{10}H_9O_7NS_2$
Amino-naphthol-sulfonic acid or G	2-Amino-8-naphthol-6-sulfonic acid	$C_{10}H_9O_4NS$
Amino-naphthol-sulfonic acid R	2-Amino-3-naphthol-6-sulfonic acid	$C_{10}H_9O_4NS$
Amino-naphthol-sulfonic acid S	1-Amino-8-naphthol-4-sulfonic acid	$C_{10}H_9O_4NS$
Amino-phenol-sulfonic acid III	3-Amino-phenol-4-sulfonic acid	$C_6H_7O_4NS$
Amino-phenol-sulfonic acid IV	3-Amino-phenol-6-sulfonic acid	$C_6H_7O_4NS$

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Amino-phenol-sulfonic acid V	3-Amino-phenol-5-sulfonic acid	$C_6H_7O_4NS$
Amino-R acid	2-Naphthylamine-3, 6-disulfonic acid	$C_{10}H_9O_6NS_2$
Ammoniak	Ammonium chloride	NH_4Cl
Ammoniated iron	Ferric ammoniochloride	2.5% $FeCl_3$ + 97.5% NH_4Cl
Amylum	Corn starch	$(C_6H_{10}O_5)_n$
Analite	Explosive mixture of gasoline and N_2O_4	.....
Andresen's acid	1-Naphthol-3, 8-disulfonic acid or 2-Naphthylamine-4, 7-disulfonic acid	$C_{10}H_9O_6NS_2$
Anhydrone	Anhydrous magnesium perchlorate	$Mg(ClO_4)_2$
Animal oil	cf. Bone oil	.....
o-Anisidine	*o*-Methoxy-aniline	C_7H_9ON
Anthion	Potassium persulfate	$K_2S_2O_8$
Antichlor	Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$
Antimonine	Antimony lactate	$Sb(C_3H_5O_3)_3$
Antimony (crude)	Antimony trisulfide	Sb_2S_3
Antimony black	Antimony trisulfide	Sb_2S_3
Antimony bloom	Antimony trioxide	Sb_2O_3
Antimony glance	Antimony trisulfide	Sb_2S_3
Antimony gray	Antimony trisulfide	Sb_2S_3
Antimony red Antimony vermilion	Antimony pentasulfide or antimony oxysulfide	Sb_2S_5 or $Sb_2S_3 + Sb_2O_3$
Antimony white	Antimony trioxide	Sb_2O_3
Antimony yellow	Basic lead antimonate	$PbO \cdot Sb_2O_5$
Ant oil (artificial)	Furfural	$C_4H_3O \cdot CHO$
Apple acid	Malic acid	$H_2C_4H_4O_5$
Aqua fortis	Nitric acid	HNO_3
Aqua regia	Mixture of nitric and hydrochloric acids	$HNO_3 + 3HCl$
Aquadag	Colloidal solution of graphite	.....
Arctic essence	Methyl chloride	CH_3Cl
Argatoxyl	Silver atoxylate	$NH_2C_6H_4 \cdot AsO \cdot AgO \cdot OH$
Argol	Impure potassium hydrogen tartrate	$KHC_4H_4O_6$
Armstrong and Wynne's acid	1-Naphthol-3-sulfonic acid	$C_{10}H_8O_4S$
Arnaudon's green	Chromic hydroxide combination with some acid as boric, phosphoric, etc.	.....
Arsenic glass	Arsenic trioxide	As_2O_3
Arsenic red (or orange)	Arsenic disulfide	As_2S_2
Ascarite	Sodium hydroxide deposited on inert material	NaOH
Atabrine	cf. Quinacrine hydrochloride	.....
Atoxyl	Sodium *p*-aminophenyl-arsonate	$NH_2C_6H_4AsO \cdot OH \cdot ONa$
Auricome	Hydrogen peroxide	H_2O_2
Auripigment	Arsenic trisulfide	As_2S_3
Aurora orange (or yellow)	Cadmium sulfide	CdS
Azure blue	cf. Cobalt blue	.....
Azure copper	cf. Copper carbonate blue	.....
B acid	1-Amino-8-naphthol-3, 5-disulfonic acid	$C_{10}H_9O_7NS_2$
Bakelite	Phenol-formaldehyde condensation resin	.....

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Baking soda	Sodium hydrogen carbonate	$NaHCO_3$
Baldwin's phosphorus	Fused calcium nitrate	$Ca(NO_3)_2$
Ballistite	Smokeless powder	50% nitroglycerin and 50% collodion cotton
Barium white	Barium sulfate	$BaSO_4$
Barium yellow	Barium chromate	$BaCrO_4$
Baryta water	Barium hydroxide solution	$Ba(OH)_2$ + aq.
Baryta yellow	Barium chromate	$BaCrO_4$
Battery acid	Sulfuric acid	H_2SO_4
Battery manganese	Manganese dioxide	MnO_2
Beckton white	cf. Lithopone	.....
Bentonite	Impure aluminum silicate	.....
Benzine	Gasoline, petroleum ether	.....
Benzinoform	Carbon tetrachloride	CCl_4
Benzoline	cf. Naphtha, petroleum	.....
Bicarburetted hydrogen	Ethylene	C_2H_4
Bichrome	Potassium (or sodium) dichromate	K_2(or Na_2)Cr_2O_7
Bismuth white	Bismuth subnitrate or bismuth oxychloride	$BiONO_3 \cdot H_2O$ or BiOCl
Bismuth yellow	Bismuth chromate	$Bi_2(CrO_4)_3$
Bitter salt	Magnesium sulfate	$MgSO_4 \cdot 7H_2O$
Black antimony	Antimony trisulfide	Sb_2S_3
Black ash	Impure sodium carbonate	Na_2CO_3
Black flux	Mixture of potassium carbonate and carbon	K_2CO_3 and C
Black precipitate	Mercurous chloride	HgCl
Blanc de perle	Bismuth oxychloride	BiOCl
Blanc d'Espagne	Bismuth oxychloride	BiOCl
Blau gas	Blue gas	44% CH_4, 52% H_2
Bleaching powder	Calcium chloro-hypochlorite	CaClOCl
Blue copperas	Copper sulfate	$CuSO_4 \cdot 5H_2O$
Blue malachite	cf. Copper carbonate blue	.....
Blue salts	Nickel sulfate	$NiSO_4 \cdot 6H_2O$
Blue stone	Copper sulfate	$CuSO_4 \cdot 5H_2O$
Blue verdigris	Basic copper acetate	$Cu(C_2H_3O_2)_2 \cdot CuO$
Blue verditer	Basic copper carbonate	$2CuCO_3 \cdot Cu(OH)_2$
Blue vitriol	Copper sulfate	$CuSO_4 \cdot 5H_2O$
Boletic acid	Fumaric acid	$(CH \cdot CO_2H)_2$
Bone black	Animal charcoal	C
Bone oil	Mixture of pyrrole, pyridine, quinoline, fatty acids and nitriles, amines, and hydrocarbons from distillation of bones	.....
Boracic acid	Boric acid	H_3BO_3
Boroform	Acetylene tetrachloride	$(CHCl_2)_2$
Bremen blue	cf. Copper carbonate blue	.....
Bremen green	cf. Brunswick green	.....
Brimstone	Sulfur	S
Brunswick green	Basic copper carbonate	$Cu_2(OH)_2CO_3$
Burnt alum	Anhydrous potassium aluminum sulfate	$K_2Al_2(SO_4)_4$
Burnt lime	Calcium oxide	CaO
Burnt ochre	Ferric oxide	Fe_2O_3
Burnt ore	Ferric oxide	Fe_2O_3
Buttercup yellow	cf. Zinc yellow	.....

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
"Butter of"	Chloride of	.....
Butter of antimony	Antimony trichloride solution	$SbCl_3$ +aq.
Butyl glycol	Glycol monobutyl ether	$HOC_2H_4OC_4H_9$
C acid	2-Naphthol-4, 8-disulfonic acid	$C_{10}H_8O_7S_2$
Cadmium yellow	Cadmium sulfide	CdS
Calamine *	Zinc carbonate	$ZnCO_3$
Calcic liver of sulfur	Calcium sulfide	CaS
Calgon	Sodium hexametaphosphate	$(NaPO_3)_6$
Caliche	Impure sodium nitrate	$NaNO_3$
Calomel	Mercurous chloride	HgCl
Calx	Calcium oxide	CaO
Calx chlorinata	cf. Bleaching powder	.....
Canadol	cf. Naphtha, petroleum	.....
Canton's phosphorus	Calcium sulfide	CaS
Caoutchouc	Rubber	$(C_5H_8)_n$
Caput mortum	Ferric oxide, red	Fe_2O_3
Carbon chloride, Julin's	Hexachlorobenzene	C_6Cl_6
Carbon hexachloride	Hexachloroethane	C_2Cl_6
Carbonic acid	Carbon dioxide	CO_2
Carbonic anhydride	Carbon dioxide	CO_2
Carborundum	Silicon carbide	SiC
Carrene	Methylene chloride	CH_2Cl_2
Cassel's green	Barium manganate	$BaMnO_4$
"Caustic"	Hydroxide of	.....
Caustic alcohol	Sodium ethylate	C_2H_5ONa
Caustic antimony	Antimony trichloride	$SbCl_3$
Cellon	Acetylene tetrachloride	$(CHCl_2)_2$
Ceruse	Basic lead carbonate	$2PbCO_3 \cdot Pb(OH)_2$
Cerussa	cf. Ceruse	.....
Chalk	Calcium carbonate	$CaCO_3$
Charlton white	cf. Lithopone	.....
Chile niter	Sodium nitrate	$NaNO_3$
Chile saltpeter	cf. Saltpeter	.....
Chinacrin	cf. Atabrin	.....
Chinese blue	cf. Prussian blue	.....
Chinese red	Basic lead chromate	$PbCrO_4 \cdot PbO$
Chinese oxide	Zinc oxide	ZnO
Chinese vermilion	Mercuric sulfide (red)	HgS
Chinese white	Zinc oxide	ZnO
Chloralum	Aluminum chloride	$AlCl_3 \cdot 6H_2O$
Chloride of lime	cf. Bleaching powder	.....
Chloride of soda	Sodium hypochlorite solution	NaOCl +aq.
Chloro-H acid	1-Chloro-8-naphthol-3, 6-disulfonic acid	$C_{10}H_7O_7S_2Cl$
Chrome alum	Potassium chromium sulfate	$K_2Cr_2(SO_4)_4 \cdot 24H_2O$
Chrome green	Chromium oxide	Cr_2O_3
Chrome red	Basic lead chromate	$PbCrO_4 \cdot PbO$
Chrome yellow	Lead chromate	$PbCrO_4$
Chromic acid	Chromium trioxide	CrO_3
Cinnabar (artificial)	Mercuric sulfide (red)	HgS
Cinnabar, Austrian	cf. Chrome red	.....
Citron yellow	cf. Zinc yellow	.....
Cleve's α-acid	1-Naphthylamine-5-sulfonic acid	$C_{10}H_9O_3NS$
Cleve's β-acid	1-Naphthylamine-6-sulfonic acid	$C_{10}H_9O_3NS$

* Chiefly of British term; cf. also Table of Minerals.

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Cleve's γ-acid	1-Naphthylamine-3-sulfonic acid	$C_{10}H_9O_3NS$
Cleve's δ-acid	1-Naphthylamine-7-sulfonic acid	$C_{10}H_9O_3NS$
Cleve's θ-acid	1-Naphthylamine-7-sulfonic acid	$C_{10}H_9O_3NS$
Cobalt black	Cobalt oxide, sesqui-	Co_2O_3
Cobalt blue	Oxides of cobalt and aluminum in varying proportions, or cobalt aluminate	.....
Cobalt green	Cobalt zincate	$CoZnO_2$
Cobalt violet	Cobaltous ammonium phosphate	$CoNH_4PO_4 \cdot H_2O$
Cobalt yellow	Potassium cobaltinitrite	$Co(NO_2)_3 \cdot 3KNO_2 \cdot 1.5H_2O$
Cobalt ultramarine	cf. Cobalt blue	.....
Colcothar	A red-brown ferric oxide obtained by heating ferrous sulfate	Fe_2O_3
Cologne yellow	Lead chromate	$PbCrO_4$
Common salt	Sodium chloride	NaCl
Copperas	Ferrous sulfate	$FeSO_4 \cdot 7H_2O$
Copper carbonate blue	Basic copper carbonate, composition variable	*ca.* $2CuCO_3 \cdot Cu(OH)_2$
Copper lasur	cf. Brunswick green	.....
Corrosive sublimate	Mercuric chloride	$HgCl_2$
Cosmetic bismuth	Bismuth oxychloride	BiOCl
Cream of tartar	Potassium hydrogen tartrate	$KHC_4H_4O_6$
Cresolin; Cresotal	Carbonate esters of cresols, guaiacol, etc.	.....
Crocus of antimony	Antimony sulfide, or a slag obtained in refining antimony, mainly sodium or potassium thioantimonite	Sb_2S_3, or Na_3SbS_3 or K_3SbS_3
Crocus of Mars (or Martis)	cf. Colcothar	.....
Crystal carbonate	Sodium carbonate (monohydrate)	$Na_2CO_3 \cdot H_2O$
Cubic nitre	Sodium nitrate	$NaNO_3$
Cupren	Acetylene polymer	$(C_2H_2)_n$ +0.2% to 0.3% Cu
Cupricin	Cuprous cyanide	$Cu_2(CN)_2$
Cystamine	cf. Hexamin	.....
Cystogen	cf. Hexamin	.....
Dahl's acid II	1-Naphthylamine-4, 6-disulfonic acid	$C_{10}H_9O_6NS_2$
Dahl's acid III	1-Naphthylamine-4, 7-disulfonic acid	$C_{10}H_9O_6NS_2$
de Haens salt	Mixture of sodium fluoride and antimony trifluoride	$NaF + SbF_3$
Dehydrite	Magnesium perchlorate	$Mg(ClO_4)_2$
Dehydro-thio-*p*-toluidine	1-(*p*-Aminophenyl)-3-methyl-benzothiazole	$C_{14}H_{12}N_2S$
Dental gas	Nitrous oxide	N_2O
Depurated tartar	Pure potassium hydrogen tartrate	$KHC_4H_4O_6$
Derby red	Basic lead chromate	$PbCrO_4 \cdot PbO$
Dermatol	Basic bismuth gallate	$Bi(OH)_2C_7H_5O_5$
Detonal	Diethylacetyl urethane	$(C_2H_5)_2CHCONHCO_2C_2H_5$
Dialozite	Manganese carbonate	$MnCO_3$
Diamine hydrate	Hydrazine hydrate	$(NH_2)_2 \cdot H_2O$
Diapthol	*o*-Hydroxyquinoline-*m*-sulfonic acid	$HOC_9H_5NSO_3H$
Diatol	Diethyl carbonate	$(C_2H_5O)_2CO$
Diazotizing salts	Sodium nitrite	$NaNO_2$
Dimethyl-gamma acid	2-Dimethylamino-8-naphthol-6-sulfonic acid	$C_{12}H_{13}O_4NS$

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Diolin	Octadecanediol	$CH_3(CH_2)_5CHOH(CH_2)_{10}\cdot CH_2OH$
Dioxogen	cf. Bone oil	.....
Dippel's oil	cf. Bone oil	.....
Dipping acid	Sulfuric acid	H_2SO_4
Dissolvan CA or DN	Mixture of 60-80°C. boiling solvents for nitro- and acetyl-celluloses	.....
Disulfo acid E	1-Naphthol-3, 8-disulfonic acid	$C_{10}H_8O_7S_2$
Disulfo acid F	2-Naphthylamine-3, 7-disulfonic acid	$C_{10}H_7O_6NS_2$
Disulfuric acid	Fuming sulfuric acid	$H_2SO_4+SO_3$
Diuretic salt	Potassium acetate	$KC_2H_3O_2$
Dolomol	Magnesium stearate	$Mg(C_{18}H_{35}O_2)_2$
Dowicide	Various chlorophenols	ClC_6H_4OH
Dragonic acid	Anisic acid	$CH_3O\cdot C_6H_4\cdot CO_2H$
Dry ice	Solid carbon dioxide	CO_2
DTS	Dehydrothio-*p*-toluidine sulfonic acid	$C_{14}H_{12}O_3N_2S_2$
Dulcose	Dulcitol	$C_6H_8(OH)_6$
Dung salt	Sodium arsenate	Na_2HAsO_4
Dunging salt	Sodium silicate	$Na_2O\cdot 4SiO_2$
Duresco	cf. Lithopone	.....
Eau-de-Javelle	Potassium hypochlorite solution	KOCl+aq.
Eau-de-Labarraque	Sodium hypochlorite solution	NaOCl+aq.
Elayl	Ethylene	C_2H_4
Electrolon	Silicon carbide	SiC
Emerald green	cf. Paris green	.....
Emeraude green	cf. Guignet's green	.....
Enamel white	cf. Lithopone	.....
English salt	Ammonium carbonate	$(NH_4)_2CO_3$
English white	Calcium carbonate	$CaCO_3$
Epsilon acid or ϵ acid	1-Naphthylamine-3, 8-disulfonic acid	$C_{10}H_9O_6NS_2$
	1-Naphthol-3, 8-disulfonic acid	$C_{10}H_8O_7S_2$
	1, 8-Dihydroxy-naphthalene-3-sulfonic acid	$C_{10}H_8O_5S$
Erdmann's μ acid	1-Naphthylamine-6-sulfonic acid	$C_{10}H_9O_3NS$
Essential salt of lemon	Potassium hydrogen oxalate	KHC_2O_4
Etherin	Ethylene	C_2H_4
Ethiops mineral	Impure black mercuric sulfide	*ca.* 60% HgS+40% S
Ethocel	Ethyl cellulose	.....
Ethyl F acid	2-Ethylaminonaphthalene-7-sulfonic acid	$C_{12}H_{13}O_3NS$
Ethyl-gamma acid	2-Ethylamino-8-naphthol-6-sulfonic acid	$C_{12}H_{13}O_4NS$
Eunatrol	Sodium oleate	$C_{17}H_{33}CO_2Na$
Euonymit	Dulcitol	$C_6H_8(OH)_6$
Everitt's salt	Potassium ferrous ferrocyanide	$K_2Fe_2(CN)_6$
F acid	2-Naphthol-7-sulfonic acid	$C_{10}H_8O_4S$
	2-Naphthylamine-7-sulfonic acid	$C_{10}H_9O_3NS$
	2-Naphthylamine-3, 7-disulfonic acid	$C_{10}H_9O_6NS_2$
	2-Amino-7-naphthol-3-sulfonic acid	$C_{10}H_9O_4NS$
	2, 7-Dihydroxy-naphthalene-3-sulfonic acid	$C_{10}H_8O_5S$
Ferro prussiate	Any ferrocyanide, specifically potassium ferrocyanide	$K_4Fe(CN)_6$
Fischer's salt	Potassium cobaltic nitrite	$K_3Co(NO_2)_6\cdot 1.5H_2O$
Fischer's yellow	cf. Fischer's salt	.....

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Fixed niter (nitre)	Potassium carbonate	K_2CO_3
Fixed white	Barium sulfate	$BaSO_4$
Flake white	Bismuth subnitrate, or (in paint) white lead	$BiONO_3 \cdot H_2O$ $2PbCO_3 \cdot Pb(OH)_2$
Flores martis	Ferric chloride	$FeCl_3 \cdot 6H_2O$
"Flowers of" a metal	Oxide of the metal	.....
Flowers of antimony	Antimony trioxide	Sb_2O_3
Flowers of bismuth	Bismuth trioxide	Bi_2O_3
Flowers of sulfur	Sublimed sulfur	S
Flowers of tin	Stannic oxide	SnO_2
Flowers of tin stone	Stannic oxide	SnO_2
Flowers of zinc	Zinc oxide	ZnO
Fluoremetic	Antimony sodium fluoride	$SbF_3 \cdot NaF$
Fluorol	Sodium fluoride	NaF
Formalin	40% Formaldehyde	HCHO + aq.
Formalith	Kieselguhr soaked in formaldehyde solution	HCHO
Formin	cf. Hexamin	.....
Formitrol	Formaldehyde	HCHO
Formolyptyol	Formaldehyde	HCHO
Freezing salt	Impure sodium chloride	NaCl
French verdigris	Basic copper acetate	$Cu_2(C_2H_3O_2)_2(OH)_2$
Freund's acid	1-Naphthylamine-3, 6-disulfonic acid	$C_{10}H_9O_6NS_2$
Fuller's earth	Hydrated aluminum and magnesium silicates	.....
Fulminating mercury	Mercuric fulminate	$Hg(ONC)_2$
Fulton white	cf. Lithopone	.....
Fumarole acid	Boric acid	H_3BO_3
Fusel oil	Mixed amyl alcohols	$C_5H_{11}OH$
Galloformin	cf. Hexamin	.....
Gasoline	Benzine or petrol	.....
Gelbin	Barium chromate, or calcium chromate	$BaCrO_4$, or $CaCrO_4 \cdot 2H_2O$
Giallioline	Lead antimoniate	$Pb_3(SbO_4)_2$
Glanzstoff	Cuprammonium artificial silk	.....
Glass liquor	Sodium silicate	$Na_2O \cdot 4SiO_2$
Glass-maker's soap	Manganese dioxide	MnO_2
Glauber's salt	Sodium sulfate	$Na_2SO_4 \cdot 10H_2O$
Glover acid	78% Sulfuric acid	H_2SO_4 + aq.
Gold salts	Sodium aurodichloride	Mixture of $AuCl_3$ and NaCl
Goulard's powder	Lead acetate	$Pb(C_2H_3O_2)_2 \cdot 3H_2O$
GR acid	cf. RG acid	.....
Graham's salt	Sodium metaphosphate	$(NaPO_3)_6$
Grain oil	cf. Fusel oil	.....
Gray antimony	Native antimony trisulfide	Sb_2S_3
Gray powder	Mixture of mercury and chalk	Hg and $CaCO_3$
Green cinnabar	Fired oxides of cobalt and zinc, or a mixture of chrome yellow and Prussian blue	.....
Green copperas	Ferrous sulfate	$FeSO_4 \cdot 7H_2O$
Green nickel oxide	Nickel oxide	NiO
Green verdigris	Basic copper acetate	$2Cu(C_2H_3O_2)_2 \cdot CuO$
Green verditer	Basic copper carbonate, or ground mineral malachite	$CuCO_3 \cdot Cu(OH)_2$
Green vitriol	Ferrous sulfate	$FeSO_4 \cdot 7H_2O$
Griffith's white	cf. Lithopone	.....

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Guignet's green	Chromic oxide and hydroxide (variable)	$Cr_2O_3 \cdot 3H_2O$
Gun cotton	Nitrocellulose	.....
Hahnem auris mercury	Mercurous chloride	HgCl
Halazone	*p*-Dichlorosulfamido-benzoic acid	$Cl_2NSO_2C_6H_4CO_2H$
Halowax	Hexachloronaphthalene	$C_{10}H_2Cl_6$
Hartshorn	Ammonium hydroxide	NH_4OH
Hartshorn salt	Ammonium carbonate-carbamate	$NH_4HCO_3 \cdot NH_2CO_2NH_4$
Heavy carburetted hydrogen	Ethylene	C_2H_4
Hedonal	Methyl-propyl-carbinol urethane	$NH_2CO_2CH(CH_3)C_3H_7$
Helcosol	Basic bismuth pyrogallate	*ca.* $C_6H_5O_4Bi$
Hepar antimony	cf. Crocus of antimony	.....
Hepar calcis	Calcium sulfide	CaS
Hepar sulfuris	Impure potassium sulfide, or calcium sulfide	K_2S, or CaS
Hepatic gas	Hydrogen sulfide	H_2S
Hexamin	Hexamethylene-tetramine	$(CH_2)_6N_4$
Hexil, or hexite	Hexanitro-diphenylamine	$(NO_2)_6C_{12}H_5N$
Hexoram	Hexachloroethane	C_2Cl_6
HNM	Mannitol hexanitrate	$C_6H_8(ONO_2)_6$
Homberg's phosphorus	Fused calcium chloride	$CaCl_2$
Horse brimstone	Impure, dark native sulfur	S
Howard's silver	Mercuric fulminate	$Hg(ONC)_2$
HTH	True calcium hypochlorite	$Ca(ClO)_2$
α-Hydro-juglone	1, 4, 5-Trihydroxy-naphthalene	$C_{10}H_8O_3$
Hydrolith	90% Calcium hydride	CaH_2
Hydrone	Lead-sodium alloy (*ca.* 30% Na)	Pb + Na
Hydrosulfite	Sodium hydrosulfite	$Na_2S_2O_4$
Hypo	Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$
Imperial green	cf. Paris green	.....
Indanthrene	Dianthraquinone-dihydroazine	$C_{28}H_{14}O_4N_2$
Indanthrone	cf. Indanthrene	.....
Indian red	Ferric oxide	Fe_2O_3
Infusible white precipitate	Dimercuri-diammonium chloride	$N_2H_4Hg_2Cl_2$
Intarvin	Glyceryl margarate	$(C_{16}H_{33}CO_2)_3C_3H_5$
Invert sugar	Mixture of equal parts of glucose and fructose	$C_6H_{12}O_6$
Iron black	Precipitated antimony	Sb
Iron ethiops	Ferroso ferric oxide	Fe_3O_4
Iron mordant	Ferric sulfate	$Fe_2(SO_4)_3$
Iron tartar	Potassium ferrous tartrate	*ca.* $K_2Fe(C_4H_4O_6)_2 \cdot xH_2O$
Iron vitriol	Ferrous sulfate	$FeSO_4 \cdot 7H_2O$
Isonaphthol	β-Naphthol	$C_{10}H_7OH$
James' powder	33.3% Sb_2O_3 and 66.6% $Ca_3(PO_4)_2$	.....
Japanese antimony	Antimony sulfide	Sb_2S_3
Jaune brilliant	Cadmium sulfide	CdS
Javelle water	cf. Eau de Javelle	.....
Jeweller's borax	Sodium tetraborate	$Na_2B_4O_7 \cdot 10H_2O$
Jeweller's rouge	Finest calcined ferric oxide	Fe_2O_3
Julin's carbon chloride	cf. Carbon chloride	.....
K acid	1-Amino-8-naphthol-4, 6-disulfonic acid	$C_{10}H_9O_7NS_2$

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Kainit	Magnesium chloride and potassium magnesium sulfate double salt	$K_2Mg(SO_4)_2 \cdot MgCl_2 \cdot 6H_2O$
Kaiser green	cf. Paris green	.....
Kalle's acid	1-Naphthylamine-2, 7-disulfonic acid	$C_{10}H_9O_6NS_2$
Kalle's salt	Acetone sodium bisulfite	$(CH_3)_2CO \cdot NaHSO_3$
Kasil	Potassium silicate solution	K_2SiO_3 +aq.
King's blue	cf. Cobalt blue	.....
King's gold	Arsenous sulfide	As_2S_3
King's green	cf. Paris green	.....
King's yellow	Arsenous sulfide, or lead chromate	As_2S_3, or $PbCrO_4$
Klee salt	Potassium hydrogen oxalate	$KHC_2O_4 \cdot H_2O$
KMS	Potassium metabisulfite	$K_2S_2O_5$
Knight's patent zinc white	cf. Lithopone	.....
Kontrastin	Pure zirconium oxide	ZrO_2
Koronium bromide	Strontium bromide	$SrBr_2 \cdot 6H_2O$
Lac sulfur(is)	Precipitated sulfur	S
Lamp black	Impure carbon	C
Land plaster	Ground gypsum	$CaSO_4 \cdot 2H_2O$
Landschoff and Meyer's acid	1-Naphthylamine-2, 5-disulfonic acid	$C_{10}H_9O_6NS_2$
Lanolin	Wool grease; cholesteryl esters of fatty acids	.....
Lapis caustic(us)	Potassium hydroxide, or fused silver nitrate	KOH or $AgNO_3$
Laughing gas	Nitrous oxide	N_2O
Laurent's α-acid	1-Nitronaphthalene-5-sulfonic acid	$C_{10}H_7O_5NS$
Lead oxide (brown)	Lead dioxide	PbO_2
Lead plaster	Essentially a mixture of lead oleate with small amounts of glycerol and oleic acid; also lead linoleate	$(C_{17}H_{33}CO_2)_2Pb$, or $(C_{17}H_{31}CO_2)_2Pb$
Lead white	Basic lead carbonate	$2PbCO_3 \cdot Pb(OH)_2$
Lead vinegar	Aqueous solution of basic lead acetate	$Pb(C_2H_3O_2)_2 \cdot PbO$ +aq.
Leipzig yellow	Lead chromate	$PbCrO_4$
Lemon chrome	Barium chromate	$BaCrO_4$
Lencogen	Sodium hydrogen sulfite	$NaHSO_3$
Leucotrope	Benzyl-dimethyl-phenyl-ammonium chloride	$C_{15}H_{18}NCl$
Ley	Sodium hydroxide	NaOH
Leyden blue	cf. Cobalt blue	.....
Lichenic acid	Fumaric acid	$(CH \cdot CO_2H)_2$
Liebman and Studer's acid	1-Naphthol-7-sulfonic acid	$C_{10}H_8O_4S$
Light oil	Coal tar distillate up to 170°C., or any petroleum oil having a high Baume gravity	.....
Ligroin(e)	Petroleum distillate, b. p. 120-35°C.	.....
Lime (unslaked or quick)	Calcium oxide	CaO
Lime (slaked)	Calcium hydroxide	$Ca(OH)_2$
Lime calcium oxide	Calcium oxide	CaO
Lime saltpeter	cf. Saltpeter	.....
Lime water	Aqueous solution of calcium hydroxide	$Ca(OH)_2$ +aq.
Liquid arsenic, fuming	Arsenic trichloride	$AsCl_3$
Liquid glass	cf. Water glass	.....
Lithopone	Zinc sulfide and barium sulfate	$ZnS + BaSO_4$

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Liver of antimony	Impure double sulfide of antimony and alkali or alkaline earth	.....
Liver of sulfur	Mixed potassium sulfides and thiosulfate, or calcium sulfide	.....
Liver ore	Mercuric sulfide (red)	HgS
Lucidol	Benzoyl peroxide	$(C_6H_5CO)_2O_2$
Lunar caustic	Fused silver nitrate	$AgNO_3$
Lunar cornea	Silver chloride	$AgCl$
Lye	Potassium or sodium hydroxide	KOH or $NaOH$
Lysol	Mixture of crude cresols in aqueous soap solution	.....
M acid	1-Amino-5-naphthol-7-sulfonic acid	$C_{10}H_9O_4NS$
Macquer's salt	Potassium arsenate	KH_2AsO_4
Magister of bismuth	Basic bismuth nitrate	$BiO \cdot NO_3 \cdot H_2O$
Magister of sulfur	Amorphous precipitated sulfur	S
"Magistery" of	A precipitate, especially a white precipitate from metallic solutions	.....
Magistery of lead	cf. White lead	.....
Magnesia alba (levis)	Magnesium carbonate	$MgCO_3$
Magnesia usta	Magnesium oxide	MgO
Magnesia white	Magnesium oxide or carbonate	MgO or $MgCO_3$
Malachite (artificial)	cf. Brunswick green	.....
Manganese black	Manganese dioxide	MnO_2
Manganese green	Barium manganate	$BaMnO_4$
Manganese white	Manganese carbonate	$MnCO_3$
Marbon white	cf. Lithopone	.....
Marignac's salt	Potassium stannosulfate	$K_2Sn(SO_4)_2$
Massicot	Unfused lead monoxide	PbO
Meadow green	cf. Paris green	.....
Meat salt	Ammonium fluoride	NH_4F
Melanpyrit	Dulcitol	$C_6H_8(OH)_6$
Mercurius vitae	Mixture of antimony oxychloride and trioxide	$SbOCl + Sb_2O_3$
Mercury chloride, mild	Mercurous chloride	$HgCl$
Mercury red precipitate	Mercuric oxide (red)	HgO
Meta	Metaldehyde	$(CH_3CHO)_3$
Metabisulfite	Sodium metabisulfite	$Na_2S_2O_5$
Methocel	Methyl cellulose	.....
Methyl anol	Methyl cyclohexanone	$CH_3 \cdot C_6H_9O$
Methyl-benzanthrene	9-Methyl-7-*meso*-benzanthrone	$C_{18}H_{12}O$
Methyl-gamma acid	2-Methylamino-8-naphthol-6-sulfonic acid	$C_{11}H_{11}O_4NS$
Methylglycol acetate	Acetate of glycol monomethyl ether	$CH_3CO_2 \cdot C_2H_4 \cdot OCH_3$
Microcosmic salt	Sodium ammonium hydrogen phosphate	$NaNH_4HPO_4 \cdot 4H_2O$
Middle oil	Coal tar distillate, b. p. 170-230°C.	.....
Mild alkali	Sodium carbonate	Na_2CO_3
Mild lime	Calcium carbonate	$CaCO_3$
Milk acid	Lactic acid	$CH_3 \cdot CHOH \cdot CO_2H$
Milk of barium	Suspension of barium hydroxide in water	$Ba(OH)_2$ + aq.
Milk of lime	Suspension of calcium hydroxide in water	$Ca(OH)_2$ + aq.
Milk of magnesia	Suspension of magnesium hydroxide in water	$Mg(OH)_2$ + aq.

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Milk of sulfur	Amorphous sulfur obtained by precipitation	S
Mineral butter	Antimony trichloride	$SbCl_3$
Mineral green	cf. Scheele's green or Brunswick green	.....
Mineral Hamburg	cf. Copper carbonate blue	.....
Mineral orange	Plumbous plumbate	Pb_3O_4
Mineral red	cf. Mineral orange	.....
Mineral white	Barium sulfate	$BaSO_4$
Mitigated caustic	Fused mixture of 1 part silver nitrate and 2 parts potassium nitrate	$AgNO_3 + KNO_3$
Mitis green	cf. Paris green	.....
Mittler's green	cf. Guignet's green	.....
Mixed acid	Mixture of nitric and sulfuric acids	$HNO_3 + H_2SO_4$
Mixed vitriol	Cupric-ferrous sulfate	$CuSO_4 \cdot 3FeSO_4 \cdot 28H_2O$
Mohr's salt	Ferrous ammonium sulfate	$FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$
Monomeric liquid	Methyl methacrylate	$CH_2{:}C(CH_3)CO_2CH_3$
Monsel's salt	Basic ferric sulfate	*ca.* $Fe_4(SO_4)_5(OH)_2 \cdot 10H_2O$
Mordant salt	Basic aluminum acetate	$Al(OH)(C_2H_3O_2)_2$
Moss green	cf. Paris green	.....
Mountain green	cf. Brunswick green	.....
Mountain vertditer	cf. Copper carbonate blue	.....
Mu acid or μ-acid	1-Naphthylamine-6-sulfonic acid	$C_{10}H_9O_3NS$
"Muriate of" a metal	Chloride of	.....
Muriatic acid	Hydrochloric acid	HCl
Muriatic ether	Ethyl chloride	C_2H_5Cl
Muthmann's liquid	Acetylene tetrabromide	$(CHBr_2)_2$
Naphtha (petroleum)	Petroleum distillate, b. p. 95-100°C.	.....
Naphtha (solvent)	Coal tar distillate, b. p. 80-110°C.	.....
Naphthalin	Naphthalene	$C_{10}H_8$
α-Naphthol sulfonic acid B	2-Naphthol-8-sulfonic acid	$C_{10}H_8O_4S$
β-Naphthol sulfonic acid S	2-Naphthol-6-sulfonic acid	$C_{10}H_8O_4S$
β-Naphthol disulfonic acid F	2-Naphthol-3, 7-disulfonic acid	$C_{10}H_8O_7S_2$
β-Naphthol disulfonic acid R	2-Naphthol-3, 6-disulfonic acid	$C_{10}H_8O_7S_2$
α-Naphthol disulfonic acid S	cf. Schoellkopf's acid	.....
α-Naphthol disulfonic acid Sch.		
α-Naphthol disulfonic acid		
α-Naphthylamine acids Cl	cf. Cleve's acids	.....
α-Naphthylamine disulfonic acids D	1-Naphthylamine-4, 6- and 4, 7-disulfonic acids	$C_{10}H_9O_6NS_2$
β-Naphthylamine-disulfonic acid R	cf. Amino-R acid	.....
α-Naphthylamine-disulfonic acid S	1-Naphthylamine-4, 8-disulfonic acid	$C_{10}H_9O_6NS_2$
Naples yellow	cf. Antimony yellow	.....
Natron	Sodium carbonate	Na_2CO_3
Natural gas	Mixture of gaseous hydrocarbons	CH_4, etc.
Needle of antimony	Antimony trisulfide	Sb_2S_3

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Nevin's white	cf. Lithopone	.....
New green	cf. Paris green	.....
Nickel black	Nickel oxide, sesqui-	Ni_2O_3
Nickel oxide, green	Nickel hydroxide	$Ni(OH)_2 \cdot H_2O$
Nigrot(in)ic acid	1, 7-Dihydroxy-6-naphthoic-3-sulfonic acid	$C_{11}H_8O_7S$
Nil alba	Zinc oxide	ZnO
Nitratine	Sodium nitrate	$NaNO_3$
Nitric ether	Ethyl nitrate	$C_2H_5O \cdot NO_2$
Nitro-1, 2, 4-acid	1-Amino-8-nitro-2-naphthol-4-sulfonic acid	$C_{10}H_8O_6N_2S$
3-Nitro-flavopurpurin	3-Nitro-1, 2, 6-trihydroxy-anthraquinone	$C_{14}H_7O_7N$
Nitro-lime	Calcium cyanamide	$CaNCN$
Norbide	Boron carbide	B_4C
Nordhausen acid	Fuming sulfuric acid	$55\%\ H_2SO_4 + 45\%\ SO_3$
Norge niter	Calcium nitrate	$Ca(NO_3)_2 \cdot 4H_2O$
Oil of hartshorn	cf. Bone oil	.....
Oil of sweet birch, synthetic	Methyl salicylate	$HOC_6H_4CO_2CH_3$
Oil of philosophers	cf. Philosopher's oil	.....
Oil of tartar	Deliquescent potassium carbonate	K_2CO_3
Oil of vitriol	Concentrated sulfuric acid	H_2SO_4
Oil of wine	Ethyl pelargonate, or a mixture of ethyl caprylate and ethyl caprate	$C_8H_{17}CO_2C_2H_5$ or $C_7H_{15}CO_2C_2H_5 + C_9H_{19}CO_2C_2H_5$
Oil of wintergreen, synthetic	Methyl salicylate	$HOC_6H_4CO_2CH_3$
Oil green	Chromium oxide	Cr_2O_3
Oil soluble	cf. Turkey red oil	.....
Oleine	cf. Turkey red oil	.....
Oleum	Fuming sulfuric acid	$H_2SO_4 + SO_3$
Oleum white	cf. Lithopone	.....
Orange cadmium	Cadmium sulfide	CdS
Orient yellow	Cadmium sulfide	CdS
Orr's white	cf. Lithopone	.....
Orthoform	Methyl *p*-amino-*m*-hydroxy-benzoate	$(NH_2)(OH)C_6H_3CO_2CH_3$
Oxone	Sodium peroxide	Na_2O_2
Oxy-dyz-ene	Mixture of potassium polysulfides and potassium thiosulfate	.....
Oxygen powder	Sodium peroxide	Na_2O_2
Oxysalicylate	Bismuth subsalicylate	$HOC_6H_4CO_2Bi(OH)_2$
Ozogen	Hydrogen peroxide	H_2O_2
Palite	Chloromethyl-chloroformate	$ClCH_2OCOCl$
Pamaquine	6-Methoxy-8-(1-methyl-4-diethyl-aminobutylamino)-quinoline	$C_{19}H_{29}ON_3$
Paradow	*p*-Dichlorobenzene	$C_6H_4Cl_2$
Paraform	Paraformaldehyde	$(CH_2O)_3$
Paranaphthalene	Anthracene	$C_6H_4(CH)_2C_6H_4$
Paris blue	Ferric ferrocyanide	$Fe_4[Fe(CN)_6]_3$
Paris green	Copper acetoarsenite	$Cu(C_2H_3O_2)_2 \cdot 3Cu(AsO_2)_3$
Paris red	cf. Mineral orange	.....
Paris yellow	Lead antimonate or lead chromate	$Pb_3(SbO_4)_2$ or $PbCrO_4$
Parrot green	cf. Paris green	.....
Patgreen	cf. Paris green	.....

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Pearl ash	Potassium carbonate	.....
Pearl white	Bismuth oxychloride	BiOCl
Perborax	Sodium perborate	$NaBO_3 \cdot 4H_2O$
Perborin	Sodium perborate	$NaBO_3 \cdot 4H_2O$
Perchloron	cf. HTH	.....
Perhydrol	Hydrogen peroxide (30%)	$H_2O_2 + aq.$
Permanent green	cf. Guignet's green	.....
Permanent white	Barium sulfate	$BaSO_4$
Permutit	Synthetic hydrated aluminum silicate with replaceable sodium	.....
Peroxydol	cf. Perborin	.....
Persian red	cf. Chrome red	.....
Petrol	Petroleum distillate, gasoline	.....
Petroleum ether	Petroleum distillate, b. p. 30-60°C. and other boiling ranges	.....
Petroline	Petroleum distillate, b. p. 120-150°C.	.....
Phene	Benzene	C_6H_6
Phenyl-gamma acid	2-Phenylamino-8-naphthol-6-sulfonic acid	$C_{16}H_{13}O_4NS$
Philosopher's egg	Mixture of salt, sulfur and mercury	NaCl, S, Hg
Philosopher's oil	Linseed oil and powdered brick	.....
Philosopher's wool	Flocculent zinc oxide	ZnO
Phosphate rock	Calcium phosphate	$Ca_3(PO_4)_2$
Phosphorus salt	Sodium ammonium hydrogen phosphate	$NaNH_4HPO_4 \cdot 4H_2O$
Photophor	Calcium phosphide	Ca_3P_2
Pickle alum	Aluminum sulfate	$Al_2(SO_4)_3$
Pickling acid	Sulfuric or acetic acid	H_2SO_4 or $HC_2H_3O_2$
Picrotol	Silver picrate	$(NO_2)_3C_6H_2OAg \cdot H_2O$
Pink salt	Ammonium stannic chloride	$(NH_4)_2SnCl_6$
Pinolith	cf. Lithopone	.....
Plasmochin	cf. Pamaquine	.....
Plate sulfate	Double salt of potassium-sodium sulfates	$K_2SO_4 \cdot Na_2SO_4$
Plessy's green	Chromium phosphate	$CrPO_4$
Plumbo	Plumbous plumbate	Pb_3O_4
Polishing powder	Impure stannic oxide	SnO_2
Ponderous magnesia	Magnesium oxide	MgO
Porcelain white	cf. Lithopone	.....
Potash	Potassium carbonate	K_2CO_3
Potash, caustic	Potassium hydroxide	KOH
Potato oil	cf. Fusel oil	.....
Potato spirit	cf. Fusel oil	.....
Powder of algaroth	Antimony oxychloride or a mixture of antimony oxychloride and antimony trioxide	SbOCl or $SbOCl + Sb_2O_3$
Precipitated chalk	Calcium carbonate	$CaCO_3$
Preservaline	Formaldehyde	HCHO
Primuline base	*p*-Toluidine heated with sulfur	$C_{28}H_{18}N_4S_3$
Printer's acetate	Basic aluminum acetate	$Al(OH)(C_2H_3O_2)_2$
Producer gas	An artificial heating gas	28-33% CO, 0.8-4% CO_2, 62-64% N_2
Prunella	Potassium nitrate	KNO_3
Prussian blue	Ferric ferrocyanide	$Fe_4[Fe(CN)_6]_3$
Prussic acid	Hydrocyanic acid	HCN

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Pthoric acid	Hydrofluoric acid	HF
Pure scarlet	Mercuric iodide	HgI_2
Purple salt	Potassium permanganate	$KMnO_4$
Putty powder	Impure stannic oxide	SnO_2
Pyroligneous acid	Crude acetic acid	$HC_2H_3O_2$
Quick lime	Calcium oxide	CaO
Quicksilver	Mercury	Hg
Quicksilver vermilion	Mercuric oxide (red)	HgS
Quinacrinehydrochloride	3-Chloro-7-methoxy-9-(1-methyl-4-diethylaminobutylamino)-acridine dihydrochloride	$C_{23}H_{30}ON_3Cl \cdot 2HCl$
2R acid	2-Amino-8-naphthol-3, 6-disulfonic acid	$C_{10}H_9O_7NS_2$
Rayon	Artificial silk	.....
Rectified spirit	90-95% Ethyl alcohol	C_2H_5OH + aq.
Red acid	1, 5-Dihydroxy-naphthalene-3, 7-disulfonic acid	$C_{10}H_8O_8S_2$
	Nitric acid of 40° Baume or stronger, containing dissolved nitrogen oxide	.....
Red antimony	Antimony oxysulfide	$Sb_2O_3 \cdot 2Sb_2S_3$
Red arsenic glass	Arsenic disulfide	As_2S_2
Red liquor	Aluminum acetate in water	$Al(C_2H_3O_2)_3$ + aq.
Red oil	cf. Turkey red oil	.....
Red oxide	Ferric oxide	Fe_2O_3
Red precipitate	Mercuric oxide	HgO
Red prussiate of potash	Potassium ferricyanide	$K_3Fe(CN)_6$
Red stone	Ferricoxide (red)	Fe_2O_3
Reinecke salt	Ammonium (or potassium) tetrathiocyano-diammono-chromate	$NH_4[Cr(NH_3)_2(SCN)_4] \cdot H_2O$
RG acid	1-Naphthol-3, 6-disulfonic acid	$C_{10}H_8O_7S_2$
Rochelle salt	Potassium sodium tartrate	$KNaC_4H_4O_6 \cdot 4H_2O$
Roman vitriol	Copper sulfate	$CuSO_4 \cdot 5H_2O$
Rose vitriol	Cobalt sulfate	$CoSO_4 \cdot (7H_2O)$
Rosenstiehl's green	Barium manganate	$BaMnO_4$
Ross' white	cf. Lithopone	.....
Ruby	Aluminum oxide	Al_2O_3
Ruby arsenic	Arsenic disulfide	As_2S_2
S acid	1, 8-Dihydroxy-naphthalene-4-sulfonic acid	$C_{10}H_8O_5S$
	1-Naphthylamine-4, 8-disulfonic acid	$C_{10}H_9O_6NS_2$
	1-Naphthol-4, 8-disulfonic acid	$C_{10}H_8O_7S_2$
Sal acetosellae	Potassium hydrogen oxalate	KHC_2O_4
Sal alembroth	Mercuric ammonium chloride	$HgCl_2 \cdot 2NH_4Cl \cdot H_2O$
Sal amarum	Magnesium sulfate	$MgSO_4 \cdot 7H_2O$
Sal ammoniac	Ammonium chloride	NH_4Cl
Sal catharticum	Magnesium sulfate	$MgSO_4 \cdot 7H_2O$
Sal chalybdis	Ferrous sulfate	$FeSO_4 \cdot 7H_2O$
Sal culinaris	Sodium chloride	NaCl
Sal de duobus	Potassium sulfate	K_2SO_4
Sal enixium	Potassium hydrogen sulfate	$KHSO_4$
Sal ethyl	Ethyl salicylate	$HOC_6H_4CO_2C_2H_5$
Saleratus	Sodium hydrogen carbonate	$NaHCO_3$
Salimac	Ammonium chloride	NH_4Cl
Salimenthol	Menthyl salicylate	$HOC_6H_4CO_2C_{10}H_{19}$

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Sal prunella	cf. Prunella	.....
Sal soda	Sodium carbonate	$Na_2CO_3 \cdot 10H_2O$
Salt	Sodium chloride	NaCl
Salt of amber	Succinic acid	$(CH_2CO_2H)_2$
Salt of hartshorn	Ammonium carbonate	$(NH_4)_2CO_3$
Salt of lemery	Potassium sulfate	K_2SO_4
Salt of lemon(s)	Potassium hydrogen oxalate	$KHC_2O_4 \cdot H_2O$
Salt of Saturn	cf. Sugar of lead	.....
Salt of Seignette	cf. Rochelle salt	.....
Salt of soda	Sodium carbonate	$Na_2CO_3 \cdot (x H_2O)$
Salt of sorrel	Potassium hydrogen oxalate	$KHC_2O_4 \cdot H_2O$
Salt of tartar	Pure potassium carbonate	K_2CO_3
Salt of tin	Stannous chloride	$SnCl_2$
Salt of Venus	Copper sulfate	$CuSO_4 \cdot 5H_2O$
Salt of wisdom	cf. Sal alembroth	.....
Salt of wormwood	Impure potassium carbonate obtained from ashes of wormwood	K_2CO_3
Saltpeter, air	Mixed calcium nitrate and calcium nitrite	$Ca(NO_3)_2 + Ca(NO_2)_2$
Saltpeter, Bengal	Potassium nitrate	KNO_3
Saltpeter, Chile	Sodium nitrate	$NaNO_3$
Saltpeter, lime	Calcium nitrate	$Ca(NO_3)_2 \cdot 4H_2O$
Saltpeter, Norway	Ammonium nitrate	NH_4NO_3
Saltpeter, Norwegian	Calcium nitrate	$Ca(NO_3)_2 \cdot 4H_2O$
Saltpeter rot	Calcium nitrate	$Ca(NO_3)_2 \cdot 4H_2O$
Saltpeter, wall	Calcium nitrate	$Ca(NO_3)_2 \cdot 4H_2O$
Salts of vitriol	Zinc sulfate	$ZnSO_4 \cdot 7H_2O$
Salufer	Sodium fluosilicate	Na_2SiF_6
Sal vegetal	Potassium tartrate	$K_2C_4H_4O_6 \cdot \frac{1}{2}H_2O$
Sal volatile	Ammonium chloride, or ammonium carbonate	NH_4Cl or $(NH_4)_2CO_3$
Salzburg vitriol	Crystals of a mixture of 1 part copper-sulfate and 3 parts ferrous sulfate	.....
Sand acid	Hydrofluosilicic acid	H_2SiF_6
Saran	Polyvinylidene chloride	$(H_2CCl_2)_x$
Satin spar	cf. Satin white	.....
Satin white	Mixture of aluminum hydroxide, calcium sulfate, and calcium oxide	$Al(OH)_3$, $CaSO_4$, CaO
Saturn red	cf. Mineral orange	.....
Scheele's green	Copper hydrogen arsenite	$CuHAsO_3$
Schlippe's salt	Sodium thioantimonate	$Na_3SbS_4 \cdot 9H_2O$
Schoellkopf's acid	1-Naphthol-4, 8-disulfonic acid	$C_{10}H_8O_7S_2$
	1-Naphthylamine-4, 8-disulfonic acid	$C_{10}H_9O_6NS_2$
Schweinfurth green	cf. Paris green	.....
Scotch soda	Impure sodium carbonate	Na_2CO_3
Secaline	Trimethylamine	$(CH_3)_3N$
Seignette salt	cf. Rochelle salt	.....
Sellite	Sodium sulfite	Na_2SO_3
Sericose	Cellulose acetate	.....
Sigmaform	cf. Xeroform	.....
Slaked lime	cf. Lime	.....
Soap dust	Zinc stearate	$(C_{17}H_{35}CO_2)_2Zn$
Soda, washing	Sodium carbonate	$Na_2CO_3 \cdot 10H_2O$
Soda ash	Anhydrous sodium carbonate	Na_2CO_3
Soda crystals	Sodium carbonate	$Na_2CO_3 \cdot 10H_2O$

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Soda lime	Mixture of sodium hydroxide and calcium oxide	NaOH, CaO
Soda nitre saliter	Sodium nitrate	$NaNO_3$
Sodium hyposulfite	Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$
Soft soap	Potassium soap	.....
Soluble glass	cf. Water glass	.....
Soluble tartar	cf. Tartar	.....
Sorensen's phosphate	(tri) Sodium phosphate	$Na_3PO_4 \cdot 12H_2O$
Soubieran's ammoniacal salt	Mercury ammonium nitrate	$(NH_2Hg_2O)NO_3$
Spanish white	Bismuth subnitrate, or calcium carbonate	$BiONO_3 \cdot H_2O$, or $CaCO_3$
Spanish whiting	cf. Spanish white	.....
Spelter	Zinc	Zn
Spirit(s) of hartshorn	Aqueous ammonia solution, or 10% solution of ammonia in alcohol	NH_3 + aq., or $NH_3 + C_2H_5OH$
Spirit of salt	Hydrochloric acid	HCl
Spirit of wine	84% Ethyl alcohol	C_2H_5OH + aq.
SS acid or 2S acid	1-Amino-8-naphthol-2, 4-disulfonic acid	$C_{10}H_9O_7NS_2$
Steinbuhl yellow	Barium chromate	$BaCrO_4$
Stibiated tartar	Potassium antimonyl tartrate	$KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$
Strontium white	Strontium sulfate	$SrSO_4$
Styron	Polystyrene	$(C_6H_5CH{:}CH_2)_x$
Sugar of lead	Lead acetate	$Pb(C_2H_3O_2)_2 \cdot 3H_2O$
Sugar of milk	Lactose	$C_{12}H_{22}O_{11} \cdot H_2O$
Sulfide white	cf. Lithopone	.....
Sulfur gold	Antimony pentasulfide	Sb_2S_5
Superphosphate	Impure calcium hydrogen phosphate	$CaH_4(PO_4)_2$
Swedish green	cf. Scheele's green	.....
Sweet oil	Olive oil	.....
Sylvine	Potassium chloride	KCl
Sylvinite	Sylvine with rock salt	.....
Table salt	Sodium chloride	NaCl
Talcum	Hydrated magnesium silicate	$3MgO \cdot 4SiO_2 \cdot H_2O$
Tar camphor	Naphthalene	$C_{10}H_8$
Tarcanum sal de duobus	Potassium sulfate	K_2SO_4
Tartar	Crude potassium hydrogen tartrate	$KHC_4H_4O_6$
Tartar, neutral	Potassium tartrate	$K_2C_4H_4O_6 \cdot \frac{1}{2}H_2O$
Tartar, soluble	Potassium tartrate	$K_2C_2H_4O_6 \cdot \frac{1}{2}H_2O$
Tartar emetic	Potassium antimonyl tartrate	$KSbOC_2H_4O_6 \cdot \frac{1}{2}H_2O$
Tartarus	Potassium tartrate	$K_2C_4H_4O_6 \cdot \frac{1}{2}H_2O$
Tasteless salt	Sodium dihydrogen phosphate	$NaH_2PO_4 \cdot (H_2O)$
δ-Tetranitro-naphthalene	1, 2, 5, 8-Tetranitro-naphthalene	$C_{10}H_4O_8N_2$
Thenard's blue	cf. Cobalt blue	.....
Thioindoxyl	2-Hydroxy-1-thionaphthene	C_8H_6OS
Tiff	Barium sulfate	$BaSO_4$
Tin ash	Stannic oxide	SnO_2
Tin crystals	Stannous chloride	$SnCl_2 \cdot 2H_2O$
Tin prepare liquor	Sodium stannate	$Na_2SnO_3 \cdot 3H_2O$
Tin protochloride	Stannous chloride	$SnCl_2 \cdot 2H_2O$
Tin salt(s)	Stannous chloride	$SnCl_2 \cdot 2H_2O$
Tin white	Stannic hydroxide	$Sn(OH)_4$
Tolite	cf. Trotyl	.....

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Tolyl-peri acid	*p*-Tolyl-1-naphthylamine-8-sulfonic acid	$C_{17}H_{15}O_3NS$
Toughened caustic	Fused mixture of silver and potassium nitrates	95% $AgNO_3$ + 5% KNO_3
Trotyl	Trinitrotoluene	$CH_3C_6H_2(NO_2)_3$
TSP	Trisodium phosphate	$Na_3PO_4 \cdot (12H_2O)$
Tungsten white	Barium tungstate	$BaWO_4$
Transparent chromium oxide	cf. Guignet's green	.....
Triformol	Paraformaldehyde	$(CH_2O)_3$
Trisulfonic acid	Naphthalene-1, 3, 6-trisulfonic acid	$C_{10}H_8O_9S_3$
Turkey red oil	Sulfonated castor oil	.....
Turnbull's blue	cf. Prussian blue	.....
Tutia	Zinc carbonate	$ZnCO_3$
Ultramarine yellow	Barium chromate	$BaCrO_4$
Unslaked lime	cf. Lime	.....
Vaseline	Soft paraffin	C_nH_{2n+2}
Venetian red	Ferric oxide	Fe_2O_3
Venus crystals	Copper acetate	$Cu(C_2H_3O_2)_2 \cdot 6H_2O$
Verdigris	Basic copper acetate	$2Cu(C_2H_3O_2)_2 + CuO$
Verdigris (crystallized)	Copper acetate	$Cu(C_2H_3O_2)_2 \cdot 6H_2O$
Vert de Mitis	cf. Paris green	.....
Vert de Vienne	cf. Paris green	.....
Verte emeraude	cf. Guignet's green	.....
Vichy salt	Sodium hydrogen carbonate, or a mixture of salts obtained on evaporation of Vichy water	$NaHCO_3$
Vienna green	cf. Paris green	.....
Vinegar acid	Acetic acid	$HC_2H_3O_2$
Vinegar naphtha	Ethyl acetate	$CH_3CO_2C_2H_5$
Viridian	cf. Guignet's green	.....
Vitriol	Sulfuric acid	H_2SO_4
"Vitriolate of"	Sulfate of	.....
Wall saltpeter	cf. Saltpeter	.....
Washing soda	Sodium carbonate	$Na_2CO_3 \cdot 10H_2O$
Water gas	An artificial gas	43% CO, 49% H_2, 4% CO_2, 4% N_2
Water glass	Aqueous solution of sodium silicates	$H_2O + Na_2SiO_3 + Na_2SiO_4$
Westrosol	Trichloroethylene	$CHCl:CCl_2$
White acid	Mixture of ammonium fluoride and hydrofluoric acid	$NH_4F + HF$
White alkali	Refined sodium carbonate	Na_2CO_3
White arsenic	Arsenous oxide	As_2O_3
White caustic	Sodium hydroxide	NaOH
White copperas	Zinc sulfate	$ZnSO_4 \cdot 7H_2O$
White lead	Basic lead carbonate	$2PbCO_3 + Pb(OH)_2$
White lead, sublimed	Basic lead sulfate	$PbSO_4 \cdot PbO$
White precipitate	Mercury ammonium chloride	NH_2HgCl
White tar	Naphthalene	$C_{10}H_8$
White vitriol	Zinc sulfate	$ZnSO_4 \cdot 7H_2O$
White wax	Beeswax, bleached	.....
Wool mordant	Chromium sulfate	$Cr_2(SO_4)_3 \cdot xH_2O$ *
Xanthiosite	Nickel arsenate	$Ni_3(AsO_4)_2$
Xeroform	Bismuth tribromophenate	ca. $BiOH(C_6H_2OBr_3)_2 \cdot Bi_2O_3$

* x = 0, 15, or 18.

TRADE NAMES OF CHEMICALS WITH SYNONYMS AND FORMULAS

Common or Trade Name	Chemical Synonym	Formula
Yellow acid	1, 3-Dihydroxy-naphthalene-5, 7-di-sulfonic acid	$C_{10}H_8O_8S_2$
Yellow lead oxide	Lead monoxide	PbO
Yellow precipitate	Mercuric oxide, yellow	HgO
Yellow prussiate of potash	Potassium ferrocyanide	$K_4Fe(CN)_6 \cdot 3H_2O$
Yellow wax	Beeswax	.....
Zinc baryta white	cf. Lithopone	.....
Zinc blende	Zinc sulfide	ZnS
Zinc chrome	cf. Zinc yellow	.....
Zincolith	cf. Lithopone	.....
Zinc powder	Zinc oxide	ZnO
Zinc sulfide white	cf. Lithopone	.....
Zinc vitriol	Zinc sulfate	$ZnSO_4 \cdot 7H_2O$
Zinc white	Zinc oxide	ZnO
Zinc yellow	Zinc chromate	$ZnCrO_4$

URINE

Normal Range of Composition

Color: slightly yellow to amber
Quantity: 1000 to 1500 cc./24 hrs.
Specific Gravity: 1.008 to $1.030^{15°}$
pH: 5.5 to 7.5
Sugar: 0.015%
Nitrogen { Total: 7 to 20 grams/24 hrs. / Amino Acid: 0.15 to 0.30 grams/24 hrs.
Urea: 12 to 35 grams/24 hrs.
Ammonia: 0.6 to 1.2 grams/24 hrs.
Creatinine: 0.8 to 2.0 grams/24 hrs.
Creatinine Coefficient: 22 to 30 milligrams creatinine per kg. per day.
Uric Acid: 0.3 to 0.8 grams/24 hrs.
Hippuric Acid: 0.7 grams/24 hrs.
Chlorides (NaCl): 10 to 15 grams/24 hrs.
Phosphorus (P): 1.2 grams/24 hrs.
Sulfur (S) { Total: 1.2 grams/24 hrs. / Inorganic: 1.0 grams/24 hrs. / Ethereal: 0.1 grams/24 hrs.
Sodium (Na): 2.5 to 4.0 grams/24 hrs.
Calcium (Ca): 0.1 to 0.3 grams/24 hrs.
Potassium (K): 1.5 to 2.0 grams/24 hrs.
Magnesium (Mg): 0.1 to 0.2 grams/24 hrs.

BLOOD

Volume* and Normal Range of Composition

pH: 7.35 to 7.45
Sugar: 70 to 120 milligrams/100 cc.
Urea: 24 to 32 milligrams/100 cc.
Nitrogen { Non-Protein: 25 to 32 milligrams/100 cc. / Amino Acid: 5 to 8 milligrams/100 cc.
Creatinine: 1 to 2.5 milligrams/100 cc.
Creatine (cells): 6 milligrams/100 cc.
Uric Acid: 2 to 3 milligrams/100 cc.
Chlorides (NaCl): 450 to 500 milligrams/100 cc.
Phosphates (P) (serum): 3 to 7 milligrams/100 cc.
Calcium (Ca) (serum): 9 to 11 milligrams/100 cc.
Cholesterol: 140 to 180 milligrams/100 cc.
CO_2 Combining Power (plasma): 49 to 65 cc./100 cc.

VOLUME { Adult Male: 89.1 cc./kg. body weight, 3410 cc./sq. meter body surface / Adult Female: 84.2 cc./kg. body weight, 3075 cc./sq. meter body surface
PLASMA { Adult Male: 51.0 cc./kg. body weight, 1958 cc./sq. meter body surface / Adult Female: 50.5 cc./kg. body weight, 1848 cc./sq. meter body surface
HEMOGLOBIN { Adult Male: 16.7 grams/100 cc. blood / Adult Female: 14.4 grams/100 cc. blood
RED BLOOD CORPUSCLES { Adult Male: 5 to 6 million/cubic millimeter / Adult Female: 4½ million/cubic millimeter
WHITE BLOOD CORPUSCLES { Adults: 7 to 8 thousand/cubic millimeter / Children: 10 thousand/cubic millimeter

*Rowntree, Brown and Roth, *Volume of Blood and Plasma*, published by W. B. Saunders Co., Philadelphia (1929).

COMPOSITION AND

See also special tables on

Proteins contain the elements of carbon, oxygen, hydrogen, nitrogen and often among others sulfur and phosphorus, thus furnishing the elements for the building and repairing of tissue as well as energy for heat and muscular power. It is supplied by vegetable proteins—grain foods, legumes and nuts, and animal proteins —flesh foods, eggs and dairy foods. *Fats* contain the elements of carbon, hydrogen and oxygen and are utilized for heat and muscular power; the excess is stored as fat in the body. The sources of this type of food are the vegetable and animal fats or oils. *Carbohydrates* contain the elements of carbon, hydrogen and oxygen; they furnish fuel for heat and muscular energy. The excess is transformed and stored in the body as fat. *Water* contains the elements oxygen and hydrogen and is a neutral substance which does not furnish energy but is necessary for the digestive fluids, for transporting soluble substances in the blood and lymph, for maintaining proper dilution of soluble substances in the body, for excreting soluble wastes and for regulating the temperature of the body. It is furnished by fluids taken (water, beverages, soups, etc.), by the water content of solid foods and by that formed in metabolism. *Mineral salts* share in forming bones, teeth, blood, etc. and aid in digestion and metabolism. Among such minerals are the following elements. *Aluminum* occurs only in traces and is probably of very little importance. *Arsenic* is an acid forming element occurring in traces in many animal and vegetable foods; it is probably of very little importance. *Calcium*, a basic forming element, is a sinew and muscle mineral and maintains the bone structure. The amount required per day is 0.7 to 1 gram calcium oxide (CaO). It is supplied by watercress, turnip-tops, dandelions, spinach, lettuce, tomatoes, lemons, oranges, strawberries, cranberries, cheese, milk, buttermilk, wheat, oats, rye, barley, peas, lentils, and nuts. *Chlorine*, an acid forming element, is a secretion mineral. The amount required per day is 6 to 8 grams. It is supplied by table salt, lettuce, spinach, cabbage, beets, parsnips, milk, cheese, strawberries, bananas, pineapples, grapes, potatoes, beans, barley, corn, oats, peas, and sea foods. *Fluorine*, an acid forming element, furnishes a substance needed in building tooth enamel and eye tissue. It is supplied in minute amounts by vegetables, fruits, eggs, milk and seeds. *Iodine*, an acid forming element, is a gland mineral. It is supplied by iodized salt, salt water fish, asparagus, cabbage, green peas, and beans, rice, potatoes, lettuce, mushrooms, tomatoes, grapes, pears, and pineapples. *Iron* is a blood mineral occurring in the red blood cells. The amount

No.	Name	% Protein	% Fat	% Carbohydrate	Ash			% Fiber
					% Ca	% P	% Fe	
1	Almonds E. P.	21.0	54.9	17.3	0.239	0.465	0.00407	2.0
2	Apples, fresh	0.4	0.5	14.2	0.007	0.012	0.00038	1.2
3	Apricots E. P., fresh	1.0	0.1	12.9	0.014	0.025	0.00152	....
4	Apricots, dried	4.7	1.0	62.5	0.066	0.117	0.00726	2.6
5	Artichokes, jer. E. P.	2.4	0.1	16.5	.....	.....	.....	....
6	Asparagus, fresh	1.8	0.2	3.3	0.025	0.039	0.00079	0.8
7	Avocado	2.0	23.2	6.7	.....	.....	.....	0.7
8	Bacon, raw	10.5	64.8	....	0.006	0.108	0.00131	0.5
9	Bacon, cooked	21.3	64.6	....	0.013	0.213	0.0027	1.0
10	Bananas E. P.	1.2	0.2	23.0	0.009	0.031	0.00176	1.0
11	Barley	8.5	1.1	77.8	0.043	0.400	0.00358	0.3
12	Beans, navy, cooked	7.5	0.6	19.8	0.054	0.157	0.00317	1.4
13	Beans, navy, dried	22.5	1.8	59.6	0.162	0.471	0.00952	4.4
14	Beans, soya	37.0	17.2	28.0	.....	.....	.....	4.4
15	Beans, lima, E.P., fresh	7.1	0.7	22.0	0.028	0.133	0.00176	0.8
16	Beans, lima, dried	18.1	1.5	65.9	0.071	0.338	0.01166	4.6
17	Beans, string, raw	2.3	0.3	7.4	0.046	0.052	0.0011	1.9
18	Beef, misc. cuts, lean	22.4	2.9	....	0.013	0.241	0.00253	....
19	Beef, fatty	16.2	24.4	....	0.009	0.175	0.00198	....

USE OF FOODS

Vitamins, and Fats and Oils.

required per day is 0.006 to 0.012 grams. It is supplied by lettuce, spinach, turnip-tops, asparagus, leeks, onions, cabbage, artichokes, radishes, pumpkin, oats, rice, rye, beans, mushrooms, grapes, raisins, strawberries, gooseberries, cherries, prunes, grapefruit, pineapple, currants, and almonds. *Magnesium* is an alkaline forming element which is a cell-building substance maintaining chiefly teeth, bone and muscular tissue. The amount required per day is 0.3 to 0.5 g magnesium oxide (MgO). It is supplied by dandelions, lettuce, watercress, turnip-tops, cabbage, celery, asparagus, tomatoes, berries, lemons, bananas, oranges, limes, pineapple, raisins, almonds, walnuts, wheat, oats, rice, and barley. *Phosphorus* is an acid forming element which is necessary for the building of nervous tissue, bones, and teeth. The amount required per day is 3 to 4 grams of the oxide (P_2O_5). It is supplied by eggs, milk, sea foods, liver, asparagus, cress, turnips, beans, lentils, figs, prunes, currants, apples, berries, wheat, oats, barley, rice, and rye. *Potassium* is a strong alkaline element helping to make the tissues elastic. The amount required per day is 2 to 3 grams of the oxide (K_2O). It is supplied by potato skins, spinach, beans, turnips, parsnips, lettuce, tomatoes, rhubarb, huckelberries, limes, and lemons. *Silicon*, an acid forming element, supplies a substance necessary for building hair, nails, skin and teeth. It is supplied by egg whites, meat, nuts, lettuce, dandelions, asparagus, onions, radishes, cucumbers, celery, strawberries, apples, apricots, cherries, prunes, mushrooms, olives, oats, rye, and millet. *Sodium*, a strongly alkaline element, aids digestion and is a blood and gland mineral. The amount required per day is 4 to 6 grams of the oxide (Na_2O). It is supplied by table salt, spinach, dandelions, cabbage, beets, cauliflower, asparagus, carrots, beets, cucumbers, turnips, strawberries, figs, prunes, apricots, olives, tomatoes and milk. *Sulfur* is an acid element utilized in building protein tissue. The amount required per day is 2 to 3.5 grams of the oxide (SO_3). It is supplied by eggs, cabbage, fish, meats, corn, cheese, brussels sprouts, string beans, lima beans, raspberries, cranberries, and raisins. *Manganese* is a tissue mineral and aids in carrying oxygen from the lungs to the cells. It is supplied in endive, watercress, parsley, almonds, walnuts, and egg yolks.

Abbreviations: A. P., food as purchased including refuse; Ca, calcium; E. P., edible portion of food; Fe, iron; P, phosphorus; var., variable; —, no appreciable amount of vitamin; +, vitamin present; ++, good source of vitamin; +++, excellent source of vitamin; ?, evidence is doubtful.

Kg. calories per 100g.	Vitamin					100 Gram Portion	No.
	A	B	C	D	E		
667	+	++	?	.....	.....	¾ cup or 107	1
63	+	+	++	.....	.....	1 small	2
56	?	?	— to +	.....	.....	⅜ cup	3
278	.....	.....	.....	.....	.....	16 halves	4
77	.....	.....	.....	.....	.....	.....	5
23	++*	+++	?	?	.....	12 stalks, 5 inch	6
122	++	++	?	.....	.....	one 2 inch	7
625	— to +	+	?	.....	.....	10 slices ⅛ x 1½ x 4½ inches	8
667	— to +	+	?	.....	.....	26 slices ⅛ x 1½ x 3 inches	9
99	+ to ++	+	++	?	?	½ large	10
363	?	++	?	?	sprouted +	½ cup	11
117	+	++	?	?	.....	½ cup	12
353	+	++	?	?	sprouted +	½ cup	13
231	+	++	—	?	sprouted +	½ cup	14
123	.....	.....	.....	.....	.....	½ cup	15
358	.....	.....	.....	.....	.....	⅔ cup	16
43	++	++	++	?	?	⅔ cup	17
119	+	+	— to +	?	+	½ x 4 x 4 inches	18
284	+	+	— to +	?	+	½ x 4 x 4 inches	19

* Absent in bleached variety

No.	Name	% Protein	% Fat	% Carbo-hydrate	Ash			% Fiber
					% Ca	% P	% Fe	
1	Beef, lean roast	23.0	12.0	....	0.013	0.248	0.00274	....
2	Beef, dried	30.0	6.5	....	0.017	0.323	0.00339	....
3	Beet greens	2.2	3.4	3.2	.....	.....	0.00355	....
4	Beets	1.6	0.1	9.7	0.029	0.039	0.00236	0.9
5	Biscuits, baking powder	8.6	8.9	50.0	0.060	0.106	0.0007	....
6	Blackberries	1.2	1.1	11.9	0.017	0.034	0.0010	2.5
7	Blueberries	0.6	0.6	15.1	0.020	0.008	0.0017	....
8	Bologna sausage	17.6	16.6	3.3	0.003	0.030	0.0013	....
9	Bran	....	....	....	0.120	1.215	0.00852	18
10	Bread, graham	8.9	1.8	52.1	0.050	0.218	0.0025	1.1
11	Bread, rye	9.0	0.6	53.2	0.024	0.148	0.0016	0.5
12	Bread, white, milk	9.6	1.4	51.4	0.027	0.093	0.0009	0.2
13	Bread, whole wheat, milk	9.7	0.9	49.7	0.05	0.175	0.0016	....
14	Butter	1.0	85.0	....	0.015	0.017	0.0002	....
15	Buttermilk	3.0	0.5	4.8	0.105	0.097	0.0003	....
16	Brussels sprouts	1.5	0.1	3.4	0.027	0.120	0.00223	....
17	Cabbage	1.6	0.3	5.6	0.045	0.029	0.00034	1.1
18	Cake	7.5	11.1	57.1	0.044	0.086	0.0008	....
19	Cantelope, E. P.	0.6	....	5.8	0.017	0.015	0.00051	2.1
20	Carrots	1.1	0.4	9.3	0.056	0.046	0.00107	1.1
21	Cauliflower, E. P.	1.8	0.5	4.7	0.123	0.061	0.00143	....
22	Celery	1.1	0.1	3.3	0.078	0.037	0.00077	0.98
23	Cheese	27.7	36.8	4.1	0.931	0.683	0.00138	....
24	Cheese, cottage	20.9	1.0	4.1	0.208	0.172	.....	....
25	Cherries, E. P.	1.3	0.5	13.3	0.019	0.031	0.00046	0.2
26	Chestnuts	6.3	5.4	40.3	.....	.....	0.00410	1.8
27	Chicken, E. P.	21.5	2.5	....	0.012	0.232	0.00070	....
28	Chocolate, bitter	12.9	48.7	30.3	0.092	0.455	0.00315	....
29	Chocolate, milk	8.0	34.9	51.1	.....	.....	.....	....
30	Cocoa, dry	20.0	28.0	36.0	0.120	0.720	0.0032	....
31	Cocoanut	6.3	57.4	31.5	0.059	0.155	0.00267	....
32	Codfish, fresh	16.7	0.3	....	0.018	0.192	0.00034	....
33	Codfish, salt, cooked	42.3	0.5	....	.....	.....	.....	....
34	Cod liver oil	....	100	....	.....	.....	.....	....
35	Cookies, plain	5.8	15.0	58.3	0.025	0.058	0.0006	....
36	Corn, canned	3.1	1.1	19.7	0.006	0.103	0.00051	0.5
37	Cornbread	6.2	7.0	39.0	0.055	0.102	0.0007	0.2
38	Cornflakes	5.5	1.5	81.0	0.018	0.190	0.00055	0.2
39	Corn meal, cooked	1.4	0.8	11.9	0.005	0.039	0.0002	0.2
40	Corn starch	....	....	90.0	.....	.....	.....	....
41	Corn syrup	....	....	75.0	0.006	0.103	0.0008	....
42	Crackers, graham	10.0	9.0	73.0	0.020	0.100	.....	1.5
43	Crackers, soda	6.6	8.8	68.8	0.022	0.011	0.002	....
44	Cranberries, A. P.	0.4	0.7	11.3	0.018	0.013	0.0006	1.5
45	Cream, 20%	2.8	22.0	2.7	0.086	0.067	0.0002	....
46	Cucumber	0.8	0.2	3.1	0.016	0.033	0.00035	0.7
47	Currants, fresh	1.6	0.4	12.7	0.026	0.038	0.00070	3.2
48	Currants, dried	2.4	1.7	74.2	0.082	0.195	0.00474	18.2
49	Dates	2.1	2.8	78.4	0.065	0.072	0.00507	5.5
50	Doughnuts	6.6	22.2	54.4	.....	.....	.....	....
51	Duck	18.3	19.0	....	0.010	0.197	0.00171	....
52	Eggs, whole	13.4	10.4	....	0.066	0.180	0.00252	....
53	Eggs, white	12.3	0.57	....	0.014	0.014	.....	....
54	Eggs, yolk	15.3	33.3	....	0.140	0.527	0.008	....
55	Endive	1.0	0.6	2.6	0.104	0.038	.....	....
56	Figs, dried	4.3	0.3	74.2	0.162	0.116	0.00396	1.8
57	Flour, buckwheat	6.4	1.2	77.9	0.039	0.226	0.00320	0.4

Kg. calories per 100g.	Vitamin A	Vitamin B	Vitamin C	Vitamin D	Vitamin E	100 Gram Portion	No.
200	+	+	—to+	?	+	¼x2½x5 inches	1
178	.....	.....	.....	.....	.....	6 slices 4x6 inches	2
52	++	++	?	.....	.....	½ cup	3
47	—to+	+	+	?	?	⅔ cup	4
715	.....	.....	.....	.....	.....	6 small	5
62	.....	.....	.....	.....	.....	1⅙ cups	6
68	.....	.....	.....	.....	.....	⅔ cup	7
203	.....	.....	.....	.....	.....	3 slices ⅛x4x4 inches	8
...	+	++	—	.....	.....	2 cups	9
266	+	++	—	.....	.....	3⅕ slices, ⅜ inch	10
260	?	++	?	.....	.....	3⅕ slices, ⅜ inch	11
262	+	+	—to+	+	.....	3⅕ slices, ⅜ inch	12
249	++	++	—to+	+	?	3⅕ slices, ⅜ inch	13
769	+++	—	?	+	+	7 tablespoons	14
36	+	++	—to+	?	?	½ cup	15
21	.....	.....	.....	.....	.....	⅔cup	16
32	—to+	++	+++	.....	.....	1½ (raw); ⅔ (cooked) cups	17
386	.....	.....	.....	.....	.....	2x3x3 inches	18
27	++	++	++	.....	.....	⅛ of 4½ inch melon	19
46	+	++	—to+	?	?	⅔ cup	20
31	+	+to++	+	.....	.....	⅔ cup	21
19	—to+	++	?	.....	?	4 stalks	22
458	++	?	?	?	?	1x2x3 inches	23
109	+	?	?	.....	.....	½ cup	24
70	++	++	?	.....	.....	⅔ cup	25
235	?	+	?	.....	.....	¾ cup	26
109	—to+	+	?	.....	.....	½ broiler	27
611	—	?	?	.....	.....	3⅛ squares	28
551	.....	.....	.....	.....	.....	3 bars 2⅞x5½x¼ inches	29
480	.....	.....	.....	.....	.....	40 teaspoons	30
688	+	++	?	.....	.....	5⅘ cups	31
70	—to+	+	?	.....	.....	1x1½x4 inches	32
173	.....	.....	.....	.....	.....	½ cup flakes	33
900	+++	—	—	+++	?	7 tablespoons	34
392	.....	.....	.....	.....	.....	8, 2¼ inches diameter	35
101	+	++	—	.....	.....	⅜ cup	36
240	.....	.....	.....	.....	.....	2 slices, 1x2x2 inches	37
360	.....	.....	.....	.....	.....	3½ cups	38
59	.....	.....	.....	.....	.....	½ cup	39
367	.....	.....	.....	.....	.....	16 tablespoons	40
300	.....	.....	.....	.....	.....	5 tablespoons	41
420	.....	.....	.....	.....	.....	10 crackers	42
378	.....	.....	.....	.....	.....	22 crackers	43
53	?	?	+	.....	.....	1 cup	44
220	+++	++	—to+	+	var.	½ cup	45
17	—to+	+	++	.....	.....	One 1¾x3 inches	46
61	.....	.....	.....	.....	.....	½ cup	47
322	.....	.....	.....	.....	.....	⅔ cup	48
358	+	++	?	.....	.....	14	49
444	.....	.....	.....	.....	.....	1	50
244	—to+	+	?	.....	.....	2 slices, ¼x1½x1¾ inches	51
148	+++	++	?	+	+	2	52
57	—	—	?	....	.....	3 whites	53
360	+++	++	?	+	.....	7 yolks	54
15	+	?	+	.....	.....	½ head	55
317	.....	.....	.....	.....	.....	17	56
348	.....	.....	.....	.....	.....	¾ cup	57

No.	Name	% Protein	% Fat	% Carbohydrate	Ash			% Fiber
					% Ca	% P	% Fe	
1	Flour, graham	13.3	2.2	71.4	0.018	0.289	0.00370	1.9
2	Flour, white	11.2	1.0	74.9	0.020	0.092	0.00091	0.3
3	Flour, whole wheat	13.8	1.9	71.9	0.031	0.238	0.0025	0.9
4	Frankfurters	19.6	18.6	1.1	0.011	0.206	0.00172	0.1
5	Fudge	2.0	5.6	73.6	0.040	0.072	0.0004	....
6	Gelatin	91.4	0.1	....	.....	.....	.....	....
7	Goose	16.3	36.2	....	0.009	0.176	0.00202	....
8	Gooseberries	0.8	0.4	10.1	0.035	0.031	0.00047	2.5
9	Grapes, E. P.	1.4	1.4	14.9	0.019	0.031	0.00136	4.3
10	Grapefruit, E. P.	0.5	....	10.1	0.021	0.020	0.00027	0.4
11	Gravy, meat stock	0.9	8.6	4.5	0.002	0.008	.....	....
12	Halibut	18.6	5.2	....	0.020	0.213	0.00093	....
13	Ham, fresh, lean	25.0	14.4	....	0.014	0.269	0.00165	....
14	Ham, smoked, med. fat	16.3	38.8	....	0.011	0.211	0.00108	....
15	Heart, beef	16.0	20.4	....	0.009	0.172	0.00435	....
16	Hickory nuts	15.4	67.4	11.4	.....	.....	0.00238	....
17	Hominy, cooked	1.1	....	11.2	0.002	0.020	0.0001	0.13
18	Ice cream	2.1	15.5	18.3	0.072	0.056	0.00017	....
19	Kidney, veal	16.9	6.4	....	0.009	0.171	0.00414	....
20	Lamb chops, E. P.	18.7	28.3	....	0.011	0.202	0.00148	....
21	Lamb, roast	19.7	12.7	....	0.012	0.216	0.00167	....
22	Lard	....	100	....	.....	.....	.....	....
23	Lemons, E. P.	0.9	0.6	8.7	0.036	0.022	0.0006	0.9
24	Lentils, dry	25.7	1.0	59.2	0.107	0.438	0.0086	2.0
25	Lettuce	1.2	0.3	2.9	0.043	0.042	0.00042	0.7
26	Liver, beef, raw	20.4	4.5	1.7	0.011	0.213	0.0083	....
27	Liver, calves, raw	19.0	5.3	....	0.009	0.171	0.0054	....
28	Lobster	16.4	1.8	0.4	0.018	0.188	0.00044	....
29	Loganberries	1.0	0.6	15.0	.....	.....	.....	1.4
30	Macaroni, cooked	2.5	0.2	14.2	0.004	0.025	0.00021	....
31	Mackerel	18.7	7.1	....	0.020	0.213	0.00075	....
32	Mayonaise dressing	1.3	83.8	....	0.007	0.018	0.00025	....
33	Milk, whole *	3.3	4.0	5.0	0.122	0.096	0.00024	....
34	Milk, skim	3.4	0.3	5.1	0.122	0.096	0.00025	....
35	Milk, evaporated	9.6	9.3	11.2	0.354	0.278	0.0009	....
36	Milk, condensed	8.8	8.3	54.1	0.300	0.235	0.0006	....
37	Molasses	2.4	....	69.3	0.211	0.044	0.00797	....
38	Mushrooms	3.5	0.4	6.0	0.017	0.108	0.00314	0.8
39	Noodles, cooked	2.0	2.9	16.5	.....	.....	.....	0.1
40	Oatmeal, uncooked	16.7	7.3	66.3	0.069	0.392	0.00380	1.3
41	Oatmeal, cooked	2.8	0.5	11.5	0.011	0.065	0.00059	0.15
42	Oleomargerine	1.2	83.0	....	.....	.....	.....	....
43	Olives, green	0.8	20.2	8.5	0.122	0.014	0.00211	....
44	Olives, ripe	1.4	21.0	3.5	.....	.....	.....	....
45	Olive oil	....	100	....	.....	.....	.....	....
46	Onions	1.6	0.3	9.0	0.034	0.045	0.00030	0.8
47	Orange, E. P.	0.9	0.2	11.2	0.045	0.021	0.00066	0.6
48	Orange juice	....	....	9.0	0.029	0.016	0.00028	....
49	Oysters	6.2	1.2	3.7	0.052	0.155	0.00314	....
50	Parsley	....	....	....	.....	.....	0.01921	....
51	Parsnips	1.6	0.5	13.5	0.059	0.076	0.00107	2.5
52	Peaches, canned	0.7	0.1	10.8	.....	.....	.....	....
53	Peaches, E. P., fresh	0.5	0.1	12.0	0.016	0.024	0.00036	0.6
54	Peanuts	25.8	38.6	24.4	0.071	0.399	0.00231	2.5
55	Peanut butter	29.3	46.5	17.1	0.072	0.396	0.0018	2.4
56	Pears, canned	0.4	0.3	17.6	0.008	0.014	0.00024	1.5
57	Pears, E. P., fresh	0.7	0.4	15.8	0.015	0.026	0.00046	2.7

* See also special tables

Kg. calories per 100g.	Vitamin A	Vitamin B	Vitamin C	Vitamin D	Vitamin E	100 gram Portion	No.
359	.....	.....	.....	.....	.....	¾ cup	1
353	—	—to+	—	—	.....	¾ cup	2
370	+	++	—	?	+	¾ cup	3
250	.....	.....	.....	.....	.....	3 links	4
356	.....	.....	.....	.....	.....	1 cubic inch	5
367	.....	.....	.....	.....	.....	33 teaspoons	6
391	—to+	+	?	.....	.....	2 slices, ¼x1½x1¾ inches	7
47	.....	.....	.....	.....	.....	½ cup	8
78	+	+to++	+	.....	.....	24 grapes	9
44	+	++	+++	—	—	½ 4 inch diameter	10
99	.....	.....	.....	.....	.....	½ cup	11
121	—to+	+	?	—	.....	¾x1¾x4 inches	12
236	—to+	++	—	.....	.....	¼x3x4½ inches	13
414	—to+	++	—	.....	.....	¼x4½x4½ inches	14
255	+	++	+	.....	.....	1x2x3 inches	15
714	?	++	?	.....	.....	½ cup	16
49	.....	.....	.....	.....	.....	½ cup	17
222	.....	.....	.....	.....	.....	⅝ cup	18
125	++	++	+	.....	.....	½ cup diced	19
330	—to+	+	?	.....	.....	3	20
193	—to+	+	?	.....	.....	½x4x4 inches	21
900	—to+	—	—	—to+	.....	10 tablespoons	22
44	+	++	+++	.....	.....	1 lemon	23
357	+	++	—	.....	.....	3 cups	24
20	+to++	++	+++	+	+	⅜ head	25
133	++to+++	++	?	.....	.....	½x3x6 inches	26
124	++to+++	++	?	.....	.....	½x3x6 inches	27
83	—to+	+	?	—	.....	⅔ cup	28
69	.....	.....	.....	.....	.....	1⅙ cups	29
69	.....	.....	.....	.....	.....	½ cup	30
139	+	+	?	—	.....	1x2x3 inches	31
760	.....	.....	.....	.....	.....	½ cup	32
69	+++	++	+	+	var.	⅜ cup	33
37	+	++	—to+	.....	.....	½ cup	34
172	+++	++	—to+	+	.....	⅓ cup	35
334	+++	++	+	+	.....	⅓ cup	36
287	—	+	—	.....	.....	5½ tablespoons	37
42	—to+	?	—	.....	.....	½ cup (canned)	38
92	.....	.....	.....	.....	.....	½ cup	39
397	—to+	++	—	.....	+	1⅓ cups	40
62	—to+	++	—	.....	+	½ cup	41
752	—to+	.....	.....	.....	+	7 tablespoons	42
225	.....	.....	.....	.....	.....	10	43
209	.....	.....	.....	.....	.....	20	44
900	—to+	—	—	.....	+	½ cup	45
46	—to+	++	+to++	.....	.....	3 medium size	46
50	?	?	+++	.....	.....	1, 2½ inch diameter	47
36	—to+	++	+++	.....	.....	½ cup	48
50	++*	++*	+*	.....	.....	4 large	49
.....	?	++	?	.....	.....	5 inch bunch	50
66	—to+	++	?	.....	.....	½ cup	51
47	+to++	+	+to++	.....	.....	½ peach + 1 tbs. juice	52
51	+to++	+	++	.....	.....	1 medium size	53
548	+	++	?	.....	.....	¾ cup	54
622	+	++	?	.....	.....	6 tablespoons	55
75	?	?	—to+	.....	.....	2 halves + 3 tbs. juice	56
70	?	+to++	+	.....	.....	1 medium size	57

* Raw

No.	Name	% Protein	% Fat	% Carbo-hydrate	Ash			% Fiber
					% Ca	% P	% Fe	
1	Peas, fresh	7.0	0.5	15.2	0.028	0.127	0.00177	1.7
2	Peas, dried, cooked	6.6	0.3	15.8	0.022	0.108	0.0015	1.2
3	Pecans, E. P.	9.6	70.5	15.3	0.089	0.335	0.00258	....
4	Peppers, green	1.6	0.2	4.5	0.006	0.026	0.00041	....
5	Pie, apple	1.4	6.2	28.8	0.007	0.019	0.00035	0.8
6	Pie, cream	5.4	7.8	26.8	0.093	0.101	0.00063	0.03
7	Pineapple, canned	0.3	0.2	36.4	0.012	0.018	0.00022	0.4
8	Pineapple, E. P., fresh	0.4	0.2	13.7	0.018	0.028	0.00032	0.4
9	Plums, E. P., fresh	0.7	0.2	12.9	0.020	0.032	0.00077	0.5
10	Popcorn, popped	10.7	5.0	78.7	.....	.....	.....	....
11	Pork chops, lean	20.3	19.0	....	0.022	0.032	0.00154	....
12	Pork chops, med. fat	16.6	31.0	....	0.001	0.014	0.00126	....
13	Pork sausage	16.7	28.9	1.6	0.002	0.027	0.00022	....
14	Potato, boiled	2.5	0.1	20.3	0.014	0.058	0.00085	0.4
15	Potato, baked	3.1	0.12	25.4	0.018	0.073	0.00106	0.4
16	Potato, mashed	2.5	4.5	18.0	0.125	0.059	0.00096	0.34
17	Potato, fried	2.3	8.6	18.3	0.012	0.054	0.0012	0.33
18	Potato, sweet, baked	2.1	0.8	32.2	0.022	0.053	0.00108	1.4
19	Potato chips	9.0	40.0	46.5	0.035	0.160	0.0040	....
20	Prunes, E. P., fresh	2.1	....	73.3	0.054	0.003	0.00517	0.5
21	Prunes, dried, cooked	0.8	....	29.3	0.022	0.001	0.00207	1.3
22	Puffed rice	8.0	....	79.0	0.010	0.090	0.0011	0.1
23	Puffed wheat	13.0	2.0	70.0	0.040	0.370	0.00410	1.6
24	Pumpkin, E. P.	1.0	0.1	5.2	0.023	0.105	0.0011	1.2
25	Quinces, E. P.	0.3	0.1	13.9	.....	.....	0.00101	1.8
26	Radishes	1.3	0.1	5.8	0.021	0.029	0.00136	0.7
27	Raisins	2.6	3.3	76.1	0.064	0.132	0.005	1.79
28	Raspberries, black, fresh	1.5	1.6	15.6	0.049	0.052	0.00099	3.5
29	Raspberries, red, fresh	1.1	0.6	14.4	0.049	0.052	0.00099	2.8
30	Rhubarb, fresh	0.5	0.1	3.8	0.044	0.031	0.00086	0.7
31	Rice, polished, cooked	2.2	0.1	22.5	0.002	0.024	0.0002	0.05
32	Salmon, fresh	22.0	12.3	....	0.024	0.253	0.00083	....
33	Salmon, canned	21.8	12.1	....	0.024	0.250	.....	....
34	Sardines	23.0	19.7	....	0.025	0.264	0.0013	....
35	Sauerkraut	1.7	....	3.8	.....	.....	.....	....
36	Shredded wheat	12.1	1.8	75.2	0.041	0.324	0.0045	1.7
37	Spaghetti, cooked	2.2	0.1	13.7	0.004	0.025	0.00021	....
38	Spinach, cooked	2.1	0.3	3.2	0.067	0.068	0.00660	0.9
39	Squash, E. P.	1.4	0.5	9.0	0.018	.....	0.00055	0.8
40	Strawberries, canned	0.7	....	24.0	.....	.....	.....	....
41	Strawberries, fresh	0.8	0.6	8.1	0.041	0.028	0.00066	1.2
42	Sugar, granulated	....	....	100	.....	.....	.....	....
43	Sugar, brown	....	....	95	.....	.....	.....	....
44	Sweetbreads	16.8	12.1	....	.....	.....	.....	....
45	Tapioca, cooked	0.1	....	13.7	0.004	0.014	0.00025	....
46	Tomato, raw, A. P.	0.9	0.4	3.9	0.011	0.026	0.00060	0.6
47	Tomato, canned	1.2	0.2	4.0	0.011	0.026	0.00060	0.5
48	Turkey, light, cooked	34.6	4.9	....	0.021	0.373	.....	....
49	Turkey, dark, cooked	39.2	4.3	....	0.023	0.423	.....	....
50	Turnips, E. P.	1.3	0.2	8.1	0.064	0.046	0.00070	1.3
51	Veal chops, med. fat	19.9	10.8	....	0.012	0.216	0.00243	....
52	Walnuts, black, E. P.	27.6	56.3	10.0	.....	.....	0.00598	1.7
53	Walnuts, English, E. P.	18.4	64.4	13.0	0.089	0.358	0.00214	1.4
54	Watercress	0.7	0.5	3.7	0.187	0.005	0.00721	....
55	Watermelon	0.5	0.2	6.9	0.011	0.003	0.00023	0.6
56	Whitefish	22.9	6.5	....	0.025	0.263	0.00042	....
57	Yeast, compressed, A. P.	11.3	0.7	20.7	.....	.....	0.00187	....
58	Zwieback	9.8	9.9	73.5	.....	.....	.....	....

Kg. calories per 100g.	Vitamin A	Vitamin B	Vitamin C	Vitamin D	Vitamin E	100 Gram Portion	No.
93	++	++	++	.....	.....	¾ cup	1
93	.....	.....	.....	.....	.....	½ cup	2
734	+	+	?	.....	.....	⅞ cup	3
26	+	++	+++	.....	.....	1 large size	4
177	.....	.....	.....	.....	.....	1/8 of 9 inch diameter	5
199	.....	.....	.....	.....	.....	1/7 of 9 inch diameter	6
149	++	++	++	.....	.....	½ cup, diced	7
58	++	++	++	.....	.....	⅔ cup, diced	8
56	?	++	?	.....	.....	3 medium size	9
403	.....	.....	.....	.....	.....	9 cups	10
253	—to+	++	?	.....	.....	1 chop ½ inch thick	11
337	—to+	++	?	.....	.....	1 chop ½ inch thick	12
333	—to+	++	?	.....	.....	2½ links, 3x3¼ inches	13
92	+	++	++	.....	.....	1, 2½ inch diameter	14
115	+	++	+to++	.....	.....	1¼, 2½ inch diameter	15
123	.....	.....	.....	.....	.....	1/7 cup	16
160	.....	.....	.....	.....	.....	½ cup	17
147	.....	.....	.....	.....	.....	½ large size	18
580	.....	.....	.....	.....	.....	50 to 60 large chips	19
93	?	++	?	.....	.....	3 medium size	20
122	?	?	?	.....	.....	4 prunes + 3 tbs. juice	21
350	.....	.....	.....	.....	.....	5 cups	22
350	.....	.....	.....	.....	.....	5 cups	23
26	++	?	?	.....	.....	½ cup, cooked	24
58	.....	.....	.....	.....	.....	⅔ medium size	25
39	—	++	++	.....	.....	10, 1 inch diameter	26
353	—	+	—	.....	.....	¾ cup	27
83	?	?	++	.....	.....	1⅙ cup	28
67	?	?	++	.....	.....	1 cup	29
18	?	?	++	.....	.....	½ cup, cooked	30
100	—	—	—	.....	.....	½ cup	31
203	+	+	?	—	.....	¾x3x4 inches	32
196	+	?	?	—	.....	½ cup	33
269	.....	.....	.....	.....	.....	4, 3½ inches	34
27	+	+	+to++	.....	.....	⅔ cup	35
374	.....	.....	.....	.....	.....	3⅛ biscuits	36
66	.....	.....	.....	.....	.....	½ cup	37
24	+++	+	+to++	.....	.....	⅓ cup	38
47	++	?	?	.....	.....	½ cup, mashed	39
99	+	+	+++	.....	.....	½ cup	40
41	+	+	+++	.....	.....	1 cup	41
400	.....	.....	.....	.....	.....	⅔ cup	42
380	.....	.....	.....	.....	.....	⅔ cup	43
176	+	+	?	.....	.....	¾x2½x3 inches	44
57	.....	.....	.....	.....	.....	⅓ cup	45
20	++	++	+++	.....	.....	1 medium size	46
23	++	++	++	.....	.....	½ cup	47
183	—to+	+	?	.....	.....	2 slices, ¼x3x3½ inches	48
196	—to+	+	?	.....	.....	2 slices, ¼x3x3½ inches	49
41	—to+	++	++	.....	.....	½ cup, cooked	50
177	—to+	+	?	.....	.....	1 chop, ⅜ inch thick	51
657	?	++	+	.....	.....	½ cup, chopped	52
705	+	++	?	.....	.....	⅞ cup	53
22	+++	?	+++	.....	.....	3 cups	54
31	.....	.....	.....	.....	.....	1½x2½x2½inches	55
150	+	+	?	.....	.....	1x2x3 inches	56
133	—to+	+++	?	++	.....	6½ cakes	57
422	.....	.....	.....	.....	.....	12slices, ½x1¼x3¼ inches	58

THE VITAMINS

In compiling data for this revision certain facts became evident in making additions to the previous table. Some of the new factors which have now been added have not as yet been shown to be indispensible to man. The importance of some are only now being recognized and clinical experimentation is practically just beginning. However, it is known that the animal body does not function properly where the intake of these factors is low. Some of these factors have been shown to be synthesized in the intestines of some animals by the intestinal flora and consequently it is very difficult to produce a recognizable deficiency. Almost invariably a deficiency of any factor in man is accompanied by a deficiency of other factors and this gives the chief impetus to preparation of poly-vitamin products. Thus far no factor essential for lower animals, bacteria, etc., has been found which is not also essential for man. Some signs of deficiencies are apparently attributable to more than one vitamin. Some deficiencies are only partially cured by one or another vitamin while complete cure is obtained only by administration of all vitamins concerned. Most of the vitamins are interdependent upon the presence of each other for proper functioning.

INTERNATIONAL VITAMIN STANDARDS

1 Unit vitamin A $\doteq$ 0.6 microgram (μg) or 0.6γ of β-carotene.
1 Unit vitamin B_1 $\doteq$ 3.3 micrograms thiamin chloride.
1 Unit vitamin C $\doteq$ 50 micrograms of *l*-ascorbic acid.
1 Unit vitamin D $\doteq$ 1 milligram of standard solution of irradiated ergosterol (corresponding to 0.1 microgram of the ergosterol used in its preparation or 0.025 microgram crystalline vitamin D_2 (viosterol or calciferol).

Name and Synonym	Physiological Effect	Sources *		
		Concentrates for Medicinal Use	Plant	Animal
Vitamin A Axerophthol Provitamins A (α-, β-, and γ-carotenes, cryptoxanthin, aphanin, aphanicin, echinenone, myxoxanthin, leprotene (and probably other carotinoids) Anti-infective Anti-ophthalmic (Fat soluble)	Increases resistance to infection of eyes, sinuses, ears, kidneys, skin, and mucous membranes. Prevents xerophthalmia, hyperkeratosis of skin and mucous membranes. Promotes appetite and growth. Essential for reproduction. The vitamin is stored in the body and is required at all ages. Deficiency results in night blindness and injury to the nervous system. Adult human requirements approximately 3000 to 5000 units daily.	Carotene, obtained from carrots or vegetables, is converted by the body into vitamin A. Unsaponifiable fractions of halibut liver oil, cod liver oil and other fish liver oils.	All yellow and green vegetables. Raw carrots, yellow turnips, yellow corn, spinach, squash, canned and fresh tomatoes, sweet potatoes, oranges, prunes, apricots and pimento peppers.	Halibut liver oil, cod liver oil and other fish liver oils, fresh milk, cream, butter, cheddar and cream cheese, egg yolk, liver and kidney.
Thiamin chloride Vitamin B_1 Anti-neuritic Anti-beriberi	Promotes appetite and digestion by stimulating metabolism. Vital to health at all ages. Required by the mother for reproduction and lactation. Prevents the diseases beriberi and	Synthetic thiamine chloride. From yeast and wheat germ.	Whole grain cereals, green leafy vegetables, water cress, carrots, canned tomatoes, green	Milk, cheese, raw oysters, brain, kidney and liver.

* See also table: Composition and Use of Foods.

THE VITAMINS (Continued)

(Soluble in water and in 90% alcohol; heat labile; acid stable; adsorbed from acid solution)	polyneuritis. Promotes normal oxidation of carbohydrates in the body and formation of fat from carbohydrates. Adult human requirements approximately 1.5 to 2.0 milligrams daily.		corn, baked potatoes, dried lima beans, turnips and nuts.	
p-Aminobenzoic acid PAB Chromotrichia factor Anti-gray-hair factor	Influences enzyme activity. In experimental rats it apparently prevents achromotrichia. Inhibits oxidation of adrenaline. Nutrilite for certain bacteria. Antagonizes sulfanilamide and sulfapyridine.	Synthetic. Extracts of yeast.	Yeast.	Widely distributed over entire plant and animal kingdoms.
Choline (Choline is replaceable by methionine or betaine with estimated efficacy of 30%)	Maintains integrity of tissues. In chickens it is necessary for normal nutrition and egg production. Deficiency results in marked deposition of liver fat. Acts as transmethylating agent. Deficiency in young rats produces severe renal lesions. Important in lipid metabolism. Deficiency causes a type of cirrhosis of the liver, hemorrhagic degeneration of kidneys, necrosis of kidney cortex, enlargement of spleen. Necessary for normal growth and lactation of rat.	Synthetic choline chloride. As lecithin in phospholipids.	Rice bran, yeast.	Liver. Present in phospholipids of practically all animal and plant cells.
Ascorbic acid Vitamin C Cevitamic acid Anti-scorbutic (Soluble in water; heat labile at alkaline reaction)	Prevents and cures scurvy. Important in formation and maintenance of connective tissue in the body; essential for normal tooth and bone formation and strength of capillary walls. Inhibits dental caries, pyorrhea, certain gum infections, anorexia, anemia, failure of wound healing and susceptibility to infection. Important in carbohydrate metabolism and in controlling infective processes. Body stores readily depleted. Adult human requirements 75 to 100 milligrams daily.	Synthetic *l*-ascorbic acid.	Oranges, lemons, grapefruit, raw and leafy vegetables, raw apples, tomatoes, carrots and paprika.	Adrenal cortex, pituitary, ovary, thymus, intestinal wall, and milk.
Vitamin D Anti-rachitic (Fat soluble)	Prevents and cures rickets in young and osteoporosis in adults. Promotes absorption of calcium and phosphorus, and highly important for normal metabolism of these mineral elements in the young. Prevents spasmophilia and osteomalacia. Limited storage in the body. Approximate human requirements: for premature babies 600 to 800 units with milk; for full term infants 300 to 400 units with milk; for children 300 to 400 units and for pregnant and nursing women 800 units daily.	The effect of this vitamin is produced by the exposure of the body to direct sunlight or ultraviolet light. Ergosterol and foods exposed to (or irradiated with) ultraviolet. Unsaponifiable fractions of liver oils of halibut, cod, and many other fish. Cholesterol and several of its derivatives after exposure to ultraviolet light.	Practically none.	Cod, halibut and other fish liver oils, butter, egg yolk, and fish.

THE VITAMINS

Name and Synonym	Physiological Effect	Sources *		
		Concentrates for Medicinal Use	Plant	Animal
Pantothenic acid Pantothen Filtrate factor Factor II Chick anti-dermatitis factor	Prevents dermatitis in chicks. Deficiency may produce lesions in nervous system or endocrine systems, or may involve skin or hair. May play a part in maintaining integrity of nervous tissue. Necessary in treatment of peripheral neuritis along with other B-vitamins. Prevents hemorrhagic adrenals and achromotrichia in rats. Prevents ulcers in intestinal tract. Essential for growth in various experimental animals and plants. Needed for reproduction in chicks and increases egg hatchability.	Synthetic calcium *d*-pantothenate. Liver and yeast extracts.	Rice bran, wheat bran, brewer's yeast, Irish potato, taro root, alfalfa, wheat germ, molasses, peanuts, cabbage, cucumbers, and rolled oats.	Mammalian liver, egg yolk, eggs, canned salmon, whole milk, kidney, heart, spleen, brain, pancreas, tongue, lung, muscle, beef.
Pyridoxin Vitamin B_6 Adermin Factor Y Anti-dermatitis Anti-acrodynia factor (Soluble in water and in dilute alcohol; heat and acid stable)	Deficiency of this vitamin causes dermatitis in rats; anemia in dogs and pigs, and is presumably essential for hemoglobin formation. In experimental animals deficiency produces convulsions resembling human epileptic fits. Requirements proportional to metabolism. Apparently concerned with metabolism of the aminoacids. Deficiency impairs liver function, produces erythrodemic dermatosis, impairs growth.	Synthetic pyridoxin. From the germ and bran of wheat and rice; yeast, and liver extracts.	Grains, chiefly in the germ, yeast, maize, and molasses, seeds, legumes, spinach, and lettuce.	Liver, heart muscles, milk, and egg yolk.
Riboflavin Vitamin B_2 Vitamin G (Soluble in water and in dilute alcohol; heat and acid stable)	Plays an important role in vision mechanism. In fowls important in production and hatchability of eggs. Deficiency produces cheilosis, glossitis, seborrheic lesions about eyes and nose, vascularizing keratitis, and mild photophobia. Is a component of several enzymes. Plays part in metabolism of amino-acids and carbohydrates. Deficiency produces loss of hair, injury to nervous system, failure to grow, yellow liver, anemia and death. Adult human requirements approximately 2 to 3 milligrams daily.	Synthetic *d*-riboflavin. From milk whey, liver and yeast. Fermentation residues.	Fruits, leafy vegetables, soy beans, wheat germ, yeast.	Kidney, liver, milk, eggs.
Vitamin E α-, β-, and γ-Tocopherols Anti-sterility (Fat soluble)	Absence of this vitamin causes sterility in either sex. It is stored in the body to a certain degree. Exerts favorable influence on growth. Limited value in certain cases of muscular dystrophy and amyotropic lateral sclerosis.	Synthetic *dl*-α-tocopherol. Unsaponifiable fraction of wheat germ oil.	Vegetable oils, lettuce, beans, whole wheat, rice, barley, corn, and water cress.	Meat, liver, milk, and eggs.

* See also table: Composition and Use of Foods.

THE VITAMINS (Continued)

Nicotinic acid Niacin Nicotinic acid amide Niacin amide Anti-pellagra Pellagra preventive (P-P) factor	Prevents and cures black tongue in dogs and pellagra in man. Is a component of several enzymes. Influences carbohydrate, protein, water, and heavy metals metabolism. Deficiency produces a certain type of anemia. Adult human requirement approximately 10 to 20 milligrams daily.	Synthetic nicotinic acid, its amide, and all hydrolyzable nicotinoyl derivatives. From liver and yeast.	Yeast, wheat germ, peas, beans, green leafy vegetables.	Liver, lean meat, milk, egg yolk.
Vitamin K Anti-hemorrhagic Coagulation factor Prothrombin factor Phylloquinones Menadione (2-methyl-1, 4-naphthoquinone) (Fat soluble, heat stable, alkali labile)	Promotes normal blood coagulation time. In chicks it prevents intestinal, subcutaneous and intramuscular hemorrhage. Deficiency reduces prothrombin formation, hemorrhagic diathesis in newborn, certain types of hepatic and biliary diseases.	Synthetic K-vitamers; i.e., many related 1,4-naphthoquinones and compounds readily converted to them, most important is 2-methyl-1, 4-naphthoquinone, which replaces commercially the vitamin, and is known commercially as menadione.	All green vegetables and green leaves, tomatoes, oat sprouts, dried carrot tops, hemp-seed oil, cotton-seed oil, soy-bean oil, and bacterial action on rice bran.	Hog-liver fat, egg yolk, bacterial action on casein and fish meal. K_2 from putrefied fish meal.
Biotin Vitamin H Coenzyme R Anti-egg-white factor Curative factor of egg-white injury Bios II Bios II_b Factor X Factor W	Essential in vital economy of animals and in normal pigment metabolism in animals. Important in intermediary metabolism. Prevents dermatitis. Prevents perosis in chicks and fatty livers. Deficiency results in seborrheic desquamative dermatitis, emaciation and death. Nutrilite for certain bacteria and for yeast. It is antagonized by avidin which occurs in egg white.	Synthetic. Extracts of egg yolk, liver, milk-sugar residues, fermentation residues.	Widely distributed in nature. Yeast, seeds, nuts, tomatoes, carrots, corn and other vegetables.	Liver, kidney, pancreas, egg yolk, pork, and milk. Occurs in small amounts in all mammals and birds, tissue of eye only exception found so far.
Inositol (Meso-inositol) Bios I Anti-alopecia factor	Promotes growth, cures baldness in mice, important in fat metabolism, prevents fatty liver, favors growth of yeast and other microorganisms.	Liver extracts. Wheat bran extracts in the form of the hexa-phosphate ester (phytic acid) which on hydrolysis yields inositol.	Citrus fruits, nuts, yeast, various whole cereals and grains.	Muscle, kidney, liver, brain, milk, and eggs.
Folic acid	Nutrilite for yeast and certain bacteria. Available physiological data thus far is meager. Appears to be a growth factor for rats.	Extracts of yeast, milk sugar residue, spinach.	Yeast, mushrooms. Leaves of many plants.	Milk. Present in all animal tissues.
Citrin Vitamin P Permeability vitamin	Promotes tissue and capillary permeability. Prolongs life of scorbutic guinea pigs. Deficiency causes nutritional purpura.	Extracts of citrus fruits.	Citrus fruit juices and the leaves of several plants.	None.

COMPOSITION OF MILK FROM VARIOUS MAMMALS

Mammal	Specific Gravity	Water	Casein	Albumin	Total Proteins	Fat	Sugar	Ash	Total Solids
Ass	1.0320	90.12	0.79	1.06	1.85	1.37	6.19	0.47	9.88
Bitch	1.0350	75.44	....	....	11.17	9.57	3.09	0.73	24.56
Buffalo	1.0350	82.25	....	....	5.05	7.51	4.44	0.75	17.75
Camel	1.0420	86.57	....	....	4.00	3.07	5.59	0.77	13.43
Cow	1.0313	87.27	2.88	0.51	3.39	3.68	4.94	0.72	12.73
Cow colustrum	1.0420	75.07	4.19	12.99	17.18	3.97	2.28	1.53	24.93
Dolphin	....	41.00	....	....	11.00	46.00	1.30	0.60	59.00
Elephant	1.0313	79.30	....	....	2.51	9.10	8.59	0.50	20.70
Goat	1.0305	86.88	2.87	0.89	3.76	4.07	4.64	0.85	13.12
Human	1.0298	87.58	0.80	1.21	2.01	3.74	6.37	0.30	12.42
Llama	1.0340	86.55	....	....	3.90	3.15	5.60	0.80	13.45
Mare	1.0347	90.58	1.30	0.75	2.05	1.14	5.87	0.36	9.42
Rabbit	1.0470	69.50	....	....	12.00	13.50	2.00	2.50	30.50
Rat	....	....	0.9	10.4	11.3	14.8	3.9	1.5	....
Reindeer	....	67.00	8.30	1.50	9.80	17.00	2.80	1.50	33.00
Sheep	1.0355	83.57	4.17	0.98	5.15	6.18	4.17	0.93	16.43
Sow	1.0380	83.94	....	....	7.23	4.55	3.23	1.05	16.06
Commercial products:									
Milk	....	87.17	3.02	0.53	3.55	3.69	4.88	0.71	12.83
Cream	....	65.51	3.61*	....	3.61	26.75	3.52	0.61	34.39
Skimmed milk	....	90.66	3.11*	....	3.11	0.74	4.75	0.74	9.34
Butter milk	....	90.27	4.06*	0.74**	4.06	0.93	3.73	0.67	9.37
Whey	....	93.24	0.85*	0.33**	0.85	0.23	4.77	0.65	6.76

*Per cent casein plus albumin
**Per cent lactic acid

COMPOSITION OF COWS MILK

(According to Van Slyke)

Whole milk = 100

- Water = 87.1
- Solids = 12.9 / 100.0
  - Fat 3.9
  - Non-fat 9.0 / 12.9
    - Nitrogen compds. 3.2 → Casein 2.5, Albumin 0.7 / 3.2
    - Milk sugar 5.1
    - Ash 0.7 / 9.0
- Gases — CO_2, N_2, O_2

(According to Babcock)

Whole milk = 100

Casein	3.00	Containing nitrogen = 3.8	
Albumin	0.60		
Galactin	0.20		
Fibrin			
Globulin			
	3.80		
Lactose	4.5	= 4.6	Solids not fat = 9.1
Citric acid	0.1		
	4.6		
Potassium oxide	0.175	Ash = 0.7	Total solids = 12.7
Sodium oxide	0.070		
Calcium oxide	0.140		
Magnesium oxide	0.017		
Ferric oxide	0.001		
Sulfur trioxide	0.027		
Phosphorus trioxide	0.170		
Chloride	0.100		
	0.700		
Olein, Palmitin, Stearin, Myristin, Butin (trace)	Glycerides of insoluble and non-volatile acids	= 3.3	Fat = 3.6
Caprylin (trace), Caproin, Caprinin (trace), Butyrin	Glycerides of soluble and volatile acids	= 0.3	
Water			= 87.3

STANDARDIZATION OF MILK AND CREAM

Pearson's Square Method. Univ. of Illinois Bull. 323

The following procedure is a convenient method for calculating the relative parts by weight of two materials containing the same component but in different amounts which are to be mixed in order to obtain a product in which the component is present in an amount lying between that of the two starting products. Thus, to calculate the relative parts by weight of a 3% butter fat milk and a 40% butter fat cream which would be required in order to obtain 500 pounds of a 5% butter fat milk, proceed as follows: Draw a square and place the number corresponding to the desired % in the center (Fig. 1) and on the two corners at the left place the numbers corresponding to the % of starting materials (Fig. 2); subtract the number in the center of the square from the larger of the two numbers on the left and write this number on the corner diagonally opposite the larger of the numbers on the left (Fig. 3); then subtract the smaller of the two numbers on the left from the number in the center and write the result on the remaining corner (Fig. 4). The two numbers on the right side of the square represent the parts by weight of each of the starting products and which in this example gives the answer that 35/37 of 500 (or 473 pounds) of 3% butter fat milk and 2/37 of 500 (or 27 pounds) of 40% butter fat cream when mixed will give 500 parts of 5% butter fat milk.

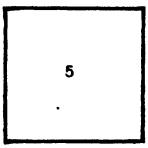


Fig. 1

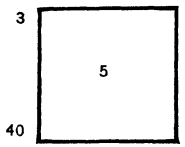


Fig. 2

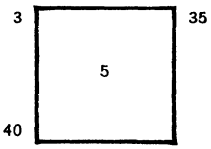


Fig. 3

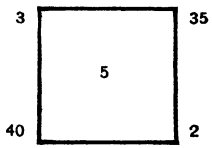


Fig. 4

ICE CREAM INGREDIENTS

Ingredient	Pounds per gallon at 60° F	% Total solids	% Fat	% Non-Fat milk solids
Water	8.3	....	....	.....
Skim milk	8.6	9.3	0.05	9.25
Milk	8.6	13.0	4.0	9.0
18% Cream	8.4	25.5	18.0	7.5
20% Cream	8.4	27.4	20.0	7.4
25% Cream	8.4	31.9	25.0	6.9
30% Cream	8.35	36.4	30.0	6.4
35% Cream	8.3	41.0	35.0	6.0
40% Cream	8.3	45.5	40.0	5.5
45% Cream	8.25	50.0	45.0	5.0
50% Cream	8.2	54.6	50.0	4.6
Condensed whole milk	8.9	27.3	7.9	19.4
3:1 Condensed skim milk	9.3	27.9	0.15	27.75
4:1 Condensed skim milk	9.66	37.1	0.19	36.91
5:1 Condensed skim milk	10.09	46.4	0.23	46.17
3:1 Sweetened skim condensed milk	11.25	71.9	0.15	27.75
3:1 Sweetened whole condensed milk	10.8	72.5	8.8	21.7
Evaporated milk	8.9	25.5	7.8	17.7
Butter	....	84.0	83.0	1.0
Skim milk powder	....	97.2	1.35	95.85
Ice cream mix 13% sugar	9.00	29.0	8.0	8.0
Ice cream mix 15% sugar	9.20	....	....	11.7
Ice cream mix 14% sugar	9.10	....	8.0	10.5

Table showing the per cent total solids in milk corresponding to the per cent of fat and Quevenne lactometer reading.*

To use the table, first find in the column at the extreme left the number correspond-

Per Cent Fat	Quevenne Lactometer Reading at 15.56°C (60°F)										
	25.0	25.5	26.0	26.5	27.0	27.5	28.0	28.5	29.0	29.5	30.0
2.6	9.5	9.6	9.8	9.9	10.0	10.1	10.3	10.4	10.5	10.6	10.8
2.7	9.6	9.8	9.9	10.0	10.1	10.3	10.4	10.5	10.6	10.8	10.9
2.8	9.8	9.9	10.0	10.1	10.3	10.4	10.5	10.6	10.8	10.9	11.0
2.9	9.9	10.0	10.1	10.2	10.4	10.5	10.6	10.7	10.9	11.0	11.1
3.0	10.0	10.1	10.2	10.4	10.5	10.6	10.7	10.9	11.0	11.1	11.2
3.1	10.1	10.2	10.4	10.5	10.6	10.7	10.9	11.0	11.1	11.2	11.4
3.2	10.2	10.4	10.5	10.6	10.7	10.9	11.0	11.1	11.2	11.4	11.5
3.3	10.4	10.5	10.6	10.7	10.9	11.0	11.1	11.2	11.4	11.5	11.6
3.4	10.5	10.6	10.7	10.8	11.0	11.1	11.2	11.3	11.5	11.6	11.7
3.5	10.6	10.7	10.8	11.0	11.1	11.2	11.3	11.5	11.6	11.7	11.8
3.6	10.7	10.8	11.0	11.1	11.2	11.3	11.5	11.6	11.7	11.8	12.0
3.7	10.8	11.0	11.1	11.2	11.3	11.5	11.6	11.7	11.8	12.0	12.1
3.8	11.0	11.1	11.2	11.3	11.5	11.6	11.7	11.8	12.0	12.1	12.2
3.9	11.1	11.2	11.3	11.4	11.6	11.7	11.8	11.9	12.1	12.2	12.3
4.0	11.2	11.3	11.4	11.6	11.7	11.8	11.9	12.1	12.2	12.3	12.4
4.1	11.3	11.4	11.6	11.7	11.8	11.9	12.1	12.2	12.3	12.4	12.6
4.2	11.4	11.6	11.7	11.8	11.9	12.1	12.2	12.3	12.4	12.6	12.7
4.3	11.6	11.7	11.8	11.9	12.1	12.2	12.3	12.4	12.6	12.7	12.8
4.4	11.7	11.8	11.9	12.0	12.2	12.3	12.4	12.5	12.7	12.8	12.9
4.5	11.8	11.9	12.0	12.2	12.3	12.4	12.5	12.7	12.8	12.9	13.0
4.6	11.9	12.0	12.2	12.3	12.4	12.5	12.7	12.8	12.9	13.0	13.2
4.7	12.0	12.2	12.3	12.4	12.5	12.7	12.8	12.9	13.0	13.2	13.3
4.8	12.2	12.3	12.4	12.5	12.7	12.8	12.9	13.0	13.2	13.3	13.4
4.9	12.3	12.4	12.5	12.6	12.8	12.9	13.0	13.1	13.3	13.4	13.5
5.0	12.4	12.5	12.6	12.8	12.9	13.0	13.1	13.3	13.4	13.5	13.6
5.1	12.5	12.6	12.8	12.9	13.0	13.1	13.3	13.4	13.5	13.6	13.8
5.2	12.6	12.8	12.9	13.0	13.1	13.3	13.4	13.5	13.6	13.8	13.9
5.3	12.8	12.9	13.0	13.1	13.3	13.4	13.5	13.6	13.8	13.9	14.0
5.4	12.9	13.0	13.1	13.2	13.4	13.5	13.6	13.7	13.9	14.0	14.1
5.5	13.0	13.1	13.2	13.4	13.5	13.6	13.7	13.9	14.0	14.1	14.2
5.6	13.1	13.2	13.4	13.5	13.6	13.7	13.9	14.0	14.1	14.2	14.4
5.7	13.2	13.4	13.5	13.6	13.7	13.9	14.0	14.1	14.2	14.4	14.5
5.8	13.4	13.5	13.6	13.7	13.9	14.0	14.1	14.2	14.4	14.5	14.6
5.9	13.5	13.6	13.7	13.8	14.0	14.1	14.2	14.3	14.5	14.6	14.7
6.0	13.6	13.7	13.8	14.0	14.1	14.2	14.3	14.5	14.6	14.7	14.8

*See also a table: *Conversion Table for Quevenne and New York Board of Health Lactometer Readings to Specific Gravity*

TOTAL MILK SOLIDS

The percentage of total milk solids may be calculated from the following expression: (A+B+0.14) = % total solids; where A = % butter fat×1.2; and B = Quevenne lactometer reading × 0.25.

SOLIDS

ing to the % of butterfat, then in the same line with this and in the same column as the observed lactometer reading as given across the top of the table will be found the % of total solids.

Quevenne Lactometer Reading at 15.56°C (60°F)											
30.5	31.0	31.5	32.0	32.5	33.0	33.5	34.0	34.5	35.0	35.5	36.0
10.9	11.0	11.1	11.3	11.4	11.5	11.6	11.8	11.9	12.0	12.1	12.3
11.0	11.1	11.3	11.4	11.5	11.6	11.8	11.9	12.0	12.1	12.3	12.4
11.1	11.3	11.4	11.5	11.6	11.8	11.9	12.0	12.1	12.3	12.4	12.5
11.2	11.4	11.5	11.6	11.7	11.9	12.0	12.1	12.2	12.4	12.5	12.6
11.4	11.5	11.6	11.7	11.9	12.0	12.1	12.2	12.4	12.5	12.6	12.7
11.5	11.6	11.7	11.9	12.0	12.1	12.2	12.4	12.5	12.6	12.7	12.9
11.6	11.7	11.9	12.0	12.1	12.2	12.4	12.5	12.6	12.7	12.9	13.0
11.7	11.9	12.0	12.1	12.2	12.4	12.5	12.6	12.7	12.9	13.0	13.1
11.8	12.0	12.1	12.2	12.3	12.5	12.6	12.7	12.8	13.0	13.1	13.2
12.0	12.1	12.2	12.3	12.5	12.6	12.7	12.8	13.0	13.1	13.2	13.3
12.1	12.2	12.3	12.5	12.6	12.7	12.8	13.0	13.1	13.2	13.3	13.5
12.2	12.3	12.5	12.6	12.7	12.8	13.0	13.1	13.2	13.3	13.5	13.6
12.3	12.5	12.6	12.7	12.8	13.0	13.1	13.2	13.3	13.5	13.6	13.7
12.4	12.6	12.7	12.8	12.9	13.1	13.2	13.3	13.4	13.6	13.7	13.8
12.6	12.7	12.8	12.9	13.1	13.2	13.3	13.4	13.6	13.7	13.8	13.9
12.7	12.8	12.9	13.1	13.2	13.3	13.4	13.6	13.7	13.8	13.9	14.1
12.8	12.9	13.1	13.2	13.3	13.4	13.6	13.7	13.8	13.9	14.1	14.2
12.9	13.1	13.2	13.3	13.4	13.6	13.7	13.8	13.9	14.1	14.2	14.3
13.0	13.2	13.3	13.4	13.5	13.7	13.8	13.9	14.0	14.2	14.3	14.4
13.2	13.3	13.4	13.5	13.7	13.8	13.9	14.0	14.2	14.3	14.4	14.5
13.3	13.4	13.5	13.7	13.8	13.9	14.0	14.2	14.3	14.4	14.5	14.7
13.4	13.5	13.7	13.8	13.9	14.0	14.2	14.3	14.4	14.5	14.7	14.8
13.5	13.7	13.8	13.9	14.0	14.2	14.3	14.4	14.5	14.7	14.8	14.9
13.6	13.8	13.9	14.0	14.1	14.3	14.4	14.5	14.6	14.8	14.9	15.0
13.8	13.9	14.0	14.1	14.3	14.4	14.5	14.6	14.8	14.9	15.0	15.1
13.9	14.0	14.1	14.3	14.4	14.5	14.6	14.8	14.9	15.0	15.1	15.3
14.0	14.1	14.3	14.4	14.5	14.6	14.8	14.9	15.0	15.1	15.3	15.4
14.1	14.3	14.4	14.5	14.6	14.8	14.9	15.0	15.1	15.3	15.4	15.5
14.2	14.4	14.5	14.6	14.7	14.9	15.0	15.1	15.2	15.4	15.5	15.6
14.4	14.5	14.6	14.7	14.9	15.0	15.1	15.2	15.4	15.5	15.6	15.7
14.5	14.6	14.7	14.9	15.0	15.1	15.2	15.4	15.5	15.6	15.7	15.9
14.6	14.7	14.9	15.0	15.1	15.2	15.4	15.5	15.6	15.7	15.9	16.0
14.7	14.9	15.0	15.1	15.2	15.4	15.5	15.6	15.7	15.9	16.0	16.1
14.8	15.0	15.1	15.2	15.3	15.5	15.6	15.7	15.8	16.0	16.1	16.2
15.0	15.1	15.2	15.3	15.5	15.6	15.7	15.8	16.0	16.1	16.2	16.3

CURDLING OF MILK

Approximate Time Required to Reach the Curdling Point of Milk at Various Temperatures.

Milk kept at deg. F	Hours to reach curdling point
40	80
45	76
50	68
55	51
60	42
65	37
70	33
75	30
80	28
85	27
90	26

TEMPERATURE CORRECTION TABLE FOR SPECIFIC GRAVITY OF MILK
(Quevenne Lactometer)

To use the table below, first find the temperature in one of the vertical columns at the extreme left or right, then in the same line with this and in the same column as the observed lactometer reading is given across the top of the table is the corrected lactometer reading.*

Temp. °F	Observed Reading on Quevenne Lactometer																Temp. °C
	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	
45	19.0	19.9	20.9	21.9	22.9	23.8	24.8	25.8	26.7	27.7	28.6	29.5	30.4	31.3	32.2	33.0	7.2
46	19.0	20.0	21.0	22.0	22.9	23.9	24.9	25.9	26.8	27.8	28.7	29.6	30.5	31.4	32.3	33.1	7.8
47	19.1	20.0	21.0	22.0	23.0	24.0	24.9	25.9	26.8	27.8	28.7	29.6	30.5	31.4	32.3	33.2	8.3
48	19.1	20.1	21.1	22.1	23.1	24.0	25.0	26.0	26.9	27.9	28.8	29.7	30.6	31.5	32.4	33.4	8.9
49	19.2	20.2	21.2	22.2	23.2	24.1	25.1	26.1	27.0	28.0	28.9	29.8	30.7	31.6	32.5	33.5	9.4
50	19.2	20.2	21.2	22.2	23.2	24.1	25.1	26.1	27.0	28.0	29.0	29.9	30.9	31.8	32.7	33.6	10.0
51	19.3	20.3	21.3	22.3	23.3	24.2	25.2	26.2	27.1	28.1	29.1	30.0	31.0	31.9	32.9	33.8	10.6
52	19.4	20.3	21.3	22.3	23.3	24.3	25.2	26.2	27.2	28.2	29.1	30.1	31.1	32.0	33.0	33.9	11.1
53	19.4	20.4	21.4	22.4	23.4	24.4	25.3	26.3	27.3	28.3	29.2	30.2	31.2	32.1	33.1	34.0	11.7
54	19.5	20.5	21.5	22.5	23.5	24.5	25.4	26.4	27.4	28.4	29.3	30.3	31.3	32.3	33.2	34.2	12.2
55	19.6	20.6	21.6	22.6	23.6	24.6	25.5	26.5	27.5	28.5	29.4	30.4	31.4	32.4	33.3	34.3	12.8
56	19.7	20.7	21.7	22.7	23.6	24.6	25.6	26.6	27.6	28.6	29.6	30.5	31.5	32.5	33.5	34.5	13.3
57	19.8	20.8	21.8	22.8	23.7	24.7	25.7	26.7	27.7	28.7	29.7	30.6	31.6	32.6	33.6	34.6	13.9
58	19.9	20.9	21.9	22.8	23.8	24.8	25.8	26.8	27.8	28.8	29.8	30.8	31.7	32.7	33.7	34.7	14.4
59	19.9	20.9	21.9	22.9	23.9	24.9	25.9	26.9	27.9	28.9	29.9	30.9	31.9	32.9	33.9	34.9	15.0
60	20.0	21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	15.6
61	20.1	21.1	22.1	23.1	24.1	25.1	26.1	27.1	28.1	29.1	30.1	31.2	32.2	33.2	34.2	35.2	16.1
62	20.2	21.2	22.2	23.2	24.2	25.2	26.2	27.3	28.3	29.3	30.3	31.3	32.3	33.3	34.3	35.3	16.7
63	20.2	21.3	22.3	23.3	24.3	25.3	26.3	27.4	28.4	29.4	30.4	31.4	32.5	33.5	34.5	35.5	17.2
64	20.3	21.4	22.4	23.4	24.4	25.4	26.5	27.5	28.5	29.5	30.5	31.5	32.6	33.6	34.6	35.6	17.8
65	20.4	21.5	22.5	23.5	24.5	25.5	26.6	27.6	28.6	29.6	30.7	31.7	32.7	33.8	34.8	35.8	18.3
66	20.5	21.6	22.6	23.6	24.6	25.6	26.7	27.7	28.7	29.8	30.8	31.8	32.9	33.9	34.9	35.9	18.9
67	20.6	21.7	22.7	23.7	24.7	25.7	26.8	27.8	28.8	29.9	30.9	31.9	33.0	34.0	35.0	36.1	19.4
68	20.7	21.8	22.8	23.8	24.9	25.9	27.0	28.0	29.0	30.1	31.1	32.0	33.2	34.2	35.2	36.2	20.0
69	20.9	22.0	23.0	24.0	25.0	26.0	27.1	28.1	29.1	30.2	31.2	32.2	33.3	34.3	35.3	36.4	20.6

*See also a table: *Conversion Table for Quevenne and New York Board of Health Lactometer Readings to Specific Gravity.*

WATER ANALYSIS

Hypothetical Results Calculated from Alkalinity and Non-carbonate Hardness Determinations.

Compiled by **O. F. Schoepfle**

M is methyl orange alkalinity
P is phenolphthalein alkalinity
N or NCH is non carbonate hardness

T or TH is total hardness
C is causticity
N⁻ is negative NCH

				Carbonate Hardness									
				Bicarbonates		Carbonates		Hydroxides					
				Ca Mg	Na	Ca Mg	Na	C	Ca	Na	Total	NCH	TH
1	T>M		P=0	M	0	0	0	0	0	0	M	N	M+N
2	T>M		P<½M	M−2P	0	2P	0	0	0	0	M	N	M+N
3	T>M		P=½M	0	0	2P	0	0	0	0	M	N	M+N
4	T>M		P>½M	0	0	2(M−P)	0	2P−M	2P−M	0	M	N	M+N
5	T>M		P=M	0	0	0	0	M	M	0	M	N	M+N
6	T=M		P=0	M	0	0	0	0	0	0	M	0	M
7	T=M		P<½M	M−2P	0	2P	0	0	0	0	M	0	M
8	T=M		P=½M	0	0	2P	0	0	0	0	M	0	M
9	T=M		P>½M	0	0	2(M−P)	0	2P−M	2P−M	0	M	0	M
10	T=M		P=M	0	0	0	0	M	M	0	M	0	M
11	T<M		C>N⁻	0	0	M−C	0	2P−M	C−N⁻	N⁻	M−N⁻	N⁻	M−N⁻
12	T<M		C=N⁻	0	0	M−C	0	2P−M	0	C	M−N⁻	N⁻	M−N⁻
13	T<M		C<N⁻	0	0	M−N⁻	N⁻−C	2P−M	0	C	M−N⁻	N⁻	M−N⁻
14	T<M	2P<M	2P>N⁻	M−2P	0	2P−N⁻	N⁻	0	0	0	M−N⁻	N⁻	M−N⁻
15	T<M	2P<M	2P=N⁻	M−N⁻	0	0	N⁻	0	0	0	M−N⁻	N⁻	M−N⁻
16	T<M	2P<M	2P<N⁻	M−N⁻	N⁻−2P	0	2P	0	0	0	M−N⁻	N⁻	M−N⁻
17	T<M		P=0	M−N⁻	N⁻	0	0	0	0	0	M−N⁻	N⁻	M−N⁻
18		M<0										T	
19		T<M										(M−T)=N⁻	

NATURAL WATERS FOR INDUSTRIAL USE

Cf. W. D. Collins, *Chem. and Eng. News* **21**, *1062 (1943)*.
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SURFACE AND GROUND WATERS

Typical natural waters available for industrial use in the United States are shown in *Table I*. They have been classified into five types as follows:

Type A. Catskill supply of New York City. This type is a *natural soft water*. For practical purposes it may be considered the equivalent of distilled or rain water and may contain not more than approximately 30 parts per million of dissolved mineral matter. Public water supplies of this type are the Catskill supply of New York City, the supply of Boston and surrounding territory, the Hetch Hetchy supply of San Francisco, and the supply of Asheville, N. C. Rivers and lakes in Maine and other New England states, and streams and lakes in or near mountains may supply these clear waters of low mineral content. The hardness of these natural waters is less than the best that could be obtained by softening methods in use before development of the ion-exchange systems. The very soft waters have a tendency to be corrosive and may require treatment or special precautions to prevent damage from corrosion.

Type B. Niagara River, filtered for public supply of Niagara Falls, N. Y. This type is a *hard water* intermediate between *Type A* and *Type C*. This water, represented by the waters of the Great Lakes, except Lake Superior, is more like the soft waters than the real hard waters. As such it has been used for many domestic supplies but for industrial uses where hardness is detrimental the water must be softened. Public supplies of this type of water are those in Detroit, Milwaukee, Chicago, Cleveland, Sandusky, Toledo, Erie, Buffalo, Niagara Falls, and many smaller places along the lakes and the St. Lawrence River.

Type C. Wells 30 to 60 feet deep used for public supply of Dayton, Ohio. This type is a genuinely *hard water* as commonly used throughout the industrial areas in the heart of the country. These hard waters are the most widely distributed throughout the United States and the water obtained from the wells is so hard that softening is needed to make it acceptable for general domestic use or for most industrial uses.

Type D. Well 2,000 feet deep used for public supply of Maywood, Ill. This type contains enough chloride to require a separate listing. In a few waters nitrate is present as a major constituent but these waters may be classed as variants of the *hard water* type if their total mineral content is in the range of usable waters.

Type E. Well 330 feet deep at Smithfield, Va. This type is representative of a smaller but distinct class of *naturally softened waters*. Their hardness may be well below the average hardness of the waters classed as soft whereas their total mineral content may be well up in the range of the really hard waters. Many of the softened waters in Louisiana and Mississippi are highly colored. The softened, or sodium bicarbonate waters, are found in widely scattered areas but they are somewhat more common in the Atlantic and Gulf Coastal Plain.

NATURAL WATERS FOR INDUSTRIAL USE

Salt Waters. This class may include all waters not considered generally usable. **Sea water** may be taken as the typical salt water. It has about 35,000 parts per million of dissolved salts. Cf. Clarke, "The Data of Geochemistry," *U. S. Geol. Survey Bull.* 770 (*1924*). It is characteristic of sea water that the magnesium greatly exceeds the calcium. Most **brines from inland wells** carry more calcium than magnesium. They also have a smaller proportion of sulfate than sea water and may have much more dissolved mineral matter, often running up to 200,000 or 300,000 parts per million. Such brines may be the raw materials of certain chemical industries.

General Characteristics. An important characteristic of natural waters is the hydrogen-ion concentration. In general the *p H* of natural waters tends to center around 7.0 or a little above. Well waters low in dissolved solid mineral constituents and high in carbon dioxide are often found with a *p H* of 8.0 or more. **Temperature** is an important factor in relation to industrial use. Cf. Collins, "Temperature of Water Available for Industrial Use in the United States," *U. S. Geol. Survey Water-Supply Paper* 520-F (*1925*). Ground waters normally have a constant temperature that is close to the mean annual air temperature for water from depths of 30 to 60 feet. Below 60 feet the temperature increases about 1° F. for each increase in depth of from 60 to 100 feet according to location. Surface water temperatures are variable and not wholly predictable. Reservoirs and lakes may show stratification. In deep lakes a top layer of 20 to 30 feet responds to atmospheric changes while the temperature at greater depths remains constant.

In *Table I* following, the waters used industrially are illustrated by analyses from a report on industrial water supplies that gives analyses for 670 supplies used by about 57,000,000 consumers. The extent to which the five analyses can be taken as representative of waters available for industrial use is as follows:

Type	Number of Supplies	Number of States	Population Supplied
A	131	25	11,170,968
B	75	29	11,581,024
C	47	16	2,153,459
D	19	10	600,785
E	8	3	128,583

Although *Table I* is based on the public supplies of only 670 places, including the larger places in each state, the general conclusions can safely be applied to water supplies that are available for industrial use in the United States. Cf. Collins, Lamar, and Lohr, "The Industrial Utility of Public Water Supplies in the United States, 1932," *U. S. Geol. Survey Water-Supply Paper* 658 (*1934*).

RIVER WATERS

Analyses of river waters are shown in *Table II*. River waters carry widely varying amounts of suspended matter. Some streams regularly have only a few parts per million of suspended matter. At times of heavy rains or rapid melting of snow they

may carry much more. Rivers like the Missouri and Colorado normally carry from a few hundred to several thousand parts per million of suspended matter. The average load in the Missouri is of the order of magnitude of about 2,000 parts per million. The average load of suspended matter in the Colorado River at Grand Canyon, Ariz., is about 1 per cent, 10,000 parts per million. At times the Colorado at Grand Canyon has carried as much as 12 per cent, 120,000 parts per million, for a day. The temperature of river waters follows the changes in air temperature, with a lag that is dependent on many conditions. In a very general way it has been found that the mean monthly temperature of a river water at any point is likely to be within a few degrees of the mean monthly air temperature unless there are conditions that affect the temperature strongly. There is a lag in the rise of spring and early summer temperature in streams that are fed by melting snow.

TABLE I. TYPICAL ANALYSES OF SURFACE AND GROUND WATERS IN THE UNITED STATES

From U. S. Geological Survey Water Supply Paper 658.

Type	(Parts per million) A	B	C	D	E
Silica (SiO_2)	2.4	12	10	9.4	22
Iron (Fe)	0.14	0.02	0.09	0.2	0.08
Calcium (Ca)	5.8	36	92	96	3.0
Magnesium (Mg)	1.4	8.1	34	27	2.4
Sodium (Na)	1.7	6.5	8.2	183	215
Potassium (K)	0.7	1.2	1.4	18	9.8
Bicarbonate (HCO_3)	14	119	339	334	549
Sulfate (SO_4)	9.7	22	84	121	11
Chloride (Cl)	2.0	13	9.6	280	22
Nitrate (NO_3)	0.54	0.1	13	0.2	0.52
Total Dissolved Solids	31	165	434	983	564
Total Hardness as $CaCO_3$	20	123	369	351	17
Type	**(Equivalents per million) A**	**B**	**C**	**D**	**E**
Calcium (Ca)	0.29	1.80	4.59	4.79	0.15
Magnesium (Mg)	0.12	0.67	2.80	2.22	0.20
Sodium (Na)	0.07	0.28	0.36	7.96	9.35
Potassium (K)	0.02	0.03	0.04	0.46	0.25
Total Cations	0.50	2.78	7.79	15.43	9.95
Bicarbonate (HCO_3)	0.23	1.95	5.56	5.47	9.00
Sulfate (SO_4)	0.20	0.46	1.75	2.52	0.23
Chloride (Cl)	0.06	0.37	0.27	7.90	0.62
Nitrate (NO_3)	0.01	0.00	0.21	0.00	0.01
Total Anions	0.50	2.78	7.79	15.89	9.86

TABLE II. AVERAGE ANALYSES OF RIVER WATER IN THE UNITED STATES

Averages of analyses of dissolved mineral matter in 10-day composites of samples collected daily for one year. From U. S. Geological Survey Professional Paper 135 and Water Supply Papers 496, 638-D, and 889-E.

(Parts per million)

River	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Silica (SiO_2)	9.0	6.6	12	11	...	20	29	15	11	29	9.4	13	14	19
Iron (Fe)	...	0.05	0.25	0.05	0.09	0.39	0.51	0.07	0.13	...	...	0.13	0.06	0.29
Calcium (Ca)	7.4	31	16	4.3	28	19	52	40	32	104	10	73	17	15
Magnesium (Mg)	1.1	7.2	3.9	1.3	5.0	4.1	16	14	8.4	23	6.2	21	3.9	7.0
Sodium (Na)	2.5	6.3	3.7	3.4	11	7.7	36	10	13	112	19	74	8.9	15
Potassium (K)	1.0		1.3	1.2						6.6		4.1		
Bicarbonate (HCO_3)	17	122	60	22	42	72	178	188	111	178	62	176	69	76
Sulfate (SO_4)	12	12	9.7	3.0	53	11	104	18	24	228	29	202	12	13
Chloride (Cl)	2.3	7.7	2.5	2.4	18	3.0	12	1.6	9.7	164	8.6	54	3.2	8.7
Nitrate (NO_3)	...	0.3	0.18	0.3	...	1.2	2.9	1.4	2.5	...	...	3.3	0.48	...
Total Dissolved Solids	42	134	85	41	164	101	346	200	166	791	113	550	97	124
Total Hardness as $CaCO_3$	23	107	56	16	90	64	196	158	114	352	50	269	58	66

(Equivalents per million)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Calcium (Ca)	0.37	1.55	0.80	0.21	1.40	0.95	2.60	2.00	1.60	5.14	0.50	3.64	0.85	0.75
Magnesium (Mg)	0.09	0.59	0.32	0.11	0.41	0.34	1.32	1.15	0.69	1.89	0.51	1.73	0.32	0.58
Sodium (Na)	0.11	0.27	0.16	0.15	0.49	0.33	1.57	0.43	0.57	4.87	0.83	3.22	0.39	0.65
Potassium (K)	0.03		0.03	0.03						0.17		0.10		
Total Cations	0.60	2.41	1.31	0.50	2.30	1.62	5.49	3.58	2.85	12.07	1.84	8.69	1.56	1.98
Bicarbonate (HCO_3)	0.28	2.00	0.98	0.36	0.69	1.18	2.92	3.08	1.82	2.92	1.02	2.88	1.13	1.25
Sulfate (SO_4)	0.25	0.25	0.20	0.06	1.10	0.23	2.17	0.37	0.50	4.65	0.60	4.21	0.25	0.27
Chloride (Cl)	0.07	0.22	0.07	0.07	0.51	0.08	0.34	0.05	0.27	4.63	0.24	1.52	0.09	0.25
Nitrate (NO_3)	...	0.00	0.00	0.01	...	0.02	0.05	0.02	0.04	...	...	0.05	0.01	...
Total Anions	0.60	2.47	1.26	0.50	2.30	1.51	5.49	3.52	2.63	12.19	1.87	8.67	1.48	1.76

1. Androscoggin River, Brunswick, Maine.
2. St. Lawrence River, Ogdensburg, N. Y.
3. James River, Cartersville, Va.
4. Savannah River, Clyo, Ga.
5. Ohio River, Cincinnati, Ohio.
6. Tennessee River, Muscle Shoals, Ala.
7. Missouri River, Ruegg, Mo.
8. Mississippi River, Minneapolis, Minn.
9. Mississippi River, New Orleans, La.
10. Rio Grande, Laredo, Tex.
11. Missouri River, Great Falls, Mont.
12. Colorado River, Grand Canyon, Ariz.
13. Columbia River, Cascade Locks, Wash.
14. Sacramento River, Sacramento, Calif.

TYPICAL ANALYSES OF VARI-

From information supplied by Geological Water Supply Paper, No. 496 (1921) and private communications.

Abbreviations: *a*—calculated; *b*—Fe and Al as Fe_2O_3 and Al_2O_3; *d*—determined;

	Analyses (parts					
	Total dissolved solids	Loss on ignition	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)
Akron, Ohio	133	.....	.....	0.04	23	5.8
Atlanta, Ga.	32	1.5	10	0.08	2.4	1.1
Baltimore, Md.	74	.....	6.5	0.07	14	4.1
Bloomington, Ill.	969a	.....	16	0.14	203	74
Boston, Mass.	28	2.3	3.7	0.02	3.0	0.7
Buffalo, N. Y.	133	.....	5.9	0.07	31	7.6
Chicago, Ill.	183	.....	18	0.4	36	10
Cincinnati, Ohio	161a	.....	.....	0.03	33	3.7
Cleveland, Ohio	159	.....	.....	0.07	35	8.4
Columbus, Ohio	206	.....	7b	1.0	20	10
Dayton, Ohio	434	17	10	0.09	92	34
Denver, Colo.	250	.....	7.0	0.20	41	10
Detroit, Mich.	99a	.....	1	0.2	27	7.0
Flint, Mich.	380a	.....	6	7b	80	28
Houston, Texas	356a	.....	17	0.7b	29	6.6
Jersey City, N. J.	81	3.5	6.5	0.08	13	5.6
Kansas City, Mo.	426	.....	37	0.73	62	18
Los Angeles, Calif. Owens River	279a	.....	22	0	39	16
Los Angeles, Calif. L. A. River	378a	.....	22	0	66	21
Louisville, Ky.	150	.....	4	1.5b	35	7
Memphis, Tenn.	78	.....	11	1.1	8.6	4.0
Miami, Fla.	772	1.6	12	0.64	116	18
Minneapolis, Minn.	191a	.....	9.1	0.05	42	16
Nashville, Tenn.	119	.....	20	0.42	26	3.6
New Haven, Conn. Lake Whitney	94	2.0	6.7	0.06	22	3.3
New Haven, Conn. Lake Dawson	39	1.8	5.9	0.16	4.9	1.7
New Haven, Conn. Lake Gaillard	76	.....	.....	.....	21	.....
New Orleans, La.	100	.....	10	0.03	15	3
New York, N. Y. Catskill	28	2.5	2.6	0.04	4.5	1.2
New York, N. Y. Croton	69	3.1	9.6	0.05	12	4.2

OUS PUBLIC WATER SUPPLIES

s—since softening works in operation; *x*—varies over large range; *xx*—estimated; *z*—includes equivalent of 6.6 ppm of CO_3; *Tr*—trace.

per million)						
Sodium & Potassium (Na+K)	Bicarbonate radical (HCO_3)	Sulfate radical (SO_4)	Chloride radical (Cl)	Nitrate radical (NO_3)	Total hardness as $CaCO_3$ (calculated)	Total hardness as $CaCO_3$ (average)
11a	66	44	4.3	.....	81	100x
Na 2.3 K 0.6	6.6	7.8	1.8	0.33	11	14
3.1	47	14	5.1	1.0	52	54
Na 14 K 2.7	504a	404	8.0	0.0	811	77s
Na 2.2 K 1.0	7.0	6.0	2.1	0.22	10	15
6.5	120	13	8.7	0.3	109	118
Na 4.6 K 1.6	144	10	6.0	1.8	131	125
13a	42	62	19	.....	97	110x
5.6	113	25	11	.....	122	120
.....	43	110	10	17	86	89
Na 8.2 K 1.4	339	84	9.6	13	369	368
26	104	80	22	0.13	143	121x
2	102	7.4	4.5	0.08	96	97
Na 15 K 6	342a	64	5.5	0.27	315	298x
94	269	27	40	.....	100	85xx
Na 3.6 K 1.0	40	22	5.1	1.1	55	55
44	202	135	13	2.2	229	221x
34	165	59	28	Tr	163	140x
33	214	103	28	Tr	251	205x
15	30	45	10	.....	85d	110x
10	78	0	4.0	0.01	38	39
141	282	56	269	Tr	364	80s
7.8	172	28	2.1	0.25	171	172x
9.6	92	14	2.1	1.2	80	80x
Na 4.0 K 1.8	62	13	7.6	1.6	69	69
Na 2.0 K 1.1	15	7.6	3.4	0.22	19	22
.....	50	12	4.2	.....	53d	48
13	50	25	9.6	0.9	50	72x
Na 1.1 K 0.6	11	7.7	1.0	0.49	16	20
Na 1.7 K 1.2	41	11	2.6	0.88	48	51

TYPICAL ANALYSES OF VARI-

	Analyses (parts					
	Total dissolved solids	Loss on ignition	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)
New York, N. Y. Ridgewood	131	17	13	0.7	11	4.4
Oklahoma City, Okla.	786	.....	20	7.2b	135	48
Philadelphia, Pa. Delaware River	70	.....	9.0	0.07	12	3.3
Philadelphia, Pa. Schuylkill River	201	13	8.0	0.33	24	12
Pittsburgh, Pa.	148	.....	8.2	0.2	28	4.8
Portland, Ore.	30	.....	9.0	0.03	2.7	0.53
Quincy, Ill.	203	.....	18	0.46	36	16
Richmond, Va.	89	.....	18	0.5	14	3.0
Saginaw, Mich.	394	1.2	10	0.12	68	21.0
St. Louis, Mo.	201	.....	8.3	2.7b	22	12
St. Paul, Minn.	211	91	.....	0.16	42	19
San Antonio, Texas	252a	.....	15	0.07	61	15
San Francisco, Calif.	369	30	.....	.....	38	18
Sandusky, Ohio	187	.....	6.6	0.11	26	5.1
Scranton, Pa.	42	2.7	2.9	0.13	6.8	1.0
Seattle, Wash.	49	.....	13	0.02	6.7	1.4
Springfield, Ill.	371a	.....	10	1.0	73	30
Stockton, Calif.	970	312	.....	0.2	139	52
Syracuse, N. Y.	124	7.7	1.5	0.24	33	6.1
Tampa, Fla.	1273	80	22	0.48	113	33
Toledo, Ohio	322	.....	.....	0.11	66	12
Tulsa, Okla.	990	.....	31	1.6	95	24
Washington, D. C.	103	3.8	6.6	0.07	23	5.4
Youngstown, Ohio	239	31	5.2	0.07	49	4.1

KILLING DOSAGE OF COPPER SULFATE FOR FISH

Moore & Kellerman

Fish	Parts per million	Pounds per million gal.
Trout	0.14	1.2
Carp	0.33	2.8
Suckers	0.33	2.8
Catfish	0.40	3.5
Pickerel	0.40	3.5

Fish	Parts per million	Pounds per million gal.
Gold fish	0.50	4.2
Perch	0.67	5.5
Sunfish	1.35	11.1
Black bass	2.00	16.6

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per million)

Sodium & Potassium (Na + K)	Bicarbonate radical (HCO_3)	Sulfate radical (SO_4)	Chloride radical (Cl)	Nitrate radical (NO_3)	Total hardness as $CaCO_3$ (calculated)	Total hardness as $CaCO_3$ (average)
Na 11.0 K 2.7	10	12	13	4.3	45	70x
58a	330	138	175	.....	534	121x
5.4	46	12	2.9	1.1	44	69x
19	56	87	11	0.80	109	120x
8.5	27	60	13	0.8	66d	90x
3.5	12	3.1	1.3	0.31	9	8
11	175	25	4.4	2.2	156	78s
6.7	60	7.1	2.3	0.3	47	56x
Na 36 K 2.7	215	57	66	0.78	256	107s
26	65	77	10	3.8	104d	83x
5.0a	213	16	1.9	.....	183	160
Na 9.5 K 1.0	240	13	16	3.0	214	221
70	276	36	76	.....	166	150xx
26.2	40	73	10	11	86	80
5.0	18	13	1.8	0.35	21	30xx
3.6	28	5.7	1.2	0.20	23	21
Na 20 K 1.7	318a	59	18	1.8	305	108s
71	157	30	352	.....	560	70s
Na 1.7 K 0.8	113	13	1.5	0.96	108	113
275a	176	92	548	2.8	418	103
.....	163	.....	16	8.9	218	253x
243	253	193	292	1.8	336	80
Na 3.0 K 1.4	70	20	3.3	2.8	80	93x
.....	28z	.....	.....	.....	139	81s

ALGAE

CHEMICALS REQUIRED FOR TREATMENT OF DIFFERENT GENERA

From *The Use of Copper Sulfate in Control of Microscopic Organisms*, by Frank E. Hale, Ph. D., copyright 1930 by Nichols Copper Co., reprinted by permission.

Organism-Odor	Copper Sulphate		Chlorine
	Parts per million	Pounds per mil. gals.	ppm
Diatomaceae			
Asterionella‡ ..... Aromatic, geranium, fishy	0.12*–0.20*	1.0–1.7	0.5*–1.0*
Cyclotella†‡ ..... Faintly aromatic			1.0
Diatoma† ..... Faintly aromatic			
Fragilaria†	0.25	2.1	
Melosira†‡§	0.20*	1.7	2.0
Meridion ..... Aromatic			
Navicula†	0.07	0.6	
Nitzchia §	0.50	4.2	
Synedra†‡ ..... Earthy	0.36*–0.50*	3.0–4.2	1.0
Stephanodiscus	0.33	2.8	
Tabellaria‡ ..... Aromatic, geranium, fishy	0.12*–0.50*	1.0–4.2	0.5*–1.0
Chlorophyceae			
Cladophora†	0.50	4.2	
Closterium	0.17	1.4	
Coelastrum†	0.05–0.33	0.4–2.8	
Conferva†	0.25	2.1	
Desmidium	2.00	16.6	
Dictyosphaerium‡ ..... Grassy, nasturtium, fishy			0.5*–1.0
Draparnaldia	0.33	2.8	
Eudorina ..... Faintly fishy	10.00	83.0	
Entomophora	0.50	4.2	
Gloeocystis ..... Offensive			
Hydrodictyon† ..... Very offensive	0.10	0.8	
Microspora	0.40	3.3	
Palmella	2.00	16.6	
Pandorina ..... Faintly fishy	10.00	83.0	
Protococcus.....			1.0
Raphidium	1.00	8.3	
Scenedesmus	1.00*	8.3	
Spirogyra†.....	0.12	1.0	0.7–1.5
Staurastrum	1.50	12.5	
Tetrastrum			1.0
Ulothrix	0.20*	1.7	
Volvox‡ ..... Fishy	0.25	2.1	0.3*–1.0
Zygnema	0.50	4.2	
Cyanophyceae			
Anabaena‡	0.12*	1.0	0.5*–1.0

ALGAE

Organism-Odor	Copper Sulphate Parts per million	Copper Sulphate Pounds per mil. gals.	Chlorine ppm
Anabaena (cont.)			
Moldy, grassy, vile			
Aphanizomenon‡	0.12*–0.50*	1.0–4.2	0.5*–1.0*
Moldy, grassy, vile			
Clathrocystis	0.12*–0.25*	1.0–2.1	0.5*–1.0
Sweet grassy, vile			
Coelosphaerium‡	0.20*–0.33	1.7–2.8	0.5*–1.0
Sweet grassy			
Cylindrospermum	0.12	1.0	
Grassy			
Microcystis	0.20	1.7	
Oscillaria†	0.20–0.50*	1.7–4.2	1.1
Rivularia			
Moldy, grassy			
Protozoa			
Bursaria			
Irish moss, salt marsh, fishy			
Ceratium†‡	0.33	2.8	0.3*–1.0
Fishy, vile, (rusty brown color)			
Chlamydomonas	0.50–1.0	4.2–8.3	
Cryptomonas	0.50	4.2	
Candied violets			
Dinobryon‡	0.18*	1.5	0.3*–1.0
Aromatic, fishy, violets			
Euglena	0.50	4.2	
Glenodinium	0.50*	4.2	
Fishy			
Mallomonas	0.50	4.2	
Aromatic, violets, fishy			
Peridinium	0.50*–2.00	4.2–16.6	
Fishy, like clam shells			
Synura‡	0.12*–0.25*	1.0–2.1	0.3*–1.0
Cucumber, muskmelon, fishy bitter taste			
Uroglena‡	0.05*–0.20*	0.4–1.6	0.3*–1.0
Fishy, oily, cod-liver oil taste			
Crustaceae			
Cyclops†‡§			1.0–3.0
Daphnia†‡§	2.00	16.6	1.0–3.0
Schizomycetes			
Beggiatoa†	5.00	41.5	
Very offensive decayed			
Cladothrix	0.20	1.7	
Crenothrix†‡	0.33–0.5*	2.8–4.2	0.5*
Very offensive decayed medicinal with chlorine			
Lepthothrix†			
Sphaerotilis, natans†	0.40	3.3	
Very offensive decayed			
Thiothrix†‡			0.5*–1.0
Fungus			
Leptomitus	0.40	3.3	
Saprolegnia†	0.18	1.5	

ALGAE

Organism-Odor	Copper Sulphate: Parts per million	Copper Sulphate: Pounds per mil. gals.	Chlorine ppm
Miscellaneous			
Blood worms			50.0
Blood worm gnats			3.0
Chara†	0.10–0.50	0.8–4.2	
Nais			1.0
Nitella, flexilis†	0.10	0.8	
Objectionable			
Potamogeton†	0.30-0.80	2.5–6.7	

*Dosage successful in New York City's supply.
†These organisms cause trouble other than odor.
‡These organisms have been affected by chlorine producing characteristic odor and in many cases controlled by dosage ranging from 0.3 to 3.0 ppm, depending largely upon the amount of organisms.
§Controlled by excess caustic lime, 5 ppm in the case of diatoms (48 hrs.).

DRINKING WATER STANDARDS

Condensed from Standards adopted by the United States Treasury Department, September 25, 1942.

As to Bacteriological Quality.

Applications *A1* and *A2* shall govern when ten-milliliter (10 ml) portions are used and applications *B1* and *B2* shall govern when one hundred-milliliter (100 ml) portions are used.

(*A1*) Of all the standard ten-milliliter (10 ml) portions examined per month in accordance with specified procedure, not more than ten (10) per cent shall show the presence of organisms of the coliform group.

(*A2*) Occasionally three (3) or more of the five (5) equal ten-milliliter (10 ml) portions constituting a single standard sample may show the presence of organisms of the coliform group, provided that this shall not be allowable if it occurs in consecutive samples or in more than:

(*a*) Five (5) per cent of the standard samples when twenty (20) or more samples have been examined per month.

(*b*) One (1) standard sample when less than twenty (20) samples have been examined per month.

(*B1*) Off all the standard one hundred-milliliter (100 ml) portions examined per month in accordance with the specified procedure, not more than sixty (60) per cent shall show the presence of organisms of the coliform group.

(*B2*) Occasionally all of the five (5) equal one hundred-milliliter portions constituting a single standard sample may show the presence of organisms of the coliform group, provided that this shall not be allowable if it occurs in consecutive samples or in more than:

(*a*) Twenty (20) per cent of the standard samples when five (5) or more samples have been examined per month.

(*b*) One (1) standard sample when less than five (5) samples have been examined per month.

As to Chemical and Physical Characteristics.

The water shall be clear and colorless with no objectionable taste or odor and shall not contain an excessive amount of soluble mineral substance, nor excessive amounts of any chemical employed in treatment.

For waters softened by the lime soda process the total alkalinity produced should not exceed the hardness by more than 35 ppm (calculated as $CaCO_3$).

For chemically treated waters the phenolphthalein alkalinity (calculated as $CaCO_3$) should not be greater than 15 ppm plus 0.4 times the total alkalinity. This requirement limits the permissible *pH* to about 10.6 at 25°C. The normal carbonate alkalinity should not exceed 120 ppm.

DRINKING WATER STANDARDS

Lead (Pb) shall not exceed 0.1 ppm. Arsenic shall not exceed 0.05 ppm.
Fluorides shall not exceed 1.0 ppm. Selenium shall not exceed 0.05 ppm.

Salts of barium, hexavalent chromium, heavy metal glucosides or other substances with deleterious physiological effects shall not be permitted in the water supply system.

The following chemical substances which may be present in natural or treated waters should preferably not occur in excess of the following concentrations where other suitable supplies are available:

Copper (Cu) should not exceed 3.0 ppm. Zinc (Zn) should not exceed 15 ppm.
Iron (Fe) and manganese (Mn) together should not exceed 0.3 ppm.
Magnesium (Mg) should not exceed 125 ppm.
Chloride (Cl) should not exceed 250 ppm.
Sulfate (SO_4) should not exceed 250 ppm.
Phenolic compounds should not exceed 0.001 ppm in terms of phenol.

Total solids should not exceed 500 ppm for a water of good chemical quality. However, if such water is not available, a total solids content of 1,000 ppm may be permitted.

STABLER'S REACTION COEFFICIENTS

The valence of a radical divided by its atomic or molecular weight.

Positive ions	Reaction Coefficient	Negative ions	Reaction Coefficient
Aluminum, Al	0.1112	Bicarbonate, HCO_3	0.0164
Calcium, Ca	0.0499	Carbonate, CO_3	0.0333
Hydrogen, H	0.9922	Chloride, Cl	0.0282
Iron, Fe"	0.0358	Hydroxide, OH	0.0588
Magnesium, Mg	0.0822	Nitrate, NO_3	0.0161
Potassium, K	0.0256	Sulfate, SO_4	0.0208
Sodium, Na	0.0435		
	Alkalinity, $CaCO_3$	0.0200	
	Free CO_2, CO_2	0.0454	

The reacting value of a radical, which is identical with the terms "milliequivalent" or "milligram equivalent" of other writers, is obtained by use of the above table; the parts per million of a radical multiplied by its reaction coefficient gives the reacting value of that radical; for example, if a water analysis showed the sample to contain 25 parts per million of magnesium then the reacting value of Mg, written rMg, would be 25×0.0822 or 2.055.

FORMULAS FOR WATER SOFTENING REQUIREMENTS

The terms in the formulas are in parts per million except those expressed as reacting values (r). Abbreviations: Alk—alkalinity as $CaCO_3$; TH—total hardness as $CaCO_3$.

Pounds of lime (90% CaO) required per 1000 gal.

$$0.26\ (r\mathrm{Fe}+r\mathrm{Al}+r\mathrm{Mg}+r\mathrm{H}+r\mathrm{HCO_3}+r\mathrm{CO_2})$$

or $$0.00931\mathrm{Fe}+0.0288\mathrm{Al}+0.0214\mathrm{Mg}+0.258\mathrm{H}+0.00426\mathrm{HCO_3}+0.0118\mathrm{CO_2}$$

Other simpler formulas for this computation are:

$$0.26\ (r\mathrm{CO_2}+r\mathrm{Mg}+r\mathrm{Alk})$$

or $$0.26\ [r\mathrm{Na}+r\mathrm{Ca}+2r\mathrm{Mg}+r\mathrm{CO_2}-(r\mathrm{SO_4}+r\mathrm{Cl})]$$

or $$0.0052\ (4.115\mathrm{Mg}+\mathrm{Alk}+2.27\ \mathrm{CO_2})$$

or $$(0.44\ \mathrm{Alk}+\mathrm{CO_2})\times 0.0118+[4.115\ \mathrm{Mg}\times 0.0052]$$

Pounds of soda ash (58% test or 100% pure) required per 1000 gal.

$$0.44\ (r\mathrm{Fe}+r\mathrm{Al}+r\mathrm{Ca}+r\mathrm{Mg}+r\mathrm{H}-r\mathrm{CO_3}-r\mathrm{HCO_3})$$

or $$0.0157\mathrm{Fe}+0.0489\mathrm{Al}+0.022\mathrm{Ca}+0.0362\mathrm{Mg}+0.437\mathrm{H}-0.0147\mathrm{CO_3}-0.0722\mathrm{HCO_3}$$

Other simpler formulas for this computation are:

$$0.44\ (r\mathrm{Ca}+r\mathrm{Mg}-r\mathrm{Alk})$$

or $$0.44\ [(r\mathrm{Ca}+r\mathrm{Mg})-r\mathrm{CO_3}]$$

or $$0.0088\ (4.115\ \mathrm{Mg}+2.495\ \mathrm{Ca}-\mathrm{Alk})$$

or $$0.0088\ (\mathrm{TH}-\mathrm{Alk})$$

Compiled from *Chemistry of Wood*, by Ritter and Fleck. Forest Products Lab

Species		% Moisture	% Ash	Solubility in Water Cold	Water Hot	Ether	1% NaOH	Acetic Acid
Bald cypress	*	5.72	0.67	1.24	1.86	1.52	9.59	0.71
	**	5.01	0.63	3.03	3.24	6.40	12.08	0.34
Balsa *Ochrona lagopus*		6.47	2.12	1.77	2.79	1.23	20.37	5.80
Hickory (Shellbark *Hicoria ovata*		8.49	0.69	4.78	5.57	0.63	19.04	2.51
Incense cedar		5.12	0.34	3.64	5.38	4.31	17.69	0.91
Libocedrus decurrens	*	6.46	0.47	1.92	2.97	0.67	11.16	1.33
	**	7.27	0.30	4.74	7.08	4.78	19.99	0.68
Mesquite *Prosopis juliflora*		5.49	0.54	12.62	15.09	2.30	28.52	2.08
Pignut hickory	*	3.54	0.40	4.91	6.45	0.29	19.11	3.58
Hicoria glabra	**	3.90	0.45	2.07	2.95	0.36	15.10	3.08
Redwood *Sequoia sempervirens*	**	9.68	0.21	7.36	9.85	1.07	20.00	1.08
Tanbark oak *Quercus densiflora*		3.66	0.83	4.10	5.60	0.80	23.96	5.23
Western yellow pine *Pinus ponderosa*		6.42	0.46	4.09	5.05	8.52	20.30	1.09
White ash	*	5.13	0.59	5.53	6.72	1.03	21.85	3.47
Fraxinus americana	**	6.44	0.31	2.18	3.93	0.45	19.28	2.49
White cedar	*	5.81	0.56	2.60	3.39	1.44	11.87	1.14
	**	6.44	0.24	2.37	3.62	1.87	12.78	0.79
White oak	*	7.40	0.47	3.41	4.92	0.56	21.40	2.96
Quercus alba	**	7.35	0.43	6.05	8.38	0.67	24.24	2.78
White pine	*	3.90	0.23	3.55	5.15	5.46	17.16	1.68
	**	2.92	0.42	5.97	7.68	3.62	19.15	1.43
Yellow birch	*	4.60	0.22	1.40	2.04	0.68	18.28	3.05
Betula lutea	**	4.56	0.32	3.46	4.83	0.90	20.83	2.31
Yellow cedar		4.89	0.43	2.47	3.11	2.55	13.41	1.59
Chamaecyparis	*	3.97	0.28	2.13	3.41	1.00	11.72	2.05
hoot Katensis	**	4.00	0.18	2.88	4.12	1.32	12.77	1.53
Yellow poplar	*	4.05	0.44	1.37	2.25	0.20	16.83	3.23
Liriodendendron tulipifera	**	3.84	0.36	1.48	2.48	0.51	17.64	2.81

*Sap wood
**Heart wood

VARIOUS WOODS

oratory, U. S. Dept. Agriculture. See also table: *Physical Properties of Wood.*

		Methyl			In Cellulose				
Meth-oxyl	Pento-san	Pento-san	Cellulose	Lignin	Pento-san	Methyl Pentosan	Alpha Cellulose	Beta Cellulose	Gamma Cellulose
4.67	8.63	3.86	52.90	35.16	6.07	1.75	67.14	16.42	16.45
4.01	7.28	3.93	51.14	32.67	6.09	1.53	67.11	14.35	18.55
5.68	17.65	0.86	54.15	26.50	19.99	1.35	75.64	0.27	24.08
5.63	18.82	0.80	56.22	23.44	21.89	1.41	76.32	2.82	20.35
6.24	10.65	1.35	41.60	37.68	9.08	1.99	46.92	11.67	41.06
5.95	12.08	0.45	49.09	34.73	10.14	1.24	50.69	12.98	36.33
6.21	12.04	0.56	44.53	33.67	11.68	1.31	66.62	11.05	22.33
5.55	13.96	0.70	45.48	30.47	17.75	0.81	76.48	2.35	21.17
5.56	18.18	1.11	56.08	21.87	16.90	1.30	51.55	21.92	26.53
5.79	18.64	1.02	53.81	22.85	16.20	1.39	59.44	23.74	16.82
5.21	7.80	2.75	48.45	34.21	7.40	2.09	78.81	2.95	18.24
5.74	19.59	....	58.03	24.85	22.82	....	56.77	19.92	23.03
4.49	7.35	1.62	57.41	26.65	6.82	1.98	62.10	10.56	30.13
5.18	20.01	2.52	50.05	27.17	19.25	1.60	64.89	20.98	14.08
5.28	19.89	2.36	53.48	27.89	17.05	1.41	53.57	28.90	17.59
5.15	11.22	1.05	55.40	31.00	9.65	1.53	71.48	7.52	21.01
5.05	10.58	1.64	54.81	31.91	8.25	1.45	58.35	23.49	18.17
5.99	22.49	0.92	51.36	31.74	24.78	1.04	60.94	18.95	20.11
5.91	21.95	1.24	50.40	32.02	24.38	0.77	60.15	16.13	23.73
4.16	9.31	2.14	54.25	26.51	6.81	2.09	54.56	17.47	27.97
4.60	8.56	1.00	50.23	26.14	7.12	2.02	57.29	22.42	19.29
5.57	21.83	1.74	57.74	26.23	21.46	1.42	52.28	29.86	17.62
5.37	21.79	1.23	55.91	26.38	21.84	1.08	57.37	24.12	18.52
5.25	7.87	3.42	53.86	31.32	7.30	1.78	62.68	11.06	26.25
4.40	8.47	1.75	58.12	29.03	7.60	2.44	54.61	26.59	18.80
4.81	8.69	1.85	56.08	28.73	7.78	2.73	.....	20.17	.....
5.85	18.60	2.25	58.08	23.47	17.27	1.50	42.23	39.63	18.15
5.95	18.78	2.12	59.52	22.94	16.40	2.09	48.99	31.48	19.54

COMPOSITION AND HEATING VALUE OF REPRESENTATIVE COALS

Analysis based on coal "as received."

State and County	Proximate Analysis				Ultimate Analysis					
	%H_2O	% Volatile matter	% Fixed carbon	%Ash	%C	%H	%N	%O	%S	B. T. U. per Lb.
Anthracite Type										
Colo., Gunnison	2.7	3.32	88.15	5.83	85.4	3.28	1.12	3.59	).80	14,099
N. Mex., Santa Fe	7.55	7.25	75.88	9.32	....	....	....	.....	).76	12,101
Pa., Schuylkill	3.33	3.27	84.28	9.12	.....	....	....	.....	).60	13,351
R. I., Providence	4.5	3.0	78.7	13.8	82.4	0.5	0.1	1.8	0.9	11,620
Wash., Lewis	7.4	4.8	52.00	35.80	....	....	....	.....	0.74	8,200
Semi-anthracite Type										
Ark., Pope	2.07	9.81	78.82	9.3	80.3	3.62	1.47	3.59	1.74	13,702
Pa., Sullivan	3.40	9.34	75.58	11.68	77.9	3.64	0.95	5.07	0.81	13,120
Va., Pulaski	3.8	9.40	62.20	24.00	....	....	....	.....	0.8	10,960
Utah, Washington	7.02	10.30	60.61	22.07	....	....	....	....	4.06	10,408
Bituminous Type										
Ala., Bibb	3.21	31.05	59.62	6.28	78.33	5.31	1.40	7.58	1.21	14,140
Ala., Jefferson	2.4	24.44	68.42	4.8	81.73	4.74	1.50	6.54	0.7	14,620
Ala., Shelby	2.31	38.63	51.92	7.2	75.0	5.2	1.0	10.0	0.8	13,650
Alaska, Moose Creek	4.74	35.52	50.91	8.9	67.6	5.3	1.9	15.9	0.3	12,150
Ark., Hartford	2.91	19.33	67.33	10.5	77.4	4.1	1.6	5.3	1.1	13,270
Colo., Gunnison	4.34	39.72	46.73	9.3	70.6	5.5	1.5	12.7	0.4	12,630
Ill., Christian	13.01	37.04	39.31	10.7	59.8	5.6	1.1	19.1	3.7	10,860
Ill., Franklin	7.30	36.72	47.93	8.05	69.0	5.4	1.6	15.0	1.0	12,160
Ill., Williamson	9.41	33.03	49.05	8.6	67.1	5.2	1.5	16.7	0.9	11,860
Ind., Green	13.52	36.31	42.93	7.3	64.5	5.8	1.5	19.8	1.1	11,540
Ind., Knox	9.52	38.33	41.45	10.9	62.3	5.5	1.0	17.1	3.2	11,540
Ind., Sullivan	14.91	34.34	44.12	6.7	63.8	5.9	1.4	20.9	1.3	11,420
Iowa, Lucas	15.41	30.52	41.52	12.6	55.8	5.7	1.1	21.5	3.2	10,240
Iowa, Polk	13.92	37.01	35.24	14.0	54.7	5.5	0.8	18.8	6.2	10,240
Kans., Cherokee	5.09	34.48	52.22	8.3	71.8	5.2	1.2	10.2	3.3	13,080
Kans., Crawford	3.91	34.22	50.08	11.8	68.8	4.9	1.2	8.7	4.6	12,500
Ky., Christian	9.18	33.72	46.37	10.7	....	....	....	....	3.1	11,680
Ky., Webster	5.37	34.93	50.36	9.3	70.4	5.1	1.6	12.6	1.1	12,500
N. Mex., San Juan	6.76	38.13	43.01	11.9	....	....	....	....	1.3	11,630
Ohio, Columbiana	3.51	36.68	48.89	10.9	69.9	5.2	1.4	8.3	4.3	12,730
Ohio, Jefferson	3.42	36.33	49.58	10.7	69.7	5.2	1.4	8.0	5.1	12,720
Okla., Coal	6.57	38.62	42.89	11.9	62.8	5.0	1.5	14.5	4.3	11,260
Okla., Latimer	3.68	36.82	53.79	5.6	....	....	....	....	0.9	13,630
Okla., Pittsburg	3.78	38.01	50.63	7.6	73.8	5.4	1.8	9.6	1.7	13,280
Pa., Allegheny Upper Freeport Bed	2.65	33.02	51.17	13.2	70.3	5.1	1.2	8.1	2.2	12,816
Pa., Armstrong	3.37	35.49	51.31	9.7	71.4	5.3	1.3	9.1	3.1	13,040
Pa., Bedford	1.61	16.29	70.01	12.1	77.4	4.1	1.4	3.4	1.0	13,810
Pa., Jefferson	2.59	30.41	59.08	7.9	76.6	5.1	1.2	7.2	2.0	13,860
Pa., Washington Pittsburgh Bed	1.96	30.55	58.24	9.3	74.4	4.8	1.5	7.9	2.2	13,622
Va., Wise	2.62	33.78	53.63	10.0	73.7	5.1	1.6	8.8	0.9	13,270
Wash., Kittitas	10.29	30.42	43.38	15.9	61.3	5.5	1.5	14.4	1.4	11,010
W. Va., Brook	4.41	37.41	50.07	8.1	72.1	5.3	1.4	10.5	2.6	12,940
W. Va., Fayette Sewell Bed	2.8	23.5	70.2	3.5	82.5	5.0	1.5	7.0	0.5	14,650
Fire Creek Bed	2.87	15.41	76.91	4.8	82.4	5.0	1.5	5.7	0.7	14,521
Eagle or No. 1 Gas Bed	3.3	25.5	66.8	4.4	81.7	5.2	1.5	6.5	0.7	14,500
No. 2 Gas Bed	3.3	28.88	62.72	5.1	79.7	5.3	1.4	7.7	0.8	14,209
W. Va., Logan Island Creek Bed	1.6	33.70	57.86	6.8	76.7	5.1	1.3	8.9	1.3	13,918
W. Va., Ohio	3.02	41.43	45.58	8.1	72.8	5.3	1.4	8.8	3.6	13,200
Wyo., Lincoln	3.59	38.38	52.51	5.5	74.5	5.3	1.3	12.5	1.0	13,310
Semi-bituminous Type										
Ark., Huntington	3.22	18.09	69.73	9.0	78.7	4.4	1.6	4.4	1.9	13,700
Md., Allegany	2.22	17.22	69.13	10.9	76.9	4.3	1.9	4.9	1.1	13,430
Md., Allegany	1.18	17.87	73.21	7.7	81.0	4.5	1.9	4.0	1.0	14,190
Pa., Cambria	2.16	22.21	70.33	5.3	....	....	....	....	1.1	14,460
Pa., Cambria	2.51	20.08	71.53	6.1	....	....	....	....	1.9	14,380
Pa., Somerset	2.36	17.29	71.41	9.0	78.5	4.3	1.2	4.5	2.5	13,740
Va., Montgomery	1.88	14.02	68.88	15.2	75.3	3.6	0.9	4.8	0.5	12,740
Va., Tazewell	3.03	20.28	72.19	4.5	84.0	4.7	1.2	5.2	0.5	14,610
W. Va., Grant	3.00	16.71	71.02	9.3	....	....	....	....	2.7	13,590

COMPOSITION AND HEATING VALUE OF REPRESENTATIVE COALS

State and County	Proximate Analysis				Ultimate Analysis					
	% H_2O	% Volatile matter	% Fixed carbon	% Ash	% C	% H	% N	% O	% S	B. T. U. per Lb.
W. Va., M'Dowell Pocahontas No. 3 Bed	2.99	12.65	78.35	6.0	82.9	4.7	1.1	4.8	0.5	14,398
W. Va., Mineral	2.39	16.11	65.89	15.6	....	....	....	....	2.5	12,600
W. Va., Raleigh Beckley Bed	2.93	14.51	79.42	3.1	84.8	4.8	1.5	5.1	0.6	14,854
Sub-bituminous Type										
Colo., Weld	24.57	29.78	42.01	3.6	54.8	6.3	1.2	33.8	0.3	9,520
Mont., Carbon	10.49	34.72	43.67	11.2	59.8	5.6	1.3	21.0	1.1	10,550
Wash., Thurston	21.67	34.81	33.30	10.3	49.9	6.3	0.9	32.4	1.2	8,700
Wyo., Lincoln	20.78	35.44	40.56	3.2	57.8	6.3	0.9	31.1	0.7	10,080
Cannel Coal										
Pa., Armstrong	1.78	32.81	37.32	28.2	56.9	4.5	1.1	5.6	3.7	10,460
Tex., Webb	4.41	46.01	30.48	19.0	59.3	5.8	1.2	12.7	2.1	11,070
Lignite										
Ark., Ouachita	39.43	26.49	24.37	9.7	36.3	7.0	0.7	45.8	0.49	6,356
Colo., Adams	35.00	27.39	30.23	7.38	....	....	....	....	0.31	6,982
N. D., Ward	36.89	24.91	27.67	10.4	37.4	6.4	0.6	45.0	0.2	6,010
N. D., Williams	42.11	25.00	24.43	8.5	35.2	7.1	0.5	47.5	1.3	5,990
Tex., Wood	33.71	29.25	29.76	7.3	42.5	6.8	0.8	42.1	0.53	7,348
Peat										
Conn., Fairchild	90.31	3.79	1.27	4.63	....	....	....	....	0.08	511
Fla., Lake	82.12	11.75	5.72	0.4	....	....	....	....	0.05	1,886
Me., Knox	90.82	6.07	2.73	0.4	....	....	....	....	0.02	819
Mich., Kalamazoo	66.91	19.04	9.29	4.8	....	....	....	....	0.09	3024
N. Y., Oswego	54.61	29.15	12.44	3.8	....	....	....	....	0.17	4,104
Wis., Marinette	76.36	10.78	4.66	8.2	....	....	....	....	0.16	1,498

HEAT OF COMBUSTION OF COAL FROM ANALYSES

The usual formula employed in calculating the heat of combustion of coal from an ultimate analysis is that of Dulong:

$$\text{BTU/pound} = 14{,}544C + 62{,}028\left(H - \frac{O}{8}\right) + 4050S$$

where C, H, O, and S are the decimal percents of carbon, hydrogen, oxygen, sulfur found on ultimate analysis made on the "as received" basis.

A proximate analysis of coal gives moisture, volatile matter, fixed carbon and ash. It is possible to compute the heat of combustion of coal from the values obtained in a proximate analysis by first finding the percent of carbon, hydrogen and oxygen by means of the formulas below and then substituting in Dulong's formula given above.

The method is as follows:—From the values of a proximate analysis find the percent of volatile matter (V) and fixed carbon *on an ash- and moisture-free basis.* These two values should add up total 100%. Then,

$$\%H = \%V\left(\frac{7.35}{\%V+10} - 0.013\right)$$

%N = 0.07V for anthracite and semi-anthracite coals.
%N = 2.10 − 0.012V for bituminous and lignite coals.
%C = Fixed C + $0.02V^2$ for anthracite coals.
%C = Fixed C + 0.9 (V − 10) for semi-anthracite coals.
%C = Fixed C + 0.9 (V − 14) for bituminous coals.
%C = Fixed C + 0.9 (V − 18) for lignite.

Sulfur increases V, therefore the volatile carbon is too high by the extent of the sulfur in the coal.

Example.—A bituminous coal from Jefferson, Pa. gives a proximate anaylsis as follows: moisture, 2.59%; volatile matter, 30.41%; fixed carbon, 59.08%; ash, 7.9%. The %ash plus %moisture = 7.9 + 2.59 = 10.49
Therefore,

$$\frac{30.41}{100-10.49} \times 100 = 33.97\% \text{ volatile matter on ash- and moisture-free basis.}$$

$$\frac{59.08}{100-10.49} \times 100 = 66.00\% \text{ fixed carbon on ash- and moisture-free basis.}$$

$$H = 33.97\left(\frac{7.35}{33.97+10} - 0.013\right) = 5.23\%H$$

N = 2.10 − 0.012 × 33.97 = 1.69%N
C = 66.00 + 0.9 (33.97 − 14) = 83.97%C
83.97 × 0.8951 = 75.16%C as received
5.23 × 0.8951 = 4.68%H as received
1.69 × 0.8951 = 1.51%N as received
7.9% ash
2.59% moisture
91.84%, therefore 100 − 91.94 = 8.16% oxygen

Then by substitution of the values above in the Dulong formula

$$14{,}544 \times 0.7516 + 62{,}028\left(0.0468 - \frac{0.0816}{8}\right) = 13{,}201 \text{ BTU/pound.}$$

The experimental value reported for this coal was 13,860 BTU/pound.

FLAME TEMPERATURES

Reprinted by permission from "Combustion Flames and Explosions of Gases," by Lewis and von Elbe, published 1938 by Macmillan.

Except as noted otherwise, the flame temperatures listed in the following table were determined by the sodium line-reversal method with a totally colored flame for moist mixtures at room temperature. The values given are the maximum flame temperatures determined for the given combustible or combination of combustibles with inert gas. In a few cases a number of values are given for different mixture compositions. All compositions are given on the dry basis.

The experimental flame temperatures are probably all influenced somewhat by heat losses, excitation lag and intermixing with the surrounding atmosphere. However, these disturbances do not cause excessive discrepancies from the theoretical flame temperatures, and the values may be taken as an approximate indication of the flame temperatures of the mixtures given.

A large number of calculated flame temperatures are to be found in the literature. They are not included in the table because they are generally based on inexact thermochemical data. Similarly, many experimental values have been omitted, since they were determined under specialized and sometimes ill-defined conditions.

Combustible	Diluent	% Combustible	Flame Temp. °C.	Reference
Hydrogen	Air	31.6	2045	1
			2047*	2
	O_2	67.0	2487	3
		73.0	2527	
		78.0	2660	
		82.0	2427	
Hydrogen atoms	.....	....	?3760†	4
Carbon monoxide	Air	20.0	1650‡	5
		25.0	1930‡	
		32.0	2100‡	
		37.0	2000‡	
		45.0	1850‡	
		55.0	1560‡	
	O_2	20.0	1850‡	5
		30.0	2400‡	
		40.0	2680‡	
		60.0	2905‡	
		70.0	2925‡	
		80.0	2805‡	
		90.0	1800‡	
Methane	Air	10.0	1875	1, 6, 7
Ethane	Air	5.8	1895	7
Propane	Air	4.15	1925	6, 7
Butane	Air	3.2	1895	7
iso-Butane	Air	3.2	1900	7
Acetylene	Air	9.0	2325	1
	O_2	18.0	2927	3
		33.0	3007	
		44.0	3137	
		50.0	2927	

*Calculated.

†Estimated for hydrogen torch.

‡Calculated, ±10° to allow for different H_2O content.

FLAME TEMPERATURES

Combustible	Diluent	% Combustible	Flame Temp. °C.	Reference
Ethylene	Air	7.0	1975	7
Propylene	Air	4.5	1935	7
Butylene	Air	3.4	1930	7
Ammonia	Air	21	1700	8
60% NH_3 + 40% ($3H_2$ + N_2)	Air	26	1745	8
40% NH_3 + 60% ($3H_2$ + N_2)		27.5	1770	
20% NH_3 + 80% ($3H_2$ + N_2)		32.5	1815	
10% NH_3 + 90% ($3H_2$ + N_2)		35.0	1850	
$6H_2$ + N_2	Air	29.5	1960	8
$4H_2$ + N_2		28.7	1925	
$3H_2$ + N_2		28.0	1880	
H_2 + N_2		23.0	1675	
$2H_2$ + $3N_2$		20.5	1565	
H_2 + $2N_2$		18.5	1475	
$3CH_4$ + O_2	Air	10.7	2040	1
$4CH_4$ + O_2		10.5	1980	
$5CH_4$ + O_2		10.4	1955	
$7CH_4$ + O_2		10.2	1925	
$19CH_4$ + O_2		10.1	1893	
$9CH_4$ + H_2	Air	10.5	1880	1
$7CH_4$ + $3H_2$		11.5	1893	
$3CH_4$ + $2H_2$		13.5	1900	
$2CH_4$ + $3H_2$		16.5	1916	
CH_4 + $4H_2$		22.0	1960	
CH_4 + $9H_2$		24.0	2000	
$9CH_4$ + C_2H_2	Air	9.7	1930	1
$7CH_4$ + $3C_2H_2$		9.3	2025	
$3CH_4$ + $2C_2H_2$		9.25	2075	
$2CH_4$ + $3C_2H_2$		9.1	2165	
CH_4 + $4C_2H_2$		9.05	2250	
CH_4 + $9C_2H_2$		9.0	2290	
$5CH_4$ + N_2	Air	11.5	1827	9
$5CH_4$ + $2N_2$		13.0	1792	
$5CH_4$ + $3N_2$		14.5	1765	
CH_4 + N_2		17.5	1727	
$2CH_4$ + $3N_2$		21.0	1694	
$5CH_4$ + $9N_2$		22.4	1675	
CH_4 + $2N_2$		24.2	1665	
$20CH_4$ + CO_2	Air	10.35	1850	9
$10CH_4$ + CO_2		10.75	1825	
$5CH_4$ + CO_2		11.5	1797	

FLAME TEMPERATURES

Combustible			Diluent	% Combustible	Flame Temp. °C.	Reference
$10CH_4 + 3CO_2$				12.3	1777	
$5CH_4 + 2CO_2$				13.0	1762	
$2CH_4 + CO_2$				13.8	1752	
$10CO + N_2$			Air	35.9	1915	9
$5CO + N_2$				37.3	1875	
$5CO + 2N_2$				40.0	1810	
$5CO + 3N_2$				42.6	1760	
$5CO + 4N_2$				45.0	1718	
$CO + N_2$				47.3	1675	
$20CO + CO_2$			Air	35.6	1890	9
$10CO + CO_2$				36.5	1850	
$5CO + CO_2$				37.6	1797	
$10CO + 3CO_2$				38.5	1764	
$58.5\%CO + 41.5\%H_2$			Air	32.6	2004	9
$31.9\%CO + 22.5\%H_2 + 45.4\%N_2$			Air	45.0	1718	9
$37.0\%CO + 27.1\%H_2 + 35.9\%N_2$			Air	41.7	1812	9
$50.1\%CO + 35.5\%H_2 + 14.4\%N_2$			Air	36.0	1940	9
Pittsburg natural gas			Air	9.0	1950* 1930†	
Mixed coal gas	H_2	49.8%	Air	17.6	1918	9
	CO	11.8				
	CH_4	25.8				
	C_2H_6	1.5				
	Illuminants	4.5				
	CO_2	2.4				
	N_2	4.2				
Carburated water gas	H_2	35.9%	Air	18.8	1930	9
	CO	23.5				
	CH_4	9.0				
	C_2H_6	2.7				
	Illuminants	10.0				
	CO_2	3.5				
	N_2	15.4				
"Electrolene" gas	H_2	69.7%	Air	30.8	1983	9
	CO	24.7				
	CH_4	1.7				
	CO_2	2.6				
	N_2	1.3				
Anthracite producer gas	H_2	16.9%	Air	46.7	1663	9
	CO	27.6				
	CH_4	0.9				
	CO_2	5.1				
	N_2	49.5				

*Calculated: dry mixture.
†Partially colored flame: dry mixture.

FLAME TEMPERATURES

Combustible	Diluent	% Combustible	Flame Temp. °C.	Reference
City gas 550 BTU	O_2	65	2730	3
Natural gas 1025 BTU	O_2	45	2930	3
Mixed natural gas and coke oven gas 808 BTU	O_2	57	2810	3
Carburated water gas 800 BTU	O_2	50	2800	3
Amyl acetate	Air	....	1422*	10

*Diffusion flame. Two color method.

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IGNITION TEMPERATURES OF VARIOUS SUBSTANCES AND LIMITS OF INFLAMMABILITY OF GASES

Name and formula	Ignition temperature at atmospheric pressure				Limits for inflammability in % by volume of gas in air at atmos. press. and ordinary temp.	
	In oxygen		In air			
	°C.	°F.	°C.	°F.	Lower	Upper
Acetaldehyde, CH_3CHO	140	284	185	365	4	57
Acetone, $(CH_3)_2CO$	568	1054	700	1292	2.5	13
Acetylene, C_2H_2	416–440	781–824	406–440	763–824	2.5	82
Amyl alcohol, $C_5H_{11}OH$	390	734	409	768	...	....
Aniline, $C_6H_5NH_2$	530	986	770	1418	...	...
Benzaldehyde, $C_6H_5{\cdot}CHO$	168	334	180	356	...	...
Benzene, C_6H_6	662	1224	740	1364	1.4	5.5
Blast-furnace gas	...	...	....	...	36	65
Blue water gas	...	...	...	...	12	67
Butane, C_4H_{10}	...	...	...	...	1.5	6
n-Butyl alcohol, C_4H_9OH	385	725	450	842	...	...
Butylene, C_4H_8	...	...	...	...	1.7	9
Carbon monoxide, CO	637–658	1179–1216	644–658	1191–1216	6.3	71.2
Coal gas	...	...	...	...	7	21
Coke-oven gas	...	...	...	...	7	21
Cylinder oil	320	608	417	783	...	...
Decane	202	396	463	865	...	...
Ethane	520-630	968–1166	520–630	968–1166	3.3	10.6
Ethyl alcohol, C_2H_5OH	425	797	558	1036	3.7	13.7
Ethyl ether, $(C_2H_5)_2O$	178	352	343	649	1.6	7.7
Ethylene, C_2H_4	500–519	932–966	542–547	1008–1018	3.4	14.1
Gas oil	270	518	336	637	...	...
Glycerol, $C_3H_5(OH)_3$	414	777	500	932	...	...
Hexane, C_6H_{14}	268	514	487	909	1.3	...
Hydrogen, H_2	580–590	1076–1094	580–590	1076–1094	6.2	71.4
Hydrogen sulfide, H_2S	...	...	....	...	4.3	45
Isopropyl alcohol, C_3H_7OH	512	954	590	1094	2.7	...
Kerosene	270	518	295	563	...	...
Methane, CH_4	556–700	1033–1292	650–750	1202–1382	5.8	13.3
Methyl alcohol, CH_3OH	555	1031	...	...	6	36
Pennsylvania crude oil	242	468	316	601	...	...
Pentane	...	...	...	...	1.3	4.9
Phenol, C_6H_5OH	574	1065	715	1319	...	...
Propane, C_3H_8	490–570	914–1058	...	...	2	7
Propyl alcohol, C_3H_7OH	445	833	505	941	2.6	...
Propylene, C_3H_6	...	...	....	...	2.2	9.7
Sugar	378	712	385	725	...	...
Toluene	552	1026	810	1490	1.3	6.8

COMBUSTION CON-

The high (gross) heat value is the value obtained by burning the gas in a Junker's calorimeter, which assumes that the products of combustion are cooled to the initial temperature and includes the heat of condensation of the water formed by the combustion; the low (net) heat value differs from the high (gross) value by the heat of vaporization of water and is calculated from the gross by subtracting the heat of

Name and formula	Mol. wt.	Sp. Gr.	B.T.U. per cu. ft., dry, 30 in. pressure			
			High (gross)		Low (net)	
		Air = 1	32°F.	60°F.	32°F.	60°F.
Acetylene, C_2H_2	26.02	0.8981	1567	1483	1514	1433
Benzene, C_6H_6	78.05	2.694	3933	3722	3774	3577
Butane, C_4H_{10}	58.08	2.005	3445	3261	3180	3010
Butylene, C_4H_8	56.06	1.935	3262	3087	3050	2887
Carbon dioxide, CO_2	44.00	1.519	....	....	....	....
Carbon monoxide, CO	28.00	0.9665	341.0	322.6	341.0	322.6
Ethane, C_2H_6	30.05	1.037	1862	1762	1703	1612
Ethylene, C_2H_4	28.03	0.9676	1734	1641	1631	1541
Hydrogen, H_2	2.02	0.0695	343.0	324.5	290.0	274.5
Hydrogen sulfide, H_2S	34.08	1.177	....	....	....	....
Methane, CH_4	16.03	0.5534	1069	1012	963	912
Naphthalene, $C_{10}H_8$	128.06	.....	....	....	....	....
Propane, C_3H_8	44.06	1.521	2652	2509	2440	2309
Propylene, C_3H_6	42.05	1.451	2487	2354	2328	2204
Toluene, C_7H_8	92.06	3.178	4693	4441	4481	4241
Xylene, C_8H_{10}	106.08	3.662	5446	5153	5181	4902
Water, H_2O	18.02	0.6219	....	....	....	....

COMBUSTION CONSTANTS AND COMPOSITION OF

The coal gas, coke-oven gases, oil gas and carburetted water gas contain in addition small amounts of benzene and oxygen. The heat values are calculated from the values as given in the table under COMBUSTION CONSTANTS OF GASES.

	Blast-furnace gas	Blue water gas	Carburetted water gas	Coal gas	Coke-oven gas
% Methane, CH_4	....	....	14.8	34.0	28.5
% Ethane, C_2H_6	....	....	....	....	....
% Propane, C_3H_8	....	....	....	....	....
% Ethylene, C_2H_4	....	....	12.8	6.6	2.9
% Carbon monoxide, CO	26.2	43.4	33.9	9.0	5.1
% Carbon dioxide, CO_2	13.0	3.5	1.5	1.1	1.4
% Hydrogen, H_2	3.2	51.8	35.2	47.0	57.4
% Nitrogen, N_2	57.6	1.3	1.8	2.3	4.2
% Oxygen, O_2	....	....	....	....	0.5
B.T.U. per cu. ft., high (gross) 60°F., 30 in. Hg, satd. H_2O	93	310	578	634	536
B.T.U. per cu. ft., low (net) 60°F., 30 in. Hg, satd. H_2O	91.6	285	529	560	476
Cu. ft. air required per cu. ft. of gas	0.70	2.28	4.85	5.50	4.65
Cu. ft. CO_2 per cu. ft. of gas burned	0.392	0.469	0.758	0.573	0.420
Cu. ft. H_2O per cu. ft. of gas burned	0.032	0.518	0.904	1.282	1.205
Cu. ft. N_2 per cu. ft. of gas burned	0.55	1.81	3.85	4.36	3.71
High (gross) B.T.U. per cu. ft. gas-air mixture	54.7	94.5	98.8	97.5	95.0
Theoretical flame temp., deg. F.	2660	4167	4090	3910	3430

STANTS OF GASES

vaporization of water at 60°F; thus, in the low (net) value the assumption is made that all of the products of combustion with the exception of the water have been cooled to the initial temperature; the flue products are calculated upon air with a composition of 79% nitrogen and 21% oxygen. The flame temperatures are not corrected for dissociation.

B.T.U. per cu. ft., satd. H_2O, 30 in. pressure.		B.T.U. per mole		Cu. ft. per cu. ft. fuel gas or mole per mole					Theoretical Flame temp., deg. F.
High (gross)	Low (net)			Required for combustion		Flue products			
60°F.	60°F.	High (gross)	Low (net)	O_2	Air	H_2O	CO_2	N_2	
1456	1396	562,000	543,000	2.5	11.90	1.0	2.0	9.40	4770
3658	3509	1,413,000	1,356,000	7.5	35.70	3.0	6.0	28.20	4110
3204	2955	1,237,000	1,142,000	6.5	30.95	5.0	4.0	24.45	3870
3033	2834	1,171,000	1,095,000	6.0	28.58	4.0	4.0	22.58	4030
.....	.....	.....	.....	....	.....	...	...	.....	....
317.1	317.1	122,400	122,400	0.5	2.38	...	1.0	1.88	4475
1731	1582	668,300	611,300	3.5	16.67	3.0	2.0	13.17	3820
1613	1514	622,400	584,400	3.0	14.29	2.0	2.0	11.29	4250
318.8	269.1	123,100	104,100	0.5	2.38	1.0	...	1.88	4010
....	....	.....	.....	1.5	7.14	1.0	1.0,SO_2	5.64	....
995	896	384,000	346,000	2.0	9.52	2.0	1.0	7.52	3750
....	....	2,219,000	2,143,000	12.0	57.10	4.0	10.0	45.00	4100
2465	2266	952,000	876,000	5.0	23.80	4.0	3.0	18.80	3840
2313	2164	893,000	836,000	4.5	21.43	3.0	3.0	16.93	4090
4364	4165	1,685,000	1,609,000	9.0	42.87	4.0	7.0	33.87	4050
5064	4815	1,955,000	1,860,000	10.5	50.00	5.0	8.0	39.50	4010
.....	....	.....	.....	....	.....	...	...	.....	....

REPRESENTATIVE MANUFACTURED AND NATURAL GASES

The flame temperatures are not corrected for dissociation. The air required, products of combustion, B. T. U. of gas-air mixture and the flame temperature are based upon air with 21% oxygen and 79% nitrogen.

Coke-oven gas	Natural gas, Follansbee, W. Va.	Natural gas residual, Follansbee, W. Va.	Natural gas, McKean Co., Pa.	Natural gas, Sandusky, Ohio	Oil gas	Producer gas
33.9	.....	.....	32.3	83.5	27.0	2.6
.....	31.8	79.4	67.0	12.5	.....	.....
.....	67.7	20.0	.....	.....	.....	.....
5.2	.....	.....	.....	.....	2.7	0.4
6.1	.....	.....	.....	.....	10.6	22.0
2.6	.....	.....	.....	0.2	2.8	5.7
47.9	.....	.....	.....	.....	53.5	10.5
3.7	0.5	0.6	0.7	3.8	3.4	58.8
0.6	.....	.....	.....	.....	.....	.....
600	2220	1868	1482	1047	516	136
538	1970	1711	1350	946	461	128
5.28	21.50	17.97	14.25	10.04	4.25	1.08
0.529	2.666	2.188	1.663	1.087	0.458	0.311
1.260	3.662	3.182	2.756	2.045	1.129	0.165
4.21	17.00	14.21	11.29	7.98	3.39	1.44
95.6	98.6	98.5	97.3	94.7	98.3	65.3
3860	3835	3830	3770	3740	3970	3050

Name of gas or vapor	Mol. weight	Spec. Grav. gas or vapor at 60°F. Air = 1.000	Boiling point °F.	Spec. Grav. of liquid at 60°F. Water = 1.000	Spec. heat eq. wts. at const. press. Water = 1.000	Cubic feet per pound 60°F. 30" Hg	Weight of 1 cubic foot in pounds	Heat of Combustion		
								Gram calories per gram-molecular wt.	B.T.U. per cubic foot	B.T.U. per pound
Acetylene	26.02	0.9056	−112	0.6130	.....	14.45	0.0692	310054	1483.0	21449
Air	.....	1.000	.....	.....	0.2374	13.09	0.0764	.....	.....	.....
Allylene	40.03	1.3823	− 10.3	.....	.....	9.447	0.10585	467550	2227.1	21040
Ammonia	17.03	0.5971	− 37.3	0.6234	0.5202	22.178	0.04509	90650	432.8	9598
Amylene	70.08	2.4211	+102	0.6511	.....	5.41	0.1849	807602	3835.0	20743
Benzene	78.05	2.6953	+176.6	0.8839	0.3754	4.86	0.2059	787993	3741.0	18175
Butane	58.08	2.0100	+ 33	.....	.....	6.51	0.1535	687203	3269.0	21298
Butylene	56.06	1.2367	+ 23	.....	.....	6.76	0.1479	650632	3089.0	20891
Carbon dioxide	44.00	1.52909	−108.4	0.8300	0.2163	8.57	0.1167	.....	.....	.....
Carbon disulfide	76.12	2.6298	+114.8	1.2920	0.159	4.965	0.20139	265130	1264.6	6279
Carbon monoxide	28.00	0.96716	−310	.....	0.2450	13.55	0.0738	67960	323.0	4369
Crotonylene	54.05	1.8661	+ 81	.....	.....	6.998	0.14290	593091	2822.6	19752
Cyanogen, CN	26.01	1.8000	− 5.8	0.8600	.....	7.258	0.13779	259620	1238.2	8986
Ethane	30.05	1.0494	−128.2	.....	.....	12.48	0.0801	370456	1778.0	22190
Ethyl alcohol	46.05	1.5894	+172.9	0.7946	1.4534	8.23	0.1215	340494	1617.0	13309
Ethylene	28.03	0.96836	−153.4	.....	0.4040	13.53	0.0739	333361	1583.0	21407
Hexane	86.11	2.9721	+160.7	0.6630	.....	4.40	0.2271	999220	4744.0	20887
Hydrogen	2.016	0.06960	−423.4	.....	3.4090	188.70	0.0053	68415	325.0	61085
Hydrogen cyanide	27.02	0.9348	+ 79.7	0.6967	.....	13.968	0.07159	158620	757.0	10575
Hydrogen sulfide	34.08	1.1906	− 79.2	0.9000	0.2423	11.00	0.0909	136701	657.0	17218
Mesitylene	120.09	4.1468	+328.1	0.8583	.....	3.149	0.31755	1282310	6108.0	19235
Methane	16.03	0.55450	−263.2	.....	0.5920	23.64	0.0423	211933	1008.0	23798
Methyl alcohol	32.03	1.1121	+131.2	0.8027	0.458	11.83	0.0845	182187	865.0	10238
Naphthalene	128.06	4.4230	+424.7	1.1508	.....	2.952	0.3387	1230657	5859.0	17298
Nitrogen	28.02	0.9674	−320.1	0.8050	0.2438	13.53	0.0739	.....	.....	.....
Oxygen	32.00	1.1055	−294.5	1.1340	0.2174	11.85	0.0844	.....	.....	.....
Pentane	72.09	2.4905	+ 98.6	0.6263	.....	5.26	0.1902	847247	4022.0	21152
Propane	44.06	1.5223	− 38.2	0.6130	.....	8.61	0.1162	529205	2513.0	21620
Propylene	42.05	1.4527	− 58.4	.....	.....	9.02	0.1109	492742	2340.0	21092
Sulfur dioxide	64.06	2.2638	+ 12.6	1.4900	0.1553	5.78	0.1729	.....	.....	.....
Toluene	92.06	3.1792	+231.8	0.8714	.....	4.12	0.2429	934409	4436.0	18270
Water	18.02	0.6217	+212	1.000	0.4805	21.004	0.04761	.....	.....	.....
m-Xylene	106.08	3.6630	+282.4	0.8697	.....	3.57	0.2800	1084986	5155.0	18410

TAIN GASES AND VAPORS

Cu. ft. per cu. ft. of gas or vapor					Pounds per pound of gas or vapor					Heat of formation constant pressure		
Required for combustion		Products of combustion			Required for combustion		Products of combustion			Calories per gram-molecular weight	B.T.U.	
Air	O_2	CO_2	H_2O	N_2	Air	O_2	CO_2	H_2O	N_2		Per cubic foot	Per pound
11.94	2.5	2.0	1.0	9.45	13.22	3.07	3.38	0.69	10.15	−47770	−227.5	−3300.7
.....	....	....	...	.....	.....	.....	....	....	.....	.....	.....	.....
19.14	4.0	3.0	2.0	15.14	13.85	3.20	3.30	0.90	10.65	−39950	−189.2	−1796.4
3.589	0.75	...	1.5	2.889	6.111	1.412	....	1.588	5.522	+11890	+ 56.7	+1259.0
35.83	7.5	5.0	5.0	28.35	14.72	3.42	3.14	1.29	11.30	+18970	+113.7	+ 614.1
35.83	7.5	6.0	3.0	28.35	13.22	3.07	3.38	0.69	10.15	−12510	− 47.3	− 229.3
31.06	6.5	4.0	5.0	24.57	15.41	3.58	3.03	1.55	11.83	+42450	+202.2	+1317.3
28.67	6.0	4.0	4.0	22.68	14.72	3.42	3.14	1.29	11.30	+10660	+ 50.7	+ 342.6
.....	....	.....	.....	.....	.....	.....	.....	.....	.....	+97266	+463.1	+3979.1
		SO_2						SO_2				
14.355	3.0	1.0	2.0	11.355	5.466	1.263	0.579	1.684	4.203	−26010	−124.0	−616.0
2.39	0.5	1.0	....	1.89	2.45	0.57	1.57	....	1.88	+29000	+138.4	+1869.2
26.32	5.5	4.0	3.0	20.828	14.11	3.26	3.26	1.30	10.85	.....	.....	.....
9.57	2.0	2.0	...	8.57	5.323	1.230	1.692	.....	4.631	−65700	−313.2	−2273.9
16.72	3.5	2.0	3.0	13.23	16.06	3.75	2.93	1.80	12.33	+28560	+136.0	+1713.6
14.33	3.0	2.0	3.0	11.34	8.95	2.08	1.91	1.17	6.87	+58470	+278.5	+2288.0
14.33	3.0	2.0	2.0	11.34	14.72	3.42	3.14	1.29	11.30	− 2710	− 12.9	− 174.2
45.39	9.5	6.0	7.0	35.91	15.20	3.53	3.07	1.46	11.67	+61080	+290.9	+1278.4
2.39	0.5	...	1.0	1.89	34.19	7.94	....	8.94	26.25	.....	.....	.....
5.981	1.25	1.0	0.5	4.781	6.410	1.481	1.63	0.333	5.447	−27480	−131.1	−1832.0
		SO_2					SO_2					
7.17	1.5	1.0	1.0	5.67	6.07	1.41	1.88	0.53	4.66	+ 4740	+ 22.6	+ 250.9
57.42	12.0	9.0	6.0	45.42	13.85	3.20	3.30	0.90	10.65	+ 490	+ 2.3	+ 7.3
9.56	2.0	1.0	2.0	7.56	17.17	3.99	2.74	2.25	13.18	+21750	+103.1	+2435.6
7.17	1.5	1.0	2.0	5.67	6.46	1.50	1.37	1.12	4.96	+51450	+246.4	+2894.0
57.42	12.0	10.0	4.0	45.42	12.984	3.00	3.437	0.563	9.984	.....	.....	.....
.....	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....
.....	.....	....	....	.....	.....	.....	.....	.....	.....	.....	.....	.....
38.22	8.0	5.0	6.0	30.24	15.28	3.55	3.05	1.50	11.73	+47850	+227.9	+1196.2
23.89	5.0	3.0	4.0	18.90	15.63	3.63	3.00	1.64	12.00	+35110	+167.2	+1436.3
21.50	4.5	3.0	3.0	17.01	14.72	3.42	3.14	1.29	11.30	+ 3220	+ 15.3	+138.0
.....	.....	....	....	.....	.....	.....	....	.....	.....	+71156	+337.3	+1999.1
43.00	9.0	7.0	4.0	34.02	13.47	3.13	3.35	0.78	10.34	− 3520	− 16.7	− 68.8
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	+68360	+327.1	+6870.4
50.17	10.5	8.0	5.0	39.69	13.65	3.17	3.32	0.85	10.48	.....	.....	.....

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS

See also the table *Corrosion- and Heat-Resistant Alloys.*

The following table has the alloys arranged alphabetically according to the name of the element which predominates. The following abbreviations are employed: A, annealed; C, cold worked; AC, annealed and cold worked; H, hardened; HR, hot rolled. The ultimate strength is given in thousands of pounds per square inch.

Composition %	Trade Name	Sp. Gr.	M. P. °C.	Thermal Expansion $\times 10^6$	Ultimate Strength
Aluminum					
99.2Al	Aluminum 2S	2.71	660	23.94	12AC
95Al, 5Cu	Lynite, body alloy	.....	650	26	.....
94Al, 4Cu, 0.5Mg, 0.5Mn, coated with 99.7+Al	Alclad 17 ST	2.96	538-46	21.96	55
90Al, 10Mg	Magnalium	2.50	600	24	.....
70Al, 30Mg	Magnalium	2.00	435	.....	.....
98Al, 1.25Mn	Aluminum Alloy 3S	2.74	640-55	23.04	16-31 AC
95Al, 5Si	Aluminum-silicon 43	2.58	577-630	21.96	19
Bismuth					
53Bi, 32Pb, 15Sn	Eutectic fusible alloy	.....	96	.....	.....
52Bi, 40Pb, 8Cd	Eutectic fusible alloy	.....	91.5	.....	.....
50Bi, 27Pb, 13Sn,10Cd	Lipowitz alloy	.....	70–2	.....	.....
50Bi, 25Pb, 12.5Sn, 12.5Cd	Wood's metal	9.7	70–2	.....	.....
40Bi, 40Pb, 20Sn	Bismuth solder	.....	111	.....	.....
Cerium					
70-3Ce, 17-24Zn, 1.6-6Fe, 0-2.4Al, Mn	Ignition pin alloy	.....	.....	.....	.....
61Ce, 37Fe	Ignition pin alloy	.....	.....	.....	.....
Cobalt					
56Co, 34-40Cr, 9.2W, 1.2-2C, 0-1Fe	Stellite No. 2	.....	.....	.....	.....
55Co,20-23Cr, 15-20W, 3-5Fe, 1.5-4C	Stellite No. 3	.....	.....	.....	.....
40-80Co, 20-35Cr, 0-25W, 0.75-2.5C	Stellite	8.50	1150	14.99	.....
Copper					
99.9+Cu	Deoxidized copper	8.50	1082	17.71	32-55
99.9Cu, 0.01P	Deoxidized copper	8.91	1082	17.71	35-55
90Cu, 10Al	Aluminum bronze	7.6	1050	16.5	.....
90Cu, 9Al, 1Fe	Resistac	.....	1066	.....	75
80-90Cu, 8-10Al, 6-7Fe	Ampco Metal	7.2	649	.....	60-100
88-96Cu, 2.3-10.5Al, Fe, Sn	Aluminum bronze	7.5-8.2	1038-71	.....	.....
47Cu, 33Au, 20Ag	8 Carat gold	.....	.....	.....	.....
40Cu, 31Au, 19Ag, 10Pd	Palladium gold	.....	.....	.....	.....
95Cu, 5Mn	Manganese bronze	8.8	1060	.....	.....
82Cu, 15Mn, 3Ni	Manganin	8.5	.....	.....	.....
61Cu, 26Mn, 13Al	Magnetic alloy	.....	.....	.....	.....
88.5Cu, 5Ni, 5Sn, 1.5Si	Barberite	8.8	1070	.....	60
75Cu, 25Ni	Nickel coinage, U.S.A.	.....	.....	.....	

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS

Composition %	Trade Name	Sp. Gr.	M.P. °C.	Thermal Expansion $\times 10^6$	Ultimate Strength
Copper					
75Cu, 20Ni, 5Zn	Ambrac A	8.58	1150	16.40	50-130
65Cu, 18Ni, 17Zn	Nickel silver	8.75	1110	18.36	55-110
60Cu, 40Ni	Constantan	8.4	1280	.....	.....
55Cu, 18Ni, 27Zn	Nickel silver	8.7	1055	.....	.....
94.8-96Cu, 3-4Si, 1-1.2Mn	Everdur	8.46	1000	16.99	50-145
95.5Cu, 4.3Sn, 0.2P	Phosphor bronze 30	8.91	1050	18.90	45-115
91.6Cu, 8.25Sn, 0.15P	Phosphor bronze 47	8.91	.....	.....	51-130
90Cu, 10Sn, P trace	Phosphor bronze 209	9.00	.....	.....	Up to 135
90Cu, 10Sn	Gun metal bronze	8.80	.....	.....	.....
82Cu, 16Sn, 2Zn	Bearing bronze	.....	.....	.....	.....
67Cu, 33Sn	Speculum metal	.....	.....	.....	.....
90Cu, 10Zn	Red brass	8.80	1050	18.18	37-100
89Cu, 9Zn, 2Pb	Hardware bronze	8.83	1050	18.18	35-60
85Cu, 15 Zn	Red brass	8.75	1030	18.72	43-75
70Cu, 29Zn, 1Sn	Admic	.....	1205	16.29	113H
70Cu, 29Zn, 1Sn	Admiralty	8.17	935	20.16	50-95
67Cu, 33Zn	Yellow brass	8.40	940	18.50	.....
60Cu, 40Zn	Muntz metal	.....	840	.....	.....
60Cu, 25Zn, 15Ni	German silver	.....	.....	18.40	.....
60Cu, 19Zn, 10Al, 6Fe, 5Mn	Hytensl bronze	.....	980	.....	105
55Cu, 25Zn, 20Ni	Usual German silver	.....	.....	.....	.....
Gold					
92Au, 8Cu	Great Britain standard	.....	900	.....	.....
90Au, 10Cu	Coinage gold	17.17	940	.....	.....
67Au, 8-27Cu, 6-26Ag	16 Carat gold	.....	.....	.....	.....
62Au, 13Cu, 11Ag	15 Carat gold	.....	.....	.....	.....
58Au, 14-28Cu,4-28Ag	14 Carat gold	.....	.....	.....	.....
50Au, 35Cu, 15Ag	12 Carat gold solder	.....	.....	.....	.....
42Au, 38-46Cu, 12-20Ag	10 Carat gold	.....	.....	.....	.....
90Au, 10Pd	Palladium or white gold	.....	1265	.....	.....
80Au, 20Pd	Palau	.....	1375	.....	.....
60Au, 40Pt	White, platinum gold	.....	1500	.....	.....
92Au, 4.9Ag, 3.4Cu	22 Carat, dark dental	.....	.....	.....	.....
92Au, 4.2Ag, 3.8Cu	22 Carat gold	.....	.....	.....	.....
84Au, 8.3-11Ag, 6-8.3Cu	20 Carat gold	.....	.....	.....	.....
			.....	.....	.....
75Au, 10-20Ag, 5-15Cu	18 Carat gold	.....	.....	.....	.....
68-70Au, 25Ag, 5-7.5 Pt or Ni	Platinum substitute, electrical	.....	.....	.....	.....
50Au, 33Ag, 17Cu	14 Carat gold solder	.....	.....	.....	.....
41Au, 37Ag, 21Cu, 0.6 brass	10 Carat gold solder	.....	.....	.....	.....
40Au, 37Ag, 23Cu	8 Carat gold solder	.....	.....	.....	.....
Iridium					
95Ir, 5Pt	.....	22.38	.....	.....	.....
Iron					
99.8Fe, 0.11O, 0.025 S, 0.017Mn 0.012C, 0.005P	Armco ingot iron	7.86	1530	.....	48

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS

Composition %	Trade Name	Sp. Gr.	M. P. °C.	Thermal Expansion $\times 10^6$	Ultimate Strength
Iron					
98.5Fe	Wrought iron	7.7	1510	.....	48
80Fe, 20Al	Ferro-aluminum	6.30	1480	.....	.....
99Fe, 1C	Steel	7.83	1430	12.0	.....
97Fe, 3C	White cast iron	7.60	1150	.....	.....
94Fe, 3.5C, 2.5Si	Gray cast iron	7.0	1230	11.2	.....
Fe, 30-40Co, 5-9W, 1.5-3Cr, 0.4-0.8C	K. S. Magnet steel	.....	.....	.....	.....
Fe, 0.45Cu, 0.07Mo, 0.03C	Molybdenum iron; Toncan copper	7.83	1525	11.99	.....
Fe, +10Cr, 0.25C, <0.5Mn	Stainless steel	7.75	1510	.....	98-250
90-92Fe, +Cr, 0.4Mn, <0.12C	Stainless steel	7.75	1450	11.00	250
90Fe, +Cr, 0.4Mn, <0.12C	Stainless iron	7.75	1450	11.00	80
88Fe, 16-17Cr, 0.4Mn, 0.1C max.	Stainless iron	.....	.....	9.99	60-80
86-88Fe, 12-14Cr, 0.3C	Carpenter stainless steel No. 2	7.75	1425	.....	260
86-88Fe, 12-14Cr, <0.5 Mn, <0.1C, Ni trace	Defirust rustless iron	7.75	1480	.....	80-160
86-88Fe, 12-14Cr, 0.1C	Carpenter stainless steel No. 1	7.78	1490	.....	85A-180H
85-89Fe, 10-14Cr, <0.5Mn, <0.13C	Stainless iron	7.78	1490	10.19	80-200
82-86Fe, 12-16Cr, <0.5Ni, <0.05Si, <0.5Mn, <0.12C	Ascoloy 33	7.64	1495	10.89	85
86.7Fe, 12.5Cr, 0.35Mn, 0.35Ni, 0.12C	Sterling stainless steel T	7.75	1430	9.99	125H
86.4Fe, 13.5Cr, 0.1C	Stainless I	7.75	.....	10.91	125
84-86Fe, 12.5-14.5Cr, 0.5Mn max., 0.5Si max., 0.5Ni min., 0.12-0.18C	Enduro S 15	7.86	1475	10.89	100A
84-86Fe, 12.5-14.5Cr 0.5 Mn max., 0.5Si max., 0.25Ni, 0.05-0.12C	Enduro S	7.86	1500	10.89	.....
85.8Fe, 13.5Cr, 0.35 Mn, 0.35C	Sterling stainless steel A	7.75	1425	10.30	200H
85.6Fe, 14Cr, 0.35C	Stainless A	7.75	.....	10.91	100
85Fe, 13-14Cr, 2Ni max., 0.3-0.6Mn, 0.12C max.	Enduro KM 1	7.75	1490	9.99	.....
82-84Fe, 16-18Cr, <0.5Mn, C	Duraloy B	7.61	1510	.....	100
84.3Fe, 12Cr, 2.15C, 0.75V, 0.75Co	Crocar	.....	.....	.....	103
82-84Fe, 16-18Cr, <0.5Mn, <0.1C, Ni trace	Special defirust rustless iron	7.75	1480	.....	80
81-83Fe, 16.5-18.5 Cr, 0.75Si, 0.1C max.	Enduro A	7.64	1510	11.00	75

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS

Composition %	Trade Name	Sp. Gr.	M. P. °C.	Thermal Expansion $\times 10^6$	Ultimate Strength
Iron					
82.8Fe, 16.5Cr, 0.65C	Stainless B	.....	.....	.....	.....
82.5Fe, 16.5Cr, 0.65C, 0.35Mn	Sterling stainless steel B	7.72	1425	10.91	200H
82Fe, 16-18Cr, <0.5 Mn, 0.5Ni, 0.35C	Sweetaloy 16	7.83	1495	11.00	75
79-82Fe, 16-19Cr, <0.5Mn, <0.5Ni, <0.5Si, <0.12C	Ascoloy 66	7.64	.....	.....	87
79-82Fe, 16.5-18.5Cr, 0.5 Mn max., 0.5-1.25Si max., 0.25Ni max., 0.1C max	Enduro A	7.86	1490	10.80	78A
79-81Fe, 16.5-18Cr, 1-1.1C, 0.75-1.0Si, 0.35-0.5Mn	Delhi hard	7.75	1500	9.99	125A
78.7Fe, 20Cr, 1Cu, 0.3C	Carpenter stainless steel 3	7.70	1475	.....	100
71-76Fe, 17-19Cr, 7-10 Ni, 0.05Mn, 0.2C	Defistain rustless iron	7.83	1455	.....	90
71-75Fe, 17-19Cr, 8-9 Ni, 0.5Mn, 0.06-0.25C	Midvale V2A	7.89	1450	16.99	90-115
70-75Fe, 25-30Cr, <0.5Mn, 0.25C, Ni trace	Defiheat rustless iron	7.89	1595	.....	75-100
Fe, 17-20Cr, 7-10Ni, <0.5Mn, <0.5Si, <0.2C	Allegheny metal	7.85	1430-70	17.30	90A
69-75Fe, 16.5-19.5Cr, 7-10Ni, 0.75Si max., 0.5Mn max., 0.15C max.	Enduro KA2	7.86	1400	15.98	90
74Fe, 18Cr, 8Ni, 0.18C	Stainless N	.....	.....	18.00	90
71-74Fe, 17.5-19Cr, 8-9Ni, 0.5 Mn, 0.15C max.	Rezistal KA2	7.86	.....	15.98	90
73.5Fe, 18Cr, 8Ni, 0.35 Mn, 0.15C	Sterling nirosta steel	7.92	1425	16.99	200C
73Fe, 18Cr, 9Ni, 0.5Mn, C	Duraloy 18-8	7.86	1475	14.99	105-115
70-73Fe, 27-30Cr, 0.5Mn, C	Duraloy A	7.61	1510	.....	40-50
72.4Fe, 18Cr, 9.5Ni, 0.1C	Carpenter stainless steel No. 4	7.72	1400	.....	89A-100HR
70-72Fe, 17.5-19Cr, 8-9Ni, 2-2.5Si, 0.1-0.2C	Rezistal 2C	7.86	.....	15.98	108
68-72Fe, 26-30Cr, <1Mn, <0.6Ni, <0.6Si, <0.25C	Ascoloy 55	7.61	.....	10.19	90
70Fe, 28Cr, 0.5Mn, 0.5 Ni, 0.5C	Sweetaloy 19	7.86	1495	11.00	50
70Fe, 19Cr, 9Ni, 1Cu, 1Mo, 0.2C	Stainless U	.....	.....	18.00	100

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS

Composition %	Trade Name	Sp. Gr.	M. P. °C.	Thermal Expansion $\times 10^6$	Ultimate Strength
Iron					
69Fe, 18-20Cr, 8-10Ni, 0.5Mn, 0.15C	Sweetaloy 17	7.86	1450	15.98	85
68.1Fe, 20Cr, 7Ni, 4W, 0.35C, 0.5Mn	Midvale HR	8.03	.....	.....	85-135
60-66Fe, 22-25Cr, 10-13 Ni, <1Mn, <0.5Si, <0.2C	Ascoloy 44	7.9	1400-25	16.20	100A
57-62Fe, 28-30Cr, 8-10 Ni, 1.5Si, 0.5-0.7C, 0.4-0.5Mn	Misco C	7.89	1540	.....	82.6
60Fe, 28Cr, 10Ni, 0.5 Mn, 0.35C	Sweetaloy 22	7.97	1495	.....	70
50Fe, 50Cr	Ferro-chromium	6.9	1460	.....	.....
50-54Fe, 25-26Cr, 19-21 Ni, 2-3Si, 0.2C	Rezistal 7	.....	.....	.....	.....
85-88Fe, 11-14Mn, 1-1.3C	Rol-Man, manganese steel	.....	1290	.....	160
86Fe, 13Mn, 1C	Manganese steel	7.81	1510	.....	.....
50Fe, 50Mn	Ferro-manganese	.....	1325	.....	.....
96.5Fe, 3.5Ni	Nickel steel	.....	1530	.....	.....
95.1Fe, 3Ni, 1.5Cr, 0.4C	Nickel-chrome steel	.....	.....	.....	.....
79Fe, 15Ni, 2.5Cr, 3Si, 0.6C	Durimet D	.....	1450	.....	75
74.2Fe, 25Ni, 0.8C	Ferro-nickel	8.1	1500	18	.....
70.9Fe, 20Ni, 8Cr, 0.75 Mn, 0.4C	Cyclops 17 Metal	8.00	1425-80	.....	125
70Fe, 25Ni, 5Si, 0.25C	Durimet A	7.89	1500	.....	.....
67.8Fe, 32Ni, 0.2C	Ferro-nickel valve steel	8.0	1480	4	.....
67Fe, 22Ni, 10Cr, 0.5 Mn, 0.2C	Sweetaloy 18	7.97	1450	18.90	79
63.8Fe, 36Ni, 0.2C	Invar	8.0	1495	0.8	.....
57-61Fe, 24-26Ni, 10-12Cr, 4.5-5.5Si, 0.15C	Rezistal 255C	7.81	.....	.....	116
51-58Fe, 25-28Ni, 13-15Cr, 3-4W, 1-1.5 Mn, 0.4-0.5C	Midvale ATV 3	8.11	.....	.....	108
57Fe, 25Ni, 15Cr, 0.3C	Pyrasteel	7.89	1450	17.10	80
47-56Fe, 33-39Ni, 10-12 Cr, 1.1-1.8Mn, 0.25-0.35C	Midvale ATV 1	8.06	1450	.....	85-100
53-56Fe, 24-26Ni, 17-18 Cr, 2.5Si, 0.15-0.25C	Rezistal 4	7.78	.....	16.29	113
53.85Fe, 46Ni, 0.15C	Platinite	8.2	1470	7.5	.....
47-52Fe, 34-36Ni, 10-12Cr, 4.5-5.5Si, 0.15C	Rezistal 355C	7.81	.....	.....	.....
Fe, 35-37Ni, 15-17Cr, 1.4-1.6Si, 0.6-0.8Mn, 0.5-0.7C	Standard Misco	7.97	1540	13.50	75
50Fe, 35Ni, 15Cr	Chromax castings	7.81	1480	12.19	60
48Fe, 35Ni, 12Cr, 5Si, 0.25C	Durimet B	7.89	1500	.....	100

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS

Composition %	Trade Name	Sp. Gr.	M. P. °C.	Thermal Expansion $\times 10^6$	Ultimate Strength
Iron					
45Fe, 36Ni, 18Cr, 0.5 Mn, 0.3C	Sweetaloy 20	7.97	1495	.....	64
97.6Fe, 2Si, 0.4C	Silicon steel	.....	.....	.....	.....
73-97Fe, 1-24Si, 2-3C, 0.1P, 0.04-0.14S	Meehanite metal	.....	.....	.....	50-65
84.86Fe, 13.5Si, 1C, 0.4 Mn, 0.18P, 0.05S	Tantiron	7.83	1315	.....	.....
84.3Fe, 14.5Si, 0.85C, 0.35Mn	Duriron	7.00	1265	15.59	14
94.5Fe, 5W, 0.5C	Tungsten steel	.....	.....	.....	.....
75Fe, 18W, 6Cr, 0.3V, 0.7C	High speed steel	.....	.....	.....	.....
66Fe, 17W, 10Cr 3.5C, 2.5Mo	Cristite 1	7.61	.....	15.59	.....
Lead					
99.8Pb, 0.2As	Lead for shot	.....	.....	.....	.....
94Pb, 6Sb	Battery plate	.....	300	.....	.....
92-94Pb, 6-8Sb	Antimonial lead	11.0	245-90	27.00	3
90Pb, 10Sb	Magnolia	.....	270	.....	.....
82Pb, 15Sb, 3Sn	Type metal	.....	.....	.....	.....
75Pb, 19Sb, 10Sn, 2Cu	White metal	9.5	238	.....	.....
92Pb, 8Cd	Aluminum solder, U.S.P.1,333,666	.....	310	.....	.....
99.93Pb, 0.08Cu	Chemical lead	11.35	327	28.98	1.74
67Pb, 33Sn	Plumber's solder	9.4	275	25.0	.....
58Pb, 26Sn, 15Sb, 1Cu	Standard type metal	.....	.....	.....	.....
50Pb, 50Sn	Half and half solder	9.4	275	25.0	.....
Magnesium					
98.5Mg, 1.5Mn	Dowmetal M	1.76	650	16	.....
95.7Mg, 4Al, 0.3Mn	Dowmetal F	1.76	625	16	.....
93.7Mg, 6Al, 0.3Mn	Dowmetal E	1.78	610	16	.....
91.8Mg, 8Al, 0.2Mn	Dowmetal A	1.80	600	16	.....
90Mg, 3-7Al, 2-5Zn, 0.5Mn	Electron	.....	.....	.....	.....
89.9Mg, 1.5 Mn	Dowmetal G	1.80	595	16	.....
88Mg, 12Al	Dowmetal B	.....	575	.....	.....
88Mg, 8.3Al, 2.0Cu, 1.0 Cd, 0.5Zn, 0.2Mn	Dowmetal D	.....	.....	.....	.....
85Mg, 15Al	Dowmetal C	.....	590	.....	.....
91.8Mg, 4Cu, 2Al, 2Cd, 0.2Mn	Dowmetal T	1.82	640	16	.....
95Mg, 4-5Zn, 0-0.6Cu	Electron	.....	.....	.....	.....
Mercury					
80Hg, 20Bi	Bismuth amalgam	.....	90	.....	.....
70Hg, 30Cu	Dentist amalgam	.....	.....	.....	.....
Nickel					
99-99.5Ni(+Co), 0.25-1.0C, 0.25-1.0Si, 0.3-1.0Mn, 0.6-1Fe, 0.25-1Cu	Nickel	8.86	1450	.....	65-140

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS

Composition %	Trade Name	Sp. Gr.	M. P. °C.	Thermal Expansion $\times 10^6$	Ultimate Strength
Nickel					
Ni-Cr steel with high Si	Elcomet	8.03	.....	.....	.....
80Ni, 20Cr	Chromel A	8.4	.....	.....	.....
80Ni, 20Cr	Tophet A	8.50	1345	13.00	120
80Ni, 20Cr	Nichrome IV	8.50	1390	13.21	110
63Ni, 21Cr, 6.5Cu, 5Mo, 2W, 1Fe, 1Al, 1Mn	Illium	.....	.....	.....	.....
60Ni, 25Cr, 7Cu	Illium G	8.31	1300	13.50	73
60Ni, 20Cr, 10Fe, 1.75 Mn, 0.5C	Fireamor	8.00	1330	13.99	60
73Ni, 17.5Co, 6.5Fe, 2.5 Ti, 0.2Mn	Konel	8.61	1450-1500	10.66	100
90Ni, 3Cu, ±10Si, 1.5Al	Hastelloy	7.81	1160	11.59	.....
60-70Ni, 25-35Cu, 1-3Fe, 0.25-2.0Mn, 0.02-1.5 Si, 0.3-0.5C	Monel metal	8.80	1330	.....	65-170
60Ni, 33Cu, 6.5Fe	Monel metal	8.90	1360	14	.....
75Ni, 12Fe, 11Cr, 2Mn	Nichrome wire	.....	.....	.....	.....
61Ni, 23Fe, 16Cr	Chromel C	8.24	.....	.....	.....
60-62Ni, 23-26Fe, 10-11Cr, 2-2.5W, 1.2-1.5Mn, 0.3-0.35C	Midvale BTG	8.47	1450	.....	.....
60Ni, 28Fe, 12Cr	Tophet C	8.19	1350	13.70	100
60Ni, 25Fe, 15Cr, 0.7C	Nichrome castings	8.08	.....	12.10	64
60Ni, 24Fe, 16Cr, 0.1C	Nichrome	8.17	1350	13.70	100
60Ni, 20Fe, 20Mo	Hastelloy A	8.80	1300	10.71	100-120
35Ni, 17Fe, 15Cr, 1.75 Mn, 0.5C	Zorite	7.92	1300	.....	50
Ni, Fe, Mo	Hastelloy C	8.91	1350	.....	60
60Ni, 20Pt, 10Pd, 10V	Palau	.....	.....	.....	.....
Palladium					
67Pd, 33Ag	Palladium alloy	.....	1415	.....	.....
Platinum					
90Pt, 10Ir	Platinum-iridium	21.61	.....	8.8	.....
80-100Pt, 0.-20Rh	Thermocouple rhodium	.....	.....	8.8	.....
Silver					
92.5Ag, 7.5Cu	Standard silver	.....	920	18	.....
90Ag, 10Cu	U. S. silver coin	10.3	890	.....	.....
63Ag, 30Cu, 7.5Zn	Silver solder	.....	.....	.....	.....
40Ag, 40Sn, 14Cu, 6Zn	Bu. Stand. silver solder	.....	.....	.....	.....
Tantalum					
99.5Ta	Tantalum	16.6	2850	6.50	130
Tin					
78Sn, 9Al, 8Zn, 5Cd	Bu. Stand. SN1 aluminum solder	.....	.....	.....	.....

COMPOSITION AND PHYSICAL PROPERTIES OF ALLOYS

Composition %	Trade Name	Sp. Gr.	M.P. °C.	Thermal Expansion $\times 10^6$	Ultimate Strength
Tin					
90Sn, 10Sb	Brittania metal	.....	255	.....	.....
90Sn, 7Sb, 3Cu	Babbitt metal	.....	.....	.....	.....
75Sn, 12.5Sb, 12.5Cu	Antifriction	7.53	233	.....	.....
85Sn, 6.8Cu, 6Bi,1.7Sb	Pewter	.....	.....	.....	.....
50Sn, 32Pb, 18Cd	Eutectic alloy	.....	145	.....	.....
86Sn, 9Zn, 5Al	Bu. Stand. SN3 aluminum solder	.....	.....	.....	.....
69Sn, 29Zn, 2.4Al, 2.4P	Bu. Stand. SN2 aluminum solder	.....	.....	.....	.....
41Sn, 28Zn, 3Cu, 0.6Mn, 0.1Al	Aluminum solder, U.S.P. 1,332,899	.....	.....	.....	.....
Tungsten					
W, 0.5-0.75ThO_2	Filament tungsten	.....	.....	.....	.....
Zinc					
90Zn, 6Al, 4Cu	Geophys. Lab., aluminum solder	.....	.....	.....	.....
75Zn, 20Cd, 5Al	Bu. Stand. ZN1, aluminum solder	.....	.....	.....	.....
67Zn, 33Cu	Easily fusible solder	.....	795	20	.....
60Zn, 40Cu	White solder	.....	840	21	.....
63 Zn,21Sn,12Pb, 3.2Cu	Battery plate	.....	.....	.....	.....

MELTING POINT AND COMPOSITION OF FUSIBLE ALLOYS

Melting Point Deg. C.	Composition			
	% Bismuth	% Lead	% Tin	% Cadmium
46.9 + 18.1% In	41	22.1	10.6	8.2
66	50	25	12.5	12.5
70*	50	27	13	10
75	27.5	27.5	10	34.5
80	43.8	25	25	6.2
86	0	25	50	25
92	52	40	0	8
96	53	32	15	0
100	50	20	30	0
108	42.1	42.1	15.8	0
111	40	40	20	0
117	36.5	36.5	27	0
123	33.3	33.3	33.3	0
130	30.8	38.4	30.8	0
136	0	26.5	59.3	14.2
145	20	40	40	0
155	16	36	48	0
160	11.2	44.4	44.4	0
165	11.4	45.6	43	0
172	12.8	49	38.2	0
178	12.5	50	37.5	0
187	0	31	69	0
200	0	20	80	0
230	0	55.6	44.4	0
265	0	71.4	28.6	0
290	0	87.5	12.5	0

*This alloy (Lipowitz's alloy) and many others can be alloyed with mercury to further reduce the melting point; after melting the alloy and removing the molten mass from the source of heat, the mercury is introduced and the mixture stirred with an iron rod. **CAUTION:** mercury vapors are poisonous.

PHYSICAL AND MECHANICAL PROPERTIES OF CAST METALS

Name	Tensile strength in 1000 lbs. per sq. inch	Yield strength in 1000 lbs. per sq. inch	Elongation % in 2 inches	Brinell Hardness	Weight in lbs. per cu. inch	Pattern maker allowance for shrinkage in inches per ft.
Aluminum alloys:						
Aluminum	12	.....	40	18	0.089	0.203
Alcoa 43	17	9	3	40	0.096	0.125
Alcoa 214	22	12	6	50	0.095	0.125
Alcoa 406	.....	.....	.....	.....	0.099	0.125
Copper alloys:						
Copper	17–20	6–9	40–50	30–40	0.320	0.250
Alcumite	65–70	23–25	30–35	120–140	0.273	0.1875
Ambrac 850	50–115	17–67	2–50	58–160	0.322	0.1875
Ampco 12	55–65	22–27	22–27	109–124	0.279	0.250
Ampco 16	70–80	32–37	18–22	131–156	0.275	0.250
Ampco 18	75–85	33–42	10–14	159–183	0.272	0.250
Ampco 20	80–90	35–43	4–6	212–248	0.268	0.250
Ampco 21	80–95	36–44	3–5	285–311	0.260	0.250
Ampco 22	85–100	37–42	1–4	321–352	0.257	0.250
Beryllium 2%	90–125	85–100	0–4	350–420	0.318	0.1875
Brass (red)	28–30	17–20	16–18	50–55	0.310	0.1875
Brass (yellow)	30–35	.....	25–35	40–50	0.310	0.1875
Bronze acid	39–40	21–22	23–24	65–68	0.310	0.1875
Bronze alumin	67–71	30–36	15–16	111–130	0.27	0.22
Everdur D	55–57	24–26	24–27	95–100	0.294	0.1875
Hills McCarma 45	67–72	30–36	15–16	111–130	0.270	0.22
Hills McCarma 52	92–100	56–57	2–3	217–223	0.310	0.250
Tempalloy	.....	.....	.....	.....	0.295	0.218
Iron alloys:						
Gray iron	20–35	.....	.....	150–200	0.26	0.125
Malleable iron	50–53	32–35	18	115	0.20	0.125
Ni hard	30–40	.....	0	575–750	.....	.....
Meehanite GD [a]	33–38	.....	.....	193	0.257	0.156
Meehanite GC [a]	38–42	.....	.....	207	0.262	0.156
Meehanite GB [a]	42–46	.....	.....	212	0.268	0.156
Meehanite GA [a]	50	.....	.....	223	0.26	0.156
Meehanite GAH [a]	70	.....	.....	250–600	0.26	0.156
Meehanite WA [b]	50	.....	.....	250–321	0.26	0.156
Meehanite WB [b]	38	.....	.....	350–550	0.26	0.156
Meehanite HR [c]	40	.....	.....	300–400	0.26	0.156
Meehanite SC [d]	27	.....	.....	200–300	0.26	0.156
Meehanite HE [d]	30	.....	.....	170–220	0.26	0.156
Meehanite CB [e]	45	.....	.....	187	0.26	0.156
Iron-silicon alloys:						
Durichlor	17	.....	.....	52 [f]	0.255	0.250
Duriron	16	.....	.....	52 [f]	0.255	0.250

[a] For general engineering purposes.
[b] Wear resisting.
[c] Heat resisting 1450° F.
[d] Heat resisting 1450°—1650° F.
[e] Corrosion resisting.
[f] Rockwell.

PHYSICAL AND MECHANICAL PROPERTIES OF CAST METALS

Name	Tensile strength in 1000 lbs. per sq. inch	Yield strength in 1000 lbs. per sq. inch	Elongation % in 2 inches	Brinell Hardness	Weight in lbs. per cu. inch	Pattern maker allowance for shrinkage in inches per ft.
Lead alloys:						
Pure lead	1.6	0.71	68	2.9–3.0	0.41	0.3125
Chemical lead	2.3	.....	52	4.5	0.41	0.3125
Hoyt hard (6% Sb)	4.5	.....	50	7.5	0.39	.....
Tellurium lead	3.0	.....	35	5.4	0.41	.....
6% Antimony lead (+ Te)	4.5	.....	50	7.5	0.39	.....
Magnesium alloys:						
Dowmetal H (as cast)	27	12	4	50	0.066	0.157
Dowmetal H (heat treated)	38	12	6	51	0.066	0.157
Dowmetal H (heat treated and aged)	38	18	2	62	0.066	0.157
Nickel alloys:						
Nickel	55–70	20–30	30–15	100–130	0.319	0.250
Durimet	68–72	30–33	40–50	130	0.282	0.3125
Hastelloy A	69–78	42–45	8–12	155–200	0.318	0.1875
Hastelloy B	75–82	55–57	6–9	190–230	0.334	0.250
Hastelloy C	72–80	45–48	10–15	175–215	0.323	0.250
Hastelloy D	36–41	.....	.....	50–55 (f)	0.282	0.250
Illium G	68	50	30–35	170–220	0.300	0.3125
Illium R	100	50	30–35	215–240	0.300	0.3125
Inconel	80	50	10	200	0.309	0.3125
Monel (regular)	60–80	30–40	40–20	125–150	0.318	0.250
Monel H	70–90	45–65	20–10	170–210	0.310	0.250
Monel S	90–115	70–90	3–1	280–325	0.310	0.250
Pioneer Metal	74	36.5	42	150	0.300	0.250
Steels (cast):						
Carbon	70	36	22	115	0.283	0.250
4–6% Cr; 0.20C	100	80	15	220	0.283	0.250
12–14% Cr; 0.15C	75–100	45–125	8–25	175–325	0.283	0.250
26–30% Cr; 0.25C	60	35	3	170	0.283	0.250
18% Cr; 8 Ni; 0.20C	72.5	32.5	40	150	0.283	0.250
25% Cr; 12 Ni; 0.16C	75	40	30–40	175	0.283	0.250
28% Cr; 10 Ni; 0.20C	80–90	40–50	35–50	187–210	0.283	0.250
18% Cr; 8 Ni; 3 Mo; 0.20C	85	43	47	160	0.283	0.250
35% Ni; 15 Cr; 0.40C	60	40	3	200	0.300	0.250
65% Ni; 15 Cr; 0.50C	60	45	3	170	0.300	0.250

DENSITIES OF VARIOUS PATTERN WOODS IN POUNDS PER CUBIC INCH

These values may be used to calculate estimated weights of castings from pattern equipment.

Red pine	0.021	Honduras mahogany	0.021
Yellow pine	0.019	Nassau mahogany	0.025
White pine	0.016	Spanish mahogany	0.031

CORROSION AND HEAT-RESISTANT ALLOYS

Composition, Trade Name and Manufacturer

By *Clayton E. Plummer (1) and Richard K. Akin (2)*

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Key to Classification

1: Aluminum (Al)	**AA: 5 to 6%**	**aa: 0.07% Maximum Carbon**
2: Chromium (Cr)	**A: 7 to 11%**	**a: 0.12% Maximum Carbon**
3: Cobalt (Co)	**B: 12 to 15%**	**b: 0.13-0.20% Carbon**
4: Copper (Cu)	**C: 16 to 23%**	**c: 0.21-0.35% Carbon**
5: Manganese (Mn)	**D: 24 to 30%**	**d: 0.36-0.50% Carbon**
6: Molybdenum (Mo)	**E: 31 to 39%**	**e: 0.51-0.65% Carbon**
7: Nickel (Ni)	**F: 40 to 48%**	**f: 0.66-0.80% Carbon**
8: Silicon (Si)	**G: 49 to 57%**	**g: 0.81-1.10% Carbon**
9: Tungsten (W)	**H: 58 to 66%**	**h: above 1.10% Carbon**
10: Tantalum (Ta)	**J: 67 to 75%**	
Sulfur (S)	**K: 76 to 84%**	
Vanadium (V)	**L: 85 to 100%**	

The chemical analysis of the Allegheny Metal, the low carbon iron-chromium-nickel alloy, for example, is: chromium 18%; nickel 8%; 0.12% maximum carbon.

This is 2(Cr) C(16-23%) for the chromium content; 7(Ni) A(7-11%) for the nickel content; and a (0.12% maximum for the carbon content.

Thus an alloy of this chemical composition would be classed as 2C 7A a. The predominating alloying element is placed first; the lesser alloying elements follow in order of their decreasing proportions.

By reason of their chemical analyses, these alloys divide themselves into natural groups.

These are: The 2B group (chromium alloys) stainless steels resistant to atmospheric and weak acid corrosion; the 2C group, more resistant to atmospheric corrosion and nitric acid; the 2D group, resistant to atmospheric and nitric acid corrosion and resistant to wear; the 2CD 7ABCD group (chromium-nickel alloys), resistant to atmospheric corrosion, oxidation at high temperatures and to nitric acid; the 7CDEFGHJ 2ABCD groups, resistant to atmospheric corrosion, oxidation at high temperatures and nitric acid; the 7H 2C 4A, the 7H 6C, the 8B, and the 10L groups resistant to certain acids.

List of Manufacturers and their Numbers

105 Allegheny Steel Co.; see also West Leechburg Steel Co.
110 Alloy Metal Wire Co.
115 American Manganese Steel Co.
120 American Sheet and Tin Plates Co.; also, see American Steel and Wire Co., Carnegie Steel Co., U. S. Steel Corporation; Illinois Steel Co.
125 American Stainless Steel Co.
120 American Steel and Wire Co.; also, see—American Sheet and Tin Plate Co., Carnegie Steel Co., U. S. Steel Corporation; Illinois Steel Co.
135 Babcock and Wilcox Co.
140 Bethlehem Foundry and Machine Co.
145 Bethlehem Steel Co.
150 Braeburn Alloy Steel Corp.
155 Brighton Electric Steel Casting Co.
158 Brown Bayley's Steel Works, Ltd.
160 Burgess-Parr Co.
165 The Calorizing Co.
170 Canadian Atlas Steels, Ltd.
120 Carnegie Steel Co.; also, see—American Sheet and Tin Plate Co., American Steel and Wire Co., U. S. Steel Corporation; Illinois Steel Co.
175 Carpenter Steel Co.
180 Chicago Steel Foundry Co.
185 Chrome Alloy Products, Inc.
190 Cincinnati Steel Casting Co.
195 Colonial Steel Co., see also Vanadium Alloys Steel Co.
200 Columbia Tool Steel Co.
205 Cooper Alloy Foundry.
210 Crucible Steel Casting Co.
215 Crucible Steel Co. of America.

CORROSION AND HEAT-RESISTANT ALLOYS

220 Cyclops Steel Co., see also Universal Steel Co.
225 Darwin and Milner, Inc.
230 Detroit Alloy Steel Co.
235 Disston and Sons, Inc.
240 Driver-Harris Co.
245 The Duraloy Co.
250 The Duriron Co., Inc.
255 Electric Steel Foundry Co.
260 The Electro Alloys Co.
265 Empire Steel Castings Co.
270 Fansteel Products Co.
275 Firth-Sterling Steel Co.
280 The Forging and Castings Corp.
285 General Alloys Co.
290 Gilby Wire Co.
293 Hadfields, Ltd.
295 Halcomb Steel Co., see also Hawkridge Bros. Co.
300 Haynes Stellite Co.
305 Hoskins Manufacturing Co.
310 Hybnickel Alloys Co.
315 Industrial Steels.
120 Illinois Steel Co.: see also Am. Steel & Wire Co., Am. Sheet & Tin Plate Co., Carnegie Steel Co., U. S. Steel Corp.
320 Ingersoll Steel and Disc.
325 International Nickel Co.
330 Inter-State Foundry and Machine Co.
335 Wm. Jessop and Sons, Inc.
340 Jessop Steel Co.
345 Kay-Brunner Steel Products, Inc.
350 La Bour Co., Inc.
355 Latrobe Electric Steel Co.
360 Labenon Steel Foundry.
363 Ludlum Steel Co.
365 Michiana Products Co.
370 Michigan Steel Casting Co.
375 The Midvale Co.
380 National Alloy Steel Co.
385 National Harris Wire Co.
390 New England High Carbon Wire Co.
395 Ohio Seamless Tube Co.
400 Ohio Steel Foundry Co.
405 Otis Elevator Co.
410 Pacific Foundry Co.
413 Pioneer Alloy Product Co.
415 Poldi Steel Corp.
420 Republic Steel Corp.
425 Rustless Iron Corp.: see also Superior Steel Co.
430 Sharon Steel Hoop Co.
435 Shawinigan Chemicals, Ltd.
436 Shawinigan Stainless Steel & Alloys, Ltd.
440 Sivyer Steel Casting Co.
445 Standard Alloy Co., Inc.
425 Superior Steel Co.; see also Rustless Iron Corp.
450 Taylor-Wharton Iron and Steel.
455 Texas Electric Steel Casting Co.
465 Timken Steel and Tube Co.
470 Uddeholm Co. of America.
120 United States Steel Corp.; see also American Sheet and Tin Plate Co.; American Steel and Wire Co.; Carnegie Steel Co.
220 Universal Steel Co.; see also Cyclops Steel Co.
195 Vanadium Alloys Steel Co.; see also Colonial Steel Co.
475 Vulcan Crucible Steel Co.
480 Walworth Co.
485 Warman Steel Casting Co.
490 The Webb Wire Works.
105 West Leechburg Steel Co.; see also Allegheny Steel Co.
495 Wehr Steel Co.
500 Wheelock, Lovejoy and Co., Inc.
505 Wickwire Spencer Steel Co.
510 Wyman-Gordon Co.

2AA a
430 Sharon 4-6 Chrome

2AA b
105 Allegheny 46
430 Sharon 4-6 Chrome

2AA c
430 Sharon 4-6 Chrome

2A a
125 Stainless Iron

2A d Al Ni
375 Midvaloy Brand 9-7-6

2A h
125 Stainless Steel

2B aa
340 Jessop Dura-Gloss CI
363 Silcrome 12 TB
450 Tisco 132

2B a
105 Allegheny 33
110 Stainless Iron
120 USS 12
120 USS 12Z
125 Stainless Iron
135 12-14 Chromium
145 Bethadur No. 1
158 Brearly S. I.
170 No-Kor-O S
175 Carpenter Stainless No 1
195 Stainless "I"
200 Stainex No. 3
215 Stainless Iron No. 12
220 Uniloy 1409
235 Stainless Iron
245 Duraloy-C (rolled)
265 Empire 12
265 Empire 12a
275 Stainless Type "T"
285 Q-Alloy Chrome J
293 Galahad "A"
295 Stainless Iron No. 12
315 Industrial No. 12 Stainless
340 Duro-Gloss CI

CORROSION AND HEAT-RESISTANT ALLOYS

2B a (Con't)

355 Stainless Iron "L"
355 Stainless Iron "LM"
360 Corrosion Resisting Circle L No. 12
363 Silcrome 12
375 Midvaloy Brand 13-00
415 Poldi AK 1
420 Enduro — S
425 Defirust
430 Sharon Stainless 12
440 Sivyer 66
450 Tisco 132
470 UHB Stainless 1
475 Stainless Iron Type C-2
500 Whelco "A"
505 Wissco Stainless No. 1

2B a Mo

295 FM2 (Free Machining)

2B a Ni

135 B&W No. 450
195 Vasco 410
293 Galahad "A"
355 Lesco 12-1½ Stainless Iron
363 Silcrome 12-2
490 "Ship Brand" Blue Label

2B a Ni S

195 Vasco 410 F

2B a Si Cu

363 Silcrome CC

2B a S

110 Free Cutting Stainless Iron
145 Bethalon (Free Machining Iron)
175 Carpenter Stainless No. 5
195 Stainless F. M. S.
215 Stainless Steel Free Machining No. 2s
275 Stainless Type "FC"
315 Industrial No. 512 Free Machining Stainless
340 Jessop Dura-Gloss S
355 Stainless Iron "LS" Free Machining
355 Stainless Iron "LMS" Free Machining
363 Silcrome 12-EZ
375 Midvaloy FC Stainless
425 Defirust-Machining
505 Wissco Stainless IM

2B b

158 Inventor
255 Esco Stainless No. 33
285 Q-Alloy Chrome C2a
293 Galahad B
340 Jessop Dura-Gloss C12
375 Midvaloy 13-00 A
390 Newco
405 Otisel 2
475 Stainless Steel Type "A"
500 Whelco No. 1

2B b Al

240 Radiohm

2B b Ni

335 Corrosion Resistant "R-1"

2B c

145 Bethadur 6
150 Braeburn Stainless Steel
158 Engineering
158 Cutlery
170 No-Kor-OH Cutlery
175 Carpenter Stainless No. 2
195 Stainless "A"
200 Stainex No. 1
215 Stainless "A"
220 Uniloy 1435 (Grade A Stainless)
235 Stainless Steel-Type A
255 Esco Stainless No. 33
265 Empire 12b
275 Stainless Type "A"
280 Fernite No. 8-s
285 Q-Alloy Chrome C2b
293 Galahad "C" & "D"
295 Grade A Stainless Steel
315 Industrial No. 35
340 Jessop Sta-Gloss A
355 Lesco Regular Stainless Steel
360 Circle L No. 13
363 Galahad "C" & "D"
375 Midvaloy Brand 13-00 A
470 UHB Stainless 6

2B c Mo

470 UHB No. 6 Ultra

2B c Ni

195 Vasco 430
335 Corrosion Resistant "R-2"
485 Nirosta Calduro KM1

2B c S

355 Lesco E-Z Stainless Steel

2B d

145 Bethadur No. 6
200 Stainex No. 1
215 Stainless Steel A
255 Esco Stainless No. 33
275 Sterling Type "A"
355 Stainless Steel-Regular
360 Corrosion Resisting Circle L No. 13
490 "Ship Brand" Red Label
500 Whelco No. 6
505 Wissco Stainless 2

2B d S

355 Lesco E-Z Stainless Steel

2B g

245 Duraloy H2 (Cast)
265 Empire 25-5
470 UHB Stainless

2B g Mn

300 Hascrome

2B h

125 Stainless Steel
230 Castaloy

2B h Co

230 Martin Steel
230 Cobaltchrome "PRK33"

2B h Co Mo

225 Cobaltchrome "PRK33"

2B h Co Ni

365 Cobaltchrome Steel

2B h Mo

280 Fernite No. 5

2B h Mo Co

280 F.C.C. A.H.

2B h Mo V

355 Lesco G. S. N. Special

2B h Ni

355 Lesco G. S. N.

2C aa

275 Stainless Type "M"
340 Jessop Dura-Gloss C2
450 Tisco 131

2C a

105 Allegheny 66
105 Allegheny 67
110 Stainless Iron
120 USS 17
125 Stainless Iron
135 Enduro AA
135 B&W No. 902
135 B&W No. 912
145 Bethadur No. 4
145 Bethadur No. 5
158 Lowscore
170 No-Kor-O A
175 Carpenter Stainless No. 6
190 Nevastain RA
195 Stainless C2
215 Stainless Iron No. 16

CORROSION AND HEAT-RESISTANT ALLOYS

2C a (Con't)

215 Stainless Iron No. 18
2?0 Uniloy 1809
215 Duraloy -B
265 Empire 18
285 Q-Alloy Chrome C2c
295 Stainless No. 16
295 Stainless No. 18
340 Duro-Gloss C2
340 Duro-Gloss C3
355 Stainless Iron "M"
355 Stainless Iron "H"
363 Silcrome 21
363 Silcrome 7
375 Midvaloy Brand 21-00
375 Midvaloy Brand C-2
375 Midvaloy Brand C-3
420 Enduro AA
425 Special Defirust
430 Sharon Stainless 17
430 Sharon Stainless 21
450 Tisco 131
465 Timken Iron Chromium
470 UHB Stainless 2
505 Wissco Stainless 3

2C a Cu Si

363 Silcrome RA
430 Sharon Stainless 16RA

2C a Ni

195 Vasco 610

2C a Ni S

195 Vasco 610 F

2C a Si

135 Enduro A

2C a S

195 Stainless C2F

2C a Si Cu S

363 Silcrome RA-EZ

2C b

165 Calite S
170 No-Kor-O RA
255 Esco Stainless No. 34
265 Empire 18 a
285 Q-Alloy Chrome C2d
293 Galahad "E"
340 Jessop Duro-Gloss C2-2
370 Misco "16"
405 Otisel 3
415 Poldi AK 2
440 Sivyer 67
445 H. R. No. 9
500 Whelco No. 4

2C b Mn

Chromium-Manganese Stee

2C b Ni

158 Two Score
430 Sharon Stainless 16-6

2C b Si

245 Duraloy B (Cast)
265 Empire 18b
425 21% Cr

2C b Si S

363 Silcrome H-17-EZ

2C c

135 B&W No. 910
205 Sweetaloy 16
255 Esco Stainless No. 34
265 Empire 18c
285 Q-Alloy Chrome C2e
360 Corrosion Resisting Circle L No. 11
380 NA-18

2C c Cu

175 Carpenter Stainless No. 3
185 Stainless No. 7
360 Circle L No. 14
375 Midvaloy 21-00 Cu

2C c Ni

335 Corrosion Resistant "R-4"
355 Lesco Ni Stainless Steel

2C d

255 Esco Stainless No. 34
285 Q Alloy Chrome C2
340 Sta-Gloss

2C d Cu

360 Corrosion Resisting Circle L No. 14

2C d Mo

415 Poldi AK 5

2C d Ni

355 Lesco Ni-Stainless Steel

2C e

200 Stainex No. 2
215 Stainless "B"
220 Uniloy 1860 (Grade B Stainless)
235 Stainless Steel-Type B
275 Stainless Type "B"
295 Grade B Stainless Steel
315 No. 65 Stainless
355 Lesco Hy-Glo Stainless Steel
390 Newco
195 Stainless "B"
500 Whelco No. 7

2C f

145 Bethadur No. 7
200 Stainex No. 2
275 Sterling Type "B"
315 Industrial No. 65
340 Jessop Sta-Gloss B
355 Lesco Radianite Stainless Steel
355 Stainless Steel Hy-Glo

2C g

145 Bethadur 8
175 Stainless Steel—2B
195 Vasco 795
275 Stainless Type "BHH"
280 Fernite 8-M
285 Q-Alloy Chrome C3a
295 Grade B-100 High Carbon Stainless Steel
315 Industrial No. 100
355 Stainless Steel Lusterite
363 Silcrome M-17

2C g Co Mo

415 Poldi AK H

2C g Mo Va

215 Stainless HC

2C g Si

363 Silcrome H-17

2C g S

195 Vasco 795 F

2C h

125 Stainless Steel
145 Bethadur No. 8
280 Fernite No. 8-H
500 Whelco No. 8

2C h Co Mo

225 Cobaltchrom (Stainless)

2C h Mo V

295 Stainless Steel HC

2D a

120 USS 27
125 Stainless Iron
340 Duro-Gloss C-4
363 Silcrome 28
375 Midvaloy Brand C-4
450 Tisco 130

2D b

105 Allegheny 55
255 Esco Stainless No. 35
265 Empire 30a
355 Stainless Iron "HH"
370 Misco "28"
375 Midvaloy Brand H. C.
420 Enduro HC
445 H. R. No. 8
470 UHB Stainless 5

2D b Ni

115 Amsco F-3

CORROSION AND HEAT-RESISTANT ALLOYS

2D b Si

495 Wehr Alloy No. 5

2D c

135 B&W No. 950
145 Bethadur No. 9
170 No-Kor-O HR
215 Stainless Iron No. 24
220 Uniloy 2825
245 Duraloy-A
255 Esco Stainless No. 35
260 Thermalloy "C"
265 Empire 30
280 Fernite No. 7
285 Q-Alloy Chrome Cla
295 Stainless No. 24
360 Circle L No. 15
400 Fahrite N-6
405 Otisel 5
425 Defiheat
430 Sharon Stainless 27
500 Whelco No. 9
505 Wissco Stainless 5-C

2D c Ni

260 Thermalloy D
375 Midvaloy 26-02

2D d

205 Sweetaloy 19
245 Duraloy A (Cast)
255 Esco Stainless No. 35
260 Thermalloy C
265 Empire 30
285 Q-Alloy Chrome C1
293 Era H. R. 4
360 Corrosion Resisting Circle L No. 15

2D d Ni

115 Fahralloy F-2
115 Fahralloy F-3
115 Fahralloy F-3-H
260 Thermalloy "D"

2D e

240 Cimet A
260 Thermalloy C
380 NA-19

2D e Ni

260 Thermalloy D

2D f

240 Cimet A
260 Thermalloy C

2D f Ni

260 Thermalloy D
510 Fahralloy F-3

2D f Ni Mn

115 Amsco F-3HH

2D g

260 Thermalloy C
265 Empire 25-5
285 Q-Alloy Chrome C3

2D g Ni

375 Midvaloy 26-02-Z

2D h

125 Stainless Steel
245 Duraloy H (Cast)

2D h Ni

360 Corrosion Resisting Circle L No. 16
450 Tisco 150

2E a

125 Stainless Iron

2E h

125 Stainless Steel

2E h Ni

450 Tisco 150

2F a

125 Stainless Iron

2F h

125 Stainless Steel

2G a

125 Stainless Iron

2G h

125 Stainless Steel

2H a

125 Stainless Iron

2H h

125 Stainless Steel

2A 9 A d

220 Cyclops K Steel

2B 7B b

505 Wissco Stainless

2C 1A b

240 Ohmax

2C 7AA h

310 Hybnickel "B"

2C 7A aa

105 Allegheny Metal
120 USS 18-8
135 B&W No. 602
135 Nirosta KA-2 S
145 Bethadur 2
170 No-Kor-O KA-2 S
175 Carpenter Stainless No. 4
185 KA-2 S
195 Stainless "N"
205 Sweetaloy No. 17
215 Rezistal KA-2 S
220 Uniloy Special 18-8 S
235 KA-2 S Nirosta
240 DH KA-2
245 Duraloy 18-8 (rolled)
250 Durco Nirosta KA-2 S
275 Nirosta KA-2 S
285 Q-Alloy Chrome KA-2 S
295 Rezistal KA-2 S
315 Industrial No. 188-U
320 Ing-O-clad
330 KA-2 S
340 Jessop Hi-Gloss
355 Stainless Iron 18-8 S
360 Corrosion Resisting Circle L No. 22
363 Silcrome KA-2 S
375 Midvaloy 18-08
395 Nirosta KA-2 S
420 Enduro 18-8S
425 Defistain
430 Sharon Stainless 18-8 S
450 Tisco 102
465 Timken 18-8-S
480 KA-2 S
495 Wehr Stainless (Special) 18-8
505 Wissco Stainless 4S

2C 7A aa Mo

135 B&W No. 642
215 Rezistal KA-2 S Mo
250 Durco-Nirosta KA-2 MS
295 Rezistal KA-2 S Mo
420 Enduro 18-8 Mo
450 Tisco 105

2C 7A aa Mo Se

450 Tisco 105A

2C 7A aa Mo Ti

295 Rezistal KA-2 S Mo T

2C 7A aa Se

450 Tisco 102A

2C 7A aa Ti

120 USS 18-8 Stabilized
215 Rezistal KA-2 ST
295 Rezistal Safweld KA-2ST
420 Enduro 18-8

2C 7A a

105 Allegheny Metal
105 Allegheny 22
120 USS 18-8
145 Bethadur 2
158 Anko
170 No-Kor-O KA-2
175 Carpenter Stainless No. 4
195 Vasco Stainless N

CORROSION AND HEAT-RESISTANT ALLOYS

2C 7A a (Con't)

220 Uniloy 18-8 S
240 DH-KA-2
265 Empire 18-8
285 Q-Alloy Chrome KA-2 S
293 Era
315 Industrial No. 188
320 Ing-O-Clad (Clad Material)
330 KA-2
340 Jessop Hi-Gloss
375 Midvaloy 18-08
390 Newco
405 Otisel 1
425 Defistain
440 Sivyer 60
470 UHB Stainless 3
490 "Ship Brand" Orange Label
505 Wissco Stainless 4
120 USS 18-8

2C 7A a Mo

170 No-Kor-O KA-4
265 Empire 18-8 Mo
375 Midvaloy KA-2 Mo (Cast only)
435 Shawinigan Nirosta KA-2 Mo
470 UHB Stainless 4

2C 7A a Se

175 Carpenter Stainless No.8
505 Wissco Stainless 4M

2C 7A a Si

170 No-Kor-O KA-2 HS

2C 7A a Ti

120 USS 18-8 Stabilized

2C 7A b

105 Allegheny Metal
105 Allegheny 22
110 Stainless Steel
120 USS 18-8
135 B&W No. 600
135 B&W No. 610
135 Nirosta KA-2
135 Nirosta KA-2 B
145 Bethadur No. 2
158 Anka H
165 Calite E
165 Calite-Nirosta KA-2
170 No-Kor-O KA-2
185 KA-2
195 Vasco Stainless U
205 Sweetaloy 17 (KA-2)
210 Rezistal KA-2 H A. R. Stainless
215 Rezistal KA-2
215 Rezistal KA-2 F M
220 Uniloy Special 18-8
235 KA-2 Nirosta
240 DH KA-2
245 Duraloy 18-8
250 Durco Nirosta KA-2
255 Esco Stainless No. 40
260 Thermalloy 18-8
265 Empire 18-8
275 Nirosta KA-2
285 Q-Alloy Chrome KA-2
293 Era Cr. 1 & Cris.
295 Rezistal KA-2
295 Rezistal KA-2 F M
335 Corrosion Resistant "R-3"
340 Hi-Gloss
340 Heat Resisting No. 5
355 Stainless Iron 18-8
360 Corrosion Resisting Circle L No. 23
360 Circle L No. 25
363 Silcrome KA-2
365 Nirosta 18-8
370 Misco "18-8" (Cast)
375 Midvaloy 18-08
375 Midvaloy 25-10
400 Fahrite Grade N-2
420 Enduro 18-8 F M
425 Defistain
430 Sharon Stainless 18-8
438 Shawinigan Nirosta
445 H. R. No. 7
450 Tisco 101
450 Tisco 103
450 Tisco 110
455 Nirosta 18-8
465 Timken 18-8
120 USS 18-8
495 Wehr Alloy No. 9
495 Wehr Stainless 18-8
500 Whelco "B"
510 Fahralloy F-8

2C 7A b Mo

135 B&W No. 640
145 Bethalon B (Free Machining 18-8)
158 BB-4K
165 Calite-Nirosta KA-4
185 KA-2-Mo
195 Vasco Stainless N
205 Sweetaloy KA-4
215 Rezistal KA-2 Mo
250 Durco Nirosta-KA-2 M
255 Esco Stainless No. 45
265 Empire 18-8 Mo
285 Q-Alloy Chrome KA-2 Mo
293 Era C.R. 48
295 Rezistal KA-2 Mo
365 Nirosta 19-9-4
365 Enduro KA-2 Mo
375 Midvaloy KA-2 Mo
435 Shawinigan Nirosta KA-2 Mo
450 Tisco 104
450 Tisco 106
450 Tisco 110

2C 7A b Mo Cu

195 Stainless "U"

2C 7A b Mo Se

450 Tisco 104A
450 Tisco 106A

2C 7A b Mo Si

295 Rezistal 2C

2C 7A b Mo Ti

295 Rezistal KA-2 Mo T

2C 7A b Se

450 Tisco 101A
450 Tisco 103A

2C 7A b Si

215 Rezistal 2-C
215 Rezistal No. 3
265 Empire 18-8 Si
420 Enduro 18-8 B

2C 7A b S

363 Silcrome KA-2 EZ

2C 7A b Ti

295 Rezistal Safweld KA-2 T

2C 7A b W Si

215 Rezistal 2-CT
295 Rezistal 2-CW

2C 7A c

165 Calite Nirosta KA-2
210 Paralloy No. 5
260 Thermalloy 18-8
280 Fernite No. 6
285 Q-Alloy Chrome KA-2 H
293 Era C. R. 18
375 Midvaloy Brand B-Metal
380 NA-4
450 Tisco 110
485 Nirosta Calmar KA-2
495 Wehr Alloy No. 8
495 Wehr Stainless 18-8
500 Whelco No. 2

2C 7A c Mo

165 Calite Nirosta KA-4
285 Q-Alloy Chrome KA-4
380 NA-4-M
450 Tisco 110

CORROSION AND HEAT-RESISTANT ALLOYS

2C 7A c W

265 Empire 24-12 W
285 Q Alloy CN2-A
293 Era H. R. 1
375 Midvaloy Brand H. R.—1

2C 7A d

135 B&W No. 661

2C 7A e

135 B&W 661

2C 7A e Si

495 Wehr Alloy No. 7

2C 7A f Al

165 Calite "B"

2C 7A h Si

293 Era H. R. 2

2C 7B a Mo

135 Nirosta KA-2 Mo

2C 7B b

135 B&W 650
220 Uniloy Special 21-12
245 Duraloy N (rolled)
265 Empire 24-12
285 Q-Alloy CN1
355 Stainless Iron 21-12
360 Circle L No. 30
405 Otisel No. 4
420 Enduro-HCN

2C 7B b Mo

135 Nirosta KA-2 Mo

2C 7B c

445 Standardalloy HR-11

2C 7C c Si

445 H. R. No. 1

2C 7B d

280 Fernite 5

2C 7C b Cu

350 Elcomet K

2D 7A b

135 B&W 650
220 Uniloy Special 24-11
363 Silcrome 25-12
375 Midvaloy 25-10

2D 7A b Si

295 Rezistal No. 3
370 Misco "C" (rolled)

2D 7A c

135 B&W No. 1500
210 Paralloy No. 6
265 Empire 24-12 b
285 Q-alloy Chrome CN1a
380 NA-1
450 Tisco 107

2D 7A c Si

370 Misco C (cast)
445 Standardalloy HR-10

2D 7A d

165 Calite "B-28"
205 Sweetaloy 22
265 Empire D
365 Nonsulite
400 Fahrite grade N-3

2D 7A e

240 Cimet B

2D 7A f

240 Cimet B

2D 7A f Si

375 Midvaloy 25-10-B

2D 7A g

135 B&W No. 800

2D 7A h

135 B&W No. 800

2D 7B

365 No. 63

2D 7B aa

250 Durco Nirosta 26-10
495 Wehr Stainless 24-12

2D 7B a

495 Wehr Stainless 24-12

2D 7B b

105 Allegheny 44
120 USS 25-12
135 B&W No. 650
265 Empire D
285 Q-Alloy Chrome CN1b
340 Jessop Heat Resisting No. 5
405 Otisel 4
440 Sivyer 62
495 Wehr Stainless 24-12

2D 7B b Mn

115 Amsco F-10

2D 7B c

360 Corrosion Resisting Circle L No. 31

2D 7B c Mo Si

445 Standard alloy HR-6M

2D 7B c Si

445 H.R. No. 6

2D 7B d

245 Duraloy-N (cast)
365 No. 100 Alloy
510 Fahralloy F-10

2D 7B d W

245 Duraloy X (Cast)

2D 7B g

135 B&W No. 800

2D 7B h

135 B&W No. 800

2D 7C a

135 Nirosta KNC 3

2D 7C b

105 Allegheny 44
135 B&W No. 1102
135 Nirosta KNC 3
205 Sweetaloy KNC 3
255 Esco Nirosta KNC 3
375 Midvaloy Brand 25-20
450 Tisco 108

2D 7C b Si

185 KNC 3
215 Rezistal No. 7 (NCT 3)
285 Q-Alloy Chrome KNC 3
293 Era H.R. 3
295 Rezistal No. 7 (NCT 3)
355 Stainless Iron 25-20
363 Silcrome 25-20
365 Nirosta 25-20
375 Midvaloy 25-20
420 Enduro-NC 3

2D 7C c

135 B&W No. 1100
485 Nirosta Caloxo KNC 3

2D 7C c Mo

445 Standardalloy HR-5M

2D 7C c Si

445 H.R. No. 5

2D 7C d

135 B&W No. 1101
280 Fernite No. 4

2D 7D e

375 Midvaloy 30-30

2E

365 Contraloy

2E 7B c

435 Shawinigan Nirosta Heat Resisting

3G 2D 9C h

300 Haynes Stellite No. 1

3H 2E h W

300 Haynes Stellite No. 6

3H 2E 9A h

300 Haynes Stellite No. 12

CORROSION AND HEAT-RESISTANT ALLOYS

4G 7F
110 Constantan

6G c Cr
205 Sweetaloy No. 14

7B h Cu Cr
345 Ni-Resist
480 Ni-Resist Cast Iron

7C h Cr Mn Si
325 Ni-Resist

7D b Cr
110 Acme
385 Chromic D

7D h Cr Mn Si
325 Ni-Resist

7F b
375 Midvaloy Brand A. M. F.

7B 2A d Si
180 Pyrasteel No. 14

7B 4A h Mn Si
325 Ni-Resist Cast Iron

7C 2A b
135 B&W No. 1200
220 Cyclops No. 17-B Metal
360 Corrosion Resisting Circle L No. 24
480 8-18

7C 2A b Si
295 Rezistal NCR 238

7C 2A b Si Cu
215 Rezistal 2600 S

7C 2A c
205 Sweetaloy 18
260 Cyclops 17-B

7C 2A c Si Cu
215 Rezistal 2600
250 Durimet-K
375 Midvaloy Brand Hy-K

7D 2A c W
375 Midvaloy ATV-4

7C 2A d
145 Bethadur No. 3
220 Cyclops No. 17-A Metal
315 CES 2 Stainless
340 Heat Resisting No. 4
400 Fahrite N-4
500 Whelco No. 3

7C 2A d Si Cu
215 Rezistal 2600 H

7C 2A e
280 Cyclops No. 17-A

7C 2B e W
375 Midvaloy Brand Aerovalve

7C 2C aa Si Mo Cu
250 Durimet-L Cast Grade

7D 2A
285 Economet

7D 2A c
310 Hybnickel "D"

7D 2B
240 Nichrome S

7D 2B c Si
180 Pyrasteel No. 18

7D 2B d W Mn Si
293 Era A.T.V.
375 Midvaloy Brand A.T.V.3

7D 2C aa Si
450 Tisco 109

7D 2C a Si
450 Tisco 109

7D 2C b Si
215 Rezistal No. 4
255 Esco Stainless No. 49
295 Rezistal No. 4
450 Tisco 109
505 Wissco Stainless 5 CN

7D 2C c
310 Hybnickel "A"

7D 2C c Si
445 H. R. No. 2
495 Wehr Alloy No. 1
495 Wehr Alloy No. 2

7D 2C d
165 Calite F
280 Fernite No. 3

7D 2C d Si
495 Wehr Alloy No. 1
495 Wehr Alloy No. 2

7D 2D a
310 Hybnickel "S"

7E 2A
285 Economet

7E 2A a
310 Hybnickel "R"

7E 2A b
310 Hybnickel "R'

7E 2A c Mn
293 Hecla A.T.V.
375 Midvaloy Brand A.T.V. -1

7E 2B
240 525 Alloy

7E 2B c
240 Chromax

7E 2B d
135 B&W No. 1300
245 Duraloy 1535 (Cast)
360 Corrosion Resisting Circle L No. 32

7E 2B e
360 Circle L No. 32

7E 2C b
115 Amsco F-1
285 Q-Alloy Chrome X-ite

7E 2C b Si
370 Misco

7E 2C c
210 Paralloy 7
375 Midvaloy Brand A Metal
380 NA-2

7E 2C c Si
180 Pyrasteel No. 20
445 H.R. No. 3

7E 2C d
135 B&W 1300
165 Calite "A"
205 Sweetaloy 20
265 Empire 35-15
280 Fernite No. 2
360 Circle L No. 32
365 Zorite
400 Fahrite Grade N-1
510 Fahralloy F-1

7E 2C d Mn Si
305 Chromel No. 502

7E 2C d Si
375 Midvaloy 17-35
495 Wehr Alloy No. 3

7E 2C e
360 Circle L No. 32
440 Sivyer 70

7E 2C f Si
370 Standard Misco (cast)
445 Standardalloy AR-1

7E 2D c Mo
413 Pioneer

7E 2D g
310 Hybnickel "C"

7F 2A a
310 Hybnickel "R"

CORROSION AND HEAT-RESISTANT ALLOYS

7F 2A b
310 Hybnickel "R"

7F 2C d Si Mn
260 Thermalloy "B"

7F 2C e Si Mn
260 Thermalloy B

7F 2C f Si Mn
260 Thermalloy B

7G 2C f
370 Misco HN (Cast)

7G 2C h Si Mn Al
225 Pireks Reactal Special

7G 2D c Si Mn
225 Pireks R-C-C

7G 2D f Si Mn
225 Pireks C-C

7G 6C 2C d W
300 Hastelloy C

7H 2A c W Mn
375 Midvaloy Brand B.T.G.

7H 2B
240 Nichrome

7H 2B a Mn
305 Chromel C

7H 2B b Mn
110 Premier
240 Nichrome Wire

7H 2B c
290 Tophet C

7H 2 B d
205 Sweetaloy 21
293 Era H.R. 5

7H 2B f
240 Nichrome Castings
385 Chromic C
400 Fahrite N-5

7H 2C b
265 Empire 60-20 a
370 Misco "HN"

7H 2C c
380 NA-65
210 Paralloy 8

7H 2C d
135 B&W No. 700
265 Empire 60-20
280 Fernite No. 1
375 Midvaloy 20-60

7H 2C d Cu Mo W
350 G-60

7H 2C d Si
293 Era H.R. 5 (Castings)
365 Fire Armor
445 H. R. No. 4

7H 2C d Si Mn
260 Thermalloy "A"

7H 2C e
135 B&W No. 700
495 Wehr Alloy No. 4
510 Fahralloy F-5

7H 2C e Si Mn
115 Amsco F-5
225 Pireks-Reactal
260 Thermalloy A

7H 2C f Si Mn
260 Thermalloy A

7H 2C g
135 B&W No. 701

7H 2C h
135 B&W 701

7H 2C 4A d Mo W Mn
160 Illium

7H 6C b Mn
300 Hastelloy A

7J 2C
285 Q-Alloy Chrome A

7J 2C c
380 NA-65

7J 2C d
135 B&W No. 700
165 Calite "N"
385 Chromic A

7J 2C e
135 B&W No. 700

7J 4D
110 Monel Metal
290 Monel
325 Monel Metal

7K 2C
110 Superior

7K 2C a Mn
305 Chromel A

7K 2C b Mn
240 Nichrome IV Wire
290 Tophet A

7L Mn
325 D Nickel

7L 8A aa Cu Al
300 Hastelloy D

8B g
250 Duriron

8B h
140 Tantiron
410 Corrosiron

9C d Cr
135 B&W 1400

10 L
270 Tantalum (99.5%)

The elements iron, chromium, nickel, cobalt, molybdenum, tungsten, silicon, and tantalum, have yielded numerous alloys possessing useful properties where resistance to corrosion is required. For the most part chromium and nickel predominate as the alloying elements with iron. The chromium iron alloys admirably resist most conditions of corrosion and oxidation. Increasing the chromium content gives increased resistance to oxidation both at room and elevated temperatures, provided the carbon content is constant. If the carbon content is increased within certain ranges a corresponding increase in chromium also is necessary to obtain the best corrosion resistance. The ratio of chromium to carbon should be 15% plus 16 times the carbon content, if the alloy is to be resistant in the annealed condition.

Although the chrome alloys may be welded electrically or by the oxy-acetylene torch, the welds are more or less brittle due to grain growth resulting from welding heat. In order to prevent oxidation, the flame should be neutral or slightly reducing.

Coated rods are generally recommended for electric welding and uncoated rods for gas welding.

Where both resistance to corrosion and erosion are desired, the high chromium alloys are very valuable, but in no case will any chromium alloy withstand the action of hydrochloric acid.

The commercially important stainless alloys may be divided into eight principal groups as follows:—

CHROMIUM IRON ALLOYS

GROUP I 2AA CHROMIUM 5—7%

This group of alloys is easily forged and made into sheets, wire, seamless tubes, etc. It finds application in the oil industry, where more corrosion resistance is desired than can be obtained by the use of the straight carbon steels. An addition of five to seven percent chromium gives this steel a life of approximately three times that of the carbon steels and, therefore, finds application where corrosive conditions warrant additional cost per pound.

GROUP II 2B CHROMIUM 12—16%

This group may be divided into three sub-groups, depending upon the carbon content:—

1. **Rustless or Stainless Iron—Carbon 0.10% maximum.**

This class is fabricated in the form of castings, forgings, hot rolled bars, cold rolled or drawn bars, plates and sheets, strips, tubes, and wire, and is used where corrosive conditions are not severe. The low carbon 14% chromium alloys will resist concentrated nitric acid, but higher percentages of chromium are necessary for resistance to dilute nitric acid.

2. **Cutlery Stainless—Carbon 0.3%**

Increasing the carbon content from 0.1 to 0.3% gives an alloy that was originally used for cutlery. The higher carbon reduces the corrosion resistant properties.

3. **Dies — Carbon 1—2%.**

Increasing the carbon to 2% produces a steel with abrasion resistance, but at the same time the higher carbon content lowers the corrosion resistance.

GROUP III 2C CHROMIUM 16—20%

1. **High Chromium Stainless-Iron—Workable Alloys—Carbon 0.12%**

This group is fabricated in the form of castings, forgings, hot rolled bars, sheets, strips, tubes, and plates. It shows heat resistance up to 1600°F. and requires no heat treatment to bring out its stainless properties. It is suitable for forming and drawing, provided the operation is not too drastic, and finds its principal application in the synthetic ammonia process. The alloy shows excellent resistance both to concentrated and dilute nitric acid.

2. **High Carbon Stainless Steel—Carbon 0.6%.**

A typical composition of these alloys is chromium 16.5%, and carbon 0.65%. This type of alloy possesses a more intense hardness and not only has a better cutting edge than the lower chromium alloy, but also a more pleasing appearance.

GROUP IV 2D CHROMIUM 25—30%

1. **Carbon Less Than 0.3%—Workable Alloys.**

The workable alloys do not usually contain more than 0.3% carbon. The increased chromium content produces an alloy which is extremely resistant to nitric acid and oxidation at elevated temperatures. These alloys are not very ductile when cold and should be heated to a cherry red before deformation.

2. **Stainless Castings — Medium Carbon.**

The 24 to 30% chromium alloys are very resistant to sulfur and sulfur gases and are generally recommended for use in oxidizing atmospheres up to 2100°F. An enamel-like coating of oxide forms at approximately 1700°F., to protect the metal from further attack. These castings are used in the form of pumps for handling mine water; they also show excellent resistance to nitric acid.

3. **Abrasion Resistant Alloys—Carbon 1—3% High Carbon.**

Where greater resistance to erosion is desired, higher carbon contents are used.

CHROMIUM-NICKEL ALLOYS

GROUP V 2C 7A 18% CHROMIUM—8% NICKEL

There are various modifications within this group. Small percentages of silicon, molybdenum, tungsten, copper, and aluminum are often added to give either strength at elevated temperatures or increased corrosion resistance against certain chemicals. These alloys are fabricated in the form of castings, forgings, hot rolled bars, cold rolled or drawn bars, plates and sheets, strips, tubes, and wires. Appearance and ease of fabrication are dominating considerations; this alloy combines beauty of appearance and permanence in service. This alloy shows carbide precipitation when held at 800 to 1450°F. One of the large manufacturers of stainless alloys uses titanium to stabilize the alloy in order to reduce the probability of inter-granular corrosion.

It finds wide application in the chemical industry as material for autoclaves, condensers, stills, digesters, pipe lines, fittings, bolts and nuts, heat exchangers and evaporators; it is used in nitric acid plant equipment as pipe lines, vats, cocks, valves, towers, tank cars, and drums; it is also employed in furnace parts such as skid bars, conveyors, sills, and doors; refrigerating machinery and equipment, and soap manufacturing equipment often employ this alloy.

Although this alloy is considered "stainless," it is not recommended for use with chlorine, bromine, iodine, or halogen acids. It is recommended, however, as being fully resistant to the following at their respective boiling points:—10% acetic acid, acetic anhydride, acetone, 20% sodium hydroxide, 10% aluminum sulfate, ammonia water, 10% ammonium chloride, ammonium nitrate, boric acid, carbolic acid, carbonate of soda, 15% citric acid, copper sulfate, dilute and concentrated nitric acid, potassium chlorate, sodium sulfide, sweet water, and zinc sulfate.

GROUP VI 2D 7B 25% CHROMIUM—12% NICKEL

Metallurgically, this group is similar to the 18 chromium, 8 nickel alloy, and their fabricating characteristics are quite similar. This alloy, however, is tougher than the 18-8. The main application for this group is for heat resistance between 1500 and 2100°F. The higher percentages of chromium and nickel produce an alloy with exceptional oxidation resistant properties; because this alloy is more expensive than the others of the stainless series, it finds only a limited application.

HEAT RESISTANT ALLOYS
NICKEL-CHROMIUM

GROUP VII 7E 2C Approx. 38% NICKEL—18% CHROMIUM

This group containing approximately 38% nickel, 18% chromium, and 0.5% carbon is fabricated in the form of castings, plates, shapes and wire, and is intended for high temperature service as furnace parts, chains, rails, retorts, carburizing boxes, annealing containers, and general parts for service at elevated temperatures.

GROUP VIII 7H 2C Approx. 67% NICKEL—20% CHROMIUM—1.5% SILICON—1% MANGANESE—1.5% CARBON

When resistance to higher temperatures is desired, an alloy containing more nickel is recommended. Alloys such as are represented in this group are widely used for carburizing containers and parts at operating temperatures up to 2200° F. These high nickel-chromium alloys have proven their merit under widely varying conditions of many plants. Some classes of these alloys with low carbon content are drawn into wire and used for electrical purposes. The introduction of these low carbon alloy wires made possible the development of present day electrical heating equipment. A large amount of the wire used has an analysis of approximately 60% nickel, 15% chromium, 0.12% carbon, and the balance iron. When greater resistance to corrosion is demanded and the additional expense warrants its use, an alloy containing 80% nickel and 20% chromium is used. In the best grades of electrical heating elements there is only a small percentage of iron present.

In conclusion, materials which are highly resistant to one agent such as nitric acid, may prove entirely incapable of resisting another one such as hydrochloric acid. Chromium imparts resistance to nitric acid. Molybdenum imparts resistance to hydrochloric or sulfuric acid. High silicon alloys (14% silicon), are fairly resistant to sulfuric, nitric, or hydrochloric acid. The metal tantalum is very resistant to hydrochloric, nitric, or sulfuric acid.

Nickel-molybdenum-iron alloys containing approximately 60% nickel and 20% molybdenum are very resistant to hydrochloric and sulfuric acids. An alloy has been developed which is very resistant to nitric, hydrochloric, or sulfuric acid, and to wet chlorine. This alloy contains nickel, chromium, molybdenum, tungsten, and iron; the chromium imparts resistance to nitric acid, the nickel and molybdenum impart resistance to hydrochloric and sulfuric acids.

When considering the use of corrosion resistant alloys in any new commercial application, the prospective user should not place too much faith in the published data. Wherever possible, test pieces should be subjected to the corrosive conditions of actual operation and these "indicators" studied critically. The selection of the proper metal for a specific application should be made under the direction of metallurgists or engineers, who are familiar with the latest developments in these alloys.

ETCHING SOLUTIONS FOR FERROUS ALLOYS

Used to Show	Composition of etching solution	Remarks
For Macroscopic Examination		
Segregations	1 part conc. hydrochloric acid, HCl 1 part water	Use at 100 to 212° F. Etch for ½ hour or until defects are brought out.
Segregations	5 g picric acid, $HOC_6H_2(NO_2)_3$ 100 cc ethyl alcohol, C_2H_5OH	Etch for 4 to 5 hours.
Phosphorus segregations	10 g cuprous ammonium chloride, $CuCl{\cdot}NH_4Cl{\cdot}6H_2O$ 100 cc water	This solution is more easily prepared than are most copper chloride solutions.
Phosphorus segregations	10 g cupric chloride, $CuCl_2$ 40 g magnesium chloride, $MgCl_2$ 20 cc hydrochloric acid, HCl 180 cc water 1000 cc absolute alcohol, C_2H_5OH	Absolute methyl alcohol, CH_3OH, may be used in place of ethyl alcohol.
Variations in crystal structure, and segregations	20 g ammonium persulfate, $(NH_4)_2S_2O_8$ 100 cc distilled water	Use at room temperature. A very good reagent for the purpose indicated.
To reveal the structure of welds and to distinguish between steel and wrought iron	1 part conc. nitric acid, HNO_3 3 parts of water	Use at about 100° F.
For Microscopic Examination		
The general structure of normal iron and steel	4 g picric acid and 95 cc of absolute alcohol, or 5 g picric acid and 100 cc of 95% alcohol, C_2H_5OH	Keep bottle well stoppered when absolute alcohol is used.
The general structure of normal iron and steel	5 cc nitric acid, HNO_3 100 cc of ethyl alcohol, C_2H_5OH	For heat treated steels use a more dilute solution.
To establish the difference between hardened and normal steels	4 parts nitric acid, HNO_3 96 parts iso-amyl alcohol, $C_5H_{11}OH$	
Sorbitic and troostitic constituents	1 part of a 40% solution of nitric acid in acetic anhydride 1 part methyl alcohol, CH_3OH 1 part ethyl alcohol, C_2H_5OH 1 part iso-amyl alcohol, $C_5H_{11}OH$	Colors troostite and troosto-sorbite.

ETCHING SOLUTIONS FOR FERROUS ALLOYS

Used to show	Composition of etching solution	Remarks
Cementite and other carbides, and tungstites	2 g picric acid, $HOC_6H_2(NO_2)_3$ 24.5 g sodium hydroxide, NaOH 73.5 cc water	Use boiling for 5 or 10 minutes. Tungsten carbide is unaffected, but other carbides and tungstides are colored.
Structure of stainless steels	10 g ferric chloride, $FeCl_3$ 30 cc hydrochloric acid water to make total volume 120 cc	May be diluted, and applied gently with a piece of cotton. Time required is less than 30 seconds.
Structure of stainless steels	30 cc hydrochloric acid, HCl 10 cc nitric acid, HNO_3 80 cc glycerol (glycerine)	Use full strength for rapid work, but handle carefully.
Carbides and tungstides in high-speed and tungsten steels	10 g potassium ferricyanide, $K_3Fe(CN)_6$ 10 g potassium hydroxide, KOH 100 cc water	Use hot.
Structure of high-speed steel and tungsten carbide	10 cc commercial hydrogen peroxide, H_2O_2 20 cc of a 10% aqueous sodium hydroxide (NaOH) solution	Use fresh from 10 to 12 minutes. Tungsten carbide is darkened.
Structure of stellite, high-chrome steels, etc.	Use a low electric current through a solution of 0.5 g sodium hydroxide (NaOH) in 100 cc of water.	Use two 4 c.p. lamps in series on a 110-volt D. C. circuit. Cover the specimen with the solution; make contact with one wire at the side and dip the other with the solution moving so as to obtain a uniform etch.

ETCHING SOLUTIONS FOR NON-FERROUS ALLOYS

Metal or Alloy	Composition of etching solution	Remarks
Copper Base Alloys		
Copper or Cu-Al alloys	5 g copper-ammonium chloride 120 cc water Add conc. ammonium hydroxide until the precipitate which forms is redissolved, giving a clear blue color.	Etch from 30 to 60 seconds; this is a very good copper etch.
Copper, brasses, Cu-Al alloys, German silver	A 10% solution of ammonium persulfate, $(NH_4)_2S_2O_8$	Etch from 1 to 2 minutes. Keep the surface of the specimen free from grease.
Copper or brasses	10 cc hydrogen peroxide, H_2O_2 40 cc conc. ammonium hydroxide, NH_4OH	Apply with a swab to the surface of polished specimen. Rub briskly until mirror-like surface is obtained.

ETCHING SOLUTIONS FOR NON-FERROUS ALLOYS

Metal or Alloy	Composition of etching solution	Remarks
Copper Base Alloys		
Brasses (Used for copper products such as sheets, rods, etc.), Cu-Al alloys, German silver	15 cc of a saturated ferric chloride ($FeCl_3$) solution 30 cc concentrated hydrochloric acid, HCl 200 cc water	Use this solution after the ammoniacal peroxide solution above. Dip the specimen into this ferric chloride solution for a few seconds after following the directions above.
Cu-Al alloys	Nitric acid (HNO_3), sp. gr. 1.42	Time for etching is very short. It is difficult to control the intensity of the attack.
Aluminum and Light Alloys		
Al and Al alloys	0.5 to 20% hydrofluoric acid (HF) acid solutions. The aqueous or alcoholic solutions are used.	Etch for about 15 seconds. Remove the black deposit so formed by immersing for a short time in conc. nitric (HNO_3) acid. $CuAl_2$ and $FeAl_3$ are darkened by HF.
Aluminum	45 cc conc. hydrochloric acid, HCl 15 cc conc. nitric acid, HNO_3 15 cc hydrofluoric acid, HF 25 cc hot water	This etch generally requires only a few seconds.
Al alloys	10 cc conc. nitric acid, HNO_3 3 to 4 cc hydrofluoric acid, HF 86 to 87 cc hot water	
Al and Al alloys	10 to 20% aqueous sulfuric acid (H_2SO_4) solution	Heat to 160°F., immerse specimen for a few seconds, quench in cold water. $FeAl_3$ is stained black.
Al and Al alloys	10 cc conc. hydrofluoric acid, HF 15 cc conc. hydrochloric acid, HCl 90 cc water	Etch from 30 to 90 seconds. Reveals grain size very clearly.
Lead, Tin, Zinc and Their Alloys		
Used for zinc	6% chromic acid, 94% nitric acid	Add a few drops of this solution to 100 cc of water before using.
Tin alloys	2% alcoholic nitric acid solution	
Lead alloys	5% aqueous nitric acid solution	

ETCHING SOLUTIONS FOR NON-FERROUS ALLOYS

Metal or Alloy	Composition of etching solution	Remarks
Lead, Tin, Zinc and Their Alloys		
All "white metals"	Hydrochloric acid, either dilute or concentrated, depending upon the composition of the alloy. A 5% solution is best for an alloy rich in zinc.	When a concentrated solution is used, dip the specimen in the acid for a few seconds, wash carefully, and dry.
Alloys rich in zinc or cadmium	1 part iodine 3 parts potassium iodide, KI 10 parts water	
Alloys of lead, tin, antimony, bismuth, and anti-friction metals	5% aqueous solution of silver nitrate, $AgNO_3$	
Antimony and lead alloys, and babbit metal	10 g ferric chloride, $FeCl_3$ 30 cc hydrochloric acid, HCl, sp. gr. 1.19 120 cc water	A good etching solution for the metals named.
Miscellaneous Metals and Alloys		
Nickel and its alloys	50 cc of 70% nitric acid, HNO_3 50 cc of 50% acetic acid, $HC_2H_3O_2$	This is *Merica's solution*. It is very good for cast, cold drawn, and annealed nickel.
Nickel and its alloys	20 to 40 cc of nitric acid, HNO_3 30 to 40 cc of 75% acetic acid, $HC_2H_3O_2$ 30 to 40 cc acetone, $(CH_3)_2CO$	This solution is very similar in action to the one above.
Magnesium and its alloys	2% aqueous nitric acid solution	Etch for about 10 seconds.
Gold, silver, platinum, and other noble metals*	1 part nitric acid, HNO_3 5 parts hydrochloric acid, HCl 6 parts water	Use at about 60°F.
Dow metals (90-96% Mg, 4-12% Al, 0.1-0.3% Mn)	2% aqueous oxalic acid solution, $H_2C_2O_4$	Swab during etching. Rinse with water, then with alcohol, and dry with a blast of warm air.

* For Au-Cu and Au-Ag alloys it is better to saturate the etching solution with either sodium chloride or ammonium chloride.

MATERIALS OF

MANUFACTURERS' RECOMMENDATIONS FOR THE CORROSION

Chemical and Metallurgical Engineering, 39, 654-5 (1932); Perry, *The Chem-*

No.	Manufacturers Name and Address
1.	American Hard Rubber Co. Butler, N. J.
2.	Amersil New York, N. Y.
3.	Atlantic Tank Corp. N. Bergen, N. J.
4.	B. F. Goodrich Rubber Co. Akron, Ohio.
5.	Bakelite Corp. Bloomfield, N. J.
6.	Carbide & Carbon Chem. Co. New York, N. Y.
7.	Continental-Diamond Fibre Co. Newark, Del.
8.	Corning Glass Works, Corning, N. Y.
9.	DuPont Viscoloid Co. Arlington, N. J.
10.	E. I. DuPont Co. Wilmington, Del.
11.	General Ceramics Co. New York, N. Y.
12.	General Electric Co. Pittsfield, Mass.
13.	General Electric Co. Schenectady, N. Y.
14.	General Plastics, Inc. N. Tonawanda, N. Y.
15.	Glascote Products, Inc. Euclid, Ohio
16.	Goodyear Tire & Rubber Co. Akron, Ohio
17.	Hanovia Chem. & Mfg. Co. Newark, N. J.

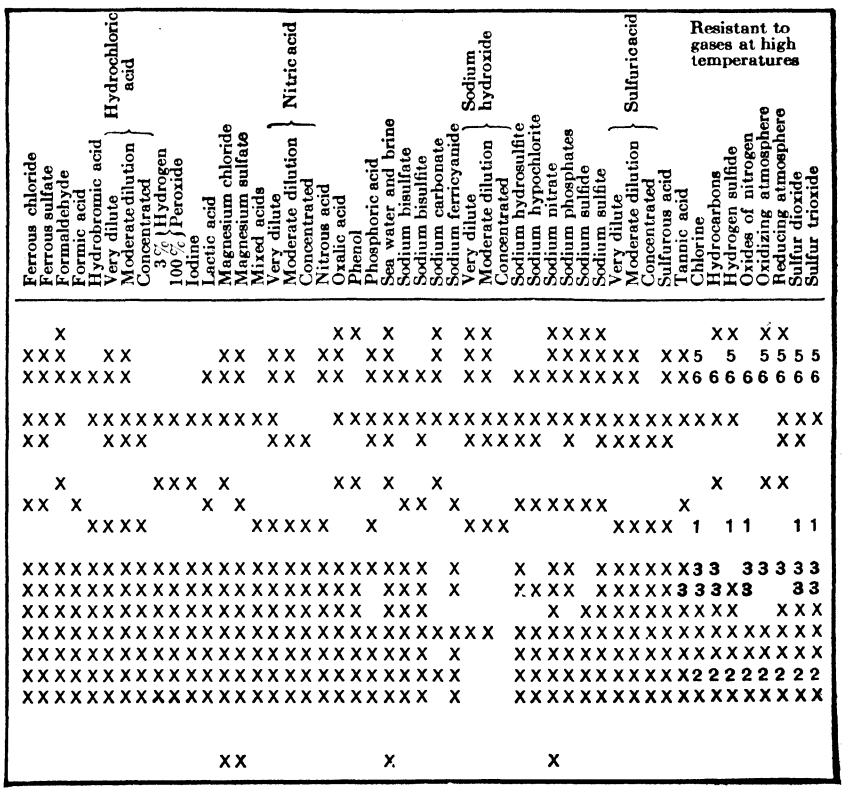
PRODUCT	Manufactured by	Acetic acid: Very dilute	Acetic acid: Moderate dilution	Acetic acid: Concentrated	Acetic anhydride	Acetone	Aluminum chloride	Aluminum sulfate	Ammonia, anhydrous	Ammonium chloride	Ammonium hydroxide	Ammonium nitrate	Ammonium sulfate	Amyl acetate	Amyl chloride	Aniline	Benzaldehyde	Bromine	Butyl acetate	Calcium chloride	Calcium hypochlorite	Carbon disulfide	Carbon tetrachloride	Carbonic acid	Chloroacetic acid	Chlorine water	Chromic acid	Citric acid	Copper sulfate	Ethyl acetate	Fatty acids	Ferric chloride	Ferric sulfate
ASBESTOS-CEMENT																																	
Transite	20					X		X	X		X					X	X					X	X	X									
Transite, ebony impregnated	20	X	X			X		X	X	X	X		X			X	X		X	X				X				X	X			X	X
Transite, W X-41 protected	20	X	X	X	X	X	X	X	X	X	X	X	X							X	X	X	X	X	X	X		X	X		X	X	X
COKE BASE CARBON																																	
Carbon	23	X	X	X		X	X	X		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Carbon	26																			X	X					X						X	X
CONCRETE																																	
Concrete									X	X	X			X		X	X	X	X	X				X		X				X			
Concrete, treated (*a*)	..	X	X	X	X	X	X	X					X								X	X	X		X		X	X	X		X	X	X
Concrete, lined (*b*)	..											X			X																		
ENAMELS, FUSED SILICA & GLASS																																	
Enameled steel	25	X	X	X	X	X	X	X		X		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Enameled steel	15	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Amersil	2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fused silica	17	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fused silica	13	X	X	X	X	X	X		X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Pyrex, chem. resistant	8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Vitreosil	30	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
PLASTICS																																	
CELLULOSE ACETATE PLASTIC																																	
Plastacele	9									X														X							X		

CONSTRUCTION

RESISTANT NON-METALLIC MATERIALS OF CONSTRUCTION

ical Engineers' Handbook (1933), McGraw-Hill Co., publisher; by permission.

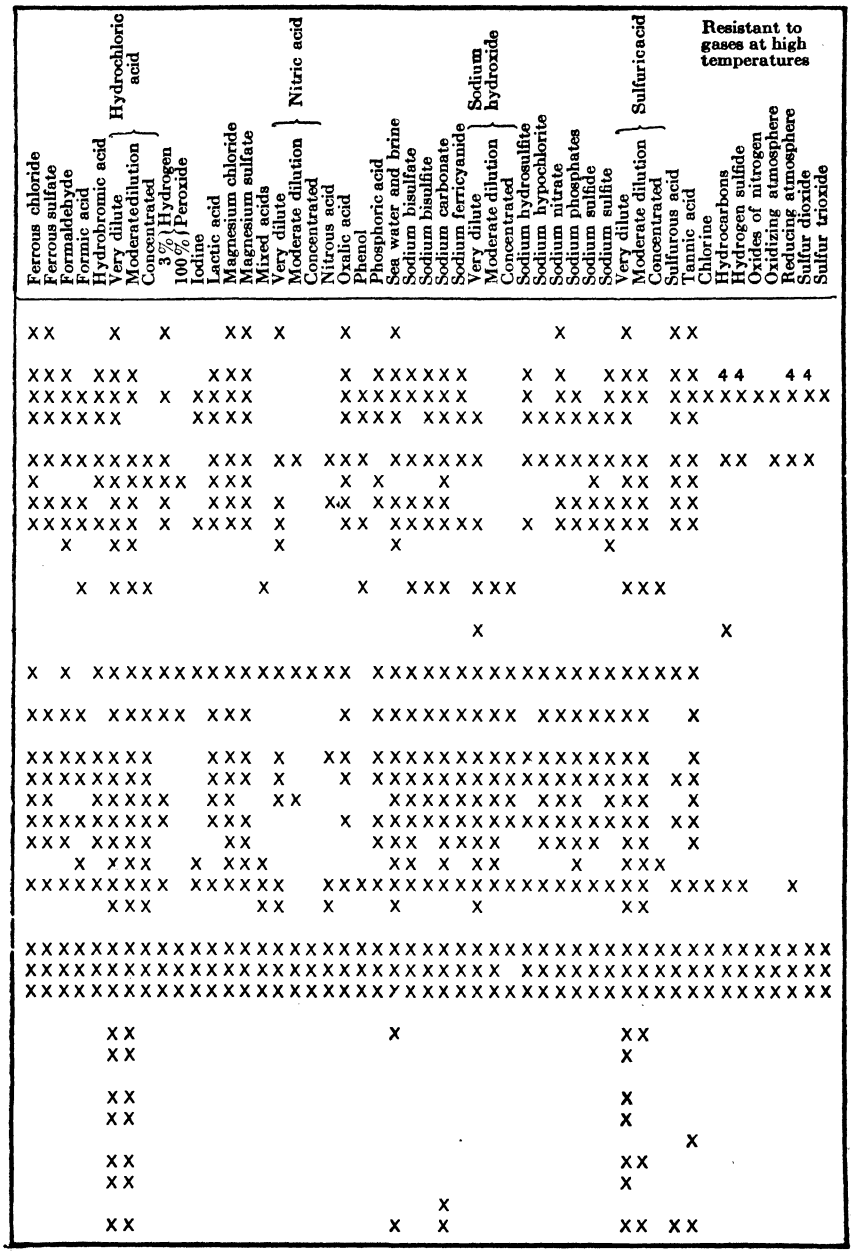
18. Hauser-Stander Tank Co. Cincinnati, O.
19. Haveg Corp. Newark, Del.
20. Johns Manville Corp. New York, N. Y.
21. Maurice A. Knight Akron, Ohio
22. Michigan Pipe Co. Bay City, Mich.
23. National Carbon Co. Cleveland, O.
24. Naugatuck Chem. Co. New York, N. Y.
25. Pfaudler Co. Rochester, N. Y.
26. Republic Carbon Co. Niagara Falls, N. Y.
27. Resinox Corp. New York, N. Y.
28. Spaulding Fibre Co., Tonawanda, N. Y.
29. Stokes & Smith Co. Philadelphia, Pa.
30. Thermal Syndicate Ltd. Brooklyn, N. Y.
31. Thiokol Corp. Yardville, N. J.
32. Toledo Synthetic Products, Inc. Toledo, Ohio.
33. U. S. Rubber Co. New York, N. Y.
34. U. S. Stoneware Co. New York, N. Y.



PRODUCT	Manufactured by	Acetic acid: Very dilute	Acetic acid: Moderate dilution	Acetic acid: Concentrated	Acetic anhydride	Acetone	Aluminum chloride	Aluminum sulfate	Ammonia, anhydrous	Ammonium chloride	Ammonium hydroxide	Ammonium nitrate	Ammonium sulfate	Amyl acetate	Amyl chloride	Aniline	Benzaldehyde	Bromine	Butyl acetate	Calcium chloride	Calcium hypochlorite	Carbon disulfide	Carbon tetrachloride	Carbonic acid	Chloroacetic acid	Chlorine water	Chromic acid	Citric acid	Copper sulfate	Ethyl acetate	Fatty acids	Ferric chloride	Ferric sulfate
CELLULOSE NITRATE PLASTIC																																
Pyralin	9	X	X			X	X		X		X	X								X		X	X	X					X			X	X	X
PHENOLIC RESINOIDS																																
Bakelite	5	X	X		X	X	X		X		X	X	X	X	X					X	X		X	X	X	X			X	X	X	X	X	X
Bakelite Dilecto	7	X	X	X	X	X	X	X	X		X	X	X	X	X					X		X	X	X		X		X	X	X	X	X	X	X
Durez 1407	14	X	X	X	X		X	X	X	X	X	X			X	X				X	X	X		X	X	X			X		X		X	X
Durez, wood filled	14					X							X	X	X					X			X					X	X	X			
Durite	29	X	X	X	X	X	X		X		X	X	X	X		X				X	X	X	X	X	X	X			X	X	X	X	X	X
Haveg	19	X	X	X			X	X	X		X									X	X		X		X			X		X	X		
Resinox	27	X	X		X	X	X		X		X	X	X	X		X				X	X		X	X		X			X	X	X	X	X	X
Spauldite	28	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X	X	X	X
Textolite	12	X	X																					X				X					
STYROL RESINOID																																
Victron	24	X	X	X		X		X	X											X													
UREA RESINOID																																
Plascon	32			X																											X		
VINYL RESINOID																																
Vinylite	6	X			X	X	X	X	X	X	X									X	X	X	X	X		X	X	X	X		X	X	X
OTHER PLASTICS																																
Plioform	16	X	X	X					X	X	X									X				X	X		X					X	X
RUBBER AND SUBSTITUTES																																
Rubber, hard	4	X	X	X	X	X	X	X		X		X	X	X						X	X	X			X	X	X	X	X	X			X	X
Rubber, hard	1	X	X	X	X	X	X	X	X	X	X	X	X							X	X			X		X		X	X				X	X
Rubber, hard (*c*)	33	X	X			X	X	X	X	X	X	X	X							X	X			X		X		X	X				X	X
Tank-lining material (*d*)	33	X	X	X	X	X	X	X	X	X	X	X								X	X			X		X		X	X				X	X
Rubber, soft	4				X	X		X		X	X									X	X								X				X	X
Rubber, soft	16	X	X			X	X	X	X		X									X			X					X	X				X	X
Du Prene	10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			X	X	X			X	X	X	X	X	X
Thiocol	31	X	X	X	X																		X											
CHEMICAL STONEWARE																																
Stoneware	11	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Stoneware	21	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Stoneware	34	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
WOOD																																
Cypress	3													X	X																X		
Cypress	18	X	X	X																X													
Fir	3	X	X	X																													
Fir	18	X	X	X																													
Maple	18	X	X	X																													
Oak, white	3																										X						
Pine, yellow	3																																
Pine	18	X	X	X																													
Redwood	3	X	X	X																											X		
Redwood	22	X	X																	X					X		X	X					

(*a*) With linseed and tung oils, cumar solution, spar varnish, sodium silicate, or bituminous coating. (*b*) With acid-proof brick or tile, lead, rubber, bituminous mastic or other lining. (*c*) Molded and fabricated parts. (*d*) Rubber bonded to metal, storage and process tanks.

CONSTRUCTION



(1) If moisture is present. (2) Below 500°C. (3) Not over 200°C. (4) Below charring point. (5) At 150°F. (6) At 350°F.

PROPERTIES OF MATERIALS OF CONSTRUCTION

Chemical and Metallurgical Engineering, 39, 651-8 (1932); Perry, *The Chemical Engineers' Handbook*, McGraw-Hill Co., publishers; by permission.

GLASS LINED AND ENAMELED STEEL

(A) Coefficients of Heat Transfer for Typical Chemical Enamels.

These coefficients are of course, only relative, and are dependent to a large extent on the amount of agitation of the contained materials. Good agitation may increase values by as much as 20 to 25 per cent. Abbreviations: K is in B. T. U.s per sq. ft. per hour per °F. of temperature difference. K_1 refers to the heat transfer from steam to water being heated, while K_2 refers to the heat transfer from steam to boiling water.

1. Dry dust enamel for very severe chemical service.
   (a) Pfaudler No. 17, $K_1 = 60$; $K_2 = 80$
   (b) Pfaudler No. 11, $K_1 = 50$; $K_2 = 70$
2. Spray enamel for organic acids and less corrosive mineral acids.
   (a) Pfaudler No. 71, $K_1 = 125$; $K_2 = 150$
3. Spray dust enamel for mineral acids in general storage service, usually for equipment of large capacities.
   (a) Pfaudler No. 186, $K_1 = 90$; $K_2 = 100$

(B) Other Physical and Mechanical Properties.

Such physical properties of enamel as the coefficient of expansion, tensile strength, etc., are generally meaningless unless considered in connection with the steel on which the lining is applied. Ability to withstand rapid thermal change is tested in an automatic machine by intermittently heating enamel plates to 450°F. and then dipping them into ice water. However, both temperature and corrosion conditions to be met in each service application should be definitely ascertained and this information supplied to the manufacturer.

CHEMICAL STONEWARE

Ultimate compressive strength	82,000–115,000 lbs./in.^{2}
Ultimate tensile strength	1,650–4,300 lbs./in.^{2}
Modulus of elasticity	$1.05-5.95\times10^6$ lbs./in.^{2}
Specific heat	0.2
Thermal conductivity	0.78–2.05 B.T.U./ft.^{3}
Linear expansion per °F.	$1.9-2.3\times10^{-6}$
Ultimate bending strength	5,900–12,500 lbs./in.^{2}

GLASS AND FUSED SILICA

These materials are marketed in the form of sheets, tubes and rods.

Properties	Boro-silicate glass	Fused silica, clear	Fused silica, opaque
Thickness	0.01 in and up	0.001 in. and up	0.005 in and up
Transparency, T= Transparent, TL= Translucent, O= Opaque	T, TL	T	TL, O
Specific gravity	2.24	2.20	2.07–2.1
Specific volume, in.^{3}/lb.	12.3	12.6	13.4
Tensile strength, lbs./in.^{2}	93×10^5	$105-126\times10^5$	$94-114\times10^5$
Hardness, 2.5 mm. ball, 25 kg. load, depth in millimeters	0.015	0.0245	.....
Thermal expansion, per °C.	0.32×10^{-5} (0–300°C.)	0.049×10^{-5}	$0.053-0.059\times10^{-5}$
Thermal conductivity, cal./sec. cm.°C.	27×10^{-4}	23.7×10^{-4}	$19-20\times10^{-4}$
Specific heat, cal./°C. gram.	0.20	.....	.....
Softening point	1,290°F.	2,600°F.	2,600–2,700°F.
Breakdown voltage, 60 cycle, volts per mil.	1,400 (0.1 in. sample)	410 (¼ in.)	436 (¼ in.)
Dielectric constant, 60 cycle	4.86	3.7	3.7
Refractive index, N_D	1.47	1.459	.....

PROPERTIES OF MATERIALS OF CONSTRUCTION

PROPERTIES OF COKE BASE CARBON

Specific gravity	2.00–2.15
Apparent density	1.42–1.65
Porosity, %	25–30
Tensile strength, lbs./in.²	600–650
Crushing strength, lbs./in.²	5500–9000
Transverse strength, lbs./in.²	2000–6000
Thermal conductivity, cal./cm./°C.	0.007–0.008
Coef. of ther. expan., °C. (100–150°C.)	1.5–2 × 10^{-6}
Specific heat, cal./gm./°C. (26–282°C.)	0.200–0.250
Volatilization point, °F.	6,300–6700
Ash, %	0.5–10.0
Start of oxidation, °F.	625–840
Machining qualities	Good
Available in	Rod, tube, brick, plates, shapes

PROPERTIES OF HARD AND SOFT RUBBER *

Property	Hard rubber	Soft rubber	Linings
Specific gravity	1.12–2	0.97–1.25	0.98–1.35
Tensile strength, lbs./in.²	1000–10000	525–600	.....
Transverse strength, lbs./in.²	9000–15000	.....	.....
Compression strength, lbs./in.²	2000–15000	.....	.....
Hardness, scleroscope	50–80	.....	.....
Max. temp. for use, °F.	130–160	150–200	190
Effect of heat	Softens	Softens	Softens
Coef. of linear expansion, 32–140°F.	0.000035	0.000036	.....
Coef. of heat cond., K in B.T.U.s/ft.²in.°F.	1.07	1.07	.....
Resistance to abrasion	.....	20 times steel	.....
Resistance to tear, lbs./in.²	.....	15–80	.....
Dielectric strength, volts/mm.	25000–40000	25000–40000	.....
Effect of sunlight	Slight discoloration	Cracks	Ages
Effect of aging	Nil	Slight	Tendency to harden at normal temp.
Machining qualities	Good	Can be ground	.....
Available forms	Pipe and fittings, tank and pipe linings, misc. forms	Tank linings, hose, misc. forms	Tank, vat, pipe, valve linings for chemical and abrasive protection

VULCANIZED FIBER

Marketed forms	Sheets, tubes and rods
Thickness	0.004 and up
Forming properties	Good
Machining qualities	Good
Colors	Red, brown, white, gray, black, olive
Effect of heat	Stable to charring
Effect of water	Swells and softens. Warps on drying. Not recommended.
Effect of mineral, animal, and vegetable oils	Very slight absorption
Specific gravity	1.2–1.5
Specific volume	18.5–23 in.³/lb.
Tensile strength	8000–16000 lbs./in.²
Breakdown voltage, 60 cycle, $\frac{1}{16}$ inch sample	175–500 volts/mil

* See section on synthetic rubbers.

PROPERTIES OF MATE-

PROPERTIES OF RE-

Type of brick	Chrome	No. 1 Fire clay	Fused alumina	Fused refractory
Typical composition, %	44 Cr_2O_3 16FeO 15MgO 15Al_2O_3 5SiO_2	42Al_2O_3 54SiO_2 2 Flux	90Al_2O_3 7 SiO_2 3 Flux	75 Al_2O_3 20 SiO_2 3.3 TiO_2
Fusion point, °F.	4000	3050	3500	3360
Load resistance, temp. °F. for 10% shrink at 25 lb.	2600	2700	2800	.....
Resistance to spalling in cycles	2	20	4	.....
Weight per standard 9 in. brick, lbs.	11.1	7.5	10	10
Porosity in %	.....	20–30	20	0.4
Specific heat (60–1200°F.)	0.20	0.23	0.20	0.23–0.255
Relative slag resistance				
Acid steel slag	Poor	Fair	Good	.....
Basic steel slag /	Good	Poor	Good	.....
Mill scale	Good	Poor	Fair	.....
Coal ash slag	Fair	Fair	Good	.....
Approximate cost per thousand, dollars	250	35–40	1000	1000

ASBESTOS FIBER AND PORTLAND CEMENT

Property	Flat sheets	Corrugated sheets	Pipe	Impregnated material
Sizes	36x48, 42x48, 42x96, all ⅛ to 4 in. thick	42 in. Wide, 3-11 ft. long, ⅜ in. thick	2-36 in. diam. 0-225 lbs./in.^{2} pressure	Same as plain
Temp. limit, °F.	700	700	700	150
Density, lbs./ft.^{3}	125	125	125	128
Water permeability	Low	Low	Very low	Very low
Modulus of rupture, lbs./in.^{2} (Aver.)	3500	3000	.....	.....
Modulus of elasticity	1,500,000	1,500,000	2,000,000	1,500,000
Electrical resistance—Megohms per inch cube		.....	.....	4,000,000

RIALS OF CONSTRUCTION

FRACTORY MATERIALS

Kaolin	Kaolin refractory insulator	Magnesite	Mulite refractory	Silica	Silicon carbide	Unburned magnesite
45 Al_2O_3 52 SiO_2 1 Flux	45 Al_2O_3 52 SiO_2 1 Flux	85 MgO 7 Fe_2O_3 3 CaO 3 SiO_2	52 Al_2O_3 44 SiO_2 2.5 Flux	96 SiO_2	100 Si	7 Al_2O_3 7 Cr_2O_3 69 MgO 6 Fe_2O_3 4 CaO 7 SiO_2
3200	3200	4000	3300	3050	4000 (dec.)	4000
2900	.....	2500	3000	3000	3100	.....
20	.....	1	25	None	25	5
7.5	1.8	10	7.0	6.5	9	10.4
20	80	.....	25	20–30	18	15
0.23	0.23	0.27	0.23	0.23	0.20	.....
Fair	Poor	Fair	Good	Good	Good	Good
Poor	Poor	Good	Fair	Poor	Good	Good
Poor	Poor	Good	Fair	Poor	Fair	Good
Fair	Poor	Good	Fair	Fair	Good	Fair
260	170	350	100	40–50	1000	275

PHYSICAL PROPERTIES OF WOOD

See also the table *Composition of Various Woods.*

Wood	Specific gravity	Tensile strength, lb./in.^{2}	Compression strength, lb./in.^{2}	Transverse strength, lb./in.^{2}	Linear expansion, per °F	Hardness
Ash	0.51	.....	.....	.....	.0000053	Hard
Chestnut	0.40	.....	.....	.....	.0000036	Hard
Cypress	0.53	4,400	3,560	.....	.....	Medium
Elm	0.48	.....	.....	.....	.0000031	Medium
Fir	0.59	3,600	2,400	.....	.....	Medium
Gum	0.45	.....	.....	.....	.....	Medium
Maple	0.49	.....	.....	.....	.0000035	Medium
Oak	0.77	4,400	2,800	4,425	.....	Hard
Pine	0.61 to 0.75	5,100	3,420	5,700	.....	Hard
Redwood	0.34 to 0.41	4,500	3,400	.....	Negligible	Mod. Hard

PROPERTIES OF MATERIALS OF CONSTRUCTION

ACID RESISTANT CEMENTS

For Brick, Metal, Earthenware, Stoneware, and Fused Silica.

	"Acid proof Cement No. 1" Quigley Co., Inc., New York, N.Y.	"Acid proof Cement No. 2" Quigley Co., Inc.	"Acipruf" Chemical Construction Corp., Charlotte, N.C.	"Basolit" Nukem Products Corp., Niagara Falls, N.Y.
Used for	Brick, for chimneys and flues	Brick and tile tank settings, chemical stoneware, fused silica	Brick, chemical and terracotta stoneware, rigid joints	Brick, porcelain, metal, chemical and terracotta stoneware, rigid joints
Composition	.....	....	.....	Silica-sulfur
Preparation for use	Ready mixed	Ready mixed	Mix with sodium silicate	Heat to 300°F. and pour
How applied	Trowel or dip bricks	Trowel	Trowel, with thin joints. For bell-and-spigot joints, press over asbestos rope	Pour into joints, with or without asbestos rope packing
Resistant to	Hot acid gases	Mineral acids	Mineral acids	Acids, fumes
Temperature range	To 2400°F.	To 1200°F.	To above boiling points of strongest acids	To 200°F.

	"Calktite" U.S. Stoneware Co., Akron, O.	"Carolina" Charlotte Chem. Labs. Inc., Charlotte, N.C.	"Chemical Putty" Charlotte Chem. Labs. Inc., Charlotte, N.C.	"Duralute" U.S. Stoneware Co., Akron, O.
Used for	Brick, bell-and-spigot joints on chemical stoneware	Brick, chemical and terracotta stoneware, rigid joints	Chemical stoneware, fused silica, Duriron, non-rigid joints	Brick
Composition	Asphaltic base	.....	Asbestos base	Asphaltic base
Preparation for use	Heat and pour	Ready mixed	Ready mixed	Heat and pour
How Applied	Pour into brick joints. For stoneware, pour over tamped asbestos wicking	Trowel with thin joints. For bell-and spigot joints, press over asbestos rope.	Press into joints	Pour into brick joints
Resistant to	Acids	Mineral acids	Mineral acids	Acids, alkalis
Temperature range	To 200°F.	To above boiling points of strongest acids	To 250°F.	To 200°F.

	"Duro" Special. Electrochemical Supply and Engineering Co., Paoli, Pa.	"Duro" Standard. Electrochem. Supply and Engrg. Co., Paoli, Pa.	"M.A. Knight Acid proof" Maurice A. Knight, Akron, O.	"Portite" U. S. Stoneware Co., Akron, O.
Used for	Brick, metal, glass, stoneware, earthware, fused silica, bell-and-spigot joint	Brick, metal, earthenware, chemical stoneware, fused silica glass	Brick, chemical stoneware	Brick
Composition	.....	.....	.....	Asphaltic base

PROPERTIES OF MATERIALS OF CONSTRUCTION

ACID RESISTANT CEMENTS

	"Duro" Special Electrochemical Supply and EngineeringCo.,Paoli, Pa.	"Duro" Standard Electrochem. Supply and Engrg.Co., Paoli, Pa.	"M. A. Knight Acid proof" Maurice A. Knight, Akron, O.	"Portite" U.S. Stoneware Co., Akron, O
Preparation for use	Mix two ingredients to consistency of thin putty	Mix two ingredients to consistency of thin putty	Mix with sodium silicate to the consistency of cream	Heat and pour
How applied	Trowel, joints thin or thick as desired. Heat to hasten drying	Trowel, thin joints. Heat surfaces before or after joining to hasten drying	Heat bricks to about 150°F. Lay with thin joints	Pour into brick joints
Resistant to	Weak acids, salts, fumes	Strong mineral acids, fumes	Acids	Acids
Temperature range	To 1500°F.	To 1500°F.	To 360°F.	To 200°F.

	"Mineralead" Atlas Mineral Products Co., Merztown,Pa.	"Pre-Mixt" U.S.Stoneware Co. Akron, O.	"S" Brand Silicate Philadelphia Quartz Co., Philadelphia, Pa.	"Thiogrout" Electrochemical Supply and Engineering Co., Paoli, Pa.
Used for	Cast iron	Brick	Brick	Bell-and-spigot joints
Composition	Sulfur base	.....	50 quartz, 20 mesh; 50quartz, 100 mesh; 70-100 "S" Brand Silicate	Sulfur base
Preparation for Use	Heat to 270-280°F. and pour	Mix with water to consistency of heavy cream	Mix to consistency of thick cream	Melt and pour
How applied	Pour over jute caulking	Bricks should be warm. Lay with thin joints	Dip bricks, lay with thinnest possible joints	Pack joint with asbestos rope and pour on cement
Resistant to	Solutions with pH under 7	Acids, neutral solutions	Acids, fumes	Weak acids, salts
Temperature range	To 200°F.	To 600°F.	.....	To 220°F.

	"U.S.Standard" U.S.Stoneware Co., Akron, O.	"Vitric-10" U.S. Stoneware Co., Akron, O.	"Vitrite-15" U. S. Stoneware Co., Akron, O.	"Vitrobond" Atlas Mineral Product Co., Merztown, Pa.
Used for	Brick	Brick	Brick	Brick, tile
Composition	.....	.....	.....	Sulfur base
Preparation for use	Mix with sodium silicate to consistency of heavy cream	Mix with sodium silicate to consistency of heavy cream	Mix with sodium silicate to consistency of heavy cream	Heat to 265°F. and pour
How applied	Bricks should be warm. Lay with thin joints	Bricks should be warm. Lay with thin joints	Bricks should be warm. Lay with thin joints	Pour into joints
Resistant to	Acids	Acids	Acids	Acids
Temperature range	To 350°F.	To 500°F.	To 500°F.	To 212°F.

PROPERTIES OF MATE-

MECHANICAL, PHYSICAL AND ELECTRI-

Characteristics	Pure, hardened resinoid	Phenolic resinoids				
		Molded			Laminated	
		Wood flour filler	Fabric filler	Asbestos filler	Paper filler	Fabric filler
Marketedforms,S= sheets, T= tubes, R= rods	S, R, castings for machining	Misc. molded forms	Misc. molded forms	Misc. molded forms	S,R,T,and pressed forms	S,R,T, and pressed forms
Molding Qualities	Machined	Excellent	Good	Good	Excellent	Excellent
Molding range, °F.	.....	300–450	300–360	300–340	250–325	250–325
lbs./in.²	.....	500–2500	3500–5000	1500–2500	1000–2000	1000–2000
Compression ratio, Vol. loose powder/ vol. solid	.....	2.0–3.5	4.5–7.5	2.3–7.0	.....	.....
Tendency to unmold	.....	None	None	None	None	None
Thickness, inches	0.01 up	0.02 up	0.02 up	0.02 up	0.005 up	0.005 up
Machining qualities	Good	Good	Fair	Fair	Good	Good
Tendency to "cold flow"	None	None	None	None	None	None
Transparency; T= transparent, TL= translucent, O= Opaque	T, TL, O	O	O	O	O	O
Colors and mottles	All Colors	Variety	Natural, darker shades	Natural, darker shades	Natural, dark	Natural, dark
Effect of heat,.....dry moist	Withstands 250°F. Tends to harden and shrink; improved electrical prop.			Withstands constant use at 375°F. Special grade475°F	Withstands 250°F. with slight hardening and shrinkage	
Burning rate	Extremely low			Practically incombustible	Extremely low	
Effects of sunlight and ultra-violet	Slight lowering of surface resistivity and darkening in light colors according to intensity of ultra-violet light.					
Effects of aging	None	None	Improvement in mechanical and electrical properties			
Effects of water, cold	.....	None	.....	Very resistant	Slight deterioration on long immersion. Effects more rapid	
hot	.....		.....			
Specific gravity	1.2–1.3	1.3–1.4	1.3–1.4	1.8—2.0	1.3–1.4	1.3–1.4
Specific volume, in.³/lb.	23–21	21–20	21–20	15–14	21–20	21–20

RIALS OF CONSTRUCTION

CAL PROPERTIES OF VARIOUS PLASTICS

Urea-formaldehyde resinoid, molding plastic	Cellulose nitrate	Cellulose acetate		Vinyl resins		Styrol resin	Resin derived from rubber
	Plastic	Plastic	Press powder	Filled	Unfilled		
Molded forms	S,T,R, and misc. forms	S,T, R, and misc. forms	S,T,R, and misc. forms	S,T,R,	S,T,R,	S,T,R,	Misc.
Good	Very good	Fair to good	Fair to good	Good	Good	Thermoplastic	Good
275–300	190–220	.....	.....	200–300	200–300	200–350	230–300
2000–10000	2000–5000	.....	.....	300–2000	300–2000	40–100	1500–3000
3	.....	.....	2.28–2.84	2.5	2.5	.....	1–2.5
None	Low	Low	Med.to high	None	None	None	None
0.02 up	0.005 up	0.005 up	0.02 up	.....	.....	.....	0.01 up
Fair	Good	Fair to good		Good	Good	Good	Good
None	.....	Depends on plasticizer		.....	.....	Slight when uncompounded	Some
T,TL, O	T,TL, O	T, TL, O	TL, O	T, TL, O	T, TL,O	T, TL, O	T, TL, O
Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Any color	Unlimited
Slight shrinking Slight swelling	Decomposed at 100-150°C	More stable than cellulose nitrate at 150°C		Slowly darkens at 150°C		Will soften under high heat	Becomes insoluble Thermoplastic
Very low	Very high	Low	Low	Nil	Nil	Compounded material will not support combustion	Medium
None	Discolored and brittle	More stable than cellulose nitrate		.....	.....	Slight surface oxidation	Slight
None	None in absence of ultra-violet light	Less than cellulose nitrate		None	None	None	None
None	Swelling is very slight	Slight swelling		None below 150°F.		None	None
None up to 30 min. boiling		Attacked		Softens		None	None
1.48–1.55	1.35–1.60	1.27–1.31	1.30–1.63	1.2–2.5	1.23	1.06 (Uncompounded)	1.06–1.35
19–18	20.5–17.3	21.8–21.2	21.3–17.0	20–15	19	Varies	26.1–20.5

PROPERTIES OF MATE-

MECHANICAL, PHYSICAL AND ELECTRI-

Characteristics	Pure, hardened resinoid	Phenolic resinoids				
		Molded			Laminated	
		Wood flour filler	Fabric filler	Asbestos filler	Paper filler	Fabric filler
Tensile strength, lbs./in.^{2}	"8" test-pc. 5000–11000	A.S.T.M. test 6000–12000	A.S.T.M. test 4500–9000	A.S.T.M. test 5000–10000	6000–20000	8000–12000
Elongation, per cent	.....	.....	.....	.....	.....	.....
Impact strength, Izod	0.5–2.5	1–2.5	10–25	0.5–4.0	5–25	10–65
Modulus of elasticity, lbs./in.^{2}	1,000,000–2,500,000	1,000,000–2,500,000	800,000–1,200,000	1,000,000–2,500,000	500,000–2,000,000	500,000–1,500,000
Hardness, 2.5mm. ball, 25Kg. load, depth in mm.	.....	.....	.....	.....	.....	.....
Thermal expansion, $10^5/^0$C.	.....	.....	.....	.....	2	2
Thermal conductivity, cal./sec.cm.°C.	0.0003–0.0004	0.0004–0.0006	0.0004–0.0006	0.0012–0.002	0.0005–0.0008	0.0005–0.0008
Specific heat, cal./°C.gram.	0.33–0.36	0.30–0.40	0.30–0.40	0.30–0.40	0.30–0.40	0.30–0.40
Softening point, °F.	.....	.....	.....	.....	.....	.....
Electrical resistivity, (volume), at 30°C., ohm cm.	1–1000 × 10^{10}	1–100 × 10^{10}	0.1–10 × 10^{10}	0.01–0.1 × 10^{10} Mica filler 10–1000 × 10^{10}	1–100 × 10^{10}	0.1–1.0 × 10^{10}
Breakdown voltage, 60 cycle, volts per mil	250–700	300–600	200–500	150–400 Mica filler 450–600	500–1300	200–600
Dielectric constant, 60 cycle	.....	4.5–8.0	.....	.....	.....	.....
Power factor, 60 cycle, %	.....	4–20	.....	.....	.....	.....
Dielectric constant, R. F.	4.5–7.0	4.5–8.0	4.5–7.0	5–20	4.5–6	4.5–7.0
Power factor, R.F., %	0.5–5.0	1–10	5–10	0.7–2.5 10–20mica filler	1.5–5	2–8
Refractive index, N_D	1.56–1.70	.....	.....	.....	.....	.....

RIALS OF CONSTRUCTION

CAL PROPERTIES OF VARIOUS PLASTICS

Urea-formaldehyde resinoid, molding plastic	Cellulose nitrate	Cellulose acetate		Vinyl resins		Styrol resin	Resin derived from rubber
	Plastic	Plastic	Press powder	Filled	Unfilled		
5000–6400	4000–10000	5,400	1800–3200	7000	9000	Varies	4500–7000
.....	5–30	13	0.2–0.5	.....	.....	Varies	Very little
0.7–1.2 (Sharpe)	10–11.5	.....	0.17–0.62	0.24–1.22	0.2–3.5	Varies	.....
.....	2,000,000–3,900,000	.....	1,100,000–2,900,000	7,500,000	.....	Varies	.....
.....	0.225–0.325	0.225–0.325	.....	.....	.....	Varies	.....
.....	12–16	.....	14–16	.....	.....	Varies	.....
.....	0.00031–0.00051	0.00054–0.00063	0.00053–0.00087	.....	.....	Varies	.....
.....	0.34–0.38	.....	.....	.....	.....	.....	.....
.....	160–195	115–160	162–300	160	150	194 up	160 up
.....	0.106–0.32 $\times 10^{10}$	0.30×10^{10}	6.2×10^{10}	$>10 \times 10^{10}$	$>10000 \times 10^{10}$	.....	.....
.....	.....	.....	.....	.....	.....	.....	.....
300–400	300–780	720	590–620	350–400	400–500	517	.....
5–6	7.3–6.7	7.5	7.1–8.4	.....	.....	2.96	.....
1–3	.....	7.0	9.1–10.5	.....	.....	0.03	.....
.....	6.8	5.3	4.3–5.4	5.0	4.0	2.96	.....
.....	9.7–7.4	13.7	6.8–10	6.2	1.43	0.03	.....
1.6	1.50	1.49–1.50	.....	.....	.....	.....	1.60–1.66

No.	Material	General composition	Commercial construction
1	Air	Still air	.....
2	Aluminum foil crumbled	Crumbled foil and air—7 layers per 2.5 in.	Pipe covering
3	Asbestos fiber cements	Asbestos and clay	Cement
4	Asbestos fiber for underground conduit insulation	Willowed asbestos fiber waterproofed	Filling
5	Asbestos millboards	Asbestos pressed	Rigid sheets
6	Asbestos paper	Indented. Has 26 laminations per in.	Pipe covering
7	Asbestos paper	With imbedded sponge particles 40 laminations per in.	Pipe covering and blocks
8	Asbestos paper products	Corrugated air cell type	Pipe covering and sheets
9	Asbestos paper, vitrified	Asbestos paper-treated with vitrifying solution and baked	Pipe covering and sheets
10	Bauxite, monohydrated	Molded with asbestos and clay	Pipe cov.-blocks and bricks
11	Cattle hair	Hair-felted	Blanket flexible
12	Cattle hair	Hair-felted	Blanket flexible
13	Cattle hair and jute	Hair and jute felted	Blanket flexible
14	Cattle hair and other fiber	Confined with building paper	Blanket flexible
15	Corkboard	No artificial binder	Pressed rigid slabs
16	Diatomaceous earth and clay, calcined	Molded and fired	Bricks
17	Diatomaceous earth blocks	Molded with asbestos, magnesia and clay	Pipe covering and blocks
18	Diatomaceous earth bricks	Natural brick cut from earth, heat flow $\perp$ to strata	Brick
19	Diatomaceous earth, calcined	Molded and fired	Bricks
20	Diatomaceous earth cements	Mixed with asbestos, magnesia and clay	Cement
21	Diatomaceous earth fillers	Coarse powder	Filler
22	Diatomaceous earth fillers	Fine powder	Filler
23	Fire felt	Long brown asbestos fiber and sodium silicate	Pipe covering and blocks
24	Fire felt	Short white asbestos fiber and sodium silicate	Pipe covering and sheets
25	Insulating boards	Pressed wood pulp	Rigid slabs
26	Insulating boards	Bagasse fiber	Rigid slabs
27	Insulating boards	Licorice roots	Rigid slabs
28	Insulating boards	Pressed wheat straw pulp	Rigid slabs
29	Kapok fiber	Tightly packed	Flexible
30	Magnesia	85% magnesia—15% asbestos	Pipe covering and blocks
31	Portland cement and calcined diatomaceous earth	Mixture of 4 pts. calcined earth to 1 pt. cement by volume	Poured as concrete
32	Rock cork	Rock wool and asphalt binder	Rigid slabs
33	Rock wool	Felted	Blankets
34	Rock wool	Felted with metal jacket	Pipe covering
35	Rock wool	Granulated	Filling
36	Rock wool	Loose	Filling
37	Rock wool	Molded with clay and asbestos	Sheets
38	Rock wool cement	Rock wool and clay	Cement
39	Sheetrock	Gypsum and sawdust	Rigid sheet between heavy papers

RIALS OF CONSTRUCTION

OF HEAT INSULATING MATERIALS*

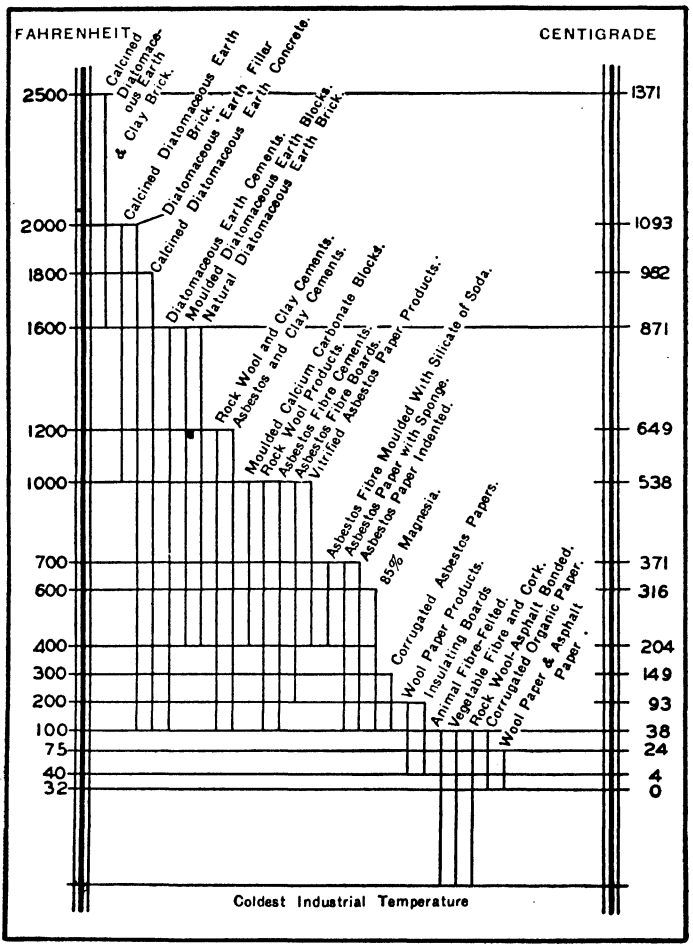
Density, lbs./ft.^{3}	K, B.T.U.s/ hr. ft.^{2} in. °F.	Mean Temp. of sample °F.	Temp. limit for service °F.	Resistance per inch thickness, 1/K	No.
0.08	0.157	32	.....	6.37	1
.....	0.680	500	.....	1.45	2
50.0	1.2	200	1,200	0.83	3
8.5	0.545	300	375	1.83	4
60.5	0.843	86	1000	1.19	5
19.1	0.665	500	700	1.50	6
30.0	0.590	500	700	1.71	7
13.7	0.632	200	300	1.58	8
21.6	1.20	300	700	0.83	9
33.0	1.20	1,600	1,600	0.83	10
9.25	0.272	60	100	3.68	11
16.88	0.247	86	.....	4.05	12
6.17	0.245	60	100	4.08	13
18.72	0.2702	86	.....	3.70	14
7.0	0.27	.....	.....	3.71	15
42.3	2.25	1,600	2,500	0.44	16
26.0	1.06	1,600	1,600	0.94	17
27.7	0.92	1,600	1,600	1.09	18
38.0	2.12	1,600	2,000	0.47	19
30.0	0.735	400	1,600	1.36	20
20.0	0.98	1,600	1,600	1.02	21
17.2	0.89	1,600	1,600	1.12	22
20.4	0.685	500	700	1.46	23
39.6	1.30	500	1,000	0.77	24
17.0	0.356	90	200	2.81	25
17.5	0.363	90	200	2.76	26
16.1	0.340	81	200	2.94	27
14.5	0.365	90	200	2.74	28
.....	0.341	78	100	2.93	29
14.5	0.548	400	600	1.83	30
61.8	2.80	1,600	1,800	0.36	31
15.6	0.328	86	100	3.05	32
8.2	0.408	300	1,000	2.45	33
19.4	0.532	400	1,000	1.88	34
9.42	0.285	156	1,000	3.51	35
10.0	0.270	90	1,000	3.70	36
15.2	0.384	200	1,000	2.60	37
30.0	1.02	500	1,200	0.98	38
60.7	1.40	90	.....	0.715	39

*See also the table: Heat Conductivity of Commercial Insulators.

PROPERTIES OF MATERIALS
PHYSICAL AND THERMAL PROPERTIES

No.	Material	General composition	Commercial construction
1	Spun glass	Fine glass fibers, ⊥ to heat flow	Blanket
2	Thermax	Shredded wool and cement	Rigid sheet
3	Wool paper and hair	Laminated	Pipe covering
4	Wool paper products	Laminated wool felt	Solid pipe covering
5	Wool paper products	Indented wool felt	Pipe covering
6	Wool paper products	Wool paper and asphalt saturated paper—alternated	Pipe covering

*TEMPERATURE RANGE AND LIMIT CHART OF INSULATING MATERIALS



*Townshend and Williams, Johns-Manville Research Lab., published in *Chem. and Met. Eng.* 39, 219 (1932); reprinted by permission.

OF CONSTRUCTION OF HEAT-INSULATING MATERIALS

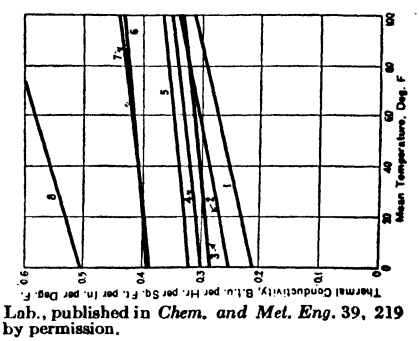
Density, lbs./ft.³	K, B.T.U.s/ hr.ft.² in.°F.	Mean Temp. of sample °F.	Temp. limit for service, °F.	Resistance per inch thickness; 1/K	No.
5.56	0.510	400	1,000	1.96	1
24.2	0.46	72	200	2.07	2
15.6	0.308	50	100	3.25	3
24.5	0.452	120	200	2.21	4
15.0	0.337	120	200	2.97	5
31.7	0.460	112	200	2.17	6

* VARIATION IN CONDUCTIVITY OF TYPICAL INSULATING MATERIALS

Low Temperature Materials

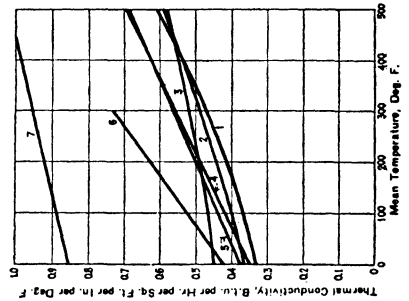
No.	Type of Material	Average Density Lb. Cu.Ft.	Average Thermal Conductivity Engineering Units at 20 Deg. Mean	at 100 Deg. Mean
1	Hair felt	10.0	0.227	0.318
2	Rock wool with asphalt binder			
3	Rock wool, blown	14.5	0.267	0.337
4	Vegetable cork*..	10.0	0.295	0.335
5	Rigid insulating boards	12.5	0.311	0.350
6	Coarse diatomite powder	16.1	0.329	0.365
7	Solid rag felt sized	20.0	0.400	0.435
8	Cork with sized wood with magnesia cement.	24.5	0.398	0.441
		25.8	0.528	0.632

*International Critical Tables, vol. 2, p. 315.



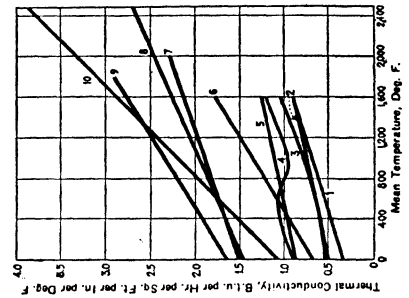
Medium Temperature Materials

No.	Type of Material	Average Thermal Conductivity Engineering Units at 100 Deg. Mean	at 500 Deg. Mean
1	Rock wool pipe covering	0.36	0.61
2	Laminated asbestos pipe and sponge particles		
3	85% magnesia	0.40	0.59
4	Crumpled aluminum foil	0.47	0.58
5	Molded asbestos fiber and sodium silicate	0.42	0.68
6	Air-cell type pipe covering	0.44	0.69
		0.52	At 300 deg. mean 0.73
7	Insulating cement	0.87	1.02



High Temperature Materials

No.	Type of Material	Average Density Lb. Cu.Ft.	Average Thermal Conductivity Engineering Units at 400 Deg. Mean	at 1600 Deg. Mean
1	Diatomic powder	17.2	0.48	0.89
2	Solid diatomite heat flow perpendicular to strata	27.7	0.61	0.92
3	Molded diatomite with binder	26.0	0.61	1.06
4	Monohydrated bauxite with binder	33.0	1.04	1.20
5	Solid diatomite heat flow parallel to strata	27.7	0.97	1.27
6	Clay with cork granules, fired	29.8	0.92	1.77
7	Diatomite brick fired	38.0	1.65	2.12
8	Diatomite brick with binder, fired	42.3	1.65	2.25
9	Diatomite with Portland cement, fired	61.8	1.94	2.80
10	Clay with cork granules, fired	36.0	1.53	2.87



*Townshend and Williams, Johns-Manville Research Lab., published in *Chem. and Met. Eng.* 39, 219 (1932); reprinted by permission.

WEIGHTS AND THICKNESSES

CAST IRON BELL AND SPIGOT PIPE—FOR WATER

Sand Cast Pipe

CLASSES A, B, C, D

American Waterworks Association Standard

MADE IN LENGTHS TO LAY 12 OR 16 FEET NET

(From Pipe Economy, 8th Ed. James B. Clow and Sons, publishers, by permission.)

Table No. 1

Nominal Inside Diameter Inches	CLASS A 100-Foot Head 43 Pounds Pressure					CLASS B 200-Foot Head 86 Pounds Pressure				
	Thickness Inches	Weight of 12-Foot Length Pounds Per		Weight of 16-Foot Length Pounds Per		Thickness Inches	Weight of 12-Foot Length Pounds Per		Weight of 16-Foot Length Pounds Per	
		Foot	L'gth	Foot	L'gth		Foot	L'gth	Foot	L'gth
3	....	....	....	....	....	.42	16.2	194	....	....
4	.42	20.0	240	19.7	315	.45	21.7	260	21.2	340
6	.44	30.8	370	30.3	485	.48	33.3	400	32.5	520
8	.46	42.9	515	42.2	675	.51	47.5	570	46.6	745
10	.50	57.1	685	55.9	895	.57	63.8	765	62.5	1000
12	.54	72.5	870	71.2	1140	.62	82.1	985	80.6	1290
14	.57	89.6	1075	....	....	.66	102.5	1230	....	....
16	.60	108.3	1300	....	....	.70	125.0	1500	....	....
18	.64	129.2	1550	....	....	.75	150.0	1800	....	....
20	.67	150.0	1800	....	....	.80	175.0	2100	....	....
24	.76	204.2	2450	....	....	.89	233.3	2800	....	....
30	.88	291.7	3500	....	....	1.03	333.3	4000	....	....
36	.99	391.7	4700	....	....	1.15	454.2	5450	....	....
42	1.10	512.5	6150	....	....	1.28	591.7	7100	....	....
48	1.26	666.7	8000	....	....	1.42	750.0	9000	....	....

Nominal Inside Diameter Inches	CLASS C 300-Foot Head 130 Pounds Pressure					CLASS D 400-Foot Head 173 Pounds Pressure				
	Thickness Inches	Weight of 12-Foot Length Pounds Per		Weight of 16-Foot Length Pounds Per		Thickness Inches	Weight of 12-Foot Length Pounds Per		Weight of 16-Foot Length of Pounds Per	
		Foot	L'gth	Foot	L'gth		Foot	L'gth	Foot	L'gth
3	.45	17.1	205	....	....	.48	18.0	216	....	....
4	.48	23.3	280	22.8	365	.52	25.0	300	24.4	390
6	.51	35.8	430	35.0	560	.55	38.3	460	37.5	600
8	.56	52.1	625	50.9	815	.60	55.8	670	54.7	875
10	.62	70.8	850	69.4	1110	.68	76.7	920	75.3	1205
12	.68	91.7	1100	90.0	1440	.75	100.0	1200	98.4	1575
14	.74	116.7	1400	....	....	.82	129.2	1550	....	....
16	.80	143.8	1725	....	....	.89	158.3	1900	....	....
18	.87	175.0	2100	....	....	.96	191.7	2300	....	....
20	.92	208.3	2500	....	....	1.03	229.2	2750	....	....
24	1.04	279.2	3350	....	....	1.16	306.7	3680	....	....
30	1.20	400.0	4800	....	....	1.37	450.0	5400	....	....
36	1.36	545.8	6550	....	....	1.58	625.0	7500	....	....
42	1.54	716.7	8600	....	....	1.78	825.0	9900	....	....
48	1.71	908.3	10900	....	....	1.96	1050.0	12600	....	....

WEIGHTS AND THICKNESSES

CAST IRON BELL AND SPIGOT PIPE—FOR WATER

Sand Cast Pipe

CLASSES E, F, G, H

American Waterworks Association Standard

MADE TO LAY 12 FEET NET

For Fire Lines and Other High Pressure Service

(From Pipe Economy, 8th Ed., James B. Clow and Sons, publishers, by permission.)

Table No. 2

Nominal Inside Diameter Inches	CLASS E 500-Foot Head 217 Pounds Pressure			CLASS F 600-Foot Head 260 Pounds Pressure		
	Thickness Inches	Weight, Pounds per		Thickness Inches	Weight, Pounds per	
		Foot	Length		Foot	Length
6	.58	42.5	510	.61	44.3	531
8	.66	60.9	731	.71	66.8	802
10	.74	86.9	1043	.80	92.8	1114
12	.82	114.6	1375	.89	122.8	1474
14	.90	145.6	1747	.99	158.8	1905
16	.98	180.7	2168	1.08	196.5	2358
18	1.07	221.8	2662	1.17	239.3	2872
20	1.15	265.8	3190	1.27	287.3	3448
24	1.31	359.1	4309	1.45	392.3	4707
30	1.55	530.9	6371	1.73	588.8	7065
36	1.80	738.1	8857	2.02	821.0	9852

Nominal Inside Diameter Inches	CLASS G 700-Foot Head 304 Pounds Pressure			CLASS H 800-Foot Head 347 Pounds Pressure		
	Thickness Inches	Weight, Pounds per		Thickness Inches	Weight, Pounds per	
		Foot	Length		Foot	Length
6	.65	48.1	577	.69	50.5	606
8	.75	72.3	868	.80	76.1	913
10	.86	101.4	1217	.92	107.3	1288
12	.97	136.2	1634	1.04	144.4	1733
14	1.07	175.1	2101	1.16	187.5	2250
16	1.18	218.0	2616	1.27	233.8	2805
18	1.28	268.2	3218	1.39	287.8	3453
20	1.39	321.8	3862	1.51	345.8	4149
24	1.75	479.8	5758	1.88	510.6	6127
30	....	....	....	....	....	....
36	....	....	....	....	....	....

WEIGHT AND THICKNESS

STANDARD DE LAVAUD CAST IRON PIPE FOR WATER

Centrifugal Cast Pipe

(From Pipe Economy, James B. Clow and Sons, publishers, by permission.)

Nominal Inside Diameter Inches	Thickness Inches	Class or Maximum Working Pressure 50				Thickness Inches	Class or Maximum Working Pressure 100			
		With Bell		Plain Ends			With Bell		Plain Ends	
		Ft.	Lgt.	Ft.	Lgt.		Ft.	Lgt.	Ft.	Lgt.
4	.30	14.6	175	13.2	159	...	.....	....	.....	....
6	.32	23.3	280	20.6	248	...	.....	....	.....	....
8	.36	34.2	410	30.7	368	...	.....	....	.....	....
10	.39	45.0	540	40.9	491	...	.....	....	.....	....
12	.42	58.3	700	52.6	631	...	.....	....	.....	....
14	.44	70.7	848	64.1	769	.50	77.6	931	72.5	870
16	.45	83.3	1000	74.7	897	.52	94.6	1135	86.3	1032
18	.48	99.2	1190	89.5	1074	.56	113.7	1367	103.9	1247
20	.50	115.0	1381	103.4	1241	.59	133.2	1599	121.5	1458

Nominal Inside Diameter Inches	Thickness Inches	Class or Maximum Working Pressure 150				Thickness Inches	Class or Maximum Working Pressure 200			
		With Bell		Plain Ends			With Bell		Plain Ends	
		Ft.	Lgt.	Ft.	Lgt.		Ft.	Lgt.	Ft.	Lgt.
4	.34	16.6	200	14.8	178	...	.....	....	.....	....
6	.36	25.8	310	23.1	277	...	.....	....	.....	....
8	.38	36.3	435	32.3	388	.42	39.6	475	35.5	426
10	.42	48.7	585	43.8	528	.48	54.7	657	49.9	600
12	.46	63.7	765	57.4	689	.52	70.8	850	64.6	776
14	.55	88.7	1065	81.4	977	.62	98.8	1186	91.3	1096
16	.60	110.4	1325	101.1	1214	.66	120.1	1442	110.8	1330
18	.64	131.6	1579	120.9	1451	.71	145.0	1740	133.7	1604
20	.69	158.7	1904	144.5	1734	.76	172.8	2074	158.7	1904

Nominal Inside Diameter Inches	Thickness Inches	Class or Maximum Working Pressure 250			
		With Bell		Plain Ends	
		Ft.	Lgt.	Ft.	Lgt.
4	.37	17.9	215	16.1	193
6	.40	28.3	340	25.5	306
8	.46	42.9	515	38.7	465
10	.52	58.7	705	53.9	647
12	.58	77.9	935	71.7	861
14	...	.....	....	.....	....
16	...	.....	....	.....	....
18	...	.....	....	.....	....
20	...	.....	....	.....	....

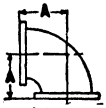
Class 50 pipe are recommended for flow lines, drains, exhaust lines and other low pressure installations where frequent tapping is not required.

GENERAL DIMENSIONS—STRAIGHT SIZES

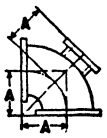
STANDARD CAST IRON FLANGED FITTINGS

AMERICAN STANDARD FOR 25, 125, AND 250 POUNDS WORKING STEAM PRESSURE

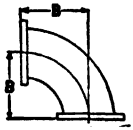
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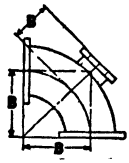
90° Elbow



Back Outlet Elbow



Long Radius Elbow



Back Outlet Long Radius Elbow



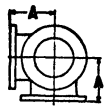
45° Elbow



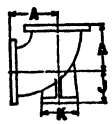
Long Radius 45° Elbow



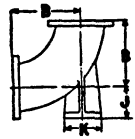
22½° Elbow



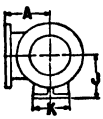
Side Outlet Elbow



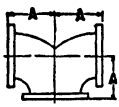
Bottom Base Elbow



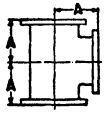
Long Radius Base Elbow



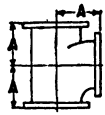
Side Base Elbow



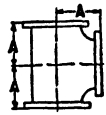
Double Branch Elbow



Tee



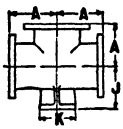
Single Sweep Tee



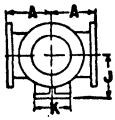
Double Sweep Tee



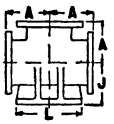
Side Outlet Tee



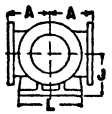
Bottom Base Tee



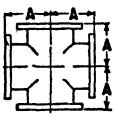
Side Base Tee



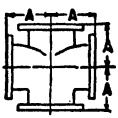
Bottom Anchorage Base Tee



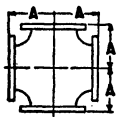
Side Anchorage Base Tee



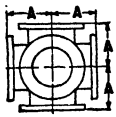
Cross



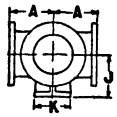
Single Sweep Cross



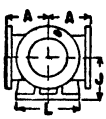
Double Sweep Cross



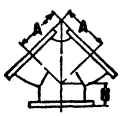
Side Outlet Cross



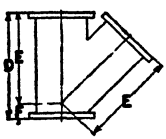
Base Cross



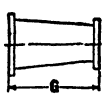
Anchorage Base Cross



True "Y"



Lateral



Reducer



Eccentric Reducer

GENERAL DIMENSIONS

STANDARD CAST IRON

AMERICAN STANDARD FOR 25 AND 125

(From Pipe Economy, 8th Ed., James B.

ALL DIMENSIONS

Size ..... Inches	1	1¼	1½	2
Diameter of Flanges	4¼	4⅝	5	6
AA—Face to Face, Tees and Crosses	7	7½	8	9
A—Center to Face Ells, Tees, Crosses and True Y's	3½	3¼	4	4½
B—Center to Face, Long Radius Ells	5	5½	6	6½
C—Center to Face, 22½° and 45° Ells	1¾	2	2¼	2½
D—Face to Face, Laterals	7½	8	9	10½
E—Center to Face, Laterals	5¾	6¼	7	8
F—Center to Face, Laterals	1¾	1¾	2	2½
G—Face to Face, Reducers	....	....	....	5
J—Center to Face, Base Flanges	3½	3⅝	3¾	4⅛
K—Diameter of Bases	3½	3½	4¼	4⅝
L—Across Flats of Anchorage Bases	....	....	....	....
M—Center to Face, 45° Long Radius Ells	2½	3	3¼	3½
N—Center to Face, True Y's	1¾	1¾	2	2½

Size ..... Inches	8	9†	10	12
Diameter of Flanges	13½	15	16	19
AA—Face to Face, Tees and Crosses	18	20	22	24
A—Center to Face Ells, Tees, Crosses and True Y's	9	10	11	12
B—Center to Face, Long Radius Ells	14	15¼	16½	19
C—Center to Face, 22½° and 45° Ells	5½	6	6½	7½
D—Face to Face, Laterals	22	24	25½	30
E—Center to Face, Laterals	17½	19½	20½	24½
F—Center to Face, Laterals	4½	4½	5	5½
G—Face to Face, Reducers	11	11½	12	14
J—Center to Face, Base Flanges	8⅜	....	9¾	11¼
K—Diameter of Bases	9	....	9	11
L—Across Flats of Anchorage Bases	13½	....	16	19
M—Center to Face, 45° Long Radius Ells	8	8½	9	9½
N—Center to Face, True Y's	4½	....	5	5½

Size ..... Inches	28†	30	32†	34†	36
Diameter of Flanges	36½	38¾	41¾	43¾	46
AA—Face to Face, Tees and Crosses	48	50	52	54	56
A—Center to Face Ells, Tees, Crosses and True Y's	24	25	26	27	28
B—Center to Face, Long Radius Ells	39	41½	44	46½	49
C—Center to Face, 22½° and 45° Ells	14	15	16	17	18
D—Face to Face Laterals	56	59	....	....	....
E—Center to Face Laterals	46½	49	....	....	....
F—Center to Face Laterals	9½	10	....	....	....
G—Face to Face Reducers	28	30	32	34	36
J—Center to Face, Base Flanges	....	22	....	....	25½
M—Center to Face, 45° Long Radius Ells	22	24	25	27	29
N—Center to Face, True Y's	....	10	....	....	....

Bold face figures in sizes indicate standard sizes of cast iron pipe.
For templates for drilling see special table.
†These sizes are special and are made to order only.

—STRAIGHT SIZES

FLANGED FITTINGS

POUNDS WORKING STEAM PRESSURE

Clow and Sons, publishers, by permission.)

ARE IN INCHES

2½	3	3½	4	4½†	5	6	7†
7	7½	8½	9	9¼	10	11	12½
10	11	12	13	14	15	16	17
5	5½	6	6½	7	7½	8	8½
7	7¾	8½	9	9½	10¼	11½	12¾
3	3	3½	4	4	4½	5	5½
12	13	14½	15	15½	17	18	20½
9½	10	11½	12	12½	13½	14½	16½
2½	3	3	3	3	3½	3½	4
5½	6	6½	7	7½	8	9	10
4½	4⅞	5¼	5½	....	6¼	7	....
4⅝	5	5	6	....	7	7	....
7	7½	8½	9	....	10	11	....
4	4½	4¾	5¼	5¼	6	6¾	7¾
2½	3	3	3	....	3½	3½	....

14	15†	16	18	20	22†	24	26†
21	22¼	23½	25	27½	29½	32	34¼
28	29	30	33	36	40	44	46
14	14½	15	16½	18	20	22	23
21½	22¾	24	26½	29	31½	34	36½
7½	8	8	8½	9½	10	11	13
33	34½	36½	39	43	46	49½	53
27	28½	30	32	35	37½	40½	44
6	6	6½	7	8	8½	9	9
16	17	18	19	20	22	24	26
12½	....	13¾	15	16	....	18½	....
11	....	11	13½	13½	....	13½	....
21	....	23½	25	27½	....	32	....
10	12	13	14	15	16	17	20
6	....	6½	7	8	....	9	..

38†	40†	42	44†	46†	48	54	60
48¾	50¾	53	55¼	57¼	59½	66¼	73
58	60	62	64	66	68	78	88
29	30	31	32	33	34	39	44
51½	54	56½	59	61½	64	71½	79
19	20	21	22	23	24	27	30
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
38	40	42	44	46	48	54	60
....	....	29¼	....	....	32¾	....	....
30	34	35	36	37	39	....	....
....	....	....	....	....	....	....	....

TEMPLATES FOR

STANDARD AND LOW PRESSURE FLANG-

AMERICAN STANDARD FOR 25 AND 125

(From Pipe Economy, 8th Ed., James B.

Size Inches	Diameter of Flanges Inches	Thickness of Flanges Inches		Bolt Circle Inches
		25 Lb. [1,2]	125 Lb.	
1	4¼†	.....	7/16	3⅛†
1¼	4⅝†	.....	½	3½†
1½	5	.....	9/16	3⅞
2	6	.....	⅝	4¾
2½	7	.....	11/16	5½
3	7½	.....	¾	6
3½	8½	.....	13/16	7
4	9	¾	15/16	7½
4½*	9¼	.....	15/16	7¾
5	10	¾	15/16	8½
6	11	¾	1	9½
7*	12½	.....	1 1/16	10¾
8	13½	¾	1 1/8	11¾
9*	15	.....	1 1/8	13¼
10	16	⅞	1 3/16	14¼
12	19	1	1¼	17
14	21	1⅛	1⅜	18¾
15*	22¼	.....	1⅜	20
16	23½	1⅛	1 7/16	21¼
18	25	1¼	1 9/16	22¾
20	27½	1¼	1 11/16	25
22*	29½	.....	1 13/16	27¼
24	32	1⅜	1⅞	29½
26*	34¼	.....	2	31¾
28*	36½	.....	2 1/16	34
30	38¾	1½	2⅛	36
32*	41¾	.....	2¼	38½
34*	43¾	.....	2 5/16	40½
36	46	1⅝	2⅜	42¾
38*	48¾	.....	2⅜	45¼
40*	50¾	.....	2½	47¼
42	53	1¾	2⅝	49½
44*	55¼	.....	2⅝	51¾
46*	57¼	.....	2 11/16	53¾
48	59½	2	2¾	56
54	66¼	2¼	3	62¾
60	73	2¼	3⅛	69¼
72	.....	2½	.....	.....
84	.....	2¾	.....	.....
96	.....	3	.....	.....

†Changed to conform to new standards, effective Jan. 1, 1925.

These Drilling Templates are in multiples of four, so that fittings may be made to face in any quarter, and bolt holes straddle the center line. For bolts smaller than 1¾ inches the bolt holes shall be drilled ⅛ inch larger in diameter than the nominal diameter of the bolt. Holes for bolts 1¾ inches and larger shall be drilled ¼ inch larger than nominal diameter of bolts. The bolt holes on cast iron flanged fittings are not spot faced for ordinary service. When required, the fittings and flanges in sizes 36 inches and larger can be spot faced or back faced, so that standard length bolts can be used. All 125 lb. cast iron standard flanges have a plain face.

DRILLING

ED PIPE, VALVES AND FITTINGS

POUNDS WORKING STEAM PRESSURE

Clow and Sons, publishers, by permission.)

Number of Bolts	Diameter of Bolts Inches		Length of Bolts Inches	Length of Studs with 2 Nuts Inches
	25 Lb.	125 Lb.		
4	.....	½†	1½	.....
4	.....	½†	1½	.....
4	.....	½	1¾	.....
4	.....	⅝	2	.....
4	.....	⅝	2¼	.....
4	.....	⅝	2¼	.....
8†	.....	⅝	2½	.....
8	⅝	⅝	2¾	.....
8	.....	¾	2¾	.....
8	⅝	¾	2¾	.....
8	⅝	¾	3	.....
8	.....	¾	3	.....
8	⅝	¾	3¼	.....
12	.....	¾	3¼	.....
12	⅝	⅞	3½	.....
12	⅝	⅞	3½	.....
12	¾	1	4	.....
16	.....	1	4	.....
16	¾	1	4¼†	.....
16	¾	1⅛	4½	.....
20	¾	1⅛	4¾	.....
20	.....	1¼	5	.....
20	¾	1¼	5¼	.....
24	.....	1¼	5½	.....
28	.....	1¼	5½	.....
28	⅞	1¼†	5¾	.....
28	.....	1½	6¼	.....
32	.....	1½	6½	.....
32	⅞	1½	6½	.....
32	.....	1⅝	6¾	9
36	.....	1⅝	7	9
36	1	1½†	7¼	9½
40	.....	1⅝	7¼	9½
40	.....	1⅝	7½	9½
44	1	1½†	7½	9½
44	1	1¾	8¼	10½
52	1⅛	1¾	8½	11
.....	1⅛	.....	.....	.....
.....	1¼	.....	.....	.....
.....	1¼	.....	.....	.....

*These sizes are special.

[1]Note: All 25 lb. cast iron standard flanges have plain faces.

[2]Note: Screwed Companion Flanges "should not be thinner than the '125 lb. American Standard' thickness on sizes 24 in. and smaller. Other types of flanges may have thicknesses as given in the table above."

GENERAL DIMENSIONS

EXTRA HEAVY CAST IRON

AMERICAN STANDARD FOR 250

(From Pipe Economy, 8th Ed., James B.

ALL DIMENSIONS

Size.....Inches	1	1¼	1½	2
Diameter of Flanges	4⅞	5¼	6⅛	6½
AA—Face to Face, Tees and Crosses	8	8½	9	10
A—Center to Face, Ells, Tees, Crosses and True Y's	4	4¼	4½	5
B—Center to Face, Long Radius Ells	5	5½	6	6½
C—Center to Face, 22½° and 45° Ells	2	2½	2¾	3
D—Face to Face, Laterals	8½	9½	11	11½
E—Center to Face, Laterals	6½	7¼	8½	9
F—Center to Face, Laterals	2	2¼	2½	2½
G—Face to Face, Reducers	....	....	....	5
J—Center to Face, Base Flanges	3¾	4	4⅛	4½
K—Diameter of Bases	4	4	4⅞	5¼
L—Across Flats of Anchorage Bases	....	....	....	....
M—Center to Face, 45° Long Radius Elbows	2¾	3½	3¾	4
N—Center to Face, True Y's	2	2¼	2½	2½

Size.....Inches	8	9†	10	12
Diameter of Flanges	15	16¼	17½	20½
AA—Face to Face, Tees and Crosses	20	21	23	26
A—Center to Face, Ells, Tees, Crosses and True Y's	10	10½	11½	13
B—Center to Face, Long Radius Ells	14	15¼	16½	19
C—Center to Face, 22½° and 45° Ells	6	6½	7	8
D—Face to Face, Laterals	25½	27½	29½	33½
E—Center to Face, Laterals	20½	22½	24	27½
F—Center to Face, Laterals	5	5	5½	6
G—Face to Face, Reducers	11	11½	12	14
J—Center to Face, Base Flanges	9	....	10½	12
K—Diameter of Bases	10	....	10	12½
L—Across Flats of Anchorge Bases	15	....	17½	20½
M—Center to Face, 45° Long Radius Elbows	8½	9	9½	10
N—Center to Face, True Y's	5	....	5½	6

Size.....Inches	28†	30	32†	34†
Diameter of Flanges	40¾	43	45¼	47½
AA—Face to Face, Tees and Crosses	52	55	58	61
A—Center to Face, Ells, Tees, Crosses	26	27½	29	30½
B—Center to Face, Long Radius Ells	39	41½	44	46½
C—Center to Face, 22½° and 45° Ells	14	15	16	17
D—Face to Face, Laterals	....	....	....	....
E—Center to Face, Laterals	....	....	....	....
F—Center to Face, Laterals	....	....	....	....
G—Face to Face, Reducers	28	30	32	34
M—Center to Face, 45° Long Radius Elbows	22	24	25	27

Bold face figures in sizes indicate extra heavy sizes of cast iron pipe.

For templates for drilling see special table.

†These sizes are special.

—STRAIGHT SIZES

FLANGED FITTINGS

POUNDS WORKING STEAM PRESSURE

Clow and Sons, publishers, by permission.)

ARE IN INCHES

2½	3	3½	4	4½†	5	6	7†
7½	8¼	9	10	10½	11	12½	14
11	12	13	14	15	16	17	18
5½	6	6½	7	7½	8	8½	9
7	7¾	8½	9	9½	10¼	11½	12¾
3½	3½	4	4½	4½	5	5½	6
13	14	15½	16½	18	18½	21½	23½
10½	11	12½	13½	14½	15	17½	19
2½	3	3	3	3½	3½	4	4½
5½	6	6½	7	7½	8	9	10
4¾	5¼	5⅝	6	....	6¾	7½	....
5¼	6⅛	6⅛	6½	....	7½	7½	....
7½	8¼	9	10	....	11	12½	....
4½	5	5¼	5¾	5¾	6½	7¼	8¼
2½	3	3	3	....	3½	4	....

14	15†	16	18	20	22†	24	26†
23	24½	25½	28	30½	33	36	38¼
30	31	33	36	39	41	45	48
15	15½	16½	18	19½	20½	22½	24
21½	22¾	24	26½	29	31½	34	36½
8½	9	9½	10	10½	11	12	13
37½	39½	42	45½	49	53	57½	....
31	33	34½	37½	40½	43½	47½	....
6½	6½	7½	8	8½	9½	10	....
16	17	18	19	20	22	24	26
13½	....	14¾	16¼	17⅞	....	20¾	....
12½	....	12½	15	15	....	17½	....
23	....	25½	28	30½	....	36	....
11	13	14½	15½	16	17	18	20
6½	....	7½	8	8½	....	10	....

36	38†	40†	42	44†	46†	48	
50	52¼	54½	57	59¼	61½	65	....
65	68	71	74	78	81	84	....
32½	34	35½	37	39	40½	42	....
49	51½	54	56½	59	61½	64	....
18	19	20	21	22	23	24	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....
36	38	40	42	44	46	48	....
29	30	34	35	36	37	39	....

TEMPLATES

EXTRA HEAVY FLANGED

AMERICAN STANDARD FOR 250

(From Pipe Economy, 8th Ed., James B.

Size Inches	Diameter of Flanges Inches	Thickness of Flanges Inches	Diam. of Raided Face
1	4⅞†	1 1/16	2 1 1/16
1¼	5¼†	¾	3 1/16
1½	6⅛†	1 3/16	3 5/16
2	6½	⅞	4 3/16
2½	7½	1	4 15/16
3	8¼	1⅛	5 1/16
3½	9	1 3/16	6 5/16
4	10	1¼	6 15/16
4½*	10½	1 5/16	7 9/16
5	11	1⅜	8 5/16
6	12½	1 7/16	9 11/16
7*	14	1½	10 13/16
8	15	1 5/8	11 15/16
9*	16¼	1¾	12 13/16
10	17½	1⅞	14 1/16
12	20½	2	16 7/16
14	23	2⅛	18 15/16
15*	24½	2 3/16	20 1/16
16	25½	2¼	21 1/16
18	28	2⅜	23 5/16
20	30½	2½	25 5/16
22*	33	2⅝	27 9/16
24	36	2¾	30 5/16
26*	38¼	2 13/16	.....
28*	40¾	2 15/16	.....
30	43	3	37 3/16
32*	45¼	3⅛	.....
34*	47½	3¼	.....
36	50	3⅜	43 11/16
38*	52¼	3 7/16	.....
40*	54½	3 9/16	.....
42	57	3 11/16	50 7/16
44*	59¼	3¾	.....
46*	61½	3⅞	.....
48	65	4	58 7/16

†Changed to conform to new standards, effective Jan. 1, 1928.

These Drilling Templates are in multiples of four, so that fittings may be made to face in any quarter, and bolt holes straddle the center line.

For bolts smaller than 1¼ inch the bolt holes shall be drilled ⅛ inch larger in diameter than the nominal size of the bolt. Holes for bolts 1¼ inches and larger shall be drilled ¼ inch larger than nominal diameter of bolts.

FOR DRILLING

PIPE, VALVES AND FITTINGS

POUNDS WORKING STEAM PRESSURE

Clow and Sons, publishers, by permission.)

Bolt Circle Inches	Number of Bolts	Diameter of Bolts Inches	Length of Bolts Inches	Length of Studs With 2 Nuts Inches
3½†	4	⅝†	2¼†	.....
3⅞†	4	⅝†	2½†	.....
4½	4	¾†	2½	.....
5	8†	⅝	2½	.....
5⅞	8†	¾	3	.....
6⅝	8	¾	3¼	.....
7¼	8	¾	3¼	.....
7⅞	8	¾	3½	.....
8½	8	¾	3½	.....
9¼	8	¾	3¾	.....
10⅝	12	¾	3¾	.....
11⅞	12	⅞	4	.....
13	12	⅞	4¼	.....
14	12	1	4¾	.....
15¼	16	1	5	.....
17¾	16	1⅛	5¼	.....
20¼	20	1⅛	5½	.....
21½	20	1¼	5¾	.....
22½	20	1¼	6	.....
24¾	24	1¼	6¼	.....
27	24	1¼†	6½	.....
29¼	24	1½	7	.....
32	24	1½†	7½	9½
34½	28	1⅝	7¾	10
37	28	1⅝	8	10
39¼	28	1¾	8¼	10½
41½	28	1⅞	8½	11
43½	28	1⅞	9	11½
46	32	2†	9¼	11½
48	32	1⅞	9¼	11½
50¼	36	1⅞	9½	12
52¾	36	2†	9¾	12
55	36	2	10	12½
57¼	40	2	10¼	13
60¾	40	2	10½	13

The bolt holes on cast iron flanged fittings are not spot faced for ordinary service. When required, the fittings and flanges in sizes 36 inches and larger can be spot faced or back faced so that standard length bolts can be used.

All 250 pound standard flanges have a ⅛ inch raised face. This raised face is included in the face to face, center to face and the minimum thickness of flange dimensions.

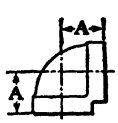
†These sizes are special.

STANDARD CAST IRON SCREWED FITTINGS

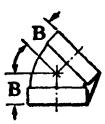
WORKING PRESSURES: 125 Pounds Steam, 175 Pounds Cold Water, Oil, or Gas, Non-shock.

(From Crane Catalogue, No. 52, by permission.)

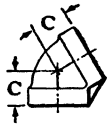
ALL DIMENSIONS ARE IN INCHES



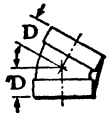
90° Elbow



45° Elbow



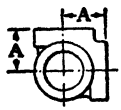
60° Elbow



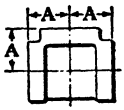
30° Elbow



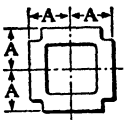
22½° Elbow



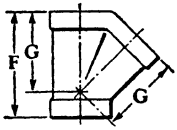
Side Outlet Elbow



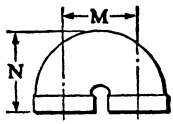
Tee



Cross



45° Y Bend



Return Bend



Cap



Reducer



Eccentric Reducer

Size	¼	⅜	½	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12
A	1 3/16	1 5/16	1 1/8	1 5/16	1 1/2	1 3/4	1 15/16	2 1/4	2 11/16	3 1/8	3 7/16	3 3/4	4 1/2	5 1/8	6 9/16	8 1/16	9 1/2
B	¾	1 3/16	⅞	1	1 1/8	1 5/16	1 7/16	1 11/16	1 15/16	2 3/16	2 3/8	2 5/8	3 1/16	3 7/16	4 1/4	5 3/16	6
C	—	—	1	1 1/16	1 1/4	1 7/16	1 5/8	1 7/8	2 3/16	2 1/2	—	3	3 1/2	4 1/16	—	—	—
D	—	—	1 3/16	1 5/16	1	1 3/16	1 5/16	1 3/4	1 13/16	1 13/16	—	2 3/8	2 5/8	2 7/8	—	—	—
E	—	—	¾	⅞	1	1 1/8	1 1/4	1 7/16	1 9/16	1 3/4	—	2 1/16	2 1/4	2 7/16	—	—	—
F	—	—	2 1/2	3	3 1/2	4 1/4	4 7/8	5 3/4	6 3/4	7 7/8	8 7/8	9 3/4	11 5/8	13 7/16	16 15/16	20 11/16	24 1/8
G	—	—	1 7/8	2 1/4	2 3/4	3 1/4	2 1/4	4 1/2	5 3/16	6 1/8	6 7/8	7 5/8	9 1/4	10 3/4	13 5/8	16 3/4	19 5/8
H	—	—	—	—	—	—	—	—	—	—	—	2 1/16	2 3/8	2 5/8	3 1/8	3 5/8	4 1/4
J	—	—	—	1 1/2	1 7/8*	2 1/8	2 1/4	2 7/16	2 5/8	2 7/8	3 1/8	3 3/8	3 7/8	4 3/8	5 1/4	6 3/16	7 1/8
K	—	—	—	—	—	2 1/8	2 1/4	2 7/16	2 11/16	2 15/16	3 1/8	3 3/8	3 7/8	4 3/8	5 1/4	—	—
M•	—	—	1 1/4	1 1/2	1 3/4	2 1/4	2 1/2	3 1/4	3 3/4	4 1/4	—	6	—	—	—	—	—
N•	—	—	1 23/32	2 1/32	2 3/8	2 29/32	3 1/4	3 31/32	4 9/16	5 3/16	—	6 13/16	—	—	—	—	—
M°	—	—	—	1 7/8	2 1/2	3	3 1/2	4 1/2	5 1/2	6 1/2	—	7 1/2	—	—	—	—	—
N°	—	—	—	2 7/32	2 11/16	3 9/32	3 3/4	4 19/32	5 7/16	6 5/16	—	7 9/16	—	—	—	—	—
Size	1	1	1	1	1	1¼	1¼	1¼	1½	1½	1½	2	2	2	2	4	
M▾	3	4	5	6	8	4	6	8	4 7/8	6	8	4 7/8	6	7	8	11	
N▾	3	3½	4	4½	5½	3¾	4¾	5¼	4 7/16	5	6	4¾	5 5/16	5 13/16	6⅞	9 5/16	

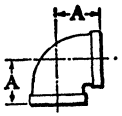
* 1 × ½-inch reducers are 1 11/16 inches end to end.
• Close pattern.
° Open pattern.
▾ Wide pattern.

STANDARD MALLEABLE IRON SCREWED FITTINGS

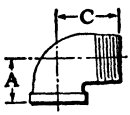
WORKING PRESSURES, BANDED FITTINGS *: 150 Pounds Steam, 300 Pounds Cold Water, Oil, or Gas, Non-shock.

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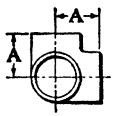
ALL DIMENSIONS ARE IN INCHES



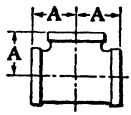
90° Elbow



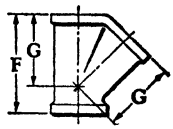
90° Street Elbow



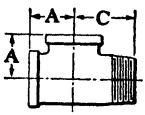
Side Outlet Elbow



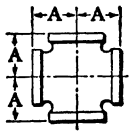
Tee



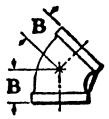
45° Y Bend



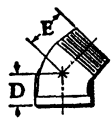
Service Tee



Cross



45° Elbow



45° Street Elbow



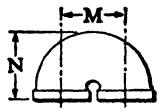
Cap



Coupling



Reducer



Return Bend

Size	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6
A	1 1/16	1 3/16	1 5/16	1 1/8	1 5/16	1 1/2	1 3/4	1 15/16	2 1/4	2 11/16	3 1/8	3 7/16	3 3/4	4 1/2	5 1/8
B	1/2	3/4	1 3/16	7/8	1	1 1/8	1 5/16	1 7/16	1 11/16	1 15/16	2 3/16	2 3/8	2 5/8	3 1/16	3 7/16
C	1	1 3/16	1 7/16	1 5/8	1 7/8	2 1/8	2 7/16	2 11/16	3 1/4	3 13/16	4 1/2	5 1/8	5 11/16	6 7/8	8
D	1 1/16	5/8	1 1/16	1 3/16	1 5/16	1 1/16	1 1/4	1 3/8	1 11/16	1 7/8	2 1/8	2 3/8	2 1/2	—	—
E	1 3/16	1 5/16	1 1/16	1 3/16	1 5/16	1 1/2	1 11/16	1 7/8	2 1/4	2 9/16	3	3 3/8	3 3/4	—	—
F	—	—	2 1/8	2 7/16	2 13/16	3 3/8	4 1/16	4 1/2	5 7/16	6 1/4	7 1/4	—	8 7/8	—	—
G	—	—	1 7/16	1 11/16	2 1/16	2 7/16	2 15/16	3 5/16	4	4 11/16	5 9/16	—	6 15/16	—	—
H	9/16	5/8	3/4	7/8	1 1/16	1 3/16	1 1/4	1 5/16	1 7/16	1 5/8	1 3/4	1 15/16	2 1/16	2 5/16	2 9/16
J	1 5/16	1 1/16	1 3/16	1 5/16	1 1/2	1 11/16	1 15/16	2 1/8	2 1/2	2 7/8	3 3/16	3 7/16	3 11/16	4 1/4	4 3/4
K	—	1	1 1/8	1 1/4	1 7/16	1 11/16	2 1/16	2 5/16	2 13/16	3 1/4	3 11/16	4	4 3/8	3 7/8	4 3/8
M•	—	—	—	1	1 1/4	1 1/2	1 3/4	2 3/16	2 5/8	—	—	—	—	—	—
N•	—	—	—	1 3/4	2 3/16	2 1/2	2 13/16	3 3/16	3 7/8	—	—	—	—	—	—
M°	—	—	—	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	—	6	—	—
N°	—	—	—	1 7/8	2 1/4	2 5/8	3 3/16	3 5/8	4 3/8	4 15/16	5 9/16	—	6 11/16	—	—
M m	—	—	—	1 1/4	1 1/2	1 7/8	2 1/4	2 1/2	3	—	—	—	—	—	—
N m	—	—	—	1 5/8	1 15/16	2 1/4	2 13/16	3 3/16	3 7/8	—	—	—	—	—	—
M w	—	—	1 1/2	—	4	6	6	6	5	—	7 1/2	—	—	—	12
N w	—	—	1 5/8	—	3 3/16	4 1/2	4 3/4	5	4 3/4	—	6 13/16	—	—	—	11 1/16
M w	—	—	—	—	6	—	—	—	6	—	8	—	—	—	—
N w	—	—	—	—	4 1/2	—	—	—	5 5/16	—	6 13/16	—	—	—	—

* Plain fittings have the same center to end dimensions as the corresponding size of banded fittings.

• Close pattern.

° Open pattern.

m Medium pattern.

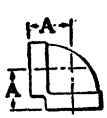
w Wide pattern.

STANDARD MALLEABLE IRON SCREWED FITTINGS

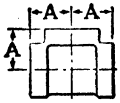
WORKING PRESSURE: 300 Pounds Steam.

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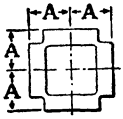
ALL DIMENSIONS ARE IN INCHES



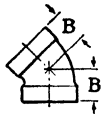
90° Elbow



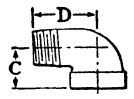
Tee



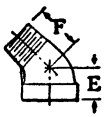
Cross



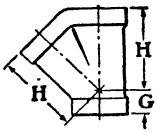
45° Elbow



90° Street Elbow



45° Street Elbow



45° Y Bend



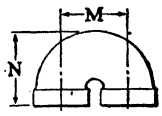
Reducer



Cap



Coupling



Return Bend

Size	¼	⅜	½	¾	1	1¼	1½	2	2½	3	
A	15/16	1 1/16	1 1/4	1 7/16	1 5/8	1 15/16	2 1/8	2 1/2	2 15/16	3 3/8	
B	13/16	7/8	1	1 1/8	1 5/16	1 1/2	1 11/16	2	2 1/4	2 1/2	
C	13/16	15/16	1 1/4	1 7/16	1 5/8	1 15/16	2 1/8	2 1/2	3 1/4	3 3/4	
D	1 7/16	1 5/8	2	2 3/16	2 9/16	2 7/8	3 1/8	2 11/16	4 1/2	5 1/8	
E	3/4	13/16	1	1 1/8	1 5/16	1 1/2	1 11/16	2	—	—	
F	1 1/8	1 1/4	1 3/8	1 9/16	1 13/16	2 1/8	2 5/16	2 11/16	—	—	
G	—	—	3/4	7/8	1	1 1/16	1 1/4	1 9/16	1 3/4	2	
H	—	—	2	2 3/8	3 1/4	3 13/16	4 1/2	5 3/16	6 1/8	6 7/8	
J	—	1 7/16	1 11/16	1 3/4	2	2 3/8	2 11/16	3 3/16	3 11/16	4 1/16	
K	25/32	7/8	1 1/16	1 1/4	1 3/8	1 1/2	1 11/16	1 13/16	2 1/8	2 1/4	
L	1 3/8	1 5/8	1 7/8	2 1/8	2 3/8	2 7/8	2 7/8	3 5/8	4 1/8	4 1/8	
Size	**1**	**1**	**1**	**1¼**	**1¼**	**1¼**	**1¼**	**1¼**	**1¼**		
M	1 3/4	2 1/2	3	2 1/4	2 1/2	3	3 1/2	4	6		
N	2 7/8	3 1/4	3 1/2	3 5/16	3 11/16	3 15/16	4 3/16	4 7/16	5		
Size	**1½**	**1½**	**1½**	**1½**	**1½**	**2**	**2**	**2**	**2**	**2**	**2**
M	2 1/2	3	3 1/2	6	8	3	3 1/2	4	4 5/8	6	8
N	3 3/8	4 3/16	3 15/16	5 11/16	6 11/16	4 5/8	4 7/8	5 1/8	5 7/16	6 1/8	7 1/8

BRIGG'S STANDARD GAGE FOR IRON PIPE

Size inches	Number of threads per inch of screw	Diameters in inches		Transverse areas			Length of pipe in feet per sq. foot of	
		External	Approximate Internal	External sq. inches	Internal sq. inches	Internal sq. feet	External surface	Internal surface
⅛	27	0.405	0.269	0.129	0.057	0.000396	9.431	14.199
¼	18	0.540	0.364	0.229	0.104	0.000722	7.073	10.493
⅜	18	0.675	0.493	0.358	0.191	0.001325	5.658	7.747
½	14	0.840	0.622	0.554	0.304	0.00211	4.547	6.141
¾	14	1.050	0.824	0.866	0.533	0.0037	3.637	4.635
1	11½	1.315	1.049	1.358	0.864	0.0060	2.904	3.641
1¼	11½	1.660	1.380	2.164	1.495	0.0137	2.301	2.767
1½	11½	1.900	1.610	2.835	2.036	0.0141	2.010	2.372
2	11½	2.375	2.067	4.430	3.355	0.0233	1.608	1.847
2½	8	2.875	2.469	6.492	4.788	0.0332	1.328	1.547
3	8	3.500	3.068	9.621	7.393	0.0513	1.091	1.245
4	8	4.500	4.026	15.904	12.730	0.0885	0.848	0.948
6	8	6.625	6.065	34.472	28.891	0.2000	0.576	0.629
8	8	8.625	7.981	58.426	50.027	0.348	0.442	0.478
10	8	10.750	10.020	90.763	78.855	0.547	0.355	0.381
12	8	12.750	12.000	127.676	113.097	0.787	0.299	0.318

FLOW OF WATER IN CAST IRON PIPE

(From Pipe Economy, 8th Ed., James B. Clow and Sons, publishers, by permission.)

In attempting to compute the capacity of a pipe line or to figure the probable loss in head, after the pipe has reached a certain age, it is absolutely essential to know something about the water to be conveyed. In most cases the quality of the water is such that the carrying capacity is affected very little by the age of the pipe. In other cases, the water may be so soft as to cause tuberculation and consequent loss in carrying capacity or so turbid as to cause deposits of sand or mud with the same effect. Waters that cause tuberculation are the rare exception and outside of a few raw water conduits, muddy water is also unusual.

In spite of this fact, many of the books and articles on hydraulics and water supply, make the bold statement that a definite correction factor must be applied to flow formulae as the pipe increases in age. It is evident that this is incorrect, since first of all a large number of experiments have been made that show quite definitely that in many places there is no change whatever in carrying capacity with age. Secondly, assume that a layer of tubercles 2 inches thick are produced as a result of many years use of a pipe, it is evident that the carrying capacity of a 12 inch pipe would be considerably more reduced than would a 48 inch pipe with the same thickness of tubercles, a fact that is not taken into consideration in the formulae in common use.

In presenting the flow tables, that follow, we are giving the values for new pipe. In most cases, it can be told beforehand whether or not the water to be conveyed will cause tuberculation. If tuberculation is not to be expected, ordinary Cast Iron Pipe should be used and the carrying capacity figured as shown in the tables. If it is known beforehand, the water is of such a nature as to cause tuberculation, cement lined Cast Iron Pipe should be used and, as in

previous case, the tables used without any correction factor.

The following tables represent the Flow of Water through Clean Cast Iron Pipe computed by the Formula derived after careful investigation by Edward Wegmann, C. E.[1] and Albert N. Aeryns, C. E.[2] The Wegmann-Aeryns Formula, which appeared in the Engineering News-Record for July 16, 1925, is as follows:

$$V = 182.5\ R^{0.723}\ S^{0.539}$$

in which

V = Velocity in feet per second
R = Hydraulic radius in feet
S = Slope of the hydraulic gradient, or loss of head in feet per foot of pipe.

It should be remembered that the "loss of head," or friction head, given in feet per thousand feet of length, is also the fall in feet per thousand (the slope) required to produce the given velocity in pipe of the diameter given. The following examples illustrate the various uses of the table:

EXAMPLE 1. MAXIMUM DELIVERY

To find the maximum delivery of an 8-inch pipe, 7,500 feet long under 150 foot head. The available head per thousand feet is 150 ÷ 7.5 = 20 feet per thousand. The table for 8-inch pipe, under "loss of head," shows that for a loss of head of 15.7 feet per thousand the corresponding delivery at velocity of 5.32 feet per second is 1,200,000 gallons per day; the approximate value for a loss of 20 feet may then be calculated by interpolation.

EXAMPLE 2. DETERMINATION OF DIAMETER

To find diameter of pipe necessary to deliver 3,000,000 gallons per day through a line 25,000 feet long under 150 foot head. The available head per thousand feet is 150 ÷ 25 = 6 feet per thousand. Reading across table from discharge of 3,000,000 gallons, at the left, the first "loss of head" of 6 feet or less per thousand is 5.1 under 14-inch pipe. Hence the least diameter which will answer in regular commercial sizes is 14 inches.

EXAMPLE 3. FRICTION LOSS

To find loss of head through a 10-inch line, 4,000 feet long delivering 1,000 gallons per minute. The table shows "loss of head" in a 10-inch pipe delivering 972 gallons per minute to be 6.8 feet per 1,000 feet of length; hence in 4,000 feet the loss will be 27.2 feet. If the water is delivered at a point 100 feet above pump, the total head pumped against is 100 feet (static) plus 27.2 feet (friction), or 127.2 feet total.

EXAMPLE 4. DELIVERY DETERMINED FROM PRESSURE REDUCTION

Two accurate pressure gauges should be placed at a known distance apart, and measurement made of the difference in elevation of the points where readings are taken; thus, if in a 12-inch pipe the gauges are 500 feet apart and show a difference in pressure of 2 pounds (4.6 feet) while one gauge is 1.8 feet above the other, the actual loss of head will be 4.6 plus or minus 1.8 = 6.4 or 2.8 feet per 500 feet, or 12.8 or 5.6 feet per thousand feet. In the table for 12-inch pipe we find that a loss of head of 5.2 feet per thousand is due to velocity of 3.94 corresponding to discharge of 2,000,000 gallons per day.

EXAMPLE 5. TO FIND THE PRESSURE

To find the pressure at any point in a water main when diameter, rate of delivery and static head are known. Assume that 1,200,000 gallons per day are to be pumped through 5,000 feet of 12-inch pipe laid on an incline to a total vertical height of 100 feet and that it is desired to learn the pressure in the pipe at each 1,000 feet from the pump. At the given delivery the loss of head in a 12-inch pipe is 2.0 per 1,000 feet or 10.0 for 5,000 feet; to this is added the static head, making total of 110 feet. The drop in pressure for each 1,000 feet will then be one-fifth of this quantity or 22 feet.

(See table on the next page)

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FLOW OF WATER IN CAST IRON PIPE

Frictional Heads, per Thousand Feet, at Given Rates of Discharge

(From Cameron Hydraulic Data, 9th Ed., 1934, Ingersoll-Rand Co., publishers, by permission.)

The tables on the following pages may be used for all liquids having a viscosity equal to that of water. The head loss will read in feet of the liquid regardless of its specific gravity. The values are those calculated for cast iron pipe. Where other types of pipe are being employed the head loss in the tables must be multiplied by a suitable factor in order to correct them. These correction factors are:

0.54 for very smooth and straight wrought iron, brass or tin pipe.
0.64 for copper tubing, ordinary straight brass or tin pipe.
0.71 for smooth wrought iron pipe.
0.84 for spiral riveted steel pipe (flow with lap).
1.00 for cast iron pipe; spiral riveted steel pipe (flow against lap).

Discharge Gals. per Minute	Discharge Gals. per 24 Hours	⅛" Pipe		¼" Pipe		⅜" Pipe	
		Velocity ft. per Second	Loss of Head ft. per 1000 ft. of pipe	Velocity ft. per Second	Loss of Head ft. per 1000 ft. of pipe	Velocity ft. per Second	Loss of Head ft. per 1000 ft. of pipe
0.2	288	1.12	62	....	....	....	....
0.4	576	2.24	220	....	....	....	....
0.5	720	....	....	1.54	78	....	....
0.6	864	3.36	470	....	....	....	....
0.8	1,152	4.48	800	....	....	....	....
1.0	1,440	5.60	1,210	3.08	280	1.67	64
1.5	2,160	....	....	4.60	600	....	....
2.0	2,880	....	....	6.16	1,030	3.35	233
2.5	3,600	....	....	7.70	1,530	....	....
3.0	4,320	....	....	....	....	5.02	490
4.0	5,760	....	....	....	....	6.70	840
5.0	7,200	....	....	....	....	8.37	1,260
		½" Pipe		¾" Pipe		1" Pipe	
1	1,440	1.05	21	....	....	....	....
2	2,880	2.10	74	1.20	19	....	....
3	4,320	3.16	158	1.80	41	1.12	12.6
4	5,760	4.21	270	2.41	70	1.49	21.4
5	7,200	5.26	410	3.01	105	1.86	32.5
6	8,640	6.31	570	3.61	147	2.23	45.5
7	10,080	7.37	760	....	....	....	....
8	11,520	8.42	980	4.81	250	2.98	78
9	12,960	9.47	1,210	....	....	....	...
10	14,400	10.52	1,470	6.02	380	3.72	117
12	17,280	....	....	7.22	530	4.46	164
14	20,160	....	....	....	....	5.20	220
15	21,600	....	....	9.02	800	....	...
16	23,040	....	....	....	....	5.95	280
18	25,920	....	....	....	....	6.69	350
20	28,800	....	....	12.03	1,360	7.44	420
25	36,000	....	....	....	....	9.30	640
30	43,200	....	....	....	....	11.15	890
35	50,400	....	....	....	....	13.02	1,190
40	57,600	....	....	....	....	14.88	1,520

FLOW OF WATER IN CAST IRON PIPE

Frictional Heads, per Thousand Feet, at Given Rates of Discharge

(From Cameron Hydraulic Data, 9th Ed., 1934, Ingersoll-Rand Co., publishers, by permission.)

Discharge Gals. per Minute	Discharge Gals. per 24 Hours	1¼" Pipe		1½" Pipe		2" Pipe	
		Velocity ft. per Second	Loss of Head ft. per 1000 ft. of pipe	Velocity ft. per Second	Loss of Head ft. per 1000 ft. of pipe	Velocity ft. per Second	Loss of Head ft. per 1000 ft. of pipe
4	5,760	0.86	5.7	0.63	2.6	....	...
5	7,200	1.07	8.4	0.79	4.0	....	...
6	8,640	1.29	12.0	0.94	5.6	0.61	2.0
7	10,080	1.50	15.9	1.10	7.4	....	...
8	11,520	1.72	20.3	1.26	9.5	0.82	3.3
9	12,960	....	....	1.42	11.8	....	...
10	14,400	2.14	30.5	1.57	14.3	1.02	5.0
12	17,280	2.57	43	1.89	20.1	1.23	7.9
14	20,160	3.00	57	2.20	26.8	1.43	9.4
16	23,040	3.43	73	2.52	34.1	1.63	12.0
18	25,920	3.86	91	2.83	42.4	1.84	14.9
20	28,800	4.29	111	3.15	52	2.04	18.2
22	31,680	....	....	3.46	62	....	....
24	34,560	....	....	3.78	73	....	....
25	36,000	5.36	166	....	..	2.55	27.3
26	37,440	....	....	4.09	84	....	....
28	40,320	....	....	4.41	97	....	....
30	43,200	6.43	230	4.72	110	3.06	38.4
35	50,400	7.51	312	5.51	147	3.57	51
40	57,600	8.58	400	6.30	188	4.08	66
45	64,800	....	....	7.08	232	4.60	82
50	72,000	10.72	600	7.87	284	5.11	99
55	79,200	....	....	8.66	340	5.62	118
60	86,400	12.87	850	9.44	396	6.13	139
65	93,600	....	....	10.23	459	6.64	161
70	100,800	15.01	1,130	11.02	530	7.15	184
75	108,000	....	....	11.80	600	7.66	209
80	115,200	17.16	1,450	12.59	680	8.17	237
85	122,400	....	....	13.38	750	....	...
90	129,600	19.30	1,800	14.71	840	9.19	294
95	136,800	....	....	14.95	930	....	...
100	144,000	....	....	15.74	1,020	10.21	358
110	158,400	....	....	17.31	1,220	11.23	429
120	172,800	....	....	18.89	1,430	12.25	500
130	187,200	....	....	20.46	1,660	13.28	580
140	210,600	....	....	22.04	1,900	14.30	670
150	216,000	....	....	....	....	15.32	760
160	230,400	....	....	....	....	16.34	860
170	244,800	....	....	....	....	17.36	960
180	259,200	....	....	....	....	18.38	1,070
190	273,600	....	....	....	....	19.40	1,180
200	288,000	....	....	....	....	20.42	1,290
220	316,800	....	....	....	....	22.47	1,540
240	345,600	....	....	....	....	24.51	1,820
260	374,400	....	....	....	....	26.55	2,110

FLOW OF WATER IN CAST IRON PIPE

Frictional Heads, per Thousand Feet, at Given Rates of Discharge

(From Cameron Hydraulic Data, 9th Ed., 1934, Ingersoll-Rand Co., publishers, by permission.)

Discharge Gals. per Minute	Discharge Gals. per 24 Hours	2½" Pipe		3" Pipe	
		Velocity ft. per Second	Loss of Head ft. per 1000 ft. of pipe	Velocity ft. per Second	Loss of Head ft. per 1000 ft. of pipe
8	11,520	0.52	1.1	....	...
10	14,400	0.65	1.7	0.45	0.7
12	17,280	0.78	2.3	....	....
14	20,160	0.92	3.2	....	...
15	21,600	....	...	0.68	1.5
16	23,040	1.05	4.2	....	...
18	25,920	1.18	5.0	....	...
20	28,800	1.31	6.1	0.91	2.5
25	36,000	1.63	9.2	1.13	3.8
30	43,200	1.96	12.9	1.36	5.4
35	50,400	2.29	17.2	1.59	7.1
40	57,600	2.61	22.0	1.82	9.1
50	72,000	3.27	33.2	2.27	13.8
60	86,400	3.92	46.5	2.72	19.2
70	100,800	4.58	62	3.18	25.7
80	115,200	5.23	79	3.63	32.8
90	129,600	5.88	98	4.09	40.8
100	144,000	6.54	120	4.54	49.6
120	172,800	7.84	160	5.45	70
140	201,600	9.15	223	6.35	92
160	230,400	10.46	290	7.26	118
180	259,200	11.76	357	8.17	148
200	288,000	13.07	431	9.08	178
220	316,800	14.38	520	9.99	213
240	345,600	15.69	610	10.89	251
260	374,400	16.99	700	11.80	291
280	403,200	18.30	810	12.71	334
300	432,000	19.61	920	13.62	380
320	460,800	20.92	1,030	14.52	428
340	489,600	22.22	1,160	15.43	479
360	518,400	23.53	1,280	16.34	530
380	527,200	24.84	1,420	17.25	590
400	576,000	26.14	1,560	18.16	650
420	604,800	27.45	1,710	19.06	710
440	633,600	28.76	1,860	19.97	770
460	662,400	30.07	2,050	20.88	840
480	691,200	....	....	21.79	910
500	720,000	....	....	22.70	980
550	792,000	....	....	24.96	1,170
600	864,000	....	....	27.23	1,370

FLOW OF WATER IN CAST IRON PIPE

Frictional Heads, per Thousand Feet, at Given Rates of Discharge

(From Pipe Economy, 8th Ed., James B. Clow and Sons, publishers, by permission.)

Discharge Gals. per Minute	Discharge Gals. per 24 Hours	4" Pipe		6" Pipe		8" Pipe	
		Velocity ft. per Second	Loss of Head ft. per 1000 ft. of pipe	Velocity ft. per Second	Loss of Head ft. per 1000 ft. of pipe	Velocity ft. per Second	Loss of Head ft. per 1000 ft. of pipe
35	50,000	0.89	1.4				
69	100,000	1.78	5.2	0.79	0.7		
104	150,000	2.68	11.0	1.18	1.4		
139	200,000	3.56	18.7	1.58	2.4	0.89	0.6
153	220,000	3.91	22.3	1.73	2.9	0.98	0.7
167	240,000	4.27	26.2	1.89	3.4	1.06	0.8
181	260,000	4.63	30.4	2.05	3.9	1.15	0.9
194	280,000	4.99	34.9	2.21	4.5	1.24	1.1
208	300,000	5.34	39.7	2.36	5.1	1.33	1.2
243	350,000	6.23	52.9	2.76	6.8	1.55	1.6
278	400,000	7.12	67.7	3.15	8.7	1.77	2.0
312	450,000	8.00	84.2	3.55	10.9	1.99	2.5
347	500,000	8.90	102.0	3.94	13.2	2.22	3.1
417	600,000	10.68	144.0	4.73	18.5	2.66	4.3
486	700,000			5.52	24.7	3.10	5.8
556	800,000			6.30	31.6	3.55	7.4
625	900,000			7.00	39.3	3.99	9.2
694	1,000,000			7.89	47.8	4.43	11.2
833	1,200,000			9.46	67.0	5.32	15.7
972	1,400,000					6.20	20.8
1111	1,600,000					7.09	26.7
1250	1,800,000					7.98	33.2
1389	2,000,000					8.86	40.4
1528	2,200,000					9.75	48.2
		10" Pipe		12" Pipe		14" Pipe	
174	250,000	0.71	0.3	0.49	0.1		
208	300,000	0.85	0.4	0.59	0.2		
243	350,000	0.99	0.5	0.69	0.2	0.51	0.1
278	400,000	1.13	0.7	0.79	0.3	0.58	0.1
312	450,000	1.28	0.8	0.89	0.3	0.65	0.2
347	500,000	1.42	1.0	0.99	0.4	0.72	0.2
417	600,000	1.70	1.4	1.18	0.6	0.87	0.3
486	700,000	1.99	1.9	1.38	0.8	1.01	0.3
556	800,000	2.27	2.4	1.58	1.0	1.16	0.4
625	900,000	2.55	3.0	1.77	1.2	1.30	0.5
694	1,000,000	2.84	3.6	1.97	1.4	1.45	0.7
833	1,200,000	3.40	5.1	2.36	2.0	1.74	0.9
972	1,400,000	3.97	6.8	2.76	2.7	2.02	1.2
1111	1,600,000	4.54	8.7	3.15	3.4	2.32	1.6
1250	1,800,000	5.11	10.7	3.55	4.3	2.60	2.0
1389	2,000,000	5.67	13.1	3.94	5.2	2.90	2.4
1528	2,200,000	6.24	15.6	4.33	6.2	3.18	2.9
1667	2,400,000	6.81	18.4	4.73	7.3	3.48	3.4
1806	2,600,000	7.38	21.3	5.12	8.5	3.76	3.9
1944	2,800,000	7.94	24.4	5.52	9.7	4.05	4.5
2083	3,000,000	8.51	27.8	5.91	11.0	4.35	5.1
2222	3,200,000	9.08	31.3	6.30	12.5	4.63	5.7
2361	3,400,000	9.65	35.0	6.70	14.0	4.92	6.4
2500	3,600,000			7.09	15.5	5.21	7.1
2639	3,800,000			7.48	17.2	5.50	7.9

FLOW OF WATER IN CAST IRON PIPE

Frictional Heads, per Thousand Feet, at Given Rates of Discharge

(From Pipe Economy, 8th Ed., James B. Clow and Sons, publishers, by permission)

Discharge Gals. per Minute	Discharge Gals. per 24 Hours	10″ Pipe		12″ Pipe		14″ Pipe	
		Velocity ft. per Second	Loss of Head ft. per 1000 ft. of pipe	Velocity ft. per Second	Loss of Head ft. per 1000 ft. of pipe	Velocity ft. per Second	Loss of Head ft. per 1000 ft. of pipe
2778	4,000 000			7.88	18.8	5.79	8.7
2917	4,200,000			8.28	20.6	6.08	9.5
3056	4,400,000			8.67	22.5	6.37	10.3
3194	4,600,000			9.06	24.4	6.66	11.2
3333	4,800,000			9.45	26.4	6.95	12.1
3472	5,000 000			9.85	28.5	7.24	13.1
		16″ Pipe		18″ Pipe		20″ Pipe	
347	500,000	0.55	0.09	0.44	0.05		
417	600,000	0.66	0.13	0.52	0.07		
486	700,000	0.77	0.17	0.61	0.10		
556	800,000	0.89	0.22	0.70	0.12		
625	900,000	1.00	0.28	0.79	0.15		
694	1,000,000	1.11	0.34	0.88	0.19	0.71	0.11
833	1,200,000	1.33	0.47	1.05	0.26	0.85	0.15
972	1,400,000	1.55	0.63	1.23	0.35	0.99	0.20
1111	1,600,000	1.77	0.80	1.40	0.44	1.13	0.26
1250	1,800,000	1.99	1.00	1.57	0.55	1.28	0.32
1389	2,000,000	2.22	1.22	1.75	0.67	1.42	0.39
1528	2,200,000	2.44	1.45	1.93	0.80	1.56	0.47
1667	2,400,000	2.66	1.71	2.10	0.94	1.70	0.55
1806	2,600,000	2.88	1.98	2.28	1.09	1.84	0.64
1944	2,800,000	3.10	2.28	2.45	1.26	1.99	0.74
2083	3,000,000	3.32	2.59	2.63	1.42	2.13	0.84
2222	3,200,000	3.55	2.91	2.80	1.61	2.27	0.94
2361	3,400,000	3.77	3.26	2.98	1.80	2.41	1.05
2500	3,600,000	3.99	3.63	3.15	2.00	2.55	1.17
2639	3,800,000	4.21	4.01	3.33	2.21	2.70	1.30
2778	4,000,000	4.43	4.41	3.50	2.43	2.84	1.43
3472	5,000,000	5.54	6.67	4.38	3.68	3.55	2.16
4167	6,000,000	6.65	9.35	5.25	5.16	4.26	3.03
4861	7,000,000	7.76	12.50	6.13	6.87	4.96	4.03
5556	8,000,000	8.86	16.00	7.00	8.80	5.67	5.17
6250	9,000,000	9.97	19.80	7.88	10.90	6.38	6.43
6944	10,000,000	11.08	24.10	8.76	13.30	7.09	7.82
7639	11,000,000	12.19	28.80	9.63	15.80	7.80	9.33
8333	12,000,000	13.30	33.80	10.51	18.70	8.51	11.00
9028	13,000,000					9.22	12.70
9722	14,000,000					9.93	14.60

RELATIVE DELIVERY OF WATER THROUGH PIPES OF VARIOUS SIZES

(From Pipe Economy, 8th Ed., James B. Clow and Sons, publishers, by permission.)

Nominal Diameter, Inches	Relative Flow Capacities of Full Smooth Pipe — Diameters in Inches																Diameter Feet	Relative Flow Capacity
	4	6	8	10	12	14	16	18	20	24	30	36	42	48	54	60		
60	.....	.....	.....	.....	.....	.....	.....	20.3	15.6	9.9	5.7	3.6	2.43	1.75	1.3	1.0	5.0	56.0
54	.....	.....	.....	.....	.....	.....	20.7	15.6	12.0	7.6	4.85	2.76	1.87	1.44	1.0	....	4.5	43.0
48	.....	.....	.....	.....	.....	21.7	15.6	11.6	8.92	5.66	3.24	2.05	1.39	1.0	....	....	4.0	32.0
42	.....	.....	.....	.....	23.0	15.6	11.05	8.33	6.4	4.05	2.32	1.47	1.0	....	....	....	3.5	22.9
36	.....	.....	.....	24.6	15.6	10.6	7.6	5.66	4.35	2.76	1.58	1.0	....	....	....	....	3.0	15.59
30	.....	.....	27.2	15.6	10.0	6.7	4.8	3.6	2.76	1.75	1.0	....	....	....	....	....	2.5	9.88
24	.....	32.0	15.6	8.9	5.66	3.85	2.76	2.05	1.58	1.0	....	....	....	....	....	....	2.0	5.657
20	56.0	20.28	9.9	5.66	3.6	2.44	1.75	1.3	1.0	....	....	....	....	....	....	....	1.67	3.586
18	43.0	15.6	7.6	4.35	2.76	1.87	1.34	1.0	.....	....	....	....	....	....	....	....	1.50	2.756
16	32.0	11.6	5.7	3.24	2.05	1.40	1.0	.....	.....	.....	....	....	....	....	....	....	1.33	2.053
14	23.0	8.3	4.05	2.32	1.47	1.0	.....	.....	.....	.....	....	....	....	....	....	....	1.18	1.47
12	15.6	5.66	2.76	1.58	1.0	.....	.....	.....	.....	.....	....	....	....	....	....	....	1.0	1.0
10	9.9	3.6	1.75	1.0	.....	.....	.....	.....	.....	.....	....	....	....	....	....	....	0.83	0.634
8	5.66	2.05	1.0	.....	.....	.....	.....	.....	.....	.....	....	....	....	....	....	....	0.67	0.363
6	2.76	1.0	.....	.....	.....	.....	.....	.....	.....	.....	....	....	....	....	....	....	0.5	0.177
4	1.0	.....	.....	.....	.....	.....	.....	.....	.....	.....	....	....	....	....	....	....	0.33	0.064

Right-hand column, Relative Flow Capacity, is based on arbitrary of 1.0 for 12-inch pipe.

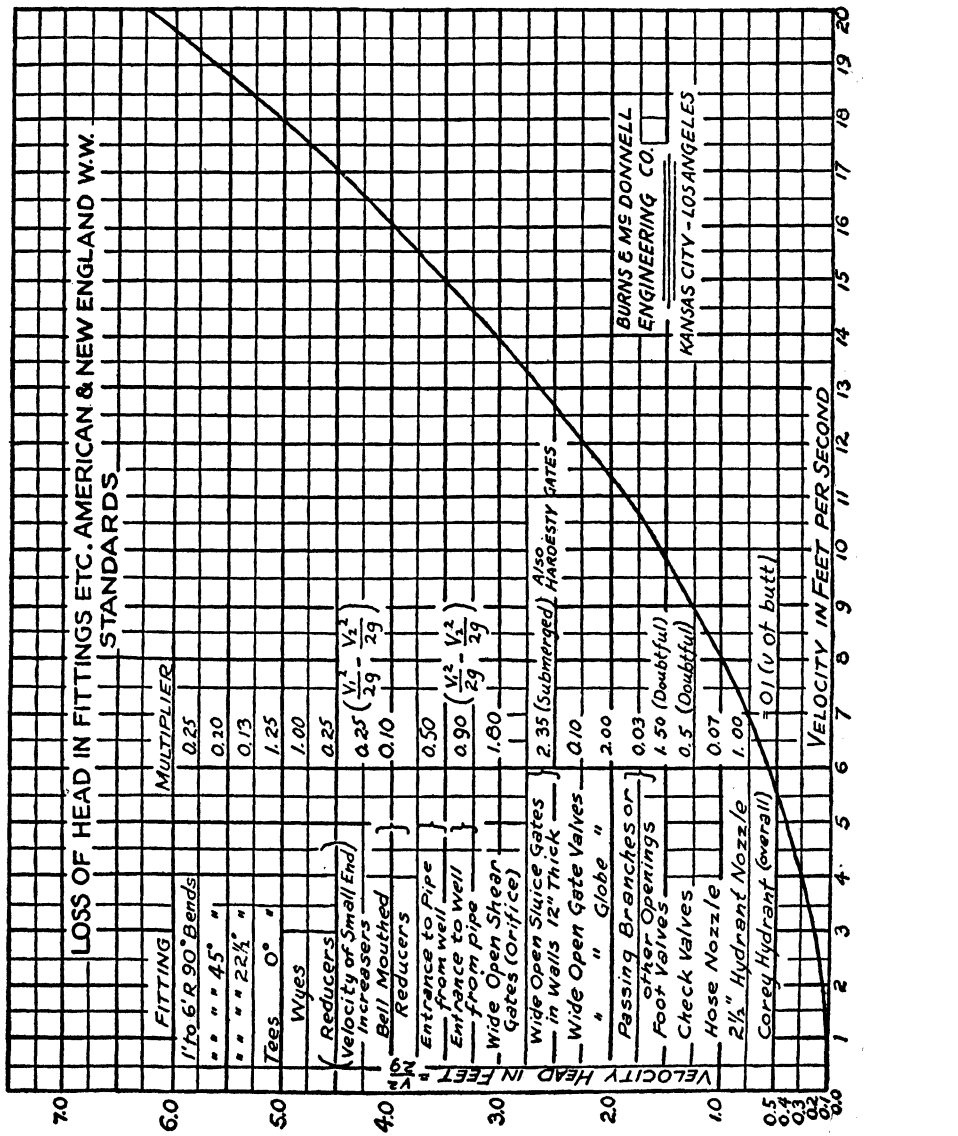
Calculations for above table based on assumption that relative deliveries at same loss of head are to each other as 5/2 power of the respective diameters.

Illustrative Example: How many 10-inch pipe will equal in total flow one 36-inch pipe?

Reading horizontally from 36 to intersection, table shows 24.6 10-inch pipe required—or, in practice, 25. Similarly 10 12-inch pipe =1 30-inch pipe.

LOSS OF HEAD IN FITTINGS

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DISCHARGE OF GAS IN CUBIC FEET PER HOUR, THROUGH PIPE OF DIFFERENT DIAMETERS AND VARIOUS LENGTHS, IN LINEAR YARDS

Pressure of Water in Inches, 1, 1.5, 2, 2.5. Specific Gravity, 0.400

(From Pipe Economy, 8th Ed., James B. Clow and Sons, publishers, by permission.)

4-Inch Pipe

Length in Yards	1	1.5	2	2.5
100	6,831	8,370	9,658	10,800
150	5,580	6,831	7,888	8,817
200	4,829	5,920	6,831	7,674
300	3,944	4,829	5,580	6,233
500	3,055	3,740	4,320	4,829
750	2,490	3,055	3,522	3,944
1,000	2,160	2,646	3,055	3,413
1,250	1,932	2,366	2,732	3,055
1,500	1,761	2,160	2,490	2,789
1,750	1,634	2,000	2,310	2,582
2,000	1,530	1,870	2,160	2,415

6-Inch Pipe

100	18,820	23,050	26,600	29,770
150	15,370	18,820	21,700	24,300
200	13,310	16,400	18,820	21,000
300	10,870	13,310	15,370	17,180
500	8,418	10,310	11,940	13,310
750	6,872	8,418	9,720	10,870
1,000	5,950	7,290	8,418	9,410
1,250	5,340	6,320	7,540	8,418
1,500	4,860	5,950	6,872	7,672
1,750	4,500	5,500	6,366	7,115
2,000	4,209	5,155	5,950	6,655

8-Inch Pipe

100	38,650	47,350	54,640	61,100
150	31,550	38,650	44,600	49,940
200	27,340	33,460	38,650	43,200
300	22,310	27,340	31,550	35,270
500	17,280	21,170	24,400	27,340
750	14,100	17,280	19,800	22,310
1,000	12,220	14,960	17,280	19,320
1,250	10,940	13,650	15,520	17,280
1,500	9,900	12,200	14,100	15,800
1,750	9,237	11,300	13,040	14,600
2,000	8,640	10,585	12,200	13,670

10-Inch Pipe

500	30,100	37,100	42,600	47,700
750	24,650	30,190	34,800	39,000
1,000	21,640	26,150	30,100	33,750
1,500	17,400	21,300	24,760	27,560
2,000	15,050	18,500	21,300	23,850
2,500	13,175	16,136	18,632	20,880
3,000	12,027	14,561	17,008	19,016
4,000	10,413	12,756	14,729	16,468

12-Inch Pipe

Length in Yards	1	1.5	2	2.5
500	47,600	58,320	67,200	75,240
750	38,800	47,600	55,000	61,470
1,000	33,660	41,200	47,600	53,240
1,500	27,500	33,600	38,880	43,515
2,000	23,800	29,250	33,600	37,620
2,500	21,190	26,100	30,116	33,631
3,000	19,440	23,800	27,500	30,740
4,000	16,830	20,600	23,800	26,620

16-Inch Pipe

500	98,000	120,200	138,240	154,560
750	79,770	97,740	113,200	128,020
1,000	69,120	84,670	98,000	109,260
1,500	56,600	69,120	79,800	89,230
2,000	49,000	60,100	69,120	77,280
2,500	43,680	53,540	61,824	69,120
3,000	39,885	48,870	56,600	64,000
4,000	34,560	42,340	49,000	54,630

20-Inch Pipe

500	170,600	204,600	241,000	270,000
750	139,600	170,600	197,600	222,400
1,000	120,744	147,900	170,600	191,000
1,500	98,800	120,700	139,600	155,800
2,000	85,300	102,300	124,500	135,000
2,500	76,500	93,500	108,000	120,744
3,000	69,800	85,300	98,800	110,200
4,000	60,370	73,950	85,300	95,500

24-Inch Pipe

500	271,200	326,000	375,000	425,800
750	217,200	271,200	310,000	344,000
1,000	189,200	233,280	271,200	301,160
1,500	155,000	190,500	217,200	245,800
2,000	134,600	163,000	187,600	212,900
2,500	119,000	145,500	168,000	194,400
3,000	108,600	135,600	155,000	172,000
4,000	95,350	116,640	135,600	150,580

DISCHARGE OF GAS IN CUBIC FEET PER HOUR, THROUGH PIPE OF DIFFERENT DIAMETERS AND VARIOUS LENGTHS, IN LINEAR YARDS

Pressure of Water in Inches 1, 1.5, 2, 2.5. Specific Gravity, 0.400

(From Pipe Economy, 8th Ed., James B. Clow and Sons, publishers, by permission.)

30-Inch Pipe					36-Inch Pipe				
Length in Yards	1	1.5	2	2.5	Length in Yards	1	1.5	2	2.5
500	468,000	574,000	664,000	744,200	500	744,000	912,000	1,121,200	1,256,400
750	384,000	468,000	558,900	607,600	750	606,000	744,000	856,000	1,032,000
1,000	332,000	406,000	468,000	526,000	1,000	530,000	644,000	744,000	832,000
1,500	272,070	332,760	384,140	457,600	1,500	428,500	524,860	606,000	677,630
2,000	234,000	287,000	332,000	372,100	2,000	372,000	456,000	524,880	628,200
2,500	210,000	257,000	298,000	332,000	2,500	332,000	408,000	468,000	530,000
3,000	192,000	234,000	270,000	303,800	3,000	303,000	372,000	428,000	516,000
4,000	166,000	203,000	234,000	263,000	4,000	265,000	322,000	372,000	416,000

Above tables computed by Dr. Pole's formula:

$$Q = 1350\, D^2 \sqrt{\frac{HD}{GL}} \qquad D = 0.056 \sqrt[5]{\frac{Q^2GL}{H}}$$

in which

Q = quantity of gas, cubic feet per hour
D = diameter of pipe, inches
H = pressure by head of water in inches
L = length of pipe, linear yards
G = specific gravity of gas (taken as 0.400)

For other values of G, multiply quantities given in table by square root of .4 and divide by square root of new value. For lengths one-fourth those in table, discharge of gas is doubled; for lengths four times greater than table, the discharge equals one-half of quantities in table.

Four times the pressure doubles the discharge.

FLOW MEASUREMENT

From Information Furnished by Members of the Technical Staff of
The Bailey Meter Co., Cleveland, Ohio

Nomenclature.—

C = Coefficient of Discharge; unit: a ratio.
W_h = Rate of flow; unit: pounds per hour.
ρ = Density of flowing fluid; unit: pounds per cubic foot.
ρ'_f = Density of dry air at 29.92 inches of mercury pressure and at the actual (experimental) temperature; unit: pounds per cubic foot.
ρ'_a = Density of saturated steam vapor at 60°F.; unit: pounds per cubic foot.
G_f = Specific gravity of air or gas under actual (experimental) conditions referred to air at 29.92 inches of mercury pressure and 60°F. as unity; unit: a ratio.
H = Differential head; unit: inches of water.
H_1 = Differential head; unit: inches of mercury.
h = Differential head; unit: inches of flowing fluid.
d_1 = Diameter of pipe; unit: inches.
d_2 = Diameter of orifice; unit: inches.
S = Saturation of air or gas mixture with moisture in per cent divided by 100, under actual (experimental) conditions.
p'_f = Pressure of saturated steam at actual (experimental) temperature; unit: inches of mercury.
p_f = Observed absolute pressure (equal to barometric reading plus gage reading in inches of mercury); unit: inches of mercury.

One of the most convenient methods for measuring the flow of fluids through a conduit, is by means of a head meter. In the head meter, a primary element is placed in the flowing fluid to produce a pressure difference or *differential head* which the secondary element then uses as an indication of the rate of flow. The primary element produces the differential head either by constricting the flow (orifice, venturi tube, flow nozzle, weir, etc.) or by measuring the impact of the flowing fluid (pitot tube). The secondary element consists of some form of manometer for measuring the differential head produced by the primary element.

If the flow is to be measured accurately, the flowing fluid must be free from turbulence, such as would be produced by obstructions and bends in the piping too near the orifice location, and must not be a pulsating flow as would be produced by reciprocating engines, pumps, and certain types of blowers. The flowing fluid must also be non-viscous unless corrections are applied, corrections which are beyond the scope of this short presentation. In general, at least, a length equal to 20 diameters of straight pipe without valves or fittings should precede the primary element location.

Manometers.—Manometers usually consist of two glass tubes connected at the bottom. The differential pressures are connected to the tops of the glass tubes. The glass tubes are usually filled half full with a liquid and the difference between the levels will give the *differential*. Liquids commonly used in manometers are: water (sp. gr. 1.00); carbon tetrachloride (sp. gr. 1.60); acetylene tetrabromide (sp. gr. 2.96); and mercury (sp. gr. 13.56). Since differentials are usually expressed in inches of water, it is necessary to convert measurements with other liquids to the corresponding head of water. This is done by multiplying the differential head of the liquid by its specific gravity. If the liquid in the gauge is under a column of the liquid whose flow is being measured, the specific gravity of the flowing liquid must be subtracted from the specific gravity of the gage liquid. If, for example, the flow of water (sp. gr. = 1) is being measured by a mercury manometer (sp. gr. = 13.56), then

$$H_1(13.56-1) = H$$

The weight of gases can usually be neglected except at high pressures.

Orifices.—One of the simplest of

the primary elements used to produce a throttling action is the *orifice plate.* It consists of a thin disc of stainless steel or monel metal in the center of which is a hole smaller in diameter than the inside of the pipe with which it is to be used. The maximum reduction in pressure produced by this throttling action is at a point, downstream from the orifice plate, called the *vena contracta.* The position of the vena contracta with a given orifice is practically the same for all rates of flow. Since the pressure is partially restored after passing the vena contracta, it is desirable to make the downstream connection to the manometer as near the vena contracta as possible.

The outside diameter of the orifice plate should fit snugly inside the bolt circle of the pipe flange so that the orifice hole will be concentric with respect to the pipe diameter. For use in pipes of six inches or less in diameter, the orifice plate should be $\frac{1}{16}$ inch in thickness; for pipe diameters from 6 inches up to 15 inches the orifice plate should be at least $\frac{1}{8}$ inch in thickness. It is essential that the inside of the orifice hole be smooth and free from burrs. The upstream edge must be sharp and square, and the downstream side should have a 45° bevel to $\frac{1}{32}$ inch edge thickness.

The connections to the orifice should be made by means of $\frac{1}{2}$ inch pipe nipples. These nipples should be filed flush with the inside of the pipe and must, under no conditions, project into the flowing stream. The upstream connection should be made about one pipe diameter from the orifice plate. The downstream connection should be at the vena contracta. If an easily condensed gas or vapor (e. g., steam) is being measured, a reservoir for collecting condensate (water) must be placed on each nipple. Each reservoir should hold about 20 or 30 cubic inches of condensed liquid, and these reservoirs must be so mounted that the liquid level is exactly at the same height in both, otherwise a false differential will be created.

Selection and Calculation of the Proper Size of Orifice.—The general formula for calculating orifices is:

$$W_h = 360 \times (d_2)^2 \times C \sqrt{\frac{H\rho}{1-\left(\frac{d_2}{d_1}\right)^4}}$$

These formulas do not take into account the compressibility of the gas nor the thermal expansion of the orifice plate but are sufficiently accurate for most practical applications. Since W_h, d_2, and H are variables, it is necessary to assign values to two of these factors in order to solve the equation. The diameter of the orifice hole d_2 is usually selected so as to give the maximum H when the flow W_h is at the maximum. H is, therefore, selected before starting the design of the orifice. It is desirable to make H as large as practical for more accurate reading if the differential is to be read by means of a U-tube manometer. If a flow meter is to be used, the H will usually be the maximum head for which the flow meter is designed. H is also limited in some instances by the pressure loss that can be tolerated, as is the case when measuring flows under low pressures. The pressure loss due to the orifice may be calculated from curve No. 3 on per cent differential head lost.

The most practical method for calculating an orifice is by trial since it eliminates solving a fourth degree equation. A value for d_2 is arbitrarily chosen, then from the orifice ratio d_2/d_1, a value for C is found from curves No. 2 on discharge coefficients. These values are then placed in the equation and the equation is solved for W_h. If an approximate value for the maximum flow through the pipe line is known, the value for d_2 is altered until the desired value for W_h is secured.

When the orifice is in operation, of course, the values for d_1, d_2, C, and ρ are constant so long as the state of the fluid does not differ from that for which the orifice was designed. These factors are then multiplied together to give a new constant by which the instantaneous value for H as read from the manometer or meter may be multiplied to give the rate of flow per hour at that instant. This is done by writing equation No. 1 (see below) in this form:

FLOW MEASUREMENT

$$W_h = \left[(360) \times (d_2)^2 \times (C) \times \sqrt{\frac{1}{1-\left(\frac{d_2}{d_1}\right)^4}} \times \sqrt{\rho} \right] \times \sqrt{H}$$

The terms enclosed within the brackets being the constant for the orifice.

The desirability for designing an orifice to give the maximum differential head will be appreciated when it is realized that the differential head developed by a flow through an orifice is a square root relationship, so that if an orifice, for example, has twice the necessary capacity, it will develop only one-fourth the head otherwise obtainable. If no estimate of the maximum flow is available, it may be necessary to design and build a trial orifice and from trial tests run with this orifice sufficient data can be secured from which an orifice of correct proportions can be designed.

Example.—The flow of water through a 6 inch pipe is estimated to be 180,000 pounds per hour. What should be the diameter of the orifice hole if used with a 10 inch manometer? Where should the downstream tap be located? What is the pressure loss due to the orifice at maximum flow? What is the flow through the 6 inch pipe when an orifice, designed for the conditions mentioned above, produces a 5 inch differential on the mercury manometer? The water (sp. gr. =1) to be measured is at a temperature of 60°F., and therefore $\rho = 62.4$; the manometer to be used has a maximum range of 10 inches of mercury (sp. gr. 13.56), or $H = 10(13.56-1) = 125.6$ inches of water.

For a trial a 3 inch orifice hole may be assumed. The ratio, d_2/d_1, will then be 3.00/6.00 = 0.50. From curve No. 2 it will be found that for a 0.50 ratio and a 6 inch pipe, C is 0.608. These values are then substituted in equation No. 1, and grouping the values which are constants gives the following:

$$W_h = \left[(360) \times (3)^2 \times (0.608) \sqrt{\frac{1}{1-\left(\frac{3.00}{6.00}\right)^4}} \times \sqrt{62.4} \right] \times \sqrt{125.6}$$

$$= 16{,}100 \times \sqrt{125.6}$$

$$= 180{,}100 \text{ pounds per hour.}$$

From curve No. 1 it will be found that for a 0.50 ratio, the downstream connection should be 0.6 diameters from the orifice plate to bring its position at the middle of the vena contracta; *i. e.*, $0.6 \times 6 = 3.6$ inches, and the minimum distance allowable is $0.4 \times 6 = 2.4$ inches, and the maximum distance allowable is $0.75 \times 6 = 4.5$ inches.

The pressure loss due to the orifice is calculated by multiplying H by a constant as read from curve No. 3. Thus, in the example given above, the pressure lost with a 0.50 ratio is 0.72 of the head which at the maximum flow is: $(0.72) \times (125.6) = 90.5$ inches of water, or since (inches of water) $\div 27.72$ = pounds per square inch, the pressure loss due to the orifice when 180,000 pounds per hour is flowing through the pipe will be: $90.5 \div 27.72 = 3.26$ pounds per square inch.

The rate of flow for 5 inches of mercury differential is calculated as follows:

$$H = 5 \times (13.56-1) = 62.8 \text{ inches of water}$$

$$W_h = 16{,}100 \times \sqrt{62.8}$$

$$= 127{,}400 \text{ pounds per hour.}$$

ORIFICE FORMULAS

For liquids:

(1) $$W_h = (360) \times (d_2)^2 \times (C) \times \sqrt{\frac{(\rho) \times (H)}{1-\left(\frac{d_2}{d_1}\right)^4}}$$

For dry gases under actual (experimental) conditions of temperature and pressure:

(2) $$W_h = (360) \times (d_2)^2 \times (C) \times \sqrt{\frac{(\rho_f)\ (G_f)\ (H)}{1-\left(\frac{d_2}{d_1}\right)^4}}$$

For wet gases under actual (experimental) conditions of temperature and pressure:

(3) $$W_h = (360) \times (d_2)^2 \times (C) \times \sqrt{\frac{[\rho'_f \times G_f (p_f - p'_f) + (\rho'_a)\ (S)]\, H}{1-\left(\frac{d_2}{d_1}\right)^4}}$$

PITOT TUBE FORMULAS

Two common types of pitot tubes are the *combined impact reverse*, and the *combined impact static*. In the combined impact reverse one opening faces upstream and the other opening downstream. In the combined impact

PITOT TUBE FORMULAS

static one opening faces upstream and the second opening faces normal to the direction of the flow.

Combined impact reverse type:

(4) $W_h = (255) \times (d_1)^2 \times \sqrt{(p) \times \left(\frac{h}{12}\right)}$

Combined impact static type:

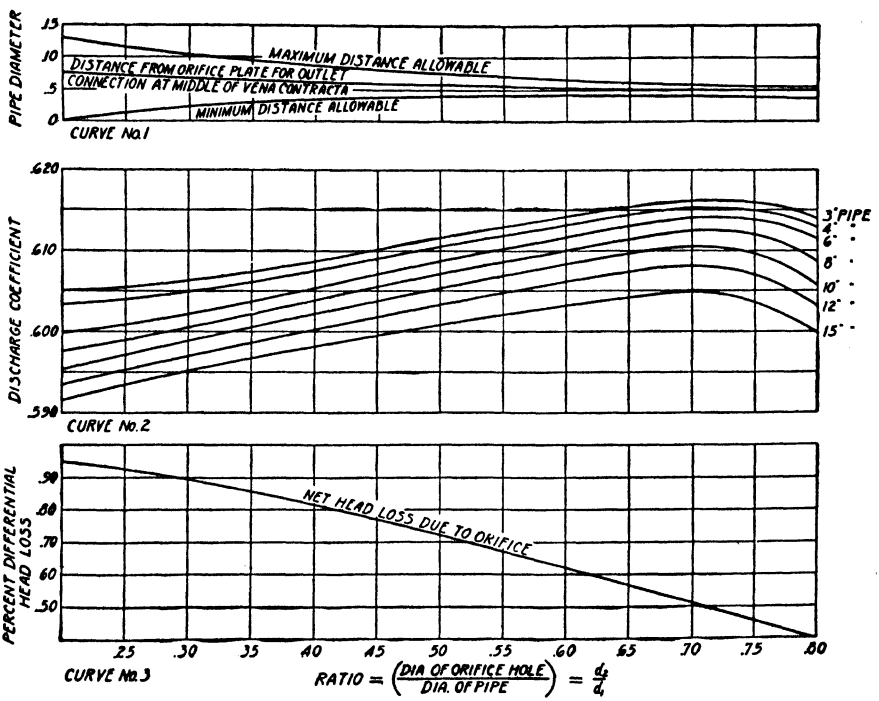
(5) $W_h = (353) \times (d_1)^2 \times \sqrt{(p) \times \left(\frac{h}{12}\right)}$

V-NOTCH WEIR FORMULA

(6) $W_h = (1946) \times (C) \times \left(\tan \frac{\alpha}{2}\right) \times h^{2.48}$

The values of C (coefficient of discharge) for various angles of the notch (α) are:

when $\alpha = 30°$	then $C = 0.5930$
$= 45°$	$= 0.5820$
$= 60°$	$= 0.5785$
$= 75°$	$= 0.5785$
$= 90°$	$= 0.5815$



CONCENTRIC ORIFICE COEFFICIENTS

NICHROME RESISTANCE WIRE

Reprinted from Catalog R-28 Driver-Harris Company by Permission.

Specific resistance 675 ohms per circular mil-foot at 20°C. (68°F.)

No. B. & S.	Diam. in Inches	Ohms Per Ft. at 20° C (68°F.)	Weight Per 1000 Ft. Bare Wire Pounds	Feet Per Pound Bare Wire	Ohms Per Pound Bare Wire
1	.289	.0081	231.0	4.33	.035
2	.258	.0101	184.0	5.43	.054
3	.229	.0128	145.0	6.90	.090
4	.204	.0162	115.0	8.70	.139
5	.182	.0203	92.0	10.9	.218
6	.162	.0257	73.0	13.7	.356
7	.144	.0325	57.0	17.5	.560
8	.1285	.0408	45.0	22.2	.910
9	.114	.0519	36.0	27.8	1.44
10	.102	.0649	29.0	34.5	2.20
11	.091	.0815	23.0	43.5	3.52
12	.081	.102	18.0	55.6	5.67
13	.072	.130	14.0	69.9	9.08
14	.064	.164	11.0	88.5	14.51
15	.057	.207	9.2	109	22.5
16	.051	.259	7.2	139	36.0
17	.045	.333	5.6	179	59.6
18	.040	.421	4.42	226	95.1
19	.036	.520	3.58	279	145
20	.032	.659	2.83	353	232
21	.0285	.831	2.24	446	370
22	.0253	1.055	1.77	565	590
23	.0226	1.321	1.41	709	936
24	.0201	1.670	1.12	893	1,491
25	.0179	2.106	.89	1,123	2,365
26	.0159	2.669	.70	1,429	3,814
27	.0142	3.347	.56	1,786	5,977
28	.0126	4.251	.44	2,273	9,662
29	.0113	5.286	.35	2,857	15,102
30	.0100	6.750	.276	3,623	24,455
31	.0089	8.521	.219	4,566	38,906
32	.0080	10.546	.177	5,650	59,584
33	.0071	13.390	.139	7,194	96,327
34	.0063	17.006	.110	9,091	154,601
35	.0056	21.524	.087	11,490	247,310
36	.0050	27.000	.069	14,490	391,230
37	.0045	33.333	.056	17,860	595,327
38	.0040	42.187	.045	22,220	937,395
39	.0035	55.102	.034	29,410	1,620,500
40	.0031	70.239	.025	40,000	2,809,500
	.00275	89.256	.021	47,600	4,248,600
	.0025	108.000	.017	58,900	6,361,200
	.00225	133.333	.014	71,500	9,533,000
	.002	168.750	.011	91,000	15,356,000
	.00175	220.408	.008	125,000	27,551,000
	.0015	300.000	.006	166,666	50,000,000

Factors to be used in determining resistance at elevated temperatures

Temp. Cent.	20	100	200	300	400	500	600	700	800	900	1000
Temp. Fahr.	68	212	392	572	752	932	1112	1292	1472	1652	1832
Resistance in Ohms	1.000	1.006	1.029	1.047	1.057	1.072	1.077	1.082	1.088	1.095	

NICHROME RESISTANCE WIRE

SUGGESTIONS ON DESIGN OF NICHROME HEATING ELEMENTS

Reprinted from Catalog R-28, Driver-Harris Company by Permission.

The table below gives the size of "Nichrome" suggested for a given number of watts at 110 volts. The sizes are selected to operate at approximately 1500°F. in open coils and are suitable for electric irons, toasters, hot plates, space heaters, etc.

NICHROME WIRE. 110 VOLTS

Watts	Amperes	B. & S. Size	Ohms 75° F	Length	
				21 Ft.	2 Ins.
250	2.27	25	43.6		
300	2.72	24	36.4	22	0
350	3.2	23	31.0	24	0
400	3.64	23	27.2	21	0
450	4.10	22	24.1	23	5
475	4.32	22	23.0	22	4
500	4.55	22	21.8	21	0
550	5.0	21	19.8	24	5
575	5.23	21	18.9	23	2
600	5.46	21	18.1	22	4
615	5.6	20	17.7	27	6
640	5.82	20	17.0	26	6
660	6.0	20	16.5	25	8
700	6.36	20	15.6	24	4
750	6.81	19	14.5	28	5

For voltages other than 110 divide the number of watts required at the given voltage by the voltage factor below. Select the nearest number of watts in the 110 volt table, multiply the length in 110 volt table by the voltage factor. Suppose an electric iron takes 550 watts and the supply voltage is 100. Factor for 100 volts is .91 and $\frac{550}{.91} = 605$ watts.

Nearest value in 110 volt table is 600 watts which requires 22′ 4″ of size 21 wire. This gives the size to be used on 110 volts, but the length should be 0.91×22′4″ or 20′4″. The winding for 550 watts, 100 volts would then be 20′4″ of size 21 "Nichrome" wire.

VOLTAGE FACTORS ON BASIS OF 110 VOLTS

Voltage	100	120	150	200	220	240	32
Factor	.91	1.09	1.36	1.82	2.0	2.18	0.29

ADVANCE RESISTANCE WIRE

Reprinted from Catalog R-28, Driver-Harris Company by Permission.

Specific resistance 294 ohms per circular mil-foot at 20°C. (68°F.). The change of resistance with change of temperature is negligible. Thermal E. M. F. against copper is approximately 0.043 milli-volts per degree Centigrade, between 0°C. and 100°C.

No. B. & S.	Diam. in Inches	Ohms Per Ft. at 20°C. (68°F.)	Weight Per 1000 Ft. Bare Wire Pounds	Feet Per Pound Bare Wire	Ohms Per Pound Bare Wire
1	.289	.003	253.0	3.95	.0136
2	.258	.004	201.0	4.98	.0217
3	.229	.005	159.0	6.29	.0346
4	.204	.007	126.0	7.94	.0549
5	.182	.008	100.0	10.0	.0874
6	.162	.011	79.0	12.7	.139
7	.144	.014	63.0	15.9	.221
8	.1285	.017	50.0	20.0	.351
9	.114	.022	39.0	25.6	.559
10	.102	.028	32.0	31.3	.888
11	.091	.035	25.0	40.0	1.41
12	.081	.044	20.0	50.0	2.246
13	.072	.056	15.7	63.7	3.573
14	.064	.071	12.4	80.6	5.678
15	.057	.090	9.8	102.0	9.03
16	.051	.113	7.8	128.0	14.36
17	.045	.145	6.2	161.0	22.83
18	.040	.184	4.9	204.0	36.29
19	.036	.226	3.9	256.0	57.71
20	.032	.287	3.1	323.0	91.74
21	.0285	.362	2.5	400.0	145.9
22	.0254	.460	1.9	526.0	232.0
23	.0226	.575	1.5	667.0	369.0
24	.0201	.725	1.2	833.0	586.6
25	.0179	.919	0.97	1,031.0	932.9
26	.0159	1.162	0.77	1,299.0	1,483
27	.0142	1.455	0.61	1,639.0	2,358
28	.0126	1.850	0.48	2,083.0	3,749
29	.0113	2.300	0.38	2,632.0	5,964
30	.0100	2.940	0.30	3,334.0	9,470
31	.0089	3.680	0.24	4,167.0	15,075
32	.0080	4.600	0.19	5,263.0	23,970
33	.0071	5.830	0.15	6,667.0	38,110
34	.0063	7.400	0.12	8,333.0	60,620
35	.0056	9.360	0.095	10,530.0	96,340
36	.0050	11.760	0.076	13,160.0	153,240
37	.0045	14.550	0.060	16,667.0	243,650
38	.0040	18.375	0.047	21,276.0	388,360
39	.0035	24.100	0.038	26,316.0	616,000
40	.0031	30.593	0.028	35,714.0	1,092,500
	.00275	38.888	0.021	47,600.0	1,850,000
	.0025	46.400	0.017	58,900.0	2,730,000
	.00225	58.103	0.014	71,500.0	4,150,000
	.002	72.500	0.011	91,000.0	6,600,000
	.00175	96.078	0.008	125,000.0	12,000,000
	.0015	130.666	0.006	166,666.0	21,600,000

Factors to be used in determining resistance at elevated temperatures

Temp. Centigrade	20	100	200	300	400	500	600°
Temp. Fahrenheit	68	212	392	572	752	932	1112°
Resistance in Ohms	1.000	1.002	1.002	1.001	1.005	1.017	1.037

MANGANIN RESISTANCE WIRE

Reprinted from Catalog R-28, Driver-Harris Co. by Permission.

Specific resistance 290 ohms per circular mil-foot at 20°C. (68°F.). Temperature coefficient over the range of 15° to 35°C. (59° to 95°F.), with the peak of the curve at 25°C. (77°F.), will be between .00002 and .000005 per degree C. Thermal E. M. F. against copper not over 0.003 millivolts per degree centigrade, between 0°C. and 100°C.

No. B & S.	Diam. in Inches	Ohms Per Ft. at 20°C. (68°F.)	Weight Per 1000 Ft. Bare Wire Pounds	Feet Per Pound Bare Wire	Ohms Per Pound Bare Wire
15	.057	.089	9.2	109.0	9.70
16	.051	.110	7.2	139.0	15.29
17	.045	.142	5.6	179.0	25.4
18	.040	.180	4.42	226.0	40.6
19	.036	.218	3.58	279.0	60.82
20	.032	.282	2.83	353.0	99.5
21	.0285	.356	2.24	446.0	158
22	.0254	.452	1.77	565.0	255
23	.0226	.567	1.41	709.0	402
24	.0201	.717	1.12	893.0	704
25	.0179	.905	0.89	1,123.0	1,016
26	.0159	1.147	0.70	1,429.0	1,639
27	.0142	1.438	0.56	1,786.0	2,568
28	.0126	1.825	0.44	2,273.0	4,148
29	.0113	2.270	0.35	2,857.0	6,485
30	.0100	2.899	0.276	3,623.0	10,503
31	.0089	3.661	0.219	4,566.0	16,716
32	.0080	4.531	0.177	5,656.0	25,627
33	.0071	5.753	0.139	7,194.0	41,387
34	.0063	7.304	0.110	9,091.0	66,400
35	.0056	9.234	0.087	11,490.0	106,098
36	.0050	11.599	0.069	14,490.0	168,069
37	.0045	14.352	0.056	17,860.0	256,326
38	.0040	18.120	0.045	22,220.0	402,626
39	.0035	23.767	0.034	29,410.0	698,987
40	.0031	32.220	0.025	40,000.0	1,288,800

ALLOWABLE CARRYING CAPACITIES OF COPPER WIRE AND CABLE

(Regulations of the Nat'l Board of Fire Underwriters)

No. AWG	Circular Mils	Amperes		Circular Mils	Amperes	
		Rubber Insulation	Varnished Cambric Insulation		Rubber Insulation	Varnished Cambric Insulation
18	1,624	3	4	250,000	250	300
16	2,583	6	8	300,000	275	330
14	4,107	15	18	350,000	300	360
12	6,530	20	25	400,000	325	390
10	10,380	25	30	450,000	362	435
8	16,510	35	40	500,000	400	480
6	26,250	50	60	600,000	450	540
4	41,740	70	85	700,000	500	600
2	66,370	90	110	800,000	550	660
1	83,690	100	120	1,000,000	650	780
0	105,500	125	150	1,250,000	750	900
00	133,100	150	180	1,500,000	850	1020
000	167,800	175	210	1,750,000	950	1140
0000	211,600	225	270	2,000,000	1050	1260

DIAMETER, WEIGHTS AND RESISTANCE OF COPPER WIRE

Courtesy General Electric Co.

No. AWG	Diameter Mils	Area Circular Mils	Weight Bare Wire		Resistance at 25° C (77°F)		
			Pounds per 1000 Ft.	Pounds per Mile	Ohms per 1000 Ft.	Ohms per Mile	Feet per Ohm
0000	460.	211,600	640.5	3382.	0.05091	0.2688	19,643.
000	410.	167,800	508.0	2682.	0.06419	0.3389	15,579.
00	365.	133,100	402.8	2127.	0.08097	0.4275	12,350.
0	325.	105,600	319.7	1688.	0.1019	0.5380	9,814.
1	289.	83,500	252.7	1334.	0.1290	0.6811	7,752.
2	258.	66,560	201.5	1064.	0.1618	0.8543	6,180.
3	229.	52,440	158.7	838.	0.2054	1.0845	4,869.
4	204.	41,620	126.0	665.	0.2588	1.3665	3,864.
5	182.	33,120	100.2	529.	0.3253	1.718	3,074.
6	162.	26,240	79.43	419.4	0.4105	2.167	2,436.
7	144.	20,740	62.78	331.5	0.5194	2.742	1,925.
8	128.	16,380	49.60	261.89	0.6574	3.471	1,521.
9	114.	13,000	39.35	207.77	0.8286	4.375	1,207.
10	102.	10,400	31.48	166.21	1.036	5.470	965.2
11	90.7	8,226	24.90	131.47	1.309	6.912	763.9
12	80.8	6,529	19.76	104.33	1.650	8.712	606.1
13	72.0	5,180	15.68	82.79	2.080	10.98	480.7
14	64.1	4,109	12.44	65.68	2.621	13.84	381.5
15	57.1	3,260	9.866	52.09	3.304	17.45	302.6
16	50.8	2,581	7.812	41.25	4.174	22.04	239.5
17	45.3	2,052	6.213	32.81	5.249	27.72	190.5
18	40.3	1,624	4.914	25.95	6.636	35.04	150.7
19	35.9	1,288	3.900	20.59	8.361	44.2	119.6
20	32.0	1,024.	3.099	16.36	10.52	55.6	95.1
21	28.5	812.3	2.459	12.98	13.26	70.0	75.4
22	25.3	640.1	1.937	10.23	16.83	88.9	59.4
23	22.6	510.8	1.546	8.16	21.09	111.4	47.4
24	20.1	404.0	1.223	6.46	26.66	140.8	37.45
25	17.9	320.4	0.9697	5.12	33.63	177.6	29.71
26	15.9	252.8	0.7650	4.04	42.57	224.8	23.48
27	14.2	201.6	0.6101	3.220	53.45	282.2	18.71
28	12.6	158.8	0.4806	2.540	67.84	358.2	14.74
29	11.3	127.7	0.3866	2.043	84.35	445.4	11.85
30	10.0	100.0	0.3027	1.600	107.8	569.2	9.28
31	8.9	79.2	0.2398	1.267	136.0	718.1	7.36
32	8.0	64.0	0.1937	1.024	168.2	888.1	5.94
33	7.1	50.4	0.1526	0.806	213.6	1128.	4.68
34	6.3	39.7	0.1201	0.635	271.1	1431.	3.69
35	5.6	31.4	0.09493	0.501	342.5	1808.	2.919
36	5.0	25.0	0.07568	0.3994	431.7	2279.	2.315
37	4.5	20.3	0.06130	0.3235	532.1	2809.	1.880
38	4.0	16.0	0.04843	0.2555	671.5	3546.	1.488
39	3.5	12.3	0.03708	0.1958	872.3	4606.	1.147
40	3.1	9.6	0.02909	0.1536	1128.	5956.	0.888

TEMPERATURE CORRECTIONS

(Based on A. I. E. E. Standards)

Temperature Coefficient of Resistance. At a temperature of 25°C the constant mass" temperature coefficient of resistance of standard annealed copper, measured between potential points rigidly fixed to the wire is 0.00385 or 1/259.5 per Centigrade degree. Resistance values of copper wire given in tables at 25°C may be corrected for any temperature by means of the following formula— $Rt = R_{25}[1+0.00385(t-25)]$, where Rt is the resistance in ohms at a temperature t°C; R_{25} is the resistance in ohms at 25°C; and, t is the temperature of wire in degrees Centigrade.

STANDARD CALIBRATION TABLES FOR THERMOCOUPLES

The following tables represent arbitrary reference curves which show fairly well the relation between E. M. F. and temperature and consequently should be used with an appropriate correction curve which must be determined for any individual thermocouple by means of a calibration at three or more fixed temperature points. Such a correction curve is constructed by plotting ΔE the difference between the observed E. M. F. at a known temperature and the E. M. F. for this same temperature (as read from the table) against the standard E. M. F. given in the table. The corrected E. M. F. for any temperature is then obtained by subtracting algebraically ΔE as read from the correction curve from the observed E. M. F., before converting the latter into a temperature as read from the table. The tables which follow are for a fixed (or cold) junction maintained at 0°C. If this fixed junction is not at 0°C. but at some other temperature which is very near to 0°C. a correction should be applied as follows: $E_h = E_o + E$ where E_o is the observed E. M. F., E is the E. M. F. corresponding to the temperature of the fixed junction and E_h is the desired E. M. F. corrected for the temperature at which the fixed junction is being maintained. In the tables which follow the E. M. F. values are expressed in millivolts and the temperatures in degrees centigrade.

PLATINUM — PLATINUM (90%), RHODIUM (10%) THERMOCOUPLE

Standard range 630° — 1083°C; applicability range 0°—1754°C. Computed from values given in Int. Crit. Tables, Vol. 1, p. 57.

°C	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
0°	0.00	0.06	0.11	0.17	0.24	0.30	0.36	0.43	0.50	0.57
100°	0.64	0.72	0.79	0.87	0.95	1.02	1.10	1.18	1.26	1.35
200°	1.43	1.52	1.60	1.69	1.78	1.86	1.95	2.04	2.13	2.22
300°	2.31	2.40	2.50	2.59	2.68	2.77	2.87	2.96	3.05	3.15
400°	3.24	3.34	3.44	3.53	3.63	3.73	3.82	3.92	4.02	4.12
500°	4.22	4.31	4.41	4.51	4.61	4.71	4.82	4.92	5.02	5.12
600°	5.22	5.32	5.43	5.53	5.63	5.74	5.84	5.94	6.05	6.16
700°	6.26	6.37	6.47	6.58	6.68	6.79	6.89	7.00	7.11	7.22
800°	7.33	7.44	7.55	7.66	7.77	7.88	7.99	8.10	8.21	8.32
900°	8.43	8.54	8.66	8.77	8.89	9.00	9.11	9.22	9.34	9.46
1000°	9.57	9.68	9.80	9.92	10.03	10.15	10.27	10.38	10.50	10.62
1100°	10.74	10.86	10.98	11.10	11.21	11.33	11.45	11.57	11.69	11.31
1200°	11.93	12.05	12.17	12.29	12.41	12.53	12.65	12.77	12.89	13.01
1300°	13.13	13.25	13.37	13.49	13.61	13.73	13.85	13.97	14.09	14.21
1400°	14.33	14.45	14.58	14.70	14.82	14.94	15.06	15.19	15.31	15.43
1500°	15.55	15.67	15.79	15.91	16.03	16.15	16.27	16.39	16.51	16.63
1600°	16.75	16.87	16.99	17.11	17.23	17.35	17.47	17.59	17.71	17.83
1700°	17.95	18.07	18.19	18.31	18.43	18.55	.....	.....	.....	.....

CHROMEL—ALUMEL THERMOCOUPLE

Bu. Standards Research Papers Nos. 767, 768, 1278.

°C	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
0	0.00	.40	.80	1.20	1.61	2.02	2.43	2.85	3.26	3.68
100	4.10	4.51	4.92	5.33	5.73	6.13	6.53	6.93	7.33	7.73
200	8.13	8.53	8.93	9.34	9.74	10.15	10.56	10.97	11.38	11.80
300	12.21	12.62	13.04	13.45	13.87	14.29	14.71	15.13	15.55	15.97
400	16.39	16.82	17.24	17.66	18.08	18.50	18.93	19.36	19.78	20.21
500	20.64	21.07	21.49	21.92	22.34	22.77	23.20	23.62	24.05	24.48
600	24.90	25.33	25.75	26.18	26.60	27.03	27.45	27.87	28.29	28.72
700	29.14	29.56	29.98	30.40	30.82	31.23	31.65	32.07	32.48	32.90
800	33.31	33.71	34.12	34.53	34.94	35.35	35.75	36.16	36.56	36.96
900	37.36	37.76	38.16	38.56	38.96	39.35	39.75	40.14	40.53	40.92
1000	41.31	41.70	42.08	42.47	42.86	43.24	43.62	44.00	44.38	44.76
1100	45.14	45.52	45.89	46.27	46.64	47.01	47.38	47.75	48.12	48.48
1200	48.85	49.21	49.57	49.94	50.29	50.65	51.00	51.36	51.71	52.06

* At −10° and −20°C., −0.39 and −0.77 milli-volts, resp.

STANDARD CALIBRATION TABLES FOR THERMOCOUPLES

COPPER—CONSTANTAN THERMOCOUPLE

Calculated from values given in Int. Crit. Tables, Vol. 1, p. 58.

°C	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
−200°	−5.53	−5.68	−5.83	.....	.....	.....	.....	.....	.....	.....
−100°	−3.35	−3.62	−3.89	−4.14	−4.38	−4.60	−4.82	−5.02	−5.20	−5.37
−0°	0.00	−0.38	−0.75	−1.11	−1.47	−1.81	−2.14	−2.46	−2.77	−3.06
+0°	0.00	0.40	0.81	1.23	1.65	2.08	2.51	2.95	3.39	3.84
100°	4.30	4.76	5.23	5.71	6.20	6.70	7.20	7.71	8.22	8.74
200°	9.27	9.81	10.36	10.91	11.47	12.03	12.60	13.16	13.73	14.31
300°	14.89	15.47	16.06	16.65	17.24	17.84	18.44	19.04	19.65	20.25

PLATINUM—PLATINUM (87%), RHODIUM (13%) THERMOCOUPLE

Values taken from Bulletin No. 325 of Charles Engelhard, Inc., New York.

°C	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
0°	0.00	0.06	0.12	0.18	0.25	0.31	0.38	0.45	0.52	0.60
100°	0.67	0.75	0.83	0.90	0.99	1.07	1.15	1.23	1.32	1.40
200°	1.49	1.58	1.67	1.76	1.85	1.94	2.03	2.12	2.21	2.30
300°	2.40	2.49	2.59	2.68	2.77	2.87	2.98	3.08	3.19	3.29
400°	3.40	3.51	3.61	3.72	3.82	3.93	4.04	4.15	4.25	4.36
500°	4.47	4.58	4.69	4.81	4.92	5.03	5.14	5.26	5.37	5.49
600°	5.60	5.72	5.83	5.95	6.06	6.18	6.30	6.42	6.53	6.65
700°	6.77	6.89	7.01	7.13	7.25	7.37	7.49	7.62	7.74	7.87
800°	7.99	8.12	8.24	8.37	8.49	8.62	8.75	8.88	9.00	9.13
900°	9.26	9.39	9.52	9.66	9.79	9.92	10.05	10.18	10.32	10.45
1000°	10.58	10.72	10.85	10.99	11.21	11.26	11.40	11.54	11.67	11.81
1100°	11.95	12.09	12.23	12.38	12.52	12.66	12.80	12.94	13.09	13.23
1200°	13.37	13.52	13.66	13.81	13.95	14.10	14.25	14.40	14.54	14.69
1300°	14.84	14.99	15.14	15.30	15.45	15.60	15.75	15.90	16.06	16.21
1400°	16.36	16.52	16.67	16.83	16.98	17.14	17.30	17.46	17.61	17.77
1500°	17.93	18.09	18.25	18.42	18.58	18.74	18.90	19.06	19.23	19.39
1600°	19.55	19.71	19.88	20.04	20.21	20.37	.....	.....	.....	.....

IRON—CONSTANTAN THERMOCOUPLE

Values taken from Bulletin No. 325 of Charles Engelhard, Inc., New York.

°C	0°	50°
0°	0.00	2.61
100°	5.28	8.01
200°	10.77	13.54
300°	16.30	19.06
400°	21.83	24.61
500°	27.41	30.24
600°	33.13	36.11

°C	0°	50°
700°	39.19	42.33
800°	45.48	48.66
900°	51.83	55.00
1000°	58.17	61.33
1100°	64.50	67.67
1200°	70.84	.....
.....	.....	.....

FIXED POINTS FOR THERMOMETER CALIBRATION

Abbreviations: B, boiling point at 760 mm of mercury pressure; C, condensing point; F, freezing point; I, inversion point; M, melting point; p, pressure in millimeters of mercury; t, temperature in centigrade of boiling point at normal pressure; T, transition point; VP, vapor pressure; †, base point used in defining the Standard Working Scale (Int. Crit. Tables) by E. F. Mueller.

Substance	Point	Deg. C Thermodynamic scale	Pressure corrections and conditions
Hydrogen	B	−252.75	+0.0044(p−760)
Nitrogen	VP	−195.80	+0.0109(p−760)
Liquid oxygen †	VP	−183.00	+0.0126(p−760) − 0.0000065(p−760)^2
Isopentane*	F	−159.6	.....
Methylcyclohexane	F	−126.3	.....
Ether	rapid F or slow M	−116.3	.....
Carbon disulfide	F	−111.6	.....
Toluene	F	−95.1	.....
Ethyl acetate	F	−83.6	.....
Carbon dioxide (solid) †	VP	−78.51	+0.01595(p−760) − 0.000011(p−760)^2
Chloroform	F	−63.5	.....
Chlorobenzene	F	−45.2	.....
Mercury †	F	−38.87	.....
Carbon tetrachloride	F	−22.9	.....
Ice †	M	0.000	.....
Sodium chromate	T	19.525	$Na_2CrO_4 \cdot 10H_2O$
Sodium sulfate	T	32.384	$Na_2SO_4 \cdot 10H_2O$
p-Toluidine	M	45	.....
α-Naphthylamine	M	50	.....
Sodium bromide	T	50.674	$NaBr \cdot 2H_2O$
Manganese chloride	T	58.089	$MnCl_2 \cdot 4H_2O$
Chloroform	B	61.3	.....
Ethyl alcohol	B	78.26	+0.034(p−760)
Benzene	B	80.0	+0.043(p−760)
Naphthalene	M	80.8	.....
Steam †	C	100.000	+0.0367(p−760) − 0.000023(p−760)^2
Benzoic acid	M	122.5	.....
Chlorobenzene	B	132	+0.050(p−760)
m-Xylene	B	138.8	+0.050(p−760)
Aniline	B	184.51	+0.051(p−760)
Salicylic acid	M	159.8	.....
o-Toluidine	B	199.7	+0.058(p−760)
Nitrobenzene	B	210.9	.....
Anthracene	M	216	.....
Naphthalene	C	217.96	+0.2075(t+273.1)·$\log_{10}$ (p/760)
Tin	F	231.85	.....
Quinoline	B	237.5	.....
Carbazole	M	246	.....
Anthraquinone	M	285	.....
Diphenylamine	B	302	.....
Benzophenone	C	305.9	+0.194(t+273.1)·$\log_{10}$ (p/760)
Cadmium	F	320.9	.....
Lead	F	327.4	.....

FIXED POINTS FOR THERMOMETER CALIBRATION

Substance	Point	Deg. C Thermodynamic scale	Pressure corrections and conditions
Mercury	B	356.9	.....
Potassium dichromate	M	397.5	.....
Zinc	F	419.45	.....
Sulfur †	C	444.60	$+0.0909(p-760)-0.000048\ (p-760)^2$
Potassium sulfate	I	583.0	.....
Antimony †	F	630.5	Approximately; to be determined with resistance thermometer.
Sodium chloride-sodium sulfate (30.5% NaCl+69.5% Na_2SO_4)	M	637.0	.....
Aluminum (99.85%)	F	658.9	.....
Potassium chloride	M	770.3	.....
Sodium chloride	M	800.4	.....
Sodium sulfate	M	884.7	.....
Silver †	F	960.5	In a reducing atmosphere.
Gold †	F	1063	.....
Potassium sulfate	M	1069.1	.....
Copper	F	1083	In a reducing atmosphere.
Lithium metasilicate	M	1202	.....
Diopside	M	1395	.....
Nickel	M or F	1452	.....
Cobalt	M or F	1490	.....
Palladium	F	1555 ± 2	.....
Anorthite	M	1555	.....
Platinum	M	1755 ± 6	.....
Alumina	M	2000	.....
Tungsten	M	3370 ± 30	.....

CHANGES IN CALIBRATION

Direct comparison with standard instruments or with a number of fixed points is more accurate than calibration between just a few fixed points over a wide range. Mercury and glass do not expand uniformly with rise in temperature the expansion accelerating with rise in temperature, and in the case of glass this varies with different varieties. Usually thermometers are calibrated for use in a vertical position and when such instruments are used in a horizontal position the readings are too high because of the difference in pressure exerted by the mercury column on the mercury contained in the bulb. This error (E), which is most pronounced with long thermometers, must be determined empirically at points along the temperature scale. For angles Θ (between the horizontal and vertical positions) the correction at the same temperature is $E \times \sin \Theta$. Thermometers are also subject to changes in readings caused by several conditions. Glass is subject to contraction over a number of years thus causing higher readings with lapse of time. After a thermometer has experienced a rise in temperature there is a lapse of time before the glass attains the volume corresponding to that temperature and if kept at a high temperature for long periods the ice point and the boiling point may be permanently lowered. Exposure to high temperatures for long periods may also cause a permanent change due to distillation of the mercury to the top of the stem, although this distillation is minimized with gas filled thermometers. Use of a thermometer in a vacuum may cause low readings. See also section on *Correction for Emergent Stem.*

CORRECTION FOR EMERGENT STEM OF LIQUID-IN-GLASS THERMOMETERS

When a thermometer which has been standardized for total immersion is used with a part of the liquid column at a temperature below that of the bulb, the reading is low and a correction must be applied. For this correction the following formula is employed.:

$$T_c = T_o + f \times l \times (T_o - T_m)$$

where T_c = corrected temperature

T_o = observed temperature

l = length of column in degrees above the surface of the liquid the temperature of which is being taken

T_m = mean temperature of mercury (or other thermometer liquid) column; i. e., the temperature of the middle point of the mercury (or other liquid) column as read from another thermometer

f = correction factor as given in the table below. In calculating the emergent stem correction for thermometers containing organic liquids (alcohol, pentane, toluene) it is sufficient to use the approximate value, $f = 0.001$. In such thermometers the value of f is practically independent of the kind of glass.

CORRECTION FACTORS FOR MERCURY-IN-GLASS THERMOMETERS

T_m °C	Values of f for various glasses				
	Verre dur	Jena 16 III	Jena 59 III	Jena 1655 III	Jena combustion
50	0.000158	0.000158	0.000164	0.000172	0.000164
150	0.000158	0.000158	0.000165	0.000173	0.000165
250	.....	0.000161	0.000170	0.000177	0.000171
350	.....	.....	0.000177	0.000184	0.000178
450	.....	.....	0.000187	0.000194	0.000188
500	.....	.....	0.000195	0.000200	0.000195

BOILING POINT CORRECTION

To correct for small differences in barometric pressure the following formula is employed:

$$T_c = T_o + 0.043\,(760 - P)$$

where T_c = corrected boiling point.

T_o = observed boiling point.

P = atmospheric pressure in millimeters of mercury.

CORRECTION OF BOILING POINT TEMPERATURE AT VARIOUS PRESSURES TO NORMAL PRESSURE (760 mm., 29.92 in. Hg)

U. S. P. XI METHOD

Pressure of Hg in		Correction °C.	Pressure of Hg in		Correction °C.
Inches	Mm.		Inches	Mm.	
28.06	712.7	+1.75	28.72	729.5	+1.13
.07	.9	1.74	.73	.8	1.12
.08	713.2	1.73	.74	730.0	1.11
.09	.5	1.72	.75	.3	1.10
.10	.7	1.71	.76	.5	1.10
.11	714.0	1.70	.77	.8	1.09
.12	.2	1.69	.78	731.0	1.08
.13	.5	1.68	.79	.27	1.07
.14	.7	1.67	.80	.52	1.06
.15	715.0	1.66	.81	.77	1.05
.16	.3	1.65	.82	732.03	1.04
.17	.5	1.64	.83	.28	1.03
.18	.8	1.64	.84	.54	1.02
.19	716.0	1.63	.85	.79	1.01
.20	.3	1.62	.86	733.04	1.00
.21	.6	1.61	.87	.29	0.99
.22	.8	1.60	.88	.55	.98
.23	717.1	1.59	.89	.80	.97
.24	.3	1.58	.90	734.06	.96
.25	.6	1.57	.91	.31	.95
.26	.8	1.56	.92	.56	.94
.27	718.1	1.55	.93	.82	.93
.28	.3	1.54	.94	735.08	.92
.29	.6	1.53	.95	.33	.91
.30	.8	1.52	.96	.58	.90
.31	719.1	1.51	.97	.84	.89
.32	.3	1.50	.98	736.10	.88
.33	.6	1.50	.99	.35	.88
.34	.8	1.49	29.00	.60	.87
.35	720.1	1.48	.01	.85	.86
.36	.3	1.47	.02	737.11	.85
.37	.6	1.46	.03	.36	.84
.38	.8	1.45	.04	.62	.83
.39	721.1	1.44	.05	.87	.82
.40	.4	1.43	.06	738.12	.81
.41	.7	1.42	.07	.38	.80
.42	.9	1.41	.08	.63	.79
.43	722.2	1.40	.09	.89	.78
.44	.4	1.39	.10	739.14	.77
.45	.7	1.38	.11	.39	.76
.46	.9	1.37	.12	.65	.75
.47	723.2	1.37	.13	.90	.74
.48	.4	1.36	.14	740.16	.73
.49	.7	1.35	.15	.41	.72
.50	.9	1.34	.16	.67	.71
.51	724.2	1.33	.17	.92	.70
.52	.4	1.32	.18	741.17	.69
.53	.7	1.31	.19	.43	.69
.54	.9	1.30	.20	.68	.68
.55	725.2	1.29	.21	.94	.67
.56	.4	1.28	.22	742.19	.66
.57	.7	1.27	.23	.44	.65
.58	.9	1.26	.24	.70	.64
.59	726.2	1.25	.25	.95	.63
.60	.4	1.24	.26	743.20	.62
.61	.7	1.24	.27	.46	.61
.62	.9	1.23	.28	.71	.61
.63	727.2	1.22	.29	.97	.60
.64	.4	1.21	.30	744.22	.59
.65	.7	1.20	.31	.49	.58
.66	.9	1.19	.32	.74	.57
.67	728.2	1.18	.33	.99	.57
.68	.4	1.17	.34	745.24	.56
.69	.7	1.16	.35	.49	.55
.70	729.0	1.15	.36	.74	.54
.71	.3	1.14	.37	746.00	.53

CORRECTION OF BOILING POINT TEMPERATURES

Pressure of Hg in		Correction °C.	Pressure of Hg in		Correction °C.
Inches	Mm.		Inches	Mm.	
29.38	746.25	+0.52	29.74	755.39	+0.17
.39	.50	.51	.75	.65	.16
.40	.76	.50	.76	.90	.15
.41	747.02	.49	.77	756.15	.14
.42	.27	.48	.78	.41	.13
.43	.52	.47	.79	.66	.12
.44	.77	.46	.80	.92	.11
.45	748.03	.45	.81	757.17	.10
.46	.29	.44	.82	.42	.09
.47	.54	.43	.83	.67	.08
.48	.79	.42	.84	.93	.07
.49	749.05	.41	.85	758.19	.07
.50	.30	.40	.86	.44	.06
.51	.55	.39	.87	.69	.05
.52	.80	.38	.88	.94	.04
.53	750.05	.37	.89	759.20	.03
.54	.32	.36	.90	.46	.02
.55	.57	.35	.91	.72	.01
.56	.82	.34	.92	.97	.00
.57	751.08	.33	.93	760.23	−.01
.58	.33	.32	.94	.48	−.02
.59	.58	.31	.95	.73	−.02
.60	.84	.30	.96	.98	−.03
.61	752.09	.29	.97	761.24	−.04
.62	.34	.28	.98	.49	−.05
.63	.60	.27	.99	.74	−.06
.64	.85	.26	30.00	762.00	−.07
.65	753.11	.25	.01	.25	−.08
.66	.36	.24	.02	.50	−.09
.67	.61	.23	.03	.76	−.10
.68	.87	.22	.04	763.01	−.11
.69	754.12	.21	.05	.26	−.12
.70	.38	.21	.06	.5	−.13
.71	.63	.20	.07	.8	−.14
.72	.88	.19	.08	764.0	−.15
.73	755.14	.18	.09	.3	−.16

CORRECTION OF BOILING POINT TEMPERATURE AT VARIOUS PRESSURES TO NORMAL PRESSURE (760 mm. Hg)

A. S. T. M. METHOD

In the *A. S. T. M. Standards on Petroleum Products and Lubricants*, September 1937, page 96, the Sydney Young equation is used for calculating the proper correction to the observed boiling point. In this equation the temperature range as well as the pressure is considered. The Sydney Young equation is as follows:

$$\text{For Centigrade scale: } C_c = 0.00012\ (760 - P)\ (273 + t_c),$$
$$\text{For Fahrenheit scale: } C_f = 0.00012\ (760 - P)\ (460 + t_f),$$

in which C_c and C_f are, respectively, corrections to be made on the observed temperatures t_c or t_f, and P is the actual barometric pressure in millimeters of mercury.

The table below is a convenient approximation of the corrections as calculated from the equations above. These approximations will suffice for ordinary work. For more precise work, the correction should be calculated using the Sydney Young equation and the temperature when 50% of the material has boiled. A new correction should be made for each variation of more than 10°C. or 18°F.

(Completed on following page.)

CORRECTION OF BOILING POINT TEMPERATURES

Boiling Point		Correction for Each One mm. Difference in Pressure*	
t_c in °C.	t_f in °F.	C_c in °C.	C_f in °F.
10–30	50–86	0.035	0.063
30–50	86–122	.038	.068
50–70	122–158	.040	.072
70–90	158–194	.042	.076
90–110	194–230	.045	.081
110–130	230–266	.047	.085
130–150	266–302	.050	.089
150–170	302–338	.052	.094
170–190	338–374	.054	.098
190–210	374–410	.057	.102
210–230	410–446	.059	.106
230–250	446–482	.062	.111
250–270	482–518	.064	.115
270–290	518–554	.066	.119
290–310	554–590	.069	.124
310–330	590–626	.071	.128
330–350	626–662	.074	.132
350–370	662–698	.076	.137
370–390	698–734	.078	.141
390–410	734–770	.081	.145

* To be added in case barometric pressure is below 760 mm., to be subtracted in case the pressure is above 760 mm.

CALCULATION OF BOILING POINTS OF ORGANIC COMPOUNDS

Cf. Kinney, *Jour. Am. Chem. Soc. 60, 3032 (1938); Ind. Eng. Chem. 32, 559 (1940).*

Boiling points of organic compounds may be calculated from their structures as follows: Obtain the molecular *B.P.N.* by adding together the appropriate boiling point numbers (*b.p.n.*) for the various atoms and structural groupings given in Table I. From the *B.P.N.* obtain the B.P. (boiling point in degrees Centigrade) using Table II.

Certain rules must be followed in applying the data:

1. The *b.p.n.'s* of 0.8 and 1.0 are applied to the carbon and hydrogen atoms, respectively, of the longest aliphatic chain in the molecule. It is essential that the longest aliphatic chain be used as the base because the boiling point is dependent, in part, upon this factor.
2. All groups or atoms attached to this chain are assigned *b.p.n.'s* as indicated in Table I.
3. With many atoms and groups the position of the group, or the presence of other groups, alters the *b.p.n.* These, as far as are known, are given in Table I.

Example: To calculate the boiling point of 1-methyl-4-(1-methylethyl)-1-cyclopentene, $(CH_3)_2$:CH·CH·CH_2·C(CH_3):CH·CH_2.

Carbon in the longest aliphatic chain (2× 0.8)	1.6
Hydrogen in the longest aliphatic chain (4× 1.0)	4.0
Methyl radical attached to the aliphatic chain	3.05
Carbon in the cyclopentene ring (5× 0.8)	4.0
Hydrogen in the cyclopentene ring (6×1.0)	6.0
B.P.N. for the 5-membered ring	2.5
B.P.N. for the ethylenic linkage, type R_2C:CHR	2.3
Methyl attached to the cyclopentene ring	3.05
Calculated *B.P.N.*, sum of the items above	26.50
Calculated B.P., from Table II	142.5°C.
Observed B.P.	143.1°C.

Example: To calculate the boiling point of 2,8-dimethyl-5-nonanone, $[(CH_3)_2CH\cdot CH_2\cdot CH_2]_2CO$.

Carbon in the longest aliphatic chain (9× 0.8)	7.2
Hydrogen in the longest aliphatic chain (16× 1.0)	16.0
Two methyl radicals (2× 3.05)	6.1
One carbonyl oxygen, type RCH_2COCH_2R	7.5
Calculated *B.P.N.*, sum of the items above	36.8
Calculated B.P., from Table II	222.5°C.
Observed B.P.	226.0°C.

TABLE I.

ATOMIC AND GROUP BOILING POINT NUMBERS.

Carbon, in the main chain	0.8	Type of olefinic linkage	
Hydrogen, attached to the main chain	1.0	CH_2=CH_2	1.2
		RCH=CH_2	1.5
Radicals, saturated, attached to the main chain or to cyclic rings		RCH=CHR	1.9
		R_2C=CHR	2.3
Methyl	3.05	R_2C=CR_2	2.8
Ethyl	5.5		
Propyl	7.0	Radicals, unsaturated, attached to main chain	
Butyl	9.7		
2,2-Dimethyl grouping	−0.4	Methylene	4.4
		Ethylidene	7.0
Two or three alkyls attached to adjacent carbons of saturated main chains of 6 carbons or less	+0.5	Vinyl	5.4
		Propylidene	9.0
		Butylidene	10.4
Four or more alkyls attached to adjacent carbons of saturated main chains of 6 carbons or less	+1.0	Type of acetylenic linkage	
		HC≡CH	4.0
		RC≡CH	4.4
		RC≡CCH_3	5.4
		RC≡CR	4.8

ATOMIC AND GROUP BOILING POINT NUMBERS (Continued)

Type of diolefin	
Allenes	4.8
Conjugated, normal values of double bonds plus	0.8
Not conjugated, normal values of double bonds only	
Type of triolefin	
All bonds conjugated, normal values of double bonds plus	2.4
Two bonds conjugated, normal values of double bonds plus	0.8
No conjugation, normal values of double bonds only	
Type of diacetylene	
1,3-Diacetylenes, normal values of triple bonds only	
All other conjugated, normal values of triple bonds plus	3.0
No conjugation, normal values of triple bonds only	
Type of enyne	
Conjugated, normal values of bonds plus	0.8
No conjugation, normal values of bonds only	
Type of dienyne	
Conjugated, normal values of bonds plus	2.4
No conjugation, normal values of bonds only	
Cyclic radicals: Add 0.8 for each carbon, 1.0 for each hydrogen, the normal values of any unsaturated linkages, and the following values for the ring:	
Cyclo-propyl, -butyl, -pentyl, -hexyl, respectively	2.1, 2.3, 2.5, 2.7
Cyclo-heptyl, -octyl, etc., (add 0.5 for each additional CH_2 in the ring)	3.4, 3.9, etc.
Alcohol —OH	
RCH_2OH	10.8
R_2CHOH	8.8
R_3COH	6.8
Ether —O—	
RCH_2OCH_3, R_2CHOCH_3, R_3COCH_3	2.9
RCH_2OCH_2R, R_2CHOCH_2R, R_3COCH_2R	2.0
$R_2CHOCHR_2$, R_3COCHR_2	1.1
R_3COCR_3	(0.2?)
Aldehyde =O	
RCH_2CHO	8.2
R_2CHCHO	7.6
R_3CCHO	7.0
Ketone =O	
RCH_2COCH_3	8.0
$R_2CHCOCH_3$, RCH_2COCH_2R	7.5
R_3CCOCH_3, $R_2CHCOCH_2R$	7.0
R_3CCOCH_2R, $R_2CHCOCHR_2$	6.5
R_3CCOCH_2R	(6.0?)
R_3CCOCR_3	(5.5?)
Ester —OO—	
RCH_2COOCH_3, CH_3COOCH_2R	8.5
$R_2CHCOOCH_3$, RCH_2COOCH_2R, $HCOOCHR_2$, $CH_3COOCHR_2$	7.6
$R_3CCOOCH_3$, $R_2CHCOOCH_2R$, $RCH_2COOCHR_2$, $HCOOCR_3$, CH_3COOCR_3	6.7
$R_3CCOOCH_2R$, $R_2CHCOOCHR_2$, RCH_2COOCR_3	5.8
$R_3CCOOCHR_2$, $R_2CHCOOCR_3$	4.9
$R_3CCOOCR_3$	4.0
Acid —COOH	
RCH_2COOH	19.3
$R_2CHCOOH$	18.6
R_3CCOOH	17.9
Amine, primary $—NH_2$	
RCH_2NH_2	7.3
R_2CHNH_2	6.2
R_3CNH_2	5.1
Amine, secondary —NH—	
RCH_2NHCH_3	5.0
$R_2CHNHCH_3$, RCH_2NHCH_2R	4.0
R_3CNHCH_3, $R_2CHNHCH_2R$	3.5
R_3CNHCH_2R, $R_2CHNHCHR_2$	3.0
Amine, tertiary =N—	
$RCH_2N(CH_3)_2$	2.0
$R_2CHN(CH_3)_2$, $(RCH_2)_2NCH_3$	1.5
$R_3CN(CH_3)_2$, $(R_2CH)_2NCH_3$, $(RCH_2)_3N$	1.25
Cyanide —CN	
RCH_2CN	14.0
R_2CHCN	12.8
R_3CCN	11.6
Isocyanide —NC	
RCH_2NC	12.2
R_2CHNC	11.1
R_3CNC	10.0

TABLE II.

MOLECULAR BOILING POINT NUMBERS AND THEIR BOILING POINTS.

Calculated from the formula: $B.P. = 230.14\sqrt[3]{B.P.N.} - 543$

B. P. N.	B. P., ° C.	Av. Increase per 0.1 Unit, ° C.	B. P. N.	B. P., ° C.	Av. Increase per 0.1 Unit, ° C.
5	−149.5	2.50	39	237.5	0.66
6	−124.5	2.18	40	244.1	0.65
7	−102.7	2.00	41	250.6	0.64
8	−82.7	1.84	42	257.0	0.63
9	−64.3	1.71	43	263.3	0.62
10	−47.2	1.60	44	269.5	0.61
11	−31.2	1.51	45	275.6	0.60
12	−16.1	1.43	46	281.6	0.59
13	−1.8	1.35	47	287.5	0.59
14	+11.7	1.29	48	293.4	0.58
15	24.6	1.23	49	299.2	0.57
16	36.9	1.19	50	304.9	0.56
17	48.8	1.14	51	310.5	0.55
18	60.2	1.10	52	316.0	0.54
19	71.1	1.06	53	321.5	0.55
20	81.7	1.03	54	326.9	0.53
21	92.0	0.99	55	332.2	0.53
22	101.9	0.96	56	337.5	0.52
23	111.5	0.94	57	342.7	0.52
24	120.9	0.90	58	347.9	0.50
25	129.9	0.89	59	352.9	0.51
26	138.8	0.86	60	358.0	0.50
27	147.4	0.85	61	363.0	0.49
28	155.9	0.82	62	367.9	0.49
29	164.1	0.80	63	372.8	0.48
30	172.1	0.79	64	377.6	0.47
31	180.0	0.76	65	382.3	0.47
32	187.6	0.76	66	387.0	0.48
33	195.2	0.74	67	391.8	0.45
34	202.6	0.73	68	396.3	0.47
35	209.9	0.70	69	401.0	0.45
36	216.9	0.70	70	405.5	0.45
37	223.9	0.68	71	410.0	
38	230.7	0.68			

BOILING POINTS AT VARIOUS PRESSURES
COX CHART METHOD

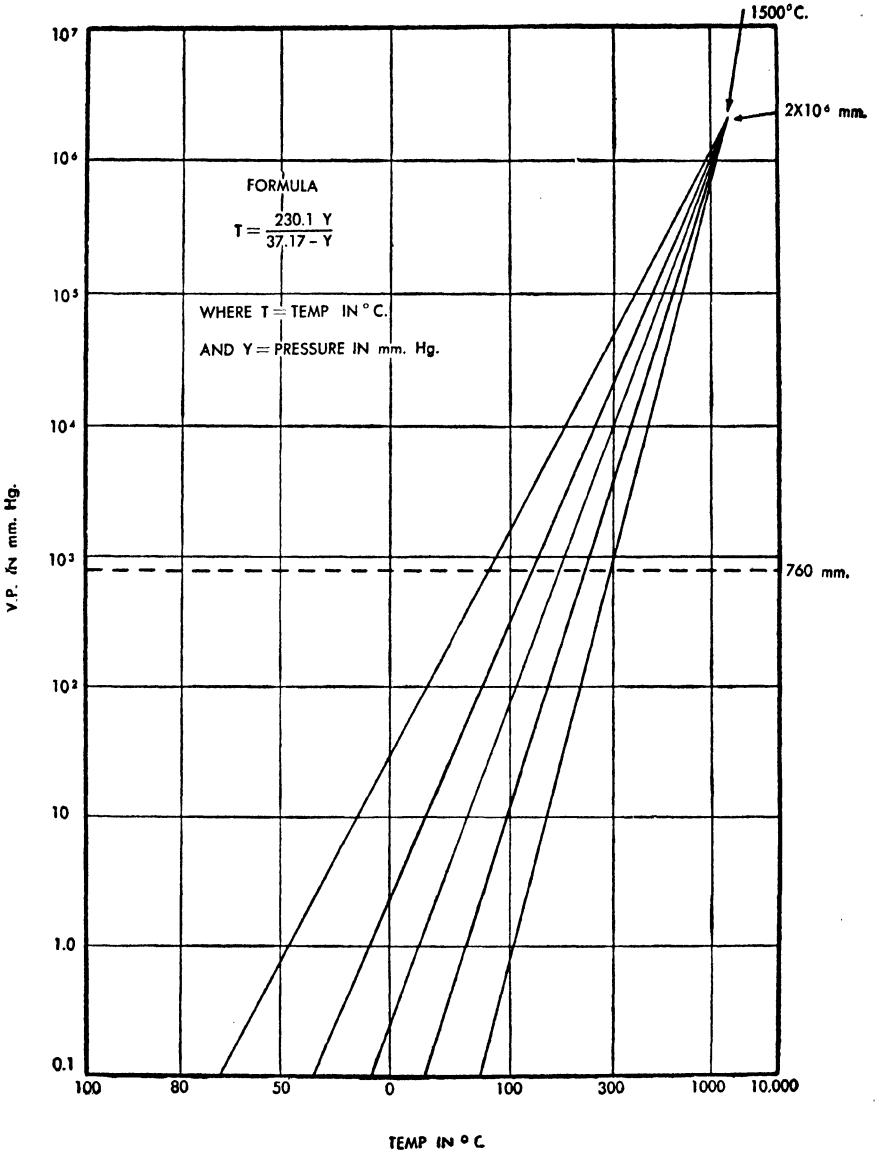
Cf. Cox, *Ind. Eng. Chem. 15, 592 (1923)*; Davis, *ibid. 17, 735 (1925)*; Calingaert and Davis, *ibid. 17, 1287 (1925)*.

A Cox chart, of the family to which a compound belongs, may be used to obtain the boiling point at any pressure, or the vapor pressure at any temperature. By drawing a straight line through the boiling point at 760 mm. and the infinite point, a curve is obtained which gives the relationship between the temperature and the vapor pressure. To construct a Cox chart, the ordinates for pressure values are laid off logarithmically with the aid of a log scale on a slide rule. The formula $T = 230.1Y \div (37.17 - Y)$ is used for spacing of the temperature values on the abscissa. Drawn in this manner, a Cox chart can be applied to any family of compounds or to any single compound. The sample chart shown on the following page shows curves for the vapor pressures of five compounds belonging to the alkyl benzene family with the infinite point at 1500°C. and 2×10^6mm. The five curves are representative of five compounds with normal boiling points at 80°, 110°, 210°, 260°, and 290°C. respectively. A size of chart which is satisfactory is 56 inches high and 38.75 inches wide with pressures from 0.1 mm. to 10^6mm. The values of T cover the range from −100°C. to +10,000°C., the 0° point being 17.25 inches from the left side or −100° point of the chart.

Some compounds, *e.g.*, the amyl alcohols, do not come within the family where they should belong. In general, aromatic compounds seem to lie in families on the Cox chart to a much greater degree than do aliphatic compounds.

COX CHART FAMILY	Infinite Point	
	°C.	10^6mm. Hg
(1) *Aliphatic hydrocarbons* The series C_nH_{2n+2}; also pinene, camphene, and limonene	1240	1.3
(2) *Aliphatic halides* Mono- and poly-halogen derivatives of the series C_nH_{2n+2} and C_nH_{2n}, except acetylene tetrachloride	1390	1.43
(3) *Aliphatic alcohols and ketones* The lower members of the alcohol series $C_nH_{2n+2}O$ and $C_nH_{2n}O$. The saturated ketones of the series $C_nH_{2n}O$; unsaturated ketones apparently are exceptions	610	1.5
(4) *Aliphatic acids and esters* The saturated acids of the series $C_nH_{2n}O_2$ where $n<7$, and the esters $C_nH_{2n}O_2$ where $n<6$	520	0.24
(5) *Aliphatic esters* The saturated esters of the series $C_nH_{2n}O_2$ where $n>5$; also acetoacetic ester; *iso*-butyl oxalate; benzyl, linalyl, bornyl, and menthyl acetates; bornyl propionate and *n*-butyrate; methyl, ethyl, *n*-propyl, and *iso*-butyl benzoates; methyl salicylate	1100	1.1
(6) *Aliphatic acids* The saturated acids of the series $C_nH_{2n}O_2$ where $n>6$ and the unsaturated acids of the series $C_nH_{2n-2}O_2$ from $n=4$ to $n=11$; also chloroacetic and benzoic acids	1100	4.2
(7) *Alkyl benzenes* The series C_nH_{2n-6}, C_nH_{2n-8}, and their ring halogen derivatives	1500	2.0
(8) *Phenols* The series $C_nH_{2n-6}O$ and *m*-chlorophenol	1900	9.0
(9) *Aromatic alcohols* The series $C_nH_{2n-6}O$ and their ring halogen derivatives	3300	20.0
(10) *Anilines* The series $C_nH_{2n-5}N$ and their ring halogen derivatives; also benzylamine	1300	2.3
(11) *Alkyl naphthalenes* The series C_nH_{2n-12} and their ring halogen derivatives	1320	1.0

COX CHART


1500°C.
2X10⁶ mm.
760 mm.
FORMULA
T = 230.1 Y / 37.17 - Y
WHERE T = TEMP IN °C.
AND Y = PRESSURE IN mm. Hg.
V.P. IN mm. Hg.
10⁷
10⁶
10⁵
10⁴
10³
10²
10
1.0
0.1
100
80
50
0
100
300
1000
10,000
TEMP IN °C

FUSING POINTS AND COMPO-

Information furnished by The Standard Pyrometric Cone Co., Columbus, O.

The fusing point values given in the table below have only a relative or theoretical value, being a summarized outline of determinations made by the U. S. Bu. of Standards (*Jour. Am. Ceramic Soc.* 9, 70 (1926) and are approximate values given to the nearest 5°C from the average of many determinations; therefore, between any two cones there may be an error of ±5°C. The values apply only when the cones are heated in kilns where the gases are normally oxidizing and free from oxides of sulfur. If the cones show a hardening of the surface ("skin effect") because of exposure to kiln gases with lack of oxygen, small corrections must be made. Kilns rich in sulfur oxides because of the fuel employed or wares which give off sulfur dioxide may cause appreciable variation in fusing points. Fusion of a cone is said to have been attained when the tip touches the base upon which the cone has been set.

From what has been stated above it is evident that pyrometric cones are not intended as a means of measuring temperature. **Their sole purpose is to serve as a guide in the firing of ceramic wares.** Since both the cones and the wares are composed of ceramic materials they are similarly affected by variable conditions within the kiln, and are thus a more reliable guide for firing than any device which indicates only one of these variables, namely the temperature. When cones behave erratically, they indicate abnormal kiln conditions which in many instances affect the

Cone Number	Fusion Temperature When Heated: Slowly 20°C. per hr. °C.	Slowly 20°C. per hr. °F.	Rapidly 150°C. per hr. °C.	Rapidly 150°C. per hr. °F.	Color Scale	Heat Treatment Range
022	585	1085	605	1121	Dull red	Jewelers' enamels
021	595	1103	615	1139	Dull red	
020	625	1157	650	1202	Dull red	Aluminum melts 658°C.
019	630	1166	660	1220	Dull red	Potters' decorating kilns; bright gold fire
018	670	1238	720	1328	Dull red	
017	720	1328	770	1418	Dull red	
016	735	1355	795	1463	Dull red	
015	770	1418	805	1481	Dull red	
014	795	1463	830	1526	Dull red	
013	825	1517	860	1580	Dull red	
012	840	1544	875	1607	Dull red	
011	875	1607	905	1661	Cherry red	
010	890	1634	895	1643	Cherry red	Silver melts 961°C. Gold melts 1063°C.
09	930	1706	930	1706	Cherry red	
08	945	1733	950	1742	Cherry red	Common red clay products:— bricks, drain tiles, flower pots, soft roofing tiles, fire proofing
07	975	1787	990	1814	Cherry red	
06	1005	1841	1015	1859	Orange	
05	1030	1886	1040	1904	Orange	
04	1050	1922	1060	1940	Orange	
03	1080	1976	1115	2039	Orange	
02	1095	2003	1125	2057	Yellow	Shale and No. 2 fire clay products:— bricks, sewer pipe, terra cotta, hard tiles for roofing and flooring, stoneware pottery and soft porcelain
01	1110	2030	1145	2093	Yellow	
1	1125	2057	1160	2120	Yellow	
2	1135	2075	1165	2129	Yellow	
3	1145	2093	1170	2138	Yellow	

SITION OF PYROMETRIC CONES

ware unfavorably. Cones in series should go over seriatim otherwise something is wrong with the firing conditions. Although fusion temperatures of cones are affected by sulfur oxides and since the majority of ceramic wares are fired with sulfurous fuel (or the ware itself contains sulfides or sulfates), nevertheless it does not follow that cones are not satisfactory under these conditions. A factory selects by trial a cone which has a satisfactory end point for its ware and since all the cones used by it go through this sulfur treatment, so far as that factory is concerned all have practically the same relative end points.

Series Classification—The *Soft* or *Decorating* series begins with No. 022, softening at dull red heat and runs through to No. 011, the temperature range between numbers being approximately 30°C or 54°F. Of these, No. 017 represents the temperature usually employed for liquid bright gold, and most overglaze colors for pottery and glass are made to work best at this heat. These cones contain lead and are quite sensitive to reducing gases; they should be used only in muffle kilns or where they cannot come in contact with flames. The *Low* temperature series includes Nos. 010 to 01 and is used chiefly for firing red burning clay products and soft glazes. The *Intermediate* temperature series includes Nos. 1 to 20 and is used chiefly for firing buff and white clay products and hard glazes. The *High* temperature series includes Nos. 23 to 42 and is used chiefly for firing and testing refractory materials.

Composition in Parts by Weight								Cone No.
Na_2O	K_2O	CaO	Fe_2O_3	PbO	Al_2O_3	SiO_2	B_2O_3	
0.5	...	....	....	0.5	....	2.00	1.0	022
0.5	....	....	....	0.5	0.1	2.20	1.0	021
0.5	....	....	....	0.5	0.2	2.40	1.0	020
0.5	....	....	....	0.5	0.3	2.60	1.0	019
0.5	....	....	....	0.5	0.4	2.80	1.0	018
0.5	....	....	....	0.5	0.5	3.00	1.0	017
0.5	....	....	....	0.5	0.55	3.10	1.0	016
0.5	....	....	....	0.5	0.6	3.20	1.0	015
0.5	....	....	....	0.5	0.65	3.30	1.0	014
0.5	....	....	....	0.5	0.7	3.40	1.0	013
0.5	....	....	....	0.5	0.75	3.50	1.0	012
0.5	....	....	....	0.5	0.8	3.60	1.0	011
....	0.3	0.7	0.2	....	0.3	3.50	0.50	010
....	0.3	0.7	0.2	....	0.3	3.55	0.45	09
....	0.3	0.7	0.2	....	0.3	3.60	0.40	08
....	0.3	0.7	0.2	....	0.3	3.65	0.35	07
....	0.3	0.7	0.2	....	0.3	3.70	0.30	06
....	0.3	0.7	0.2	....	0.3	3.75	0.25	05
....	0.3	0.7	0.2	....	0.3	3.80	0.20	04
....	0.3	0.7	0.2	....	0.3	3.85	0.15	03
....	0.3	0.7	0.2	....	0.3	3.90	0.10	02
....	0.3	0.7	0.2	....	0.3	3.95	0.05	01
....	0.3	0.7	0.2	....	0.3	4	....	1
....	0.3	0.7	0.1	....	0.4	4	....	2
....	0.3	0.7	0.05	....	0.45	4	....	3

Cone Number	Fusion Temperature When Heated: Slowly 20°C. per hr. °C.	Slowly 20°C. per hr. °F.	Rapidly 150°C. per hr. °C.	Rapidly 150°C. per hr. °F.	Color Scale	Heat Treatment Range
4	1165	2129	1190	2174	Yellow	
5	1180	2156	1205	2201	Yellow	Albany slip melts
6	1190	2174	1230	2246	Yellow	
7	1210	2210	1250	2282	Yellow	
8	1225	2237	1260	2300	White	Commercial white feldspar melts
9	1250	2282	1285	2345	White	
10	1260	2300	1305	2381	White	China, porcelain, abrasive wheels, electrical porcelain, fire bricks
11	1285	2345	1325	2417	Brlnt. white	
12	1310	2390	1335	2435	Brlnt. white	
13	1350	2462	1350	2462	Brlnt. white	
14	1390	2534	1400	2552	Brlnt. white	
15	1410	2570	1435	2615	Brilliant white	Spark plugs, high tension electrical porcelain
16	1450	2642	1465	2669	Brlnt. white	
17	1465	2669	1475	2687	Brlnt. white	
18	1485	2705	1490	2714	Brlnt. white	
19	1515	2759	1520	2768	Brlnt. white	
20	1520	2768	1530	2786	Dazzling white	
	When heated at 100°C. per hr.					Chrome and silica bricks; fusion tests of
	Deg. C.		Deg. F.			
23	1580		2876		Dzlng. white	No. 2 fire brick.
26	1595		2903		Dzlng. white	No. 2 fire brick melts
27	1605		2921		Dzlng. white	
28	1615		2939		Dzlng. white	
29	1640		2984		Dzlng. white	
30	1650		3002		Dzlng. white	
31	1680		3056		Dzlng. white	
32	1700		3092		Dzlng. white	No. 1 fire brick melts
33	1745		3173		Dzlng. white	
34	1760		3200		Dzlng. white	Fusion tests of No. 1 fire brick
35	1785		3245		Dzlng. white	
36	1810		3290		Dzlng. white	
37	1820		3308		Dzlng. white	
38	1835		3335		Dzlng. white	Fusion tests of bauxite, alumina and synthetic refractories
39	1865		3389		Dzlng. white	
40	1885		3245		Dzlng. white	
41	1970		3578		Dzlng. white	
42	2015		3659		Dzlng. white	Alumina melts

SITION OF PYROMETRIC CONES

Composition in Parts by Weight								Cone No.
Na_2O	K_2O	CaO	Fe_2O_3	PbO	Al_2O_3	SiO_2	B_2O_3	
....	0.3	0.7	....	....	0.5	4	....	4
....	0.3	0.7	....	....	0.5	5	....	5
....	0.3	0.7	....	....	0.6	6	....	6
....	0.3	0.7	....	....	0.7	7	....	7
....	0.3	0.7	....	....	0.8	8	....	8
....	0.3	0.7	....	....	0.9	9	....	9
....	0.3	0.7	....	....	1.0	10	....	10
....	0.3	0.7	....	....	1.2	12	....	11
....	0.3	0.7	....	....	1.4	14	....	12
....	0.3	0.7	....	....	1.6	16	....	13
....	0.3	0.7	....	....	1.8	18	....	14
....	0.3	0.7	....	....	2.1	21	....	15
....	0.3	0.7	....	....	2.4	24	....	16
....	0.3	0.7	....	....	2.7	27	....	17
....	0.3	0.7	....	....	3.1	31	....	18
....	0.3	0.7	....	....	3.5	35	....	19
....	0.3	0.7	....	....	3.9	39	....	20
....	0.3	0.7	....	....	5.4	54	....	23
....	0.3	0.7	....	....	7.2	72	....	26
....	0.3	0.7	....	....	20.0	200	....	27
....	....	....	....	....	1.0	10	....	28
....	....	....	....	....	1.0	8	....	29
....	....	....	....	....	1.0	6	....	30
....	....	....	....	....	1.0	5	....	31
....	....	....	....	....	1.0	4	....	32
....	....	....	....	....	1.0	3	....	33
....	....	....	....	....	1.0	2.5	....	34
....	....	....	....	....	1.0	2	....	35
....	....	....	....	....	1.0	1.5	....	36
....	....	....	....	....	1.0	1.25	....	37
....	....	....	....	....	1.0	1.00	....	38
Cones Nos. 39, 40, 41 and 42 were heated at 600°C. per hour.					1.0	0.75	....	39
					1.0	0.50	....	40
					1.0	0.05	....	41
					1.0	0.00	....	42

A SHORT GLOSSARY OF CERAMIC TERMS

Compiled by F. C. SMITH, B. S. (Chem. Eng.) and R. O. HUMMEL
of The Harshaw Chemical Co., Cleveland, Ohio.

Albany slip, a natural glaze burning brown to black.

Anneal, to relieve strains by heat.

Bait, a device for grabbing glass prior to drawing.

Belleek, a soft translucent ivory porcelain, usually very thin.

Bisque (body), unglazed, fired clayware.

Blunging, a mechanical mixing of clay or slip with water, and separating from sand and pebbles; washing.

Body stain, cf. *ceramic colors.*

Bone china, a china made with a body containing bone ash.

Casing, coating one piece of glass with another while hot.

Casting (pottery), forming pottery by pouring slip into a porous mold; e. g. in plaster of Paris.

Casting (glass), pouring glass from a crucible to a plate; flat glass.

Ceramic, clay or siliceous products hardened by the action of heat.

Ceramic colors—

Body stains, colors used in the body.

Engobe, colors used in a slip over a body or between the body and the glaze.

Glass colors, fusible colors fired over glassware.

Glaze stains, colors used in the glaze.

Lustres, organic solutions of metals which when applied to pottery and fired give iridescent metallic films.

Overglaze, fusible colors fired over glazed ware.

Underglaze, color applied over the body before glazing.

China, translucent vitrified glazed opaque ware, body usually vitrified before glazing.

Cloisonne (enamel), colored vitrified enamel on a metal base in which the different colors are separated by metal strips.

Cloisonne ware, colored pottery in which the different colored glazes are separated by a narrow line of hard black glaze.

Colors, cf. *ceramic colors.*

Cones, pyramid shaped fusible bodies of progressive softening order, employed as a guide in determining the finishing point of the ceramic kiln.

Continuous furnace or lehr, a furnace or lehr in which the firing takes place in a continuous operation.

Copper heads, copper colored spots in ground coat enamel.

Cords, variations in the density of glass.

Crackle (Craquelle), cracks in glaze due to crazing and which are sometimes produced intentionally.

Cranny, the sharp edge of a marver.

Crawl, a grouping of glaze, slip, or enamel during drying or firing, generally due to fineness of particles.

Crazing, the development of fine cracks caused by excessive contraction of a glaze or enamel.

Decalcomania, designs produced on enamels, pottery, or glass by transferring to them vitreous colors on paper and then firing.

Deflocculation, a dispersion of particles and agglomerates resulting in thinning the suspension; an excess of electrolytes; long; sol.

Devitrification, the crystallization of a vitreous material.

Dipping, an application of glaze or enamel by immersion and allowing the excess to drain off.

Draw, absorption of glaze by an unglazed surface nearby during firing.

Dunting, splitting of claywares due to silica inversion.

Egg shell, incomplete vitrification; cf. *devitrification.*

Enamel, a fusible vitreous coating for metals or claywares at low temperatures; an opaque coating.

Enamel frit, cf. *frit.*

Encaustic tile, a variety of tile having an inlaid design of a different color from that of the body of the tile; the term is now sometimes used to designate any dry pressed tile with a colored slip.

Engobe, cf. *ceramic colors.*

Faience, a general term covering "colored clay bodies glazed"; named after the town of Faenza, Italy.

Fining, removing small gas bubbles from molten glass; planing.

Firing racks, refractory racks or boxes for holding ware while firing.

Fishscaling, small fish-scale shaped chips jumping or chipping from enamel.

Flashing, coating a piece of glass with

A SHORT GLOSSARY OF CERAMIC TERMS

a thin layer of colored glass while hot.

Flocculation, the agglomeration of particles by the addition of electrolytes to give a proper consistency for dipping, casting, or spraying, setting-up; short; thickening.

Flux, a material or mixture having a low melting point; the first to fuse at a definite temperature.

Frit, any fused substance or mixture quenched; enamel frit; glaze frit.

Gathering, the collecting of glass on a blow-pipe.

Glass colors, cf. *ceramic colors.*

Glaze, vitrifiable coating for brick, bisque, porcelain, or pottery, or stoneware body.

Glaze frit, cf. *frit.*

Glaze stain, cf. *ceramic colors.*

Glory hole, a furnace for reheating glass.

Glost, a term applied to glazed ware.

Glost kiln, a kiln for firing glaze.

Graining, the application and firing of a net work of one colored enamel or glaze over another colored enamel or glaze to imitate a natural wood or marble finish.

Green ware, formed but unfired pottery.

Grog, crushed bisque fire-brick, saggers, crucibles, or calcined clay.

Hacking, a stacking of claywares without the aid of stilts or saggers.

Hairlines, the fine lines appearing in fired enamel.

Intermittent kiln or lehr, a furnace or lehr that is loaded, fired, allowed to cool and unloaded; intermittent charges.

Jacks, cf. *stilts.*

Jigger, a machine for shaping pottery by means of a rotating mold and a profile tool.

Jumpers, small chips of enamel that jump from finished surface.

Kiln, a furnace or oven for firing pottery.

Lehr, a furnace for annealing or decorating glass.

Lustres, cf. *ceramic colors.*

Majolica, a rather general term for a colored, enameled, clay body; named after the Island of Majorca.

Marver, a polished stone or steel plate for working glass while blowing.

Monkey pots, small crucibles for experimental glass melts.

Mosaic, the union of pieces of colored glass, stone, tile, etc. to form an artistic design, laid in metal, cement, etc.

Muffle furnace or kiln, a furnace or kiln so constructed that the space in which the ware is fired does not come in contact with fire or furnace gases.

Overglaze, cf. *ceramic colors.*

Parison, glass on the blow-pipe ready for final blowing.

Pin, cf. *stilts.*

Pin holes, holes left by the bursting of a blister during firing.

Planing, cf. *fining.*

Porcelain, a vitrified ware, generally translucent, made by one firing only.

Pot, a container for smelting.

Potters' wheel, a wheel for rotating plastic clay in forming ware by hand.

Pottery, a term commonly used to include all articles made of clay, or clay and mineral mixtures, and hardened by fire; in present usage the term does not include structural, refractory, or glass wares, or insulators.

Pugging, the intimate wet mixing of body constituents.

Punty, a tool upon which glass shapes are handled.

Pyrometric cone, cf. *cones.*

Refractory, having resistance to melting or fusion; a ware that does not fuse under 1500°C.

Saggers, refractory containers in which pottery is stacked for firing.

Seeds, the small bubbles in glass.

Seger cones, cf. *cones.*

Semi-vitreous china, semi-porous china.

Setters, a refractory support in which chinaware, tile, etc. are placed for firing. This ware is supported on its own base or its contour rests on sand, no stilts being used.

Setting-up, cf. *flocculation.*

Sherds (shords), broken saggers and bisque.

Shiners, shiny spots in enamel caused by fish-scaling or jumpers.

Shivering, a glaze or enamel expanding excessively on firing; chips.

Shords, cf. *sherds.*

Short, cf. *flocculation.*

Slip, a siliceous material (clay, glaze, engobe, or enamel) in aqueous suspension.

Slushing, the application of a heavy-bodied enamel or glaze by dipping and shaking off the excess.

Spalling, a disintegration on the sur-

A SHORT GLOSSARY OF CERAMIC TERMS

face of refractories, due to continued expansion and contraction, or to the formation of salts and the swelling of salts in service.

Spitout, a glaze defect conceded to be due to moisture in the body and which appears on refiring to the decorating temperature.

Spurs, cf. *stilts.*

Stilts, refractory pieces for supporting or separating ware in saggers during burning; various shapes are known as pins, jacks, spurs, or thimbles, etc.

Stones, refractory lumps in glass.

Tank, a furnace for smelting glass.

Tearing, cracks appearing in enamel during drying.

Terracotta, buff burned porous clay-ware used for interior and exterior decoration; sometimes glazed in colors.

Thickening, cf. flocculation.

Thimbles, cf. *stilts.*

Throwing, hand-forming pottery on a potter's wheel.

Tile, a fired clay body, white or colored, glazed or unglazed, porous or vitrified, in structural shapes; varieties are named according to method of manufacture and use; e.g. drain, encaustic, floor, hollow, mosaic, quarry, wall, etc.

Underglaze, cf. *ceramic colors.*

Watermark, discoloration of enameled or glazed ware after firing caused by an accumulation of soluble salts during drying.

COMMONLY USED CERAMIC MATERIALS
Composition, Formula, Trade Name, and Synonym

Compiled by F. C. SMITH, B. S. (Chem. Eng.) and R. O. HUMMEL
of the Harshaw Chemical Co., Cleveland, Ohio

See also the table *Common or Trade Names of Chemicals with Synonyms and Formulas,* and the tables on *Minerals.*

Material	Essential Composition	Formula
Adularia	Cf. potash feldspar	$K_2O \cdot Al_2O_3 \cdot 6SiO_2$
Albite	Cf. feldspar	$Na_2O \cdot Al_2O_3 \cdot 6SiO_2$
Andalusite	Aluminum silicate	$Al_2O_3 \cdot SiO_2$
Anorthite	Cf. lime feldspar	$CaO \cdot Al_2O_3 \cdot 2SiO_2$
Apatite	Tri-calcium phosphate	$(CaF)Ca_4(PO_4)_3 \pm Cl$
Aragonite	Cf. calcite	$CaCO_3$
Baddeleyite	Zirconium oxide	ZrO_2
Baryta	Barium oxide	BaO
Barytes (Barite)	Barium sulfate	$BaSO_4$
Bauxite	Hydrated aluminum oxide	$Al_2O_3 \cdot 2H_2C$
Beryl	Beryllium aluminum silicate	$3BeO \cdot Al_2O_3 \cdot 6SiO_2$
Biotite	Cf. magnesia mica	
Blanc-fixe	Barium sulfate	$BaSO_4$
Blue vitriol	Copper sulfate	$CuSO_4 \cdot 5H_2O$
Bone ash	Calcium phosphate and carbonate	$xCa_3(PO_4)_2 + yCaCO_3$
Borax	Sodium tetra-borate	$Na_2B_4O_7 \cdot 10H_2O$
Boric (Boracic) acid	Boric hydrate	$B_2O_3 \cdot 3H_2O$
Brown acid	Impure boric hydrate	$B_2O_3 \cdot 3H_2O$
Calcite	Calcium carbonate	$CaCO_3$
Calcothar	Calcined copperas	Fe_2O_3
Celestite	Strontium sulfate	$SrSO_4$
Chalk	Calcium carbonate	$CaCO_3$
Chile niter (nitre)	Sodium nitrate	$NaNO_3$
Chile saltpeter	Sodium nitrate	$NaNO_3$
China clay	Hydrated aluminum silicate	$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$
Chromite	Ferrous chromite	$FeO \cdot Cr_2O_3$
Colemanite	Calcium borate	$2CaO \cdot 3B_2O_3 \cdot 5H_2O$
Copperas	Ferrous sulfate	$FeSO_4 \cdot 7H_2O$
Cornwall stone	Soda-potash aluminum silicate	Indefinite
Cristobalite	Silicon dioxide	SiO_2
Crocus martis	Ferric oxide	Fe_2O_3
Cryolite	Sodium aluminum fluoride	$3NaF \cdot AlF_3$
Cullet	Scrap glass	Indefinite
Cyanite (Kyanite)	Aluminum silicate	$Al_2O_3 \cdot SiO_2$
Diaspore	Hydrated aluminum oxide	$Al_2O_3 \cdot H_2O$

COMMONLY USED CERAMIC MATERIALS

Material	Essential Composition	Formula
Diatomaceous earth	Silicon dioxide	SiO_2
Diopside	Calcium magnesium silicate	$CaO \cdot MgO \cdot 2SiO_2$
Dolomite	Calcium magnesium carbonate	$CaCO_3 \cdot MgCO_3$
English chalk	Calcium carbonate	$CaCO_3$
Epsom salts	Magnesium sulfate	$MgSO_4 \cdot 7H_2O$
Feldspars	.....	.....
Albite (soda)	Sodium aluminum silicate	$Na_2O \cdot Al_2O_3 \cdot 6SiO_2$
Anorthite (lime)	Calcium aluminum silicate	$CaO \cdot Al_2O_3 \cdot 2SiO_2$
Orthoclase (potash)	Potassium aluminum silicate	$K_2O \cdot Al_2O_3 \cdot 6SiO_2$
Flints	.....	.....
Cristobalite	Silicon dioxide	SiO_2
Diatomaceous earth	Silicon dioxide	SiO_2
Ganister	Silicon dioxide	SiO_2
Kieselguhr	Silicon dioxide	SiO_2
Quartz	Silicon dioxide	SiO_2
Sand	Silicon dioxide	SiO_2
Silica	Silicon dioxide	SiO_2
Tridymite	Silicon dioxide	SiO_2
Tripoli	Silicon dioxide	SiO_2
Fluorite	Calcium fluoride	CaF_2
Fluorspar	Calcium fluoride	CaF_2
French chalk	Hydrated magnesium silicate	$3MgO \cdot 4SiO_2 \cdot H_2O$
Ganister	Silicon dioxide	SiO_2
Gibbsite	Hydrated aluminum oxide	$Al_2O_3 \cdot 3H_2O$
Granite	Mixture of feldspar, mica and quartz	Indefinite
Gypsum	Calcium sulfate	$CaSO_4 \cdot 2H_2O$
Heavy spar	Barium sulfate	$BaSO_4$
Hematite	Ferric oxide	Fe_2O_3
Ilmenite	Ferrous titanate	$FeO \cdot TiO_2$
Kaolin	Hydrated aluminum silicate*	$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$
Kaolinite	Hydrated aluminum silicate**	$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$
Kieselguhr	Silicon dioxide	SiO_2
Lepidolite	Lithia mica	Indefinite
Leucite	Hydrated potassium silicate	$K_2O \cdot Al_2O_3 \cdot 4SiO_2$
Lime (quick)	Calcium oxide	CaO
Lime stone	Calcium carbonate	$CaCO_3$
Limonite	Hydrated ferric oxide	$2Fe_2O_3 \cdot 3H_2O$
Litharge	Lead oxide	PbO
Magnesia	Magnesium oxide	MgO
Magnesite	Magnesium carbonate	$MgCO_3$
Magnetite	Ferrous-ferric oxide	Fe_3O_4
Marble	Calcium carbonate	$CaCO_3$
Marcasite	Iron sulfide	FeS_2
Marl	Mixture of calcium carbonate and lay	Indefinite
Mica	Mixed hydrated aluminum silicates	.....
(magnesia) (Biotite)	Magnesium aluminum silicate	$H_2K(Mg,Fe)_3(Al,Fe)(SiO_4)_3$
(potash) (Muscovite)	Potassium aluminum silicate	$H_2KAl_3(SiO_4)_3$
Minium (red lead)	Plumbus plumbate	Pb_3O_4
Monazite sand	Rare earth phosphates	Indefinite
Mullite	Aluminum silicate	$3Al_2O_3 \cdot 2SiO_2$
Muscovite (potash mica)	Potassium aluminum silicate	$H_2KAl_3(SiO_4)_3$
Niter (nitre)	Potassium nitrate	KNO_3
Niter (nitre) cake	Mixture of sodium sulfate and bisulfate	$x\,NaHSO_4 + y\,Na_2SO_4$
Ochre	Mixture of clay, ferric hydroxide and lime	Indefinite
Orthoclase (feldspar)	Potassium aluminum silicate	$K_2O \cdot Al_2O_3 \cdot 6SiO_2$
Paris white	Calcium carbonate	$CaCO_3$
Pearl ash	Potassium carbonate	K_2CO_3
Pegmatite (granite)	Mixture of feldspar, mica and quartz	Indefinite
Plaster of Paris	Calcium sulfate	$CaSO_4 \cdot \frac{1}{2}H_2O$
Powder blue	Cobalt silicate	Indefinite
Pyrite (pyrites)	Iron sulfide	FeS_2
Pyrolusite	Manganese dioxide	MnO_2
Quartz	Silicon dioxide	SiO_2
Quick lime	Calcium oxide	CaO
Red lead (minium)	Plumbus plumbate	Pb_3O_4
Rock salt	Sodium chloride	$NaCl$
Rouge	Ferric oxide	Fe_2O_3
Rutile	Titanium oxide	TiO_2

*Amorphous
**Crystalline

COMMONLY USED CERAMIC MATERIALS

Material	Essential Composition	Formula
Salt (Rock salt)	Sodium chloride	NaCl
Salt cake	Commercial sodium sulfate	Na_2SO_4
Salt peter (salt petre)	Potassium nitrate	KNO_3
Sand	Silicon dioxide	SiO_2
Siderite	Ferrous carbonate	$FeCO_3$
Sienna	Ferric aluminum silicate, clay and sand	Indefinite
Silica	Silicon dioxide	SiO_2
Sillimanite	Aluminum silicate	$Al_2O_3 \cdot SiO_2$
Smaltz (Smalts)	Cobalt silicate	Indefinite
Soapstone (talc)	Hydrated magnesium silicate	$3MgO \cdot 4SiO_2 \cdot H_2O$
Spanish oxide	Impure ferric oxide	Fe_2O_3
Steatite (talc)	Hydrated magnesium silicate	$3MgO \cdot 4SiO_2 \cdot H_2O$
Talc (French chalk, steatite, soapstone)	Hydrated magnesium silicate	$3MgO \cdot 4SiO_2 \cdot H_2O$
Terra alba (gypsum)	Calcium sulfate	$CaSO_4 \cdot 2H_2O$
Tincal (borax)	Sodium tetra-borate	$Na_2B_4O_7 \cdot 10H_2O$
Tripoli	Silicon dioxide	SiO_2
Trydimite	Silicon dioxide	SiO_2
Tuscany acid	Crude boric acid	$B_2O_3 \cdot 3H_2O$
Umber	Iron-manganese silicate and clay	Indefinite
White lead	Basic lead carbonate	$2PbCO_3 \cdot Pb(OH)_2$
Whiting	Calcium carbonate	$CaCO_3$
Willemite	Zinc silicate	$2ZnO \cdot SiO_2$
Witherite	Barium carbonate	$BaCO_3$
Wollastonite	Calcium silicate	$CaO \cdot SiO_2$
Zaffre (powder blue)	Cobalt silicate	Indefinite
Zircon	Zirconium silicate	$ZrO_2 \cdot SiO_2$
Zirconia	Zirconium oxide	ZrO_2

MELTING POINTS OF SOME COMPOUNDS IN COMMON USE IN CERAMICS

Compiled by F. C. SMITH, B. S. (Chem. Eng.) and R. O. HUMMEL
of The Harshaw Chemical Co., Cleveland, Ohio.

The compounds in the table below are arranged according to increasing melting points. The melting points are values selected from those reported in the *International Critical Tables* or in the *Jour. Amer. Ceramic Soc.* The values followed by an **E** are for eutectics.

Melting Point °C.	Formula
415 E	$77.6PbO, 6.1B_2O_3, 16.3SiO_2$
532 E	$88.0PbO, 12.0SiO_2$
570 E	$24.2Na_2O, 35.2B_2O_3, 40.6SiO_2$
650 E	$60.8PbO, 7.1Al_2O_3, 31.45SiO_2$
655 E	$23.7K_2O, 37.2B_2O_3, 39.1SiO_2$
746±10	$2PbO \cdot SiO_2$
750 E	$76.5BaO, 23.5B_2O_3$
766±10	$PbO \cdot SiO_2$
780 E	$55.0K_2O, 45.0SiO_2$
800 E	$50K_2O \cdot B_2O_3, 50Na_2O \cdot B_2O_3$
800 E	$17.5Na_2O, 5.4Al_2O_3, 77.1SiO_2$
830 E	$51.5Na_2O, 48.5SiO_2$
860 E	$18.4Na_2O, 81.6SiO_2$
870 E	$17.4K_2O, 5.2Al_2O_3, 77.4SiO_2$
874±2	$Na_2O \cdot 2SiO_2$
880E	$17.5K_2O, 82.5SiO_2$
888±10	PbO
948	$Li_2O \cdot SiO_2$
976	$K_2O \cdot SiO_2$

Melting Point °C.	Formula
980	$K_2O \cdot 2TiO_2$
995 E	$35CaO, 65B_2O_3$
1010	$2Li_2O \cdot SiO_2$
1041	$K_2O \cdot 2SiO_2$
1070 E	$47.5CaO, 52.5B_2O_3$
1088±2	$Na_2O \cdot SiO_2$
1100±10	$Na_2O \cdot Al_2O_3 \cdot 6SiO_2$
1157 E	84.3 albite, 15.7CaO
Cone 3 E	71.5 feldspar, 8.6$CaCO_3$, 7.7 kaolin, 12.2 flint
Cone 4 E	42.1 potash feldspar, 17.7$CaCO_3$, 13.0 hydrous kaolin, 27.2 flint
1242±2	$CdO \cdot SiO_2$
Cone 6 E	69 albite, 29 microcline
Cone 6 E	35-40BaO, 10.0Al_2O_3, 50-55SiO_2
1248±5	$Na_2O \cdot Al_2O_3$; nephelite
Cone 7 E	67.0($Al_2O_3 \cdot 2SiO_2$), 33.0CaO
Cone 8 E	90.0 potash feldspar, 10.0 kaolin
1261 E	98.3 orthoclase, 1.7CaO

MELTING POINTS OF SOME COMPOUNDS IN COMMON USE IN CERAMICS

Melting Point °C.	Formula
1271 E	98.6 orthoclase, 1.4 MgO
1273 ± 5	$MnO_2 \cdot SiO_2$
1284 ± 5	$Na_2O \cdot 2CaO \cdot 3SiO_2$
Cone 9 E	90.0 microcline, 10.0 quartz
Cone 10 E	74.4 ($Al_2O_3 \cdot SiO_2$), 25.6 CaO
Cone 10 E	30 MgO, 30 kaolin, 40 quartz
Cone 10 E	31 MgO, 13 Al_2O_3, 56 SiO_2
d1355 ± 5	$3CaO \cdot Al_2O_3 \cdot SiO_2$
Cone 12 E	20.0 MgO, 20.0 Al_2O_3, 60.0 SiO_2
Cone 12-13 E	50 ZnO, 20 Al_2O_3, 30 SiO_2
1358	46.5 SrO, 53.5 SiO_2
1360 E	50.8 ZnO, 14.45 Al_2O_3, 35.75 SiO_2
1374	47.0 BaO, 53.0 SiO_2
1388 ± 5	$Li_2O \cdot Al_2O_3 \cdot 2SiO_2$
1391 ± 2	$CaO \cdot MgO \cdot 2SiO_2$
1400 ± 3	$Li_2O \cdot Al_2O_3 \cdot 4SiO_2$
1436	37.0 CaO, 63.0 SiO_2
1437	65.0 BaO, 35.0 SiO_2
1437 ± 2	$ZnO \cdot SiO_2$
1450	62.9 BaO, 37.1 SiO_2
1455	54.5 CaO, 45.5 SiO_2
1458 ± 2	$2CaO \cdot MgO \cdot 2SiO_2$
1475*	58.2 CaO, 41.8 SiO_2
1475	55.5 CaO, 44.5 SiO_2
1509 ± 3	$2ZnO \cdot SiO_2$
1526 ± 2	$Na_2O \cdot Al_2O_3$ (carnegietite
1540	48.2 CaO, 51.8 SiO_2
1545	65.5 SrO, 34.5 SiO_2
1550 ± 2	$CaO \cdot Al_2O_3 \cdot 2SiO_2$

Melting Point °C.	Formula
1550 ± 10	$\alpha K_2O \cdot Al_2O_3 \cdot 2SiO_2$
1551	74.5 BaO, 25.5 SiO_2
1570	65 CaO, 35 SiO_2
1578	63.2 SrO, 36.8 SiO_2
1590 ± 2	$2CaO \cdot Al_2O_3 \cdot SiO_2$
1604	71.8 BaO, 28.2 SiO_2
> 1625	$Li_2O \cdot Al_2O_3$
1650	$Na_2O \cdot Al_2O_3$
> 1650**	MnO
1692	Ce_2O_3
> 1700	$BaO \cdot Al_2O_3 \cdot 2SiO_2$
> 1700	$SrO \cdot Al_2O_3 \cdot 2SiO_2$
> 1755	$BeO \cdot SiO_2$
> 1775	$\beta K_2O \cdot Al_2O_3 \cdot 2SiO_2$
1810 ± 10	$3Al_2O_3 \cdot 2SiO_2$***
1890 ± 20	$2MgO \cdot SiO_2$
1900****	73.6 CaO, 26.4 SiO_2
1923 ± 10	BaO
1975	ZnO
1990 ± 20	Cr_2O_3
2050 ± 10	αAl_2O_3
2065	67.5 CaO, 32.5 SiO_2
2135 ± 20	$MgO \cdot Al_2O_3$
2240****	SiC
2400 ± 50	BeO
2550	$ZrO_2 \cdot SiO_2$
2550-3000	ZrO_2
> 2790	ThO_2
2800	MgO

*Dissociates
**In vacuo
***Deforms: liquid + Al_2O_3
****Dissociates

SILICON DIOXIDE INVERSION TABLE

Compiled from the values given in the *International Critical Tables*, published by McGraw-Hill Book Co., New York, and Mellor: *A Comprehensive Treatise on Inorganic and Theoretical Chemistry*, published by Longmans, Green and Co., New York.

Crystalline Variety	Inversion Temperature, °C.
αQuartz	Stable to 575
βQuartz	Stable to 870 ± 10
β_2 Tridymite	Stable to 1470 ± 10
βCristobalite	Melts at 1625-1710
αTridymite	Stable to 117

Crystalline Variety	Inversion Temperature, °C.
β_1 Tridymite	Stable to 163
β_2 Tridymite	Stable to 1470
βCristobalite	Melts at 1625
αCristobalite	Stable to 225
βCristobalite	Melts at 1625

COEFFICIENTS OF CUBICAL EXPANSION FOR VARIOUS SOLIDS

The table below gives the average value over the range from room temperature to the melting point expressed in millimeters per degree Centigrade, as determined by Winkelmann and Schott, and Mayer and Havas. See also Landrum, *Enamels* (1918), published by The Harshaw Chemical Co., Cleveland, Ohio. See also the table *Coefficients of Cubical Expansion for Liquids and Solutions.*

Substance	Coefficient
AlF_3	4.4×10^{-7}
Al_2O_3	5.0×10^{-7}
As_2O_5	2.0×10^{-7}
B_2O_3	0.1×10^{-7}
BaO	3.0×10^{-7}
BeO	4.7×10^{-7}
CaF_2	2.5×10^{-7}
CaO	5.0×10^{-7}
CeO_2	4.2×10^{-7}
CoO	4.4×10^{-7}
Cr_2O_3	5.1×10^{-7}
CuO	2.2×10^{-7}
Fe_2O_3	4.0×10^{-7}
K_2O	8.5×10^{-7}
LiO_2	2.0×10^{-7}
MgO	0.1×10^{-7}

Substance	Coefficient
MnO_2	2.2×10^{-7}
NaF	7.4×10^{-7}
Na_3AlF_6	7.4×10^{-7}
Na_2O	10.0×10^{-7}
*$NaSbO_3$	4.6×10^{-7}
NiO	4.0×10^{-7}
P_2O_5	2.0×10^{-7}
PbO	4.2×10^{-7}
Sb_2O_5	3.6×10^{-7}
SiO_2	0.8×10^{-7}
SnO_2	2.0×10^{-7}
ThO_2	6.3×10^{-7}
TiO_2	4.1×10^{-7}
ZnO	1.8×10^{-7}
ZrO_2	2.1×10^{-7}

*Calculated

BALL MILL SPEEDS

For the mathematics of the ball mill, see E. W. Davis, *Am. Inst. Min. and Met. Eng.* Vol. 61 (1920), and Haultain and Dyer, *Canadian Inst. Min. and Met.*, June 1922.

Diameters being equal the efficient speed of a ball mill depends upon the size and amount of the pebbles or balls, slippage between the lining of the mill and the charge (consistency), and the size of the charge.

In general practice the ball mill is first half filled with balls or pebbles, and then half as much enamel or glaze is added, and the required water if it is to be wet ground.

The speeds in the table given below are an average covering a large variety of materials and conditions.

Inside Diameter of Ball Mill in Feet	Speed of Ball Mill in RPM*
8.0	12 to 14
7.5	16 to 18
6.0	17 to 20
5.0	20 to 23
4.5	22 to 24
4.0	23 to 27

Inside Diameter of Ball Mill in Feet	Speed of Ball Mill in RPM*
3.5	25 to 28
3.0	26 to 30
2.5	30 to 38
2.0	35 to 40
1.5	40 to 53
1.0	42 to 55
Laboratory mills	50 to 85

*For dry mills use the higher values.

FORMULAS FOR CALCULATING PHYSICAL PROPERTIES OF CERAMIC MATERIALS

Reprinted from 1928 *Standards Report Amer. Ceramic Society*, by permission.

1. DETERMINATION OF WATER IN CERAMIC MATERIALS

Dry a 200 gram sample to constant weight at 110-50°C.

$$\% H_2O = \frac{W - D}{W} \times 100$$

W = weight of material received
D = weight of material after drying to constant weight

2. DETERMINATION OF TOTAL LINEAR DRY AND FIRED SHRINKAGE

Green bar size 2½″×4½″×9″; gauge marks 8″ apart
Fire to 1400°C. in not less than 5 hrs.; natural cooling

$$\% \text{ Shrinkage} = \frac{Lw - Lb}{Lw} \times 100$$

Lw = length of specimen in plastic state
Lb = length of specimen after firing to 1400°C.

3. DETERMINATION OF WATER OF PLASTICITY

$$T = \frac{Wp - Wd}{Wd} \times 100$$

T = % water of plasticity
Wp = weight of plastic test piece
Wd = weight of dry test piece

4. DETERMINATION OF SHRINKAGE WATER

$$t_1 = \frac{Vp - Vd}{Wd} \times 100$$

t_1 = % shrinkage water

Vp = plastic volume in cc.
Vd = dry volume in cc.
Wd = dry weight in grams

5. DETERMINATION OF PORE WATER

$t_2 = T - t_1$
t_1 = % shrinkage water
t_2 = % pore water
T = % water of plasticity

6. DETERMINATION % VOLUME SHRINKAGE

$$b = \frac{Vp - Vd}{Vd} \times 100$$

b = % volume shrinkage
Vp = plastic volume
Vd = dry volume

7. DETERMINATION OF LINEAR SHRINKAGE

$$a = 100\left(\sqrt[3]{1 + \frac{b}{100}} - 1\right)$$

a = % linear shrinkage

FORMULAS FOR CALCULATING PHYSICAL PROPERTIES OF CERAMIC MATERIALS

8. DETERMINATION OF THE TRUE SPECIFIC GRAVITY

$$Gt = \frac{w-p}{(w-p)-(w_2-w_1)}$$

Gt = true specific gravity
w = weight of stoppered pycnometer and sample
p = weight of stoppered pycnometer
w_1 = weight of stoppered pycnometer filled with water
w_2 = weight of stoppered pycnometer sample and water

9. DETERMINATION OF APPARENT POROSITY

$$P = \frac{Sf-Wf}{Vf} \times 100$$

P = % apparent porosity
Sf = weight of saturated fired test piece in grams
Wf = weight of fired test piece in grams
Vf = volume of fired test piece in cc.

10. DETERMINATION OF VOLUME CHANGE

$$b_l = \frac{Vd-Vf}{Vd} \times 100$$

b_l = % volume change
Vd = volume of the dry test piece in cc.

11. DETERMINATION OF APPARENT SPECIFIC GRAVITY

$$G = \frac{Wf}{Vf-(Sf-Wf)}$$

G = apparent specific gravity

12. DETERMINATION OF BULK SPECIFIC GRAVITY

$$Gb = \frac{Wf}{Vf}$$

Gb = bulk specific gravity

13. DETERMINATION OF MODULUS OF RUPTURE

$$M = \frac{3PL}{2bd^2}$$

M = modulus of rupture in kg./sq. cm.
P = breaking load in kg. (read to nearest 0.1 kg.)
L = distance between knife edges in cm.
b = breadth of bar in cm.
d = depth of bar in cm.

14. DETERMINATION OF TRANSVERSE STRENGTH

$$M = \frac{8PL}{\pi d^3}$$

M = modulus of rupture
P = load in pounds at rupture
L = distance between supports
d = diameter of specimen in inches
$\pi = 3.1416$

FORMULAS FOR CALCULATING PHYSICAL PROPERTIES OF CERAMIC MATERIALS

SHRINKAGE CONVERSION TABLES

For a complete explanation of the following tables, the reader is referred to the original paper by WESTMAN, Jour. Am. Ceramic Soc. 11, No. 9, p. 715, (1928).

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Relations Between Linear and Volume Change

Nature of change	Percentage basis	Volume change to linear change	Linear change to volume change	Percentage basis	Nature of change
Expansion	Initial values	$a = 100\left[\sqrt[3]{\frac{b}{100}+1}-1\right]$	$b = 100\left[\left(\frac{a}{100}+1\right)^3-1\right]$	Final values	Contraction (or shrinkage)
	Final values	$a = 100\left[\sqrt[3]{\frac{b}{100}-1}+1\right]$	$b = 100\left[\left(\frac{a}{100}-1\right)^3+1\right]$	Initial values	

Conversion of Percentage Basis

Nature of change in size	Equations* for converting: Percentage of initial value to final value	Percentage of final value to initial value
Expansion	$c = \frac{100d}{100+d}$	$d = \frac{100c}{100-c}$
Contraction	$c = \frac{100d}{100-d}$	$d = \frac{100c}{100+c}$

Calculation of Design Factors, Combination of Changes

Nature of changes	Percentage basis	Equation* for calculating resultant per cent change	Percentage basis	Nature of changes
Both expansions	Initial values	$Z = X + Y + \frac{XY}{100}$	Final values	Both contractions (or shrinkages)
	Final values	$Z = X + Y - \frac{XY}{100}$	Initial values	

*In the equations, a = % linear change, b = % volume change, c = % change based on final value, and d = % change based on initial value; substitutions are to be made arithmetically. Z = % resultant change or overall change, X = % change in first process (e.g. drying), and Y = % change in second process (e.g. firing); if X and Y are percentages of final values, Z will be a percentage of the final value.

SHRINKAGE CONVERSION TABLE
TABLE I

Four Figure Table for Converting:

(1) Volume Drying Shrinkage (per cent of plastic volume) to Linear Drying Shrinkage (per cent of plastic length),

(2) Volume Firing Shrinkage (per cent of unfired or dry volume) to Linear Firing Shrinkage (per cent of unfired or dry length), and

(3) Volume Expansion (per cent of final volume) to Linear Expansion (per cent of final length).

Per cent volume change	Per cent volume change 0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	Differences
	Per cent linear change										
0	0.000	0.033	0.067	0.100	0.134	0.167	0.200	0.234	0.267	0.301	.034
1	0.334	0.368	0.402	0.435	0.469	0.503	0.536	0.570	0.604	0.638	.034
2	0.672	0.705	0.739	0.773	0.806	0.840	0.874	0.908	0.942	0.976	.034
3	1.010	1.044	1.078	1.112	1.146	1.181	1.215	1.249	1.283	1.317	.034
4	1.352	1.386	1.420	1.455	1.489	1.523	1.558	1.592	1.626	1.661	.034
5	1.695	1.730	1.764	1.799	1.834	1.868	1.903	1.937	1.972	2.007	.035
6	2.041	2.076	2.111	2.146	2.181	2.216	2.251	2.285	2.320	2.355	.035
7	2.390	2.425	2.460	2.495	2.530	2.565	2.600	2.636	2.671	2.706	.035
8	2.741	2.776	2.812	2.847	2.882	2.918	2.953	2.988	3.023	3.059	.035
9	3.095	3.130	3.166	3.201	3.237	3.273	3.308	3.344	3.380	3.415	.036
10	3.451	3.487	3.523	3.559	3.594	3.630	3.666	3.702	3.738	3.774	.036
11	3.810	3.846	3.882	3.918	3.954	3.990	4.027	4.063	4.099	4.135	.036
12	4.172	4.208	4.244	4.281	4.317	4.354	4.390	4.426	4.463	4.500	.036
13	4.536	4.572	4.609	4.646	4.683	4.719	4.756	4.793	4.830	4.866	.037
14	4.903	4.940	4.977	5.014	5.051	5.088	5.125	5.162	5.199	5.236	.037
15	5.273	5.310	5.348	5.385	5.422	5.459	5.497	5.534	5.571	5.609	.037
16	5.646	5.684	5.721	5.759	5.797	5.834	5.872	5.909	5.947	5.984	.037
17	6.022	6.060	6.098	6.136	6.174	6.212	6.249	6.287	6.325	6.363	.038
18	6.401	6.439	6.477	6.515	6.553	6.592	6.630	6.668	6.706	6.745	.038
19	6.783	6.822	6.860	6.899	6.937	6.975	7.014	7.052	7.091	7.130	.038
20	7.168	7.207	7.246	7.284	7.323	7.362	7.401	7.440	7.479	7.518	.039
21	7.557	7.596	7.635	7.674	7.713	7.752	7.791	7.831	7.870	7.909	.039
22	7.949	7.988	8.027	8.067	8.106	8.146	8.185	8.225	8.265	8.304	.039
23	8.344	8.383	8.423	8.463	8.503	8.543	8.582	8.622	8.662	8.702	.040
24	8.742	8.782	8.822	8.862	8.903	8.943	8.983	9.023	9.063	9.104	.040
25	9.144	9.184	9.225	9.265	9.306	9.346	9.387	9.428	9.468	9.509	.040
26	9.550	9.590	9.631	9.672	9.713	9.754	9.795	9.836	9.877	9.918	.040
27	9.959	10.00	10.04	10.08	10.12	10.16	10.21	10.25	10.29	10.33	.040
28	10.37	10.41	10.45	10.50	10.54	10.58	10.62	10.66	10.71	10.75	.040
29	10.79	10.83	10.87	10.91	10.96	11.00	11.04	11.08	11.13	11.17	.040
30	11.21	11.25	11.29	11.34	11.38	11.42	11.46	11.51	11.55	11.59	.040
31	11.63	11.68	11.72	11.76	11.81	11.85	11.89	11.93	11.98	12.02	.04
32	12.06	12.11	12.15	12.19	12.23	12.28	12.32	12.37	12.41	12.45	.04
33	12.50	12.54	12.58	12.63	12.67	12.72	12.76	12.80	12.85	12.89	.04
34	12.93	12.97	13.02	13.07	13.11	13.15	13.20	13.24	13.29	13.33	.04
35	13.38	13.42	13.47	13.51	13.55	13.60	13.64	13.69	13.74	13.78	.04
36	13.82	13.87	13.91	13.96	14.00	14.05	14.09	14.14	14.18	14.23	.04
37	14.27	14.32	14.36	14.41	14.46	14.50	14.55	14.59	14.64	14.68	.05
38	14.73	14.78	14.82	14.87	14.91	14.96	15.01	15.05	15.10	15.14	.05
39	15.19	15.24	15.28	15.33	15.38	15.42	15.47	15.52	15.56	15.61	.05
40	15.66	15.70	15.75	15.80	15.84	15.89	15.94	15.99	16.03	16.08	.05
41	16.13	16.18	16.23	16.27	16.32	16.37	16.41	16.46	16.51	16.56	.05
42	16.60	16.65	16.70	16.75	16.80	16.84	16.89	16.94	16.99	17.04	.05
43	17.09	17.14	17.18	17.23	17.28	17.33	17.38	17.43	17.48	17.53	.05
44	17.57	17.62	17.67	17.72	17.77	17.82	17.87	17.92	17.97	18.02	.05
45	18.07	18.12	18.17	18.22	18.27	18.32	18.37	18.42	18.47	18.52	.05
46	18.57	18.62	18.67	18.72	18.77	18.82	18.87	18.92	18.97	19.02	.05
47	19.07	19.12	19.18	19.23	19.28	19.33	19.38	19.43	19.48	19.53	.05
48	19.59	19.64	19.69	19.74	19.79	19.84	19.90	19.95	20.00	20.05	.05
49	20.10	20.16	20.21	20.26	20.31	20.37	20.42	20.47	20.52	20.58	.05
50	20.63	20.68	20.74	20.79	20.84	20.90	20.95	21.00	21.06	21.11	.05

SHRINKAGE CONVERSION TABLE
TABLE II

Four Figure Table for Converting:

(1) Volume Drying Shrinkage (per cent of dry volume) to Linear Drying Shrinkage (per cent of dry length),

(2) Volume Firing Shrinkage (per cent of fired volume) to Linear Firing Shrinkage (per cent of fired length), and

(3) Volume Expansion (per cent of initial volume) to Linear Expansion (per cent of initial length).

Per cent volume change	Per cent volume change										Differences
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	
	Per cent linear change										
0	0.000	0.033	0.067	0.100	0.133	0.166	0.200	0.233	0.266	0.299	.033
1	0.332	0.365	0.398	0.431	0.464	0.497	0.530	0.563	0.596	0.629	.033
2	0.662	0.695	0.728	0.761	0.794	0.826	0.859	0.892	0.925	0.957	.033
3	0.990	1.023	1.055	1.088	1.121	1.153	1.186	1.218	1.251	1.283	.033
4	1.316	1.348	1.381	1.413	1.446	1.478	1.510	1.543	1.575	1.607	.032
5	1.640	1.672	1.704	1.736	1.769	1.801	1.833	1.865	1.897	1.929	.032
6	1.961	1.993	2.025	2.057	2.089	2.121	2.153	2.185	2.217	2.249	.032
7	2.281	2.313	2.345	2.376	2.408	2.440	2.472	2.503	2.535	2.567	.032
8	2.599	2.630	2.662	2.693	2.725	2.757	2.788	2.820	2.851	2.883	.032
9	2.914	2.946	2.977	3.009	3.040	3.071	3.103	3.134	3.165	3.196	.031
10	3.228	3.259	3.291	3.322	3.353	3.384	3.415	3.446	3.478	3.509	.031
11	3.540	3.571	3.602	3.633	3.664	3.695	3.726	3.757	3.788	3.819	.031
12	3.850	3.881	3.912	3.943	3.973	4.004	4.035	4.066	4.097	4.127	.031
13	4.158	4.189	4.219	4.250	4.281	4.311	4.342	4.373	4.403	4.434	.031
14	4.464	4.495	4.525	4.556	4.586	4.617	4.647	4.678	4.708	4.739	.030
15	4.769	4.799	4.830	4.860	4.890	4.921	4.951	4.981	5.011	5.042	.030
16	5.072	5.102	5.132	5.162	5.192	5.222	5.253	5.283	5.313	5.343	.030
17	5.373	5.403	5.433	5.463	5.493	5.523	5.553	5.583	5.612	5.642	.030
18	5.672	5.702	5.732	5.762	5.791	5.821	5.851	5.881	5.910	5.940	.030
19	5.970	6.000	6.029	6.059	6.088	6.118	6.148	6.177	6.206	6.236	.030
20	6.266	6.295	6.325	6.354	6.384	6.413	6.443	6.472	6.501	6.531	.029
21	6.560	6.590	6.619	6.648	6.678	6.707	6.736	6.765	6.795	6.824	.029
22	6.853	6.882	6.911	6.940	6.970	6.999	7.028	7.057	7.086	7.115	.029
23	7.144	7.173	7.202	7.231	7.260	7.289	7.318	7.347	7.376	7.405	.029
24	7.434	7.463	7.491	7.520	7.549	7.578	7.607	7.635	7.664	7.693	.029
25	7.722	7.750	7.779	7.808	7.836	7.865	7.894	7.922	7.951	7.980	.029
26	8.008	8.037	8.065	8.094	8.122	8.151	8.179	8.208	8.236	8.265	.028
27	8.293	8.322	8.350	8.378	8.407	8.435	8.463	8.492	8.520	8.548	.028
28	8.577	8.605	8.633	8.661	8.690	8.718	8.746	8.774	8.802	8.831	.028
29	8.859	8.887	8.915	8.943	8.971	8.999	9.027	9.055	9.083	9.111	.028
30	9.139	9.167	9.195	9.223	9.251	9.279	9.307	9.335	9.363	9.391	.028
31	9.418	9.446	9.474	9.502	9.530	9.557	9.585	9.613	9.641	9.668	.028
32	9.696	9.724	9.751	9.779	9.807	9.834	9.862	9.890	9.917	9.945	.027
33	9.972	10.00	10.02	10.05	10.08	10.11	10.14	10.16	10.19	10.22	.03
34	10.25	10.27	10.30	10.33	10.36	10.38	10.41	10.44	10.47	10.49	.03
35	10.52	10.55	10.58	10.60	10.63	10.66	10.68	10.71	10.74	10.77	.03
36	10.79	10.82	10.85	10.87	10.90	10.93	10.96	10.98	11.00	11.03	.03
37	11.06	11.09	11.12	11.14	11.17	11.20	11.23	11.25	11.28	11.31	.03
38	11.33	11.36	11.39	11.41	11.44	11.47	11.49	11.52	11.55	11.57	.03
39	11.60	11.63	11.65	11.68	11.71	11.74	11.76	11.79	11.82	11.84	.03
40	11.87	11.90	11.92	11.95	11.98	12.00	12.03	12.05	12.08	12.11	.03
41	12.13	12.16	12.19	12.21	12.24	12.27	12.29	12.32	12.35	12.37	.03
42	12.40	12.43	12.45	12.48	12.50	12.53	12.56	12.58	12.61	12.64	.03
43	12.66	12.69	12.71	12.74	12.77	12.79	12.82	12.85	12.87	12.90	.03
44	12.92	12.95	12.98	13.00	13.03	13.05	13.08	13.11	13.13	13.16	.03
45	13.19	13.21	13.24	13.26	13.29	13.31	13.34	13.37	13.39	13.42	.03
46	13.44	13.47	13.50	13.52	13.55	13.57	13.60	13.62	13.65	13.68	.03
47	13.70	13.73	13.75	13.78	13.81	13.83	13.86	13.88	13.91	13.93	.03
48	13.96	13.99	14.01	14.04	14.06	14.09	14.11	14.14	14.17	14.19	.03
49	14.22	14.24	14.27	14.29	14.32	14.34	14.37	14.39	14.42	14.44	.03
50	14.47	14.50	14.52	14.55	14.57	14.60	14.62	14.65	14.67	14.70	.03

SHRINKAGE CONVERSION TABLE

TABLE III

Four Figure Table for Converting:
(1) Drying Shrinkage (per cent of plastic size) to Drying Shrinkage (per cent of dry size),
(2) Firing Shrinkage (per cent of unfired or dry size) to Firing Shrinkage (per cent of fired size), and
(3) Expansion (per cent of final size) to Expansion (per cent of initial size).

Unconverted percentage	Unconverted percentage										Differences
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	
	Converted percentage										
0	0.00	0.100	0.200	0.301	0.402	0.503	0.604	0.705	0.806	0.908	.101
1	1.010	1.112	1.215	1.317	1.420	1.523	1.626	1.729	1.833	1.937	.103
2	2.041	2.145	2.249	2.354	3.459	3.564	2.670	2.775	2.881	2.987	.105
3	3.093	3.199	3.306	3.413	3.520	3.627	3.734	3.842	3.950	4.058	.107
4	4.167	4.275	4.384	4.493	4.603	4.712	4.822	4.932	5.042	5.152	.110
5	5.263	5.374	5.485	5.597	5.708	5.820	5.932	6.045	6.157	6.270	.112
6	6.383	6.496	6.610	6.724	6.838	6.952	7.066	7.181	7.296	7.411	.114
7	7.527	7.643	7.759	7.875	7.991	8.108	8.225	8.342	8.460	8.578	.117
8	8.696	8.814	8.932	9.051	9.170	9.290	9.409	9.529	9.649	9.769	.119
9	9.890	10.01	10.13	10.25	10.38	10.50	10.62	10.74	10.86	10.99	.12
10	11.11	11.23	11.36	11.48	11.61	11.73	11.86	11.98	12.11	12.23	.12
11	12.36	12.49	12.61	12.74	12.87	12.99	13.12	13.25	13.38	13.51	.13
12	13.64	13.77	13.90	14.03	14.16	14.29	14.42	14.55	14.68	14.81	.13
13	14.94	15.07	15.21	15.34	15.47	15.61	15.74	15.87	16.01	16.14	.13
14	16.28	16.41	16.55	16.69	16.82	16.96	17.10	17.23	17.37	17.51	.14
15	17.65	17.79	17.92	18.06	18.20	18.34	18.48	18.62	18.76	18.91	.14
16	19.05	19.19	19.33	19.47	19.62	19.76	19.90	20.05	20.19	20.34	.14
17	20.48	20.63	20.77	20.92	21.07	21.21	21.36	21.51	21.65	21.80	.15
18	21.95	22.10	22.25	22.40	22.55	22.70	22.85	23.00	23.15	23.30	.15
19	23.46	23.61	23.76	23.92	24.07	24.22	24.38	24.53	24.69	24.84	.15
20	25.00	25.16	25.31	25.47	25.63	25.79	25.94	26.10	26.26	26.42	.16
21	26.58	26.74	26.90	27.06	27.23	27.39	27.55	27.71	27.88	28.04	.16
22	28.21	28.37	28.53	28.70	28.87	29.03	29.20	29.37	29.53	29.70	.17
23	29.87	30.04	30.21	30.38	30.55	30.72	30.89	31.06	31.23	31.41	.17
24	31.58	31.75	31.93	32.10	32.28	32.45	32.63	32.80	32.98	33.16	.18
25	33.33	33.51	33.69	33.87	34.05	34.23	34.41	34.59	34.77	34.95	.18
26	35.14	35.32	35.50	35.69	35.87	36.05	36.24	36.43	36.61	36.80	.19
27	36.99	37.17	37.36	37.55	37.74	37.93	38.12	38.31	38.50	38.70	.19
28	38.89	39.08	39.28	39.47	39.66	39.86	40.06	40.25	40.45	40.65	.20
29	40.85	41.04	41.24	41.44	41.64	41.84	42.05	42.25	42.45	42.65	.20
30	42.86	43.06	43.27	43.47	43.68	43.88	44.09	44.30	44.51	44.72	.21
31	44.93	45.14	45.35	45.56	45.77	45.99	46.20	46.41	46.63	46.84	.21
32	47.06	47.28	47.49	47.71	47.93	48.15	48.37	48.59	48.81	49.03	.22
33	49.25	49.48	49.70	49.93	50.15	50.38	50.60	50.83	51.06	51.29	.23
34	51.52	51.75	51.98	52.21	52.44	52.67	52.91	53.14	53.37	53.61	.23
35	53.85	54.08	54.32	54.56	54.80	55.04	55.28	55.52	55.76	56.01	.24
36	56.25	56.49	56.74	56.99	57.23	57.48	57.73	57.98	58.23	58.48	.25
37	58.73	58.98	59.24	59.49	59.74	60.00	60.26	60.51	60.77	61.03	.26
38	61.29	61.55	61.81	62.07	62.34	62.60	62.87	63.13	63.40	63.67	.26
39	63.93	64.20	64.47	64.74	65.02	65.29	65.56	65.84	66.11	66.39	.27
40	66.67	66.94	67.22	67.50	67.79	68.07	68.35	68.63	68.92	69.20	.28
41	69.49	69.78	70.07	70.36	70.65	70.94	71.23	71.53	71.82	72.12	.29
42	72.41	72.71	73.01	73.31	73.61	73.91	74.22	74.52	74.83	75.13	.30
43	75.44	75.75	76.06	76.37	76.68	76.99	77.30	77.62	77.94	78.25	.31
44	78.57	78.89	79.21	79.53	79.86	80.18	80.51	80.83	81.16	81.49	.32
45	81.82	82.15	82.48	82.82	83.15	83.49	83.82	84.16	84.50	84.84	.34
46	85.19	85.53	85.87	86.22	86.57	86.92	87.27	87.62	87.97	88.32	.35
47	88.68	89.04	89.39	89.75	90.11	90.48	90.84	91.20	91.57	91.94	.36
48	92.31	92.68	93.05	93.42	93.80	94.17	94.55	94.93	95.31	95.69	.38
49	96.08	96.46	96.85	97.24	97.63	98.02	98.41	98.81	99.20	99.60	.39
50	100.0	100.4	100.8	101.2	101.6	102.0	102.4	102.8	103.3	103.7	.4

SHRINKAGE CONVERSION TABLE

TABLE IV

Four Figure Table for Converting:

(1) Drying Shrinkage (per cent of dry size) to Drying Shrinkage (per cent of plastic size),

(2) Firing Shrinkage (per cent of fired size) to Firing Shrinkage (per cent of unfired or dry size), and

(3) Expansion (per cent of initial size) to Expansion (per cent of final size).

Unconverted percentage	Unconverted percentage										Differences
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	
	Converted percentage										
0	0.000	0.100	0.200	0.299	0.398	0.498	0.596	0.695	0.794	0.892	.099
1	0.990	1.088	1.186	1.283	1.381	1.478	1.575	1.672	1.768	1.865	.097
2	1.961	2.057	2.153	2.248	2.344	2.439	2.534	2.629	2.724	2.818	.095
3	2.913	3.007	3.101	3.195	3.288	3.382	3.475	3.568	3.661	3.754	.093
4	3.846	3.939	4.031	4.123	4.215	4.306	4.398	4.489	4.580	4.671	.091
5	4.762	4.853	4.943	5.033	5.123	5.213	5.303	5.393	5.482	5.571	.090
6	5.660	5.749	5.838	5.927	6.015	5.103	6.191	6.279	6.367	6.455	.088
7	6.542	6.629	6.716	6.803	6.890	6.977	7.063	7.149	7.236	7.322	.087
8	7.407	7.493	7.579	7.664	7.749	7.834	7.919	8.004	8.088	8.173	.085
9	8.257	8.341	8.425	8.509	8.592	8.676	8.759	8.842	8.925	9.008	.083
10	9.091	9.173	9.256	9.338	9.420	9.502	9.584	9.666	9.747	9.829	.082
11	9.910	9.991	10.07	10.15	10.23	10.31	10.39	10.47	10.55	10.63	.08
12	10.71	10.79	10.87	10.95	11.03	11.11	11.19	11.27	11.35	11.43	.08
13	11.50	11.58	11.66	11.74	11.92	11.89	11.97	12.05	12.13	12.20	.08
14	12.28	12.36	12.43	12.51	12.59	12.66	12.74	12.82	12.89	12.97	.08
15	13.04	13.12	13.19	13.27	13.34	13.42	13.49	13.57	13.64	13.72	.08
16	13.79	13.87	13.94	14.02	14.09	14.16	14.24	14.31	14.38	14.46	.07
17	14.53	14.60	14.68	14.75	14.82	14.89	14.97	15.04	15.11	15.18	.07
18	15.25	15.33	15.40	15.47	15.54	15.61	15.68	15.75	15.82	15.90	.07
19	15.97	16.04	16.11	16.18	16.25	16.32	16.39	16.46	16.53	16.60	.07
20	16.67	16.74	16.81	16.87	16.94	17.01	17.08	17.15	17.22	17.29	.07
21	17.36	17.42	17.49	17.56	17.63	17.70	17.76	17.83	17.90	17.97	.07
22	18.03	18.10	18.17	18.23	18.30	18.37	18.43	18.50	18.57	18.63	.07
23	18.70	18.76	18.83	18.90	18.96	19.03	19.09	19.16	19.22	19.29	.07
24	19.35	19.42	19.48	19.55	19.61	19.68	19.74	19.81	19.87	19.94	.06
25	20.00	20.06	20.13	20.19	20.26	20.32	20.38	20.45	20.51	20.57	.06
26	20.63	20.70	20.76	20.82	20.89	20.95	21.01	21.07	21.14	21.20	.06
27	21.26	21.32	21.38	21.45	21.51	21.57	21.63	21.69	21.75	21.81	.06
28	21.87	21.94	22.00	22.06	22.12	22.18	22.24	22.30	22.36	22.42	.06
29	22.48	22.54	22.60	22.66	22.72	22.78	22.84	22.90	22.96	23.02	.06
30	23.08	23.14	23.20	23.25	23.31	23.37	23.43	23.49	23.55	23.61	.06
31	23.66	23.72	23.78	23.84	23.90	23.95	24.01	24.07	24.13	24.18	.06
32	24.24	24.30	24.36	24.41	24.47	24.53	24.59	24.64	24.70	24.76	.06
33	24.81	24.87	24.92	24.98	25.04	25.09	25.15	25.21	25.26	25.32	.06
34	25.37	25.43	25.48	25.54	25.60	25.65	25.71	25.76	25.82	25.87	.06
35	25.93	25.98	26.04	26.09	26.14	25.20	26.25	26.31	26.36	26.42	.05
36	26.47	26.52	26.58	26.63	26.69	26.74	26.79	26.85	26.90	26.95	.05
37	27.01	27.06	27.11	27.17	27.22	27.27	27.33	27.38	27.43	27.48	.05
38	27.54	27.59	27.64	27.69	27.75	27.80	27.85	27.90	27.95	28.01	.05
39	28.06	28.11	28.16	28.21	28.26	28.32	28.37	28.42	28.47	28.52	.05
40	28.57	28.62	28.67	28.72	28.77	28.83	28.88	28.93	28.98	29.03	.05
41	29.08	29.13	29.18	29.23	29.28	29.33	29.38	29.43	29.48	29.53	.05
42	29.58	29.63	29.68	29.73	29.78	29.82	29.87	29.92	29.97	30.02	.05
43	30.07	30.12	30.17	30.22	30.26	30.31	30.36	30.41	30.46	30.51	.05
44	30.56	30.60	30.65	30.70	30.75	30.80	30.84	30.89	30.94	30.99	.05
45	31.03	31.08	31.13	31.18	31.22	31.27	31.32	31.37	31.41	31.46	.05
46	31.51	31.55	31.60	31.65	31.69	31.74	31.79	31.83	31.88	31.93	.05
47	31.97	32.02	32.07	32.11	32.16	32.20	32.25	32.30	32.34	32.39	.05
48	32.43	32.48	32.52	32.57	32.61	32.66	32.71	32.75	32.80	32.84	.05
49	32.89	32.93	32.98	33.02	33.07	33.11	33.16	33.20	33.24	33.29	.04
50	33.33	33.38	33.42	33.47	33.51	33.55	33.60	33.64	33.69	33.73	.04

SIEVES AND SCREENS

The following terms are often employed in reporting the results of a screen analysis.

Cumulative Per Cent is the term employed to express the percentage of the total amount of a material which would remain on a testing sieve if only one sieve were used for testing the entire sample; to obtain the **cumulative weight,** it is necessary to add the weight of all of the material which remains on sieves coarser than the one in question to the amount remaining on the sieve in question. When such data is plotted as a curve, each point on the curve represents the *total* material that would be retained if only the one sieve represented by that particular point were used in the sieve analysis.

Effective Size is a term customarily employed in specifications for filtration sands; effective size is measured by that opening in millimeters which will just pass 10% of a representative sample of sand.

Uniformity Co-efficient is the numerical value obtained by dividing the sieve opening (in millimeters) which will pass 60% of the sample by the sieve opening (in millimeters) which will just pass 10% of the sample.

TYLER STANDARD SCREEN SCALE SIEVES

The W. S. Tyler Co., Cleveland, Ohio

Meshes per Lineal		Sieve Opening		Wire Diameter	
inch	em.	inch	mm.	inch	mm.
2.5	0.98	0.312	7.92	0.088	2.24
3	1.18	0.263	6.68	0.070	1.78
3.5	1.38	0.221	5.61	0.065	1.65
4	1.57	0.185	4.70	0.065	1.65
5	1.97	0.156	3.96	0.044	1.12
6	2.36	0.131	3.33	0.036	0.914
7	2.76	0.110	2.79	0.0328	0.833
8	3.15	0.093	2.36	0.032	0.813
9	3.54	0.078	1.98	0.033	0.838
10	3.94	0.065	1.65	0.035	0.889
12	4.72	0.055	1.40	0.028	0.711
14	5.51	0.046	1.17	0.025	0.635
16	6.30	0.0390	0.991	0.0235	0.597
20	7.87	0.0328	0.833	0.0172	0.437
24	9.45	0.0276	0.701	0.0141	0.358
28	11.02	0.0232	0.589	0.0125	0.318
32	12.60	0.0195	0.495	0.0118	0.300
35	13.78	0.0164	0.417	0.0122	0.310
42	16.54	0.0138	0.351	0.0100	0.254
48	18.90	0.0116	0.295	0.0092	0.234
60	23.62	0.0097	0.246	0.0070	0.178
65	25.59	0.0082	0.208	0.0072	0.183
80	31.50	0.0069	0.175	0.0056	0.142
100	39.37	0.0058	0.147	0.0042	0.107
115	45.28	0.0049	0.124	0.0038	0.097
150	59.06	0.0041	0.104	0.0026	0.066
170	66.93	0.0035	0.089	0.0024	0.061
200	78.74	0.0029	0.074	0.0021	0.053
250	98.43	0.0024	0.061	0.0016	0.041
270	106.3	0.0021	0.053	0.0016	0.041
325	128.0	0.0017	0.043	0.0014	0.036

U. S. SIEVE SERIES
U. S. Bu. Standards, Standard Screen Series, 1919

Sieve No.	Meshes per Lineal		Sieve Opening		Wire Diameter		% Tolerance in		
	inch	cm.	inch	mm.	inch	mm.	Average Opening	Maximum Opening	Wire Diameter
2.5	2.58	1	0.315	8.00	0.073	1.85	1	10	5
3	3.03	1.2	0.265	6.73	0.065	1.65	1	10	5
3.5	3.57	1.4	0.223	5.66	0.057	1.45	1	10	5
4	4.22	1.7	0.187	4.76	0.050	1.27	1	10	5
5	4.98	2	0.157	4.00	0.044	1.12	1	10	5
6	5.81	2.3	0.132	3.36	0.040	1.02	1	10	5
7	6.80	2.7	0.111	2.83	0.036	0.92	1	10	5
8	7.89	3	0.0937	2.38	0.0331	0.84	2	10	5
10	9.21	3.5	0.0787	2.00	0.0299	0.76	2	10	5
12	10.72	4	0.0661	1.68	0.0272	0.69	2	10	5
14	12.58	5	0.0555	1.41	0.0240	0.61	2	10	5
16	14.66	6	0.0469	1.19	0.0213	0.54	2	10	5
18	17.15	7	0.0394	1.00	0.0189	0.48	2	10	5
20	20.16	8	0.0331	0.84	0.0165	0.42	3	25	5
25	23.47	9	0.0280	0.71	0.0146	0.37	3	25	5
30	27.62	11	0.0232	0.59	0.0130	0.33	3	25	5
35	32.15	13	0.0197	0.50	0.0114	0.29	3	25	5
40	38.02	15	0.0165	0.42	0.0098	0.25	3	25	5
45	44.44	18	0.0138	0.35	0.0087	0.22	3	25	5
50	52.36	20	0.0117	0.297	0.0074	0.188	4	40	10
60	61.93	24	0.0098	0.250	0.0064	0.162	4	40	10
70	72.46	29	0.0083	0.210	0.0055	0.140	4	40	10
80	85.47	34	0.0070	0.177	0.0047	0.119	4	40	10
100	101.01	40	0.0059	0.149	0.0040	0.102	4	40	10
120	120.48	47	0.0049	0.125	0.0034	0.086	4	40	10
140	142.86	56	0.0041	0.105	0.0029	0.074	5	60	15
170	166.67	66	0.0035	0.088	0.0025	0.063	5	60	15
200	200	79	0.0029	0.074	0.0021	0.053	5	60	15
230	238.10	93	0.0024	0.062	0.0018	0.046	5	60	15
270	270.26	106	0.0021	0.053	0.0016	0.041	5	60	15
325	323	125	0.0017	0.044	0.0014	0.036	5	60	15

BRITISH STANDARD SCREEN SCALE SIEVES
British Engineering Standards Association

Meshes per Lineal		Sieve Opening		Wire Diameter		Standard Gauge	Tolerance Average Aperture ±%	Approx. Screening Area
inch	cm.	inch	mm.	inch	mm.			
5	1.97	0.1320	3.35	0.068	1 73	15.5	3	44
6	2.36	0.1107	2.81	0.056	1.42	17	3	44
7	2.76	0.0949	2.41	0.048	1.22	18	3	44
8	3.15	0.0810	2.06	0.044	1.12	18.5	3	42
10	3.94	0.0660	1.68	0.034	0.864	20.5	3	44
12	4.72	0.0553	1.40	0.028	0.711	22	3	44
14	5.51	0.0474	1.20	0.024	0.610	23	3	44
16	6.30	0.0395	1.00	0.023	0.584	23.5	3	40
18	7.09	0.0336	0.853	0.022	0.559	24	5	36
22	8.66	0.0275	0.699	0.018	0.457	26	5	36
25	9.84	0.0236	0.599	0.0164	0.417	27	5	35
30	11.81	0.0197	0.500	0.0136	0.345	29	5	35
36	14.17	0.0166	0.422	0.0112	0.284	31.5	5	36

BRITISH STANDARD SCREEN SCALE SIEVES

Meshes per Lineal		Sieve Opening		Wire Diameter		Standard Gauge	Tolerance Average Aperture ±%	Approx. Screening Area
inch	cm.	inch	mm.	inch	mm.			
44	17.32	0.0139	0.353	0.0088	0.224	34.5	5	38
52	20.47	0.0116	0.295	0.0076	0.193	36	6	37
60	23.62	0.0099	0.251	0.0068	0.173	37	6	35
72	28.35	0.0083	0.211	0.0056	0.142	38.5	6	36
85	33.47	0.007	0.178	0.0048	0.122	40	6	35
100	39.37	0.006	0.152	0.004	0.102	42	6	36
120	47.24	0.0049	0.124	0.0034	0.086	43.5	6	35
150	59.06	0.0041	0.104	0.0026	0.066	45.5	8	37
170	66.93	0.0035	0.089	0.0024	0.061	46	8	35
200	78.74	0.003	0.076	0.002	0.051	47	8	36
240	94.49	0.0026	0.066	0.0016	0.041	48	8	38

CERAMIC EQUIVALENT WEIGHTS

Based Upon the International Atomic Weights of 1933.
Compiled by F. C. SMITH, B. S. (Chem. Eng.) and R. O. HUMMEL of The Harshaw Chemical Co., Cleveland, Ohio.

Abbreviations used in the table:

anhyd., anhydrous
atm., atmosphere of pressure
d., decomposition
diss., dissociation
$-H_2O$, loss of 1 mole water
monocl., monoclinic
m. p., melting point
$-O$, loss of 1 atom of oxygen
RO, base equivalent
R_2O_3, amphoteric equivalent
RO_2, acid equivalent
subl., sublimes
<, below or less than
>, above or greater than

Mineral or Compound	Formula	Formula Weight	Equivalent Weight			Melting Point °C.
			RO	R_2O_3	RO_2	
Albite (soda feldspar)	$Na_2O \cdot Al_2O_3 \cdot 6SiO_2$	524.29	524.29	524.29	87.38	1100±
Alum (ammonium)	$Al_2(SO_4)_3 \cdot (NH_4)_2SO_4 \cdot 24H_2O$	906.63	.....	906.63	.....	94
Alum (potash)	$Al_2(SO_4)_3 \cdot K_2SO_4 \cdot 24H_2O$	948.75	948.75	948.75	.....	92
Alum (soda)	$Al_2(SO_4)_3 \cdot Na_2SO_4 \cdot 24H_2O$	916.55	916.55	916.55	.....	61
Alumina	Al_2O_3	101.94	.....	101.94	.....	2050
Aluminum fluoride	AlF_3	83.97	.....	167.94	55.98	1040
hydrate (hydroxide)	$Al_2O_3 \cdot 3H_2O$	155.99	.....	155.99	.....	2050
sulfate	$Al_2(SO_4)_3 \cdot 18H_2O$	666.40	.....	666.40	.....	d87
sulfate (anhyd.)	$Al_2(SO_4)_3$	342.12	.....	342.12	.....	d770
Andalusite	$Al_2O_3 \cdot SiO_2$	162.00	.....	162.00	162.00	.....
Anorthite (calcium feldspar)	$CaO \cdot Al_2O_3 \cdot 2SiO_2$	278.14	278.14	278.14	139.07	1550
Antimony pentoxide	Sb_2O_5	323.52	.....	323.52	.....	$-O$, 450 $-2O$, 1060
tetroxide	Sb_2O_4	307.52	.....	307.52	.....	$-O$,1060
trioxide	Sb_2O_3	291.52	.....	291.52	.....	652
sulfide (needle)	Sb_2S_3	339.70	.....	339.70	.....	550
Apatite	$3CaO \cdot P_2O_5$	310.28	103.43	.....	310.28	1670
Arsenous oxide	As_2O_3	197.86	.....	197.86	.....	subl.
Barium carbonate	$BaCO_3$	197.36	197.36	.....	.....	d900
chloride	$BaCl_2 \cdot 2H_2O$	244.31	244.31	.....	.....	$-2H_2O$, 100° m.p.962

CERAMIC EQUIVALENT WEIGHTS

Mineral or Compound	Formula	Formula Weight	Equivalent Weight			Melting Point °C.
			RO	R_2O_3	RO_2	
chloride (anhyd.)	$BaCl_2$	208.27	208.27	.....	.....	962
chromate	$BaCrO_4$	253.37	253.37	506.74	.....	.....
fluoride	BaF_2	175.36	175.36	.....	175.36	1280
fluosilicate	$BaSiF_6$	279.42	279.42	.....	SiO_2 279.42; 2F 93.14	.....
hydroxide	$Ba(OH)_2 \cdot 8H_2O$	315.50	315.50	.....	.....	$-8H_2O$, 550 m.p. 78
oxide	BaO	153.36	153.36	.....	.....	1923
selenite	$BaSeO_3$	264.56	264.56	.....	264.56	d.
sulfate (barytes)	$BaSO_4$	233.42	233.42	.....	.....	d1580
Beryllium oxide	BeO	25.02	25.02	.....	.....	2450±50
Beryl	$3BeO \cdot Al_2O_3 \cdot 6SiO_2$	537.36	179.12	537.36	89.56	1410
Bismuth oxide	Bi_2O_3	466.00	.....	466.00	.....	860
sub-nitrate.	$BiO \cdot NO_3 \cdot H_2O$	305.02	.....	610.04	.....	d260
Bone ash	imp. $Ca_3(PO_4)_2$	.....	.....	.....	.....	.....
Borax	$Na_2O \cdot 2B_2O_3 \cdot 10H_2O$	381.43	381.43	190.71	.....	75
Borax (anhyd.)	$Na_2O \cdot 2B_2O_3$	201.27	201.27	100.63	.....	741
Boric acid	$B_2O_3 \cdot 3H_2O$	123.69	.....	123.69	.....	d185 $-1\frac{1}{2}H_2O$, 300
oxide (anhyd.)	B_2O_3	69.64	.....	69.64	.....	577
Cadmium carbonate	$CdCO_3$	172.41	172.41	.....	.....	d <500
oxide	CdO	128.41	128.41	.....	.....	d900-1000
selenide	CdSe	191.61	191.61	.....	191.61	<1350
sulfate	$3CdSO_4 \cdot 8H_2O$	769.53	256.51	.....	.....	tr. 42
sulfate (anhyd.)	$CdSO_4$	208.47	208.47	.....	.....	1000
sulfide	CdS	144.47	144.47	.....	.....	$1750^{100 atm}$
Calcium borate	$2CaO \cdot 3B_2O_3 \cdot 5H_2O$	411.16	205.58	137.05	.....	.....
carbonate	$CaCO_3$	100.08	100.08	.....	.....	d825
chloride	$CaCl_2 \cdot 6H_2O$	219.09	219.09	.....	.....	30
chloride (anhyd.)	$CaCl_2$	110.99	110.99	.....	.....	772
fluoride	CaF_2	78.08	78.08	.....	78.08	1330
fluosilicate	$CaSiF_6$	182.14	182.14	.....	SiO_2 182.14; 2F 60.71	d.
hydroxide	$Ca(OH)_2$	74.10	74.10	.....	.....	$-H_2O$, 580
oxide	CaO	56.08	56.08	.....	.....	2572
phosphate (ortho)	$3CaO \cdot P_2O_5$	310.28	103.43	310.28	.....	1670
silicate	$CaO \cdot SiO_2$	116.14	116.14	.....	116.14	1540+
sulfate (gypsum)	$CaSO_4 \cdot 2H_2O$	172.17	172.17	.....	.....	$-1\frac{1}{2}H_2O$, 128 $-2H_2O$, 163
sulfate (plaster)	$CaSO_4 \cdot \frac{1}{2}H_2O$	145.15	145.15	.....	.....	$-\frac{1}{2}H_2O$, 163
sulfate (anhyd.)	$CaSO_4$	136.14	136.14	.....	.....	monocl. 1450
Celestite	$SrSO_4$	183.69	183.69	.....	.....	d1580
Cerium oxide	CeO_2	172.13	.....	.....	172.13	1950
China clay	$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$	258.09	.....	258.09	129.05	1755±
Chromic acid	CrO_3	100.01	.....	200.02	.....	d190
fluoride	$CrF_3 \cdot 9H_2O$	271.15	.....	542.30	180.77	.....
oxide (green)	Cr_2O_3	152.02	.....	152.02	.....	1900
sulfate	$Cr_2(SO_4)_3 \cdot 18H_2O$	716.48	.....	716.48	.....	$-12H_2O$, 100
Chromite	$FeO \cdot Cr_2O_3$	223.86	223.86	223.86	223.86	2180
Cobaltous acetate	$Co(CH_3CO_2)_2 \cdot 4H_2O$	249.05	249.05	498.10	.....	$-4H_2O$, 140
carbonate	$CoCO_3$	118.94	118.94	237.88	.....	d100
chloride	$CoCl_2 \cdot 6H_2O$	237.95	237.95	475.90	.....	$-6H_2O$, 110

CERAMIC EQUIVALENT WEIGHTS

Mineral or Compound	Formula	Formula Weight	Equivalent Weight			Melting Point °C.
			RO	R_2O_3	RO_2	
Cobaltous nitrate	$Co(NO_3)_2 \cdot 6H_2O$	291.05	291.05	582.10	.....	<100
oxide	CoO	74.94	74.94	149.88	.....	d1800
cobaltic oxide (blk.)	Co_3O_4	240.82	80.27	160.54	.....	.....
phosphate (anhyd.)	$Co_3(PO_4)_2$	366.86	122.29	244.58	.....	.....
sulfate	$CoSO_4 \cdot 7H_2O$	281.11	281.11	562.22	.....	96.8
sulfate (anhyd.)	$CoSO_4$	155.00	155.00	310.00	.....	d880
Copperas	$FeSO_4 \cdot 7H_2O$	278.01	278.01	556.02	.....	$-7H_2O$, 300 m.p. 64
Cupric acetate	$Cu(CH_3CO_2)_2 \cdot H_2O$	199.63	199.63	.....	.....	d240
carbonate (basic)	$CuCO_3 \cdot Cu(OH)_2$	221.16	110.58	.....	.....	d.
chloride	$CuCl_2 \cdot 2H_2O$	170.52	170.52	.....	.....	$-2H_2O$, 110 m. p. d.
nitrate	$Cu(NO_3)_2 \cdot 6H_2O$	295.68	295.68	.....	.....	$-HNO_3$, 170 $-3H_2O$, 26.4
oxide (black)	CuO	79.57	79.57	.....	.....	d1026
sulfate	$CuSO_4 \cdot 5H_2O$	249.71	249.71	.....	.....	$-5H_2O$, 250 d650
Cuprous oxide (red)	Cu_2O	143.14	143.14	.....	.....	$-O$, 1800 m.p. 1235
Cryolite	$3NaF \cdot AlF_3$	209.96	139.98	419.92	2F, 69.98	1000
Cornwall stone (aprx.)	$RO \cdot 2\frac{1}{2}Al_2O_3 \cdot 20SiO_2$	.....	.....	.....	.....	.....
Dolomite	$CaCO_3 \cdot MgCO_3$	184.40	*	.....	.....	.....
Feldspar (potash)	$K_2O \cdot Al_2O_3 \cdot 6SiO_2$	556.50	556.50	556.50	92.75	1250±
Feldspar (soda)	$Na_2O \cdot Al_2O_3 \cdot 6SiO_2$	524.29	524.29	524.29	87.38	1100±
Feldspar (lime)	$CaO \cdot Al_2O_3 \cdot 2SiO_2$	278.14	278.14	278.14	139.61	1550
Ferric chloride	$FeCl_3 \cdot 6H_2O$	270.30	**	.....	.....	37
hydroxide	$Fe(OH)_3$	106.86	***	.....	.....	$-1\frac{1}{2}H_2O$, 500
oxide (red)	Fe_2O_3	159.68	****	.....	.....	d1560
Ferrous-ferric oxide (black, magnetic)	$FeO \cdot Fe_2O_3$	231.52	77.17	154.34	.....	d1538
Ferrous oxide	FeO	71.84	71.84	143.68	.....	1420
sulfate	$FeSO_4 \cdot 7H_2O$	278.01	278.01	556.02	.....	$-7H_2O$, 300 m.p. 64
Flint	SiO_2	60.06	.....	.....	60.06	1600 to 2230
Fluorspar	CaF_2	78.08	78.08	.....	78.08	1330
Gypsum	$CaSO_4 \cdot 2H_2O$	172.17	172.17	.....	.....	$-1\frac{1}{2}H_2O$, 128 $-2H_2O$, 163
Kaolin	$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$	258.09	.....	258.09	129.05	1755 to 1790
Lead acetate	$Pb(CH_3CO_2)_2 \cdot 3H_2O$	379.31	379.31	.....	.....	$-3H_2O$, 75
borate	$PbO \cdot B_2O_3 \cdot H_2O$	310.88	310.88	310.88	.....	$-H_2O$, 160
carbonate	$PbCO_3$	267.22	267.22	.....	.....	d315
carbonate (basic)	$2PbCO_3 \cdot Pb(OH)_2$	775.68	258.56	.....	.....	d400
chloride	$PbCl_2$	278.13	278.13	.....	.....	501
chromate	$PbCrO_4$	323.23	232.23	646.46	.....	844
oxide (litharge)	PbO	223.22	223.22	.....	.....	888
oxide (red)	Pb_3O_4	685.66	228.55	.....	.....	d500
bi-silicate	$PbO \cdot 2SiO_2$	343.34	343.34	171.67	.....	.....
sulfate	$PbSO_4$	303.28	303.28	.....	.....	1170
sulfide (galena)	PbS	239.28	239.28	.....	.....	1120
Lithium carbonate	Li_2CO_3	73.88	73.88	.....	.....	618
oxide	Li_2O	29.88	29.88	.....	.....	subl. <1000
Lime	CaO	56.08	56.08	.....	.....	2570
Magnesium carbonate	$MgCO_3$	84.32	84.32	.....	.....	d350
chloride	$MgCl_2 \cdot 6H_2O$	203.33	203.33	.....	.....	d118
hydroxide	$Mg(OH)_2$	58.34	58.34	.....	.....	d.

*$CaCO_3$ 100.08; $MgCO_3$ 84.32

**FeO 270.30; Fe_2O_3 540.60

***FeO 106.86; Fe_2O_3 213.72

****FeO 79.84; Fe_2O_3 159.68

CERAMIC EQUIVALENT WEIGHTS

Mineral or Compound	Formula	Formula Weight	Equivalent Weight			Melting Point °C.
			RO	R_2O_3	RO_2	
Magnesium oxide	MgO	40.32	40.32	.....	.....	2800
silicate (talc)	$3MgO{\cdot}4SiO_2{\cdot}H_2O$	379.22	126.41	.....	94.80	.....
sulfate	$MgSO_4{\cdot}7H_2O$	246.49	246.49	.....	.....	d70
Manganese carbonate	$MnCO_3$	114.93	114.93	.....	.....	d.
dioxide (black)	MnO_2	86.93	86.93	.....	.....	−O,535
oxide (green)	MnO	70.93	70.93	.....	.....	1650
sulfate (anhyd.)	$MnSO_4$	150.99	150.99	.....	.....	700
Manganic oxide (brown)	Mn_2O_3	157.86	78.93	.....	.....	−O,1080
Manganous-manganic oxide (red)	Mn_3O_4	228.79	76.26	.....	.....	1705
Molybdic acid	$H_2MoO_4{\cdot}H_2O$	180.03	.....	.....	180.03	$-H_2O$, 70
Molybdic trioxide	MoO_3	144.00	.....	.....	144.00	795
Neodymium oxalate	$Nd_2(C_2O_4)_3{\cdot}10H_2O$	732.70	.....	.....	732.70	d400
oxide	Nd_2O_3	336.54	336.54	.....	.....	1900±
Nickel carbonate	$NiCO_3$	118.69	118.69	.....	.....	d.
chloride	$NiCl_2{\cdot}6H_2O$	237.70	237.70	.....	.....	d.
chloride (anhyd.)	$NiCl_2$	129.60	129.60	.....	.....	.....
sulfate	$NiSO_4{\cdot}7H_2O$	280.86	280.86	.....	.....	$-H_2O$, 6103
sulfate (anhyd.)	$NiSO_4$	154.75	154.75	.....	.....	$-SO_3$, 840
oxide (black)	Ni_2O_3	165.38	165.38	.....	.....	to NiO, 600
oxide (green)	NiO	74.69	74.69	.....	.....	to Ni_2O_3, 400
Orthoclase	$K_2O{\cdot}Al_2O_3{\cdot}6SiO_2$	556.50	556.50	556.50	92.75	1170
Phosphorus pentoxide	P_2O_5	142.04	.....	.....	142.04	subl.
Potassium carbonate	$K_2CO_3{\cdot}2H_2O$	174.23	174.23	.....	.....	$-2H_2O$,100-200
Potassium carbonate (pearl ash)	K_2CO_3	138.20	138.20	.....	.....	891
chloride	KCl	74.56	74.56	.....	.....	790
chromate	K_2CrO_4	194.21	194.21	388.42	.....	975
dichromate	$K_2Cr_2O_7$	294.22	294.22	294.22	.....	398
nitrate (salt peter)	KNO_3	101.11	101.11	.....	.....	tr. 129;d400
oxide	K_2O	94.20	94.20	.....	.....	.....
silicate	$K_2O{\cdot}SiO_2$	154.26	154.26	.....	154.26	976
Quartz	SiO_2	60.06	.....	.....	60.06	1600 to 2230
Rutile	TiO_2	79.90	.....	.....	79.90	d1640
Selenium	Se_8	633.60	.....	.....	79.20	50 to 217
dioxide	SeO_2	111.20	.....	.....	111.20	subl. 317
Silica	SiO_2	60.06	.....	.....	60.06	1600 to 2230
Silicon carbide	SiC	40.06	.....	.....	40.06	*diss. 2240
Sodium aluminate	$Na_2O{\cdot}Al_2O_3$	163.93	163.93	163.93	.....	1650
antimonate	$Na_2O{\cdot}Sb_2O_5$	385.51	385.51	385.51	.....	.....
bicarbonate	$NaHCO_3$	84.00	84.00	.....	.....	$-H_2CO_3$, 270
carbonate (crystals)	$Na_2CO_3{\cdot}10H_2O$	286.15	286.15	.....	.....	$-H_2O$, 100
carbonate (anhyd.)	Na_2CO_3	105.99	105.99	.....	.....	851
chloride	NaCl	58.45	58.45	.....	.....	804
chromate	$Na_2CrO_4{\cdot}10H_2O$	342.16	342.16	684.32	.....	20
dichromate	$Na_2Cr_2O_7{\cdot}2H_2O$	298.05	298.05	298.05	.....	$-2H_2O$, 100
fluoride	NaF	42.00	84.00	.....	84.00	992
fluosilicate	Na_2SiF_6	188.05	188.05	.....	**	980
nitrate	$NaNO_3$	85.01	170.01	.....	.....	308
oxide	Na_2O	61.99	61.99	.....	.....	.....
phosphate, di-	$Na_2HPO_4{\cdot}12H_2O$	358.21	358.21	.....	716.42	35
phosphate, tri-	$Na_3PO_4{\cdot}12H_2O$	380.20	253.46	.....	760.40	d73
selenide	Na_2Se	125.19	125.19	.....	125.19	>875

*Formation at 1840°C.

**SiO_2 188.05; 2F 62.68

CERAMIC EQUIVALENT WEIGHTS

Mineral or Compound	Formula	Formula Weight	Equivalent Weight			Melting Point °C.
			RO	R_2O_3	RO_2	
Sodium selenite	$Na_2O{\cdot}SeO_2$	173.19	173.19	.....	173.19	.....
silicate	$Na_2O{\cdot}SiO_2$	122.05	122.05	.....	122.05	1088
silicate, di-	$Na_2O{\cdot}2SiO_2$	182.11	182.11	.....	91.06	.....
sulfate (anhyd.)	Na_2SO_4	142.05	142.05	.....	.....	884
uranate**	Na_2UO_4	348.13	348.13	.....	348.13	.....
uranyl carbonate**	$2Na_2CO_3{\cdot}UO_2CO_3$	542.13	271.06	.....	542.13	d.
Stannic chloride	$SnCl_4$	260.53	.....	.....	260.53	30
oxide (tin oxide)	SnO_2	150.70	.....	.....	150.70	1127
Stannous chloride	$SnCl_2{\cdot}2H_2O$	225.65	.....	.....	225.65	38
Strontium carbonate	$SrCO_3$	147.63	147.63	.....	.....	$1497^{60\,atm.}$
oxide	SrO	103.63	103.63	.....	.....	2430
sulfate (celestite)	$SrSO_4$	183.69	183.69	.....	.....	d1580
Tin oxide	SnO_2	150.70	.....	.....	150.70	1127
Titanium dioxide	TiO_2	79.90	.....	.....	79.90	d1640
Uranium oxide	U_3O_8	842.42	.....	.....	842.42	d.
trioxide	UO_3	286.14	.....	.....	286.14	d.
Vanadium pentoxide	V_2O_5	181.90	.....	.....	181.90	800
Zinc carbonate	$ZnCO_3$	125.38	125.38	.....	.....	$-CO_2$, 300
oxide	ZnO	81.38	81.38	.....	.....	>1800
selenite	$ZnO{\cdot}SeO_2$	192.58	192.58	.....	192.58	.....
Zirconium oxide	ZrO_2	123.22	.....	.....	123.22	2700
silicate	$ZrO_2{\cdot}SiO_2$	183.28	183.28	.....	183.28	2550
Zirconia	ZrO_2	123.22	.....	.....	123.22	2700

**Position of this oxide depends upon acid-base ratio; status questionable.

INDEX OF REFRACTION

The index of refraction of air, 1.000294, is so near unity that it is commonly used as a more convenient standard than vacuum. After measurement of the index of a substance in any medium, as air, its index in a vacuum may be computed, being equal to the index as obtained by measurement multiplied by the index (measured in a vacuum) of the medium used.

Index of refraction varies inversely with the wave length of light employed, being greater for violet than for red light. This variation is known as *dispersion* and is greater (in general) for liquids than for solids. The yellow light of sodium (*D*) is commonly employed as an approximate mean value for all parts of white light. Other wave lengths which have been used in determinations of refractive index are those corresponding to certain spectrum lines of some of the elements and are indicated by the symbols of the elements or by the letters *A'*, *C*, *D*, *E*, *F*, *G'*, and *H* which are the Fraunhofer designations. The wave lengths most commonly employed are:

Ca = (*H*)	= 3968Å	= 396.8$m\mu$	= 0.3968 × 10^{-4}cm.
Hγ = (*G'*)	= 4340Å	= 434.0$m\mu$	= 0.4340 × 10^{-4}cm.
Hβ = (*F*)	= 4861Å	= 486.1$m\mu$	= 0.4861 × 10^{-4}cm.
Tl = ...	= 5350Å	= 535.0$m\mu$	= 0.5350 × 10^{-4}cm.
Hg = ...	= 5791Å	= 579.1$m\mu$	= 0.5791 × 10^{-4}cm.
He = (*E*)	= 5876Å	= 587.6$m\mu$	= 0.5876 × 10^{-4}cm.
Na = (*D*)	= 5893Å	= 589.3$m\mu$	= 0.5893 × 10^{-4}cm.
Hα = (*C*)	= 6563Å	= 656.3$m\mu$	= 0.6563 × 10^{-4}cm.
Li = (*Red*)	= 6708Å	= 670.8$m\mu$	= 0.6708 × 10^{-4}cm.
A = ...	= 7594Å	= 759.4$m\mu$	= 0.7594 × 10^{-4}cm.
Kα = (*A'*)	= 7699Å	= 769.9$m\mu$	= 0.7699 × 10^{-4}cm.

The index of refraction is lowered by raising the temperature. This thermal variation of index is considerable in many liquids and negligible (affecting only the 4th or 5th decimal place) in crystals. Pressure plays a noticeable role only with gases.

Optically all substances may be classified as follows:

- Isotropic Group
  - Liquids
  - Isometric system solids
- Anisotropic Group
  - Uniaxial
    - Tetragonal — Positive or Negative
    - Hexagonal — Positive or Negative
  - Biaxial
    - Orthorhombic — Positive or Negative
    - Monoclinic — Positive or Negative
    - Triclinic — Positive or Negative

References.—The data in the following tables of refractive indices of solids have been collected mainly from the following sources:—

Winchell: *The Microscopic Characters of Artificial Inorganic Solid Substances or Artificial Minerals*, 2d edition (1931). Published by John Wiley and Sons, Inc., New York.

Larsen and Berman: *The Microscopic Determination of the Nonopaque Minerals*, 2d edition (1934). U. S. Geological Survey, Bull. 848, Washington, D. C.

Fry: *Tables for the Microscopic Identification of Inorganic Salts*, U. S. Department of Agriculture, Bull. 1108 (1922), Washington, D. C.

International Critical Tables, Vols. I and VII. Published by McGraw-Hill Book Co., New York.

ISOTROPIC GROUP (SOLIDS*)

Isotropic substances transmit light with equal velocity in all directions (isoaxial) and include gas, liquid, amorphous materials such as resins and glasses, and isometric crystals. In the table below most of the substances are isometric; a considerable number are amorphous and therefore rather variable and indefinite in their chemical composition and all their properties; a few, which are included also in their proper birefracting group, are birefracting, but their birefringence is so weak or uncertain as to make them easily mistaken for isotropic substances.

Arrangement. The substances are arranged in the order of increasing values of refractive index.

Substance	Ref. Ind. n_D	Substance	Ref. Ind. n_D
NaF	1.3258	$CsGa(SO_4)_2 \cdot 12H_2O$	1.4650
$3NaF \cdot 3LiF \cdot 2AlF_3$	1.339	$CsIn(SO_4)_2 \cdot 12H_2O$	1.4652
K_2SiF_6	1.34–39	$KGa(SO_4)_2 \cdot 12H_2O$	1.4653
KF	1.352	$RbGa(SO_4)_2 \cdot 12H_2O$	1.4658
$(NH_4)_2SiF_6$	1.3696	$NH_4In(SO_4)_2 \cdot 12H_2O$	1.4664
K_2SiF_6	1.39±	$NH_4Ga(SO_4)_2 \cdot 12H_2O$	1.4684
LiF	1.3915	$RbV(SO_4)_2 \cdot 12H_2O$	1.469
RbF	1.396	$2Na_3AsO_4 \cdot NaF \cdot 19H_2O$	1.4693
K_3HfF_7	1.403	NaH	1.470
$Al_2O_3 \cdot 6SiO_2 \cdot 18 \pm H_2O$ (?)	1.403	$NaAlSi_2O_6 \cdot H_2O$	1.472
K_3ZrF_7	1.408	$CaTi(SO_4)_2 \cdot 12H_2O$	1.4736
$SiO_2 \cdot H_2O$ (Opal)	1.41	BaF_2	1.475
KCN	1.410	$NH_4V(SO_4)_2 \cdot 12H_2O$	1.475
$SiCl_4$	1.412	$CsV(SO_4)_2 \cdot 12H_2O$	1.478
$K_2Zn(CN)_4$	1.413	CsF^a	1.48
$K_2Cd(CN)_4$	1.413	$Na_2O \cdot CaO \cdot 3Al_2O_3 \cdot 9SiO_2 \cdot 8H_2O$	1.48
$(NH_4)_3HfF_7$	1.426	SiO_2[b]	1.480
$(Na_2, Mg)F_2 \cdot 3Al(F,OH)_3 \cdot 2H_2O$	1.427	$KAl(SeO_4)_2 \cdot 12H_2O$	1.4801
$(NH_4)_3ZrF_7$	1.433	$CsCr(SO_4)_2 \cdot 12H_2O$	1.4810
CaF_2	1.4339	$KCr(SO_4)_2 \cdot 12H_2O$	1.4814
$(Y, Er, Ce)F_3 \cdot 5CaF_2 \cdot H_2O$	1.434	$RbCr(SO_4)_2 \cdot 12H_2O$	1.4815
SrF_2	1.438	$KFe(SO_4)_2 \cdot 12H_2O$	1.4817
$NaAl(SO_4)_2 \cdot 12H_2O$	1.4388	$RbFe(SO_4)_2 \cdot 12H_2O$	1.4823
$BaCa_2(C_3H_5O_2)_6$ (Propionate)	1.444	$CsMn(SO_4)_2 \cdot 12H_2O$	1.483±
$Na_3PO_4 \cdot 10H_2O$	1.450	$3Na_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 2NaCl$	1.483
$2Na_3PO_4 \cdot NaF \cdot 19H_2O$	1.4519	$CsFe(SO_4)_2 \cdot 12H_2O$	1.4838
NaCN	1.452	$NH_4Cr(SO_4)_2 \cdot 12H_2O$	1.4842
KH	1.453	$NH_4Fe(SO_4)_2 \cdot 12H_2O$	1.485
$NH_3(CH_3)Al(SO_4)_2 \cdot 12H_2O$	1.454	SiO_2[c]	1.486
$2Na_2SO_4 \cdot NaCl \cdot NaF$	1.454	$Na_2O \cdot Al_2O_3 \cdot 4SiO_2 \cdot 2H_2O$	1.487
$KAl(SO_4)_2 \cdot 12H_2O$	1.4564	$NaAlSi_3O_8$ (Glass)	1.4891
$RbAl(SO_4)_2 \cdot 12H_2O$	1.4566	KCl	1.4904
$NaC_4H_7O_4$ (Diacetate)	1.457	RbCl	1.4936
$(Ca_3, Y_2)F_6$	1.457	$5Na_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 2SO_3$	1.495
$K_2Hg(CN)_4$	1.458	$5(Na_2, Ca)O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 2SO_3$	1.495
$CaAl(SO_4)_2 \cdot 12H_2O$	1.4586	$LiAlSi_4O_{10}$ (Glass)	1.495
SiO_2 (Glass)	1.4588	$TlAl(SO_4)_2 \cdot 12H_2O$	1.4975
B_2O_3 (Glass)	1.459	$3Na_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 2Na_2S$	1.50±
$NH_4Al(SO_4)_2 \cdot 12H_2O$	1.4594	2NaCl·7KCl	1.500
$RbTi(SO_4)_2 \cdot 12H_2O$	1.462_{Li}	$NaU(C_2H_3O_2)_3$	1.501
$RbIn(SO_4)_2 \cdot 12H_2O$	1.4638	$RbRh(SO_4)_2 \cdot 12H_2O$	1.501±
$NaK(CN)_2$	1.465	$KAlSi_2O_6$	1.501±

* See also special table for liquids.
a Lower temp. phase.
b Ignited gel.
c Metacristobalite.

INDEX OF REFRACTION—ISOTROPIC

Substance	Ref. Ind. n_D	Substance	Ref. Ind. n_D
$2NaCl \cdot 5KCl$	1.503	$MgSiO_3$ (Glass)	1.5801
$TlGa(SO_4)_2 \cdot 12H_2O$	1.5067	$CsBr$	1.582
$RbFe(SeO_4)_2 \cdot 12H_2O$	1.5070	$Sr(NO_3)_2$	1.5878
$CsRh(SO_4)_2 \cdot 12H_2O$	1.5077	$Sr(NO_2)_2 \cdot H_2O$	1.589
$3Na_2O \cdot 2MgO \cdot 4CO_2 \cdot SO_3$	1.508	$NaBrO_3$[a]	1.5943
$KAlSiO_4$ (Glass)	1.508	$[(CH_3)_3N]_2H_2PtCl_6$	1.6000
$2NaCl \cdot 3KCl$	1.5085	Na_2CaSiO_4	1.60
$K_2O \cdot Al_2O_3 \cdot 4SiO_2$	1.509	$Ca_3Al_2O_6 \cdot 6H_2O$	1.604
$NaAlSiO_4$ (Glass)	1.510	$BaSi_2O_5$ (Glass)	1.606
$NH_4Rh(SO_4)_2 \cdot 12H_2O$	1.5103	GeO (Glass)	1.607
$CsFe(SeO_4)_2 \cdot 12H_2O$	1.5116	$5CaO \cdot 3Al_2O_3$	1.608–13
$Mg(BrO_3)_2 \cdot 6H_2O$	1.5136	$2Fe_2O_3 \cdot P_2O_5 \cdot 2SO_3 \cdot 2H_2O$	1.61 ±
$TlV(SO_4)_2 \cdot 12H_2O$	1.514	$3NiO \cdot CO_2 \cdot H_2O$	1.61 ±
$NaCl \cdot KCl$	1.514	$NaBrO_3$[b]	1.617
$NaCl \cdot Na_2CO_3 \cdot MgCO_3$	1.5144	$GeBr_4$	1.6269
$Na_2B_4O_7$ (Glass)	1.5147	$CaSiO_3$ (Glass)	1.6280
$NaClO_3$	1.5151	$Ca_2Al_2SiO_7$ (Glass)	1.638
$4NaCl \cdot 3KCl$	1.518	$ThSiO_4 \cdot 4H_2O$	1.638
$LiAlSi_2O_6$ (Glass)	1.519	NH_4Cl[c]	1.639
$3NaCl \cdot 2KCl$	1.519	$Ca_2MgSi_2O_7$ (Glass)	1.641
$CaCl_2$	1.52	$NaBr$	1.6412
$K_3Cu(CN)_4$	1.522 ±	$CsCl$	1.6418
$TlCr(SO_4)_2 \cdot 12H_2O$	1.5228	NH_4Cl[d]	1.6426
$2Na_3VO_4 \cdot NaF \cdot 19H_2O$	1.5230	$(NH_4)_2FeCl_4$	1.6439
$2NaCl \cdot KCl$	1.523	Li_2O	1.644
$K_2Be_3Si_4O_{12}$	1.523	RbI	1.6474
$TlFe(SO_4)_2 \cdot 12H_2O$	1.5237	$SrCl_2$	1.6499
$2Cs_2O \cdot 2Al_2O_3 \cdot 9SiO_2 \cdot H_2O$	1.525	Al_2O_3[e]	1.65–9
$3NaCl \cdot KCl$	1.528	$ZnSiO_3$ (Glass)	1.650
$Na_3VO_4 \cdot 10H_2O$	1.5305	$FeSiO_3 \cdot nH_2O$	1.650–4
$K_2SO_4 \cdot 2MgSO_4$	1.5329	K_2SnCl_6	1.6574
$5NaCl \cdot KCl$	1.533	$Ca_4P_2O_9$	1.660 ±
$CsCl$	1.534	CsI	1.661
Amber (Succinite)	1.535 ±	$Ca_5Al_6O_{14}$ (Glass)	1.662
$7NaCl \cdot KCl$	1.536	$LiCl$	1.662
$K_2Ni(COS)_4$	1.54 ±	KI	1.6670
$K_2Al_2SiO_6$	1.540	$CaO \cdot Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$	1.67
$LiAlSiO_4$	1.541	$MgAl_2O_4$ (Glass)	1.67–8
$NaCl$	1.5443	$K_2O \cdot 2Al_2O_3 \cdot 3B_2O_3$	1.69
$Zn(BrO_3)_2 \cdot 6H_2O$	1.5452	Al_2O_3[e]	1.69–65
Li_2SiO_3 (Glass)	1.548	Al_2O_3[f]	1.696
$TlRh(SO_4)_2 \cdot 12H_2O$	1.5480	$CsBr$	1.6984
$Co(ClO_4)_2 \cdot 6H_2O$	1.55 ±	$MnSiO_3$ (Glass)	1.700
$Ni(ClO_4)_2 \cdot 6H_2O$	1.55 ±	NH_4I	1.7031
$RbBr$	1.5528	$3MgO \cdot Al_2O_3 \cdot 3SiO_2$	1.705
KBr	1.5594	$3CaO \cdot Al_2O_3$	1.710
CdF_2	1.56	$Ca_3Al_2O_6$	1.710–5
$Cr_2(SO_4)_3 \cdot 18H_2O$	1.564	NH_4Br	1.7108
$3NiO \cdot CO_2 \cdot H_2O$	1.57 ±	$MgAl_2O_4$	1.718–23
$Na_4CaSi_3O_9$	1.571	$Ca_3Al_2Si_3O_{12}$	1.735
$Ba(NO_3)_2$	1.572	MgO	1.7364
$K_4CaSi_3O_9$	1.572	$3AuCl_3 \cdot 3AgCl \cdot 8NH_4Cl$	1.74 ±
$CaAl_2Si_2O_8$ (Glass)	1.5755	$UO_2 \cdot ThO_2 \cdot PbO \cdot 4SiO_2 \cdot 4H_2O$	1.74 ±
CsF	1.578	As_2O_3	1.755
$SiBr_4$	1.579	$MgAl_2O_4$ (+9% $MgFe_2O_4$)	1.76

a See also *n* 1.617
b See also *n* 1.5943
c See also *n* 1.6426
d See also *n* 1.639
e Ignited gel.
f High temp. phase.

INDEX OF REFRACTION—ISOTROPIC

Substance	Ref. Ind. n_D	Substance	Ref. Ind. n_D
NaI	1.7745	$Fe_2O_3 \cdot nH_2O$	2.15±
$ZnO \cdot Al_2O_3$	1.780	BaS	2.155
$CoAl_2O_4$	1.78+	MnO	2.16
$Pb(NO_3)_2$	1.7815	$FeCr_2O_4$	2.16
LiBr	1.784	ZnS (Glass?)	2.18–.25
CsI	1.7876	ThO_2	2.20
$CsCl \cdot HgCl_2$	1.791	$4AgI \cdot CuI$	2.20
$FeO \cdot Al_2O_3$	1.80±	$5CaO \cdot 2TiO_2 \cdot 3Sb_2O_5$	2.20
$(NH_4)_2PtCl_6$	1.8	$2AgCl \cdot 2AgBr \cdot AgI$	2.20
$3MnO \cdot Al_2O_3 \cdot 3SiO_2$	1.80	SrSe	2.22
$3FeO \cdot Al_2O_3 \cdot 3SiO_2$	1.801	TlCl	2.247
$ZnAl_2O_4$	1.805	AgBr	2.252
$3MnO \cdot Al_2O_3 \cdot 3SiO_2$	1.811	MgS	2.268
K_2PtCl_6	1.825±	BaSe	2.271
$5CaO \cdot 3Sb_2O_5$	1.83	CaSe	2.274
$3FeO \cdot Al_2O_3 \cdot 3SiO_2$	1.830	$ZnFe_2O_4$	2.31_{Li}
CaO	1.837	CuI	2.345
$3CaO \cdot Cr_2O_3 \cdot 3SiO_2$	1.838	ZnS*	2.3682
$MnO_2 \cdot H_2O$	1.862(?)	NiO	2.37
$3CuO \cdot CuCl_2 \cdot 3H_2O$	1.864±	$MgFe_2O_4$	2.39_{Li}
SrO	1.870	$CdFe_2O_4$	2.39_{Li}
$3CaO \cdot Fe_2O_3 \cdot 3SiO_2$	1.895	SrTe	2.408
LiI	1.955	C (Diamond)	2.4173
CuCl	1.973	TlBr	2.4–.8
BaO	1.98	MgSe	2.42+
S (Glass)	2.0–2.9	BaTe	2.44
SbO_2	2.0	CdO	2.49_{Li}
$Fe_2O_3 \cdot nH_2O$	2.0–2.2	CaTe	2.5
$HgO \cdot 2HgCl_2$	2.001	MnS_2	2.69_{Li}
$2Bi_2O_3 \cdot 3SiO_2$	2.05	MnS	2.70_{Li}
$PbO \cdot CuCl_2 \cdot H_2O$	2.05	Cu_2O	2.705
AgCl	2.071	$5Cu_2S \cdot 2ZnS \cdot 2Sb_2S_3$	$>2.72_{Li}$
Sb_2O_3	2.087	$5Cu_2S \cdot 2ZnS \cdot 2As_2S_3$	$>2.72_{Li}$
$10PbO \cdot 3As_2O_5 \cdot 3H_2O$	2.09(?)	TlI	2.78
SnI_4	2.106	Se (Glass)	2.92
SrS	2.107	ZnTe	3.56
CuBr	2.116	Si	3.736
P (yellow)	2.1168	PbS	3.912
CaS	2.137		

*Low temp. phase. High temp. phase is uniaxial positive.

INDEX OF REFRACTION

ANISOTROPIC GROUP—UNIAXIAL

Uniaxial crystals have two refractive indices, one of the rays vibrating parallel to the optic axis and another at right angles to this direction. The ordinary ray is indicated by the symbol ω and the extraordinary ray by the symbol ϵ. If $\epsilon > \omega$ in a uniaxial substance, the substance is optically positive; if the reverse is true, negative. Uniaxial crystals may be considered simply as a small group of biaxials in which β is equal to α for a positive crystal, and to γ for a negative one.

The greater part of the substances of this group are tetragonal or hexagonal, but some that are strictly biaxial but with nearly zero axial angle are included here as well as in their proper biaxial group. A considerable proportion of these biaxial substances with nearly uniaxial optical properties have also nearly hexagonal form.

Arrangement. The substances are listed in the order of increasing values of the ω index.

Abbreviations. Hex., hexagonal; Tetr., tetragonal; Trig., trigonal; Rhomb., rhombohedral.

UNIAXIAL POSITIVE SUBSTANCES

Substance	System	ω_D	ϵ_D
H_2O (Ice)	Hex.	1.3090	1.3104
$MgSiF_6 \cdot 6H_2O$	Trig.	1.3439	1.3602
$MnSiF_6 \cdot 6H_2O$	Trig.	1.3570	1.3742
$FeSiF_6 \cdot 6H_2O$	Rhomb.	1.3638	1.3848
MgF_2	Tetr.	1.378	1.390
$CoSiF_6 \cdot 6H_2O$	Trig.	1.3817	1.3872
$ZnSiF_6 \cdot 6H_2O$	Trig.	1.3824	1.3956
$CoF_2 \cdot 5HF \cdot 6H_2O$	Trig.	1.384	1.399
$NaCNO$	Hex.	1.389	1.627
$NiSiF_6 \cdot 6H_2O$	Trig.	1.3910	1.4066
$NiF_2 \cdot 5HF \cdot 6H_2O$	Trig.	1.392	1.408
$CaCu(C_2H_3O_2)_4 \cdot 6H_2O$	Tetr.	1.436	1.478
$Na_2SO_4 \cdot NaF$	Hex.	1.436	1.439
$Na_3PO_4 \cdot 12H_2O$	Trig.	1.4458	1.4524
CuS [a]	Hex.	1.45	.....
$K_2S_2O_6$	Trig.	1.4550	1.5153
$Rb_2S_2O_6$	Trig.	1.4565	1.5068
$Na_3AsO_4 \cdot 12H_2O$	Trig.	1.4589	1.4669
$CuO \cdot SiO_2 \cdot 2H_2O$	.....	1.46±	1.57
$Na_2B_4O_7 \cdot 5H_2O$	Rhomb.	1.461	1.474
$LiKSO_4$	Hex.	1.4715	1.4721
$UO_2(C_2H_3O_2)_2 \cdot NH_4C_2H_3O_2$	Tetr.	1.481	1.493
$(NH_2)_2CO$ (Urea)	Tetr.	1.484	1.602
$SrCa_2(C_3H_5O_2)_6$ (Propionate)	Tetr.	1.487	1.496
$2Na_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 7H_2O$	Hex.	1.490	1.502
$K_3Na(SO_4)_2$	Trig.	1.4901	1.4996
$Na_3VO_4 \cdot 12H_2O$	Trig.	1.5095	1.5232
$Na_2O \cdot Al_2O_3 \cdot 9SiO_2 \cdot 2NaF$	Hex.	1.518	1.522
$2MgO \cdot Al_2O_3 \cdot 2MgCl_2 \cdot 8H_2O$	Trig.	1.52	1.55
$LiAlSi_2O_6$ (α-Phase)	Tetr.	1.521	.....
$Cs_2S_2O_6$	Trig.	1.5230	1.5438
$C_{10}H_{13}OH$ (Thymol)	Hex.	1.525	1.609
$Ca_2Pb(C_3H_5O_2)_6$ (Propionate)	Tetr.	1.527	1.539
$C_7H_{14}O_6$ [b] (β-Methylglucoside)	.....	1.529	1.513

[a] Covellite.

[b] Indices indicate negative.

INDEX OF REFRACTION—UNIAXIAL POSITIVE

Substance	System	ωD	ϵD
$Na_3VO_4 \cdot 10H_2O$ (Hex. phase)	Hex.	1.5398	1.5475
SiO_2 (Quartz or low temp. phase)	Hex.	1.5442	1.5533
$C_{15}H_{26}O$ (Guajol)	.....	1.545	1.548
$CaSO_4 \cdot 0.5H_2O$	Hex.(?)	1.55	1.57
$CsNO_3$	Hex.	1.55	1.56
$CaCO_3$ (Least stable phase)	Hex.	1.550	1.650
$ZrOCl_2 \cdot 8H_2O$[a]	Tetr.	1.552	1.563
$3Na_2SO_4 \cdot Fe(SO_4)_3 \cdot 6H_2O$	Trig.	1.558	1.613
$MgO \cdot H_2O$	Trig.	1.559	1.580
$3Na_2O \cdot Fe_2O_3 \cdot 6SO_3 \cdot 6H_2O$	Trig.	1.559	1.627
$Al_2O_3 \cdot 2SiO_2 \cdot 4H_2O$	Tetr.	1.560	1.580
$MgPt(CN)_4 \cdot 7H_2O$	Tetr.	1.5608	1.91
$La_2(SO_4)_3 \cdot 9H_2O$	Hex.	1.564	1.569
$MgO \cdot B_2O_3 \cdot 3H_2O$	Tetr.	1.565	1.575
$CH_3OC_6H_4OH$ (Guaiacol)	Hex.	1.569	1.666
$CaO \cdot 2CeOF \cdot 3CO_2$	Trig.	1.5690	1.6700
$K_2O \cdot 3Al_2O_3 \cdot 4SO_3 \cdot 6H_2O$	Trig.	1.572	1.592
$2Fe_2O_3 \cdot P_2O_5 \cdot 12H_2O$	Hex.	1.582	1.645
$Al_2O_3 \cdot 2SO_3$	Trig.	1.583	1.602
$MgCl_2 \cdot SnCl_4 \cdot 6H_2O$	Trig.	1.5885	1.5970
$FeCl_2 \cdot 3KCl \cdot NaCl$	Trig.	1.589	1.590
$4KCl \cdot MnCl_2$	Trig.	1.59	.....
$C_6H_{15}SP$ (Triethyl phosphinesulfide)	.....	1.590	1.650
$4KCl \cdot CdCl_2$	Trig.	1.5906	1.5907
Li_2SiO_3	Trig.	1.591	1.611
$SrSiO_3$	Hex.	1.599	1.637
$C_{12}H_{11}O_2NS$ (Benzenesulfanilide)	.....	1.600	1.649
CaNCN	Rhomb.	1.60	1.59
K_2CaSiO_4	Hex.	1.600	1.605
$CdCl_2 \cdot 4NH_4Cl$	Trig.	1.6038	1.6042
$Na_5Fe(SiO_3)_4$	Hex.	1.609	1.625
$CaSiO_3$	Hex.	1.6150	1.6360
$3CaO \cdot 5Al_2O_3$	Tetr.(?)	1.617	1.652
KIO_4	Tetr.	1.6205	1.6479
$CuO \cdot UO_3 \cdot P_2O_5 \cdot 8H_2O$	Tetr.	1.623	1.625
$KAg(CN)_2$	Trig.	1.625	1.63
$2SrO \cdot 3Al_2O_3 \cdot 2P_2O_5 \cdot 7H_2O$	Trig.	1.629	1.639
$2CaO \cdot MgO \cdot 2SiO_2$	Tetr.	1.631	1.638
$PbS_2O_6 \cdot 4H_2O$	Trig.	1.6351	1.6531
K_2PtCl_4	Tetr.	1.64	1.67
$(NH_4)_3PdCl_3SO_3 \cdot H_2O$	Trig.	1.643	.....
$KReO_4$	Tetr.	1.643	1.673
$CuO \cdot SiO_2 \cdot H_2O$	Trig.	1.644	1.697
$Sr_5Cl(PO_4)_3$	Hex.	1.650	1.655
Be_2SiO_4	Trig.	1.654	1.668
$2PbO \cdot 3Al_2O_3 \cdot 2P_2O_5 \cdot 7H_2O$	Hex.	1.654	1.676
$4NH_3 \cdot IrCl_3 \cdot H_2O$	Trig.	1.6576	1.6666
$Sr_5Cl(PO_4)_3$	Hex.	1.658	1.664
$C_6H_5COCOC_6H_5$ (Benzil)	Rhomb.	1.6588	1.6784
$4CaO \cdot B_2O_3 \cdot As_2O_5 \cdot 4H_2O$	Tetr.	1.662	1.663
$3Al_2O_3 \cdot Ce_2O_3 \cdot 2P_2O_5 \cdot 6H_2O$	Trig.	1.680±	1.685
AgCN	.....	1.685±	1.94
$ZnCl_2$	.....	1.687	1.713
$2ZnO \cdot SiO_2$[b]	Trig.	1.691	1.719
$CeOF \cdot CO_2$	Hex.	1.717	1.817

[a] Int. Crit. Tab. gives —, with ω1.563 and ϵ1.552

[b] Int. Crit. Tab. gives 1.694 and 1.723

INDEX OF REFRACTION—UNIAXIAL POSITIVE

Substance	System	ω_D	ϵ_D
BeO	Hex.	1.719	1.733
$Y_2O_3 \cdot P_2O_5$	Tetr.	1.721	1.816
$20CuO \cdot SO_3 \cdot 2CuCl_2 \cdot 20H_2O$	Hex.	1.724	1.746
$K_3Na(CrO_4)_2$	Trig.	1.7278	1.7361
$20CuO \cdot Bi_2O_3 \cdot 5As_2O_5 \cdot 22H_2O$	.....	1.730	1.810
$2Fe_2O_3 \cdot PbO \cdot 3SO_3 \cdot 4H_2O$	Hex.	1.755	1.82
$BaO \cdot TiO_2 \cdot 3SiO_2$	Hex.	1.757	1.804
$4(NH_4)_2O \cdot Mn_2O_3 \cdot 13MoO_3 \cdot 9H_2O$	Rhomb.	1.757	1.819
SeO_2	.....	>1.76	.....
Tl_2 (d $-C_4H_4O_6$)	Trig.	1.768	1.812
$AgBrO_3$	Tetr.	1.8466	1.920
$4CaO \cdot 5PbO \cdot PbCl_2 \cdot 6SiO_2$	Hex.	1.945	1.971
$5MnO \cdot SiO_2 \cdot As_2O_3 \cdot H_2O$	Hex.	1.96	.....
$CaWO_4$	Tetr.	1.9200	1.9365
$ZrO_2 \cdot SiO_2$	Tetr.	1.936	1.991
Hg_2Cl_2	Tetr.	1.9733	2.6559
$CaMoO_4$	Tetr.	1.974	1.984
SnO_2 (Most stable phase; cassiterite)	Tetr.	1.9968	2.0929
ZnO	Hex.	2.004	2.020
$Y_2(MoO_4)_3$	Tetr.	2.03	.....
$PbO \cdot PbCl_2 \cdot CO_2$	Tetr.	2.114	2.140
$PbO \cdot 2PbCl_2$	Hex.	2.13	2.21
AgI	Hex.	2.218	2.229
ZnS (α; high temp. phase)	Hex.	2.356	2.378
Cr_2O_3	Rhomb.	2.5±	.....
CdS	Hex.	2.506	2.529
HgS (Metastable phase)	Trig.	2.58	2.82
TiO_2	Tetr.	2.616	2.903
SiC	Trig.	2.654	2.697
Al_4C_3	Hex.	2.70*	2.75*
HgS (Stable phase; cinnabar)	Hex.	2.854	3.201
Se	Trig.	3.00	4.04

*At 700mμ

UNIAXIAL NEGATIVE SUBSTANCES

Substance	System	ω_D	ϵ_D
Na_2SiF_6	Hex.	1.312	1.309
$2NaF \cdot AlF_3$	Tetr.	1.349	1.342
$(NH_4)_2SiF_6$*	Hex.	1.406	1.391
$CuSiF_6 \cdot 6H_2O$	Trig.	1.4092	1.4080
$CaCl_2 \cdot 6H_2O$	Trig.	1.417	1.393
$KAl(SO_4)_2 \cdot 12H_2O$	Hex.(?)	1.456	1.429
$3CaO \cdot Al_2O_3 \cdot 3CaSO_4 \cdot 31H_2O$	Hex.	1.464	1.458
$(NH_4)_3ScF_6$	Tetr.	<1.47	.....
$BeSO_4 \cdot 4H_2O$	Tetr.	1.4720	1.4395
$LiKSO_4$	Hex.	1.4723	1.4717
$BeO \cdot Be(C_2H_5SO_4)_2 \cdot 4H_2O$	Tetr.	1.473	1.435
K_2TiF_6	Trig.	1.475	.....
$11Na_2O \cdot 9SO_3 \cdot 2CO_2 \cdot KCl$	Hex.	1.481	1.461
$La(C_2H_5SO_4)_6 \cdot 18H_2O$	Hex.	1.482	1.473
$Ce(C_2H_5SO_4)_6 \cdot 18H_2O$	Hex.	1.482	1.474
$Pr(C_2H_5SO_4)_6 \cdot 18H_2O$	Hex.	1.486	1.479

*Formed by evaporation at 5°C.

INDEX OF REFRACTION—UNIAXIAL NEGATIVE

Substance	System	ω_D	ϵ_D
$Nd(C_2H_5SO_4)_6 \cdot 18H_2O$	Hex.	1.487	1.479
SiO_2 (β-Cristobalite)	Tetr.	1.487	1.484
$6CaO \cdot Al_2O_3 \cdot 3SO_3 \cdot 33H_2O$	Hex.	1.488	1.474
$Er(C_2H_5SO_4)_6 \cdot 18H_2O$	Hex.	1.490	1.480
$Sm(C_2H_5SO_4)_6 \cdot 18H_2O$	Hex.	1.490	1.481
$Gd(C_2H_5SO_4)_6 \cdot 18H_2O$	Hex.	1.490	1.482
$Na_2SO_4 \cdot MgSO_4 \cdot 2.5H_2O$	Tetr.	1.490	1.471
$Y(C_2H_5SO_4)_6 \cdot 18H_2O$	Hex.	1.493	1.480
$Eu(C_2H_5SO_4)_6 \cdot 18H_2O$	Hex.	1.494	1.484
$Dy(C_2H_5SO_4)_6 \cdot 18H_2O$	Hex.	1.495	1.480
$(NH_4)_3UO_2F_5$	Tetr.	1.495	1.490
$CoSO_4 \cdot 6H_2O$	Tetr.	1.495	1.460
$CaO \cdot Al_2O_3 \cdot 3SiO_2 \cdot 5H_2O$	Trig.	1.496	1.491
$C_{10}H_{20}O$ (*l*-α-Menthol)	.....	1.497	1.476
$C_3H_{12}O_3N_6$ (Guanidine carbonate)	.....	1.499	1.49
$Sr(OH)_2 \cdot 8H_2O$	Tetr.	1.499	1.476
$3CaO \cdot Al_2O_3 \cdot CaSO_4 \cdot 12H_2O$	Hex.	1.504	1.488
$3CaO \cdot CO_2 \cdot SO_3 \cdot SiO_2 \cdot 15H_2O$	Hex.	1.507	1.468
$2MgO \cdot MgF_2 \cdot 3CaF_2$	Hex.	1.509	1.486
KH_2PO_4	Tetr.	1.5095	1.4684
$NiSO_4 \cdot 6H_2O$	Tetr.	1.5109	1.4873
$6MgO \cdot Al_2O_3 \cdot CO_2 \cdot 12H_2O$	Hex.	1.512	1.498
$CaCl_2 \cdot 2MgCl_2 \cdot 12H_2O$	Trig.	1.520	1.512
$K_3Cu(CN)_4$	Trig.	1.5215	.....
$Mg_2Al_4Si_5O_{18}$[a] (α-phase)	.....	1.522	1.519
$3Mg(NO_3)_2 \cdot 2La(NO_3)_3 \cdot 24H_2O$	Trig.	1.5220	1.5150
$NH_4H_2PO_4$	Tetr.	1.5246	1.4792
$3Mg(NO_3)_2 \cdot 2Ce(NO_3)_3 \cdot 24H_2O$	Trig.	1.5249	1.5176
$3Mg(NO_3)_2 \cdot 2Pr(NO_3)_3 \cdot 24H_2O$	Trig.	1.5255	1.5182
$3Mg(NO_3)_2 \cdot 2Nd(NO_3)_3 \cdot 24H_2O$	Trig.	1.5266	1.5192
$Ca_3Al_2O_6 \cdot 12H_2O$	Hex.	1.527	1.505
$Mg_2Al_4Si_5O_{18}$[a] (α-phase)	.....	1.528	1.524
$3CaO \cdot Al_2O_3 \cdot CaSO_4 \cdot 6H_2O$	Hex.(?)	1.529–35	1.510–27
$ZnSeO_4 \cdot 6H_2O$	Tetr.	1.5291	1.5039
$SrS_2O_6 \cdot 4H_2O$	Trig.	1.5296	1.5252
$(C_2H_4O)_4$ (Metaldehyde)	Tetr.	1.530	1.430
$RbAlSiO_4$	Hex.	1.530	1.526
$K_2CO_3 \cdot CaCO_3$	Hex.	1.530	1.48±
$LiAlSiO_4$	Hex.	1.531	.....
$K_2O \cdot 4CaO \cdot 2Al_2O_3 \cdot 24SiO_2 \cdot H_2O$	Hex.	1.532	1.529
$KAlSiO_4$ (β-phase)	Hex.	1.532	1.527
$Ba(ClO_4)_2 \cdot 3H_2O$	Hex.	1.5330	1.5323
$6ZnO \cdot 3Al_2O_3 \cdot 2SO_3 \cdot 18H_2O$	Hex.	1.534	1.514
$SrCl_2 \cdot 6H_2O$	Rhomb.	1.5364	1.4866
$K_2O \cdot 8CaO \cdot 16SiO_2 \cdot 16H_2O$	Tetr.	1.537	1.535
$NaAlSiO_4$ (β-phase or low temp. phase)	Hex.	1.537	1.533
$Ca_3Al_2O_6 \cdot 8H_2O$	Hex.	1.538	1.520
$NaLiCO_3$	Hex.	1.538	1.406
$Al_2O_3 \cdot C_{12}O_9 \cdot 18H_2O$ (Mellite)	Tetr.	1.539	1.511
$ZnCl_2 \cdot 6NH_3$	Hex.	1.539	1.530(?)
$NiSeO_4 \cdot 6H_2O$	Tetr.	1.5393	1.5125
CH_3CONH_2 (Acetamide)*	Hex.	1.54	1.46
$6MgO \cdot Fe_2O_3 \cdot CO_2 \cdot 12H_2O$	Hex.	1.540	1.510
$Na_2O \cdot Al_2O_3 \cdot 2SiO_2$	Hex.	1.542	1.538
$6MgO \cdot Cr_2O_3 \cdot CO_2 \cdot 12H_2O$	Hex.	1.542	1.516

[a] Stable >925 to 1150°C.

*Stable modification.

INDEX OF REFRACTION—UNIAXIAL NEGATIVE

Substance	System	ω_D	ϵ_D
$Li_2O \cdot Al_2O_3 \cdot 2SiO_2$	Hex.	1.545	.....
$(CH_2OHCHOH)_2$ (*dl*-Erythritol)	Tetr.	1.544	1.521
$K_2SO_4 \cdot Al_2(SO_4)_3$	Hex.	1.545	1.533 ±
$Na_2CO_3 \cdot CaCO_3$	Hex.	1.547	1.504
$K_8CaSi_{10}O_{25}$	Hex.	1.548	1.537
$CaS_2O_6 \cdot 4H_2O$	Trig.	1.5496	1.54 ±
$3NaAlSiO_4 \cdot CaCO_3$	Hex.	1.550	1.519
$Co(ClO_4)_2 \cdot 6H_2O$	Hex.	1.55 ±	.....
$Ni(ClO_4)_2 \cdot 6H_2O$	Hex.	1.55 ±	.....
$3NaAlSiO_4 \cdot CaCO_3$	Hex.	1.550	1.519
$3CaO \cdot Al_2O_3 \cdot CaCl_2 \cdot 10H_2O$	Hex.	1.550	1.535
$CaS_2O_6 \cdot 4H_2O$	Trig.	1.5516	1.5414
$C_4H_8O_2Cl_2$ (Dichlorobutylene glycol)	.....	1.554	1.515
$HfOCl_2 \cdot 8H_2O$	.....	1.557	1.543
$C_5H_{12}O_4$ (Pentaerythritol)	Tetr.	1.559	1.548
$AlCl_3 \cdot 6H_2O$	Trig.	1.560	1.507
$4AlCl_3 \cdot 3Al_2O_3 \cdot 3SO_3 \cdot 36H_2O$	Trig.	1.560	1.495
$ZrOCl_2 \cdot 8H_2O$[a]	Tetr.	1.563	1.552
Na_2SO_3	Hex.	1.565	1.515
$3CaO \cdot CaF_2 \cdot 3SiO_2 \cdot 2H_2O$	Trig.	1.565	1.560
$FeCl_2$	Hex.	1.567	.....
KH_2AsO_4	Tetr.	1.5674	1.5179
$Ca(OH)_2$	Hex.	1.574	1.545
$3MnO \cdot 4SiO_2 \cdot 4H_2O$	Hex.	1.576	1.546
$NH_4H_2AsO_4$	Tetr.	1.5766	1.5217
$C_{34}H_{50}O_2$ (Cholesterol benzoate)	.....	1.579	1.540
$NaH(UO_2)_2P_2O_8 \cdot 7.3H_2O$	.....	1.580 ±	.....
$3BeO \cdot Al_2O_3 \cdot 6SiO_2$	Hex.	1.580	1.574
$C_{11}H_{11}ON_2Br$ (4-Bromoantipyrine)	.....	1.581	1.493
$NaNO_3$	Trig.	1.5874	1.3361
$2NiO_2 \cdot 3SiO_2 \cdot 2H_2O$	Hex.	1.59 ±	1.56
$K_2CO_3 \cdot MgCO_3$	Hex.	1.597	1.47
$Cu(UO_2)_2P_2O_8 \cdot 8 \pm H_2O$	Tetr. (?)	1.598	1.586
$Ca(UO_2)_2P_2O_8 \cdot 7H_2O$	Tetr.	1.600	1.590
$6CaO \cdot Al_2O_3 \cdot 2P_2O_5 \cdot 5H_2O$	Hex. (?)	1.601	1.591
$Cu(UO_2)_2P_2O_8 \cdot 6H_2O$	Tetr. (?)	1.608	.....
$PtCl_2 \cdot 4NH_3 \cdot nH_2O$	Tetr.	1.612	1.607
$2CaO \cdot 2BeO \cdot 3SiO_2 \cdot NaF$	Tetr.	1.612	1.593
(Ce, La, Di) F_3	Hex.	1.613	1.607
$Ba(UO_2)_2P_2O_8 \cdot 6H_2O$	Tetr. (?)	1.613	1.604
$(NH_4)_4Fe(CN)_6 \cdot 2NH_4Cl \cdot 3H_2O$	Trig.	1.6198	1.5922
$7CaO \cdot 2P_2O_5 \cdot CO_2 \cdot 0.5H_2O$	Hex.	1.620 ±	1.609
$Sr_5F(PO_4)_3$	Hex.	1.621	1.619
$BaO \cdot FeO \cdot 4SiO_2$	Tetr.	1.621	1.619
$Na_2O \cdot 3CaO \cdot P_2O_5$[b]	Hex. (?)	1.623	1.620
$3UO_3 \cdot As_2O_5 \cdot 12H_2O$	Tetr. (?)	1.627	1.582
$8MnO \cdot 7SiO_2 \cdot 5H_2O$	.....	1.632	1.602
$Ca_5F(PO_4)_3$	Hex.	1.6325	1.629 ±
$C_6H_4(OH)_2$ (Hydroquinone)	Hex.	1.633	1.626
$10CaO \cdot 3P_2O_5$	Hex.	1.633	1.629
$3Ca_3P_2O_8 \cdot CaCO_3$	Hex.	1.635	1.626
$CaCuSi_4O_{10}$	Tetr.	1.6354	1.6053
$2KCl \cdot CuCl_2 \cdot 2H_2O$[c]	Tetr.	1.637	1.615
$CaO \cdot CaCl_2$	Hex.	1.638	1.634
$BaF_2 \cdot BaCl_2$	Tetr.	1.640	1.633

[a] Winchell gives this + with ϵ1.563 and ω1.552

[b] Found only in meteorites.

[c] Some specimens are orthorhombic and biaxial.

INDEX OF REFRACTION—UNIAXIAL NEGATIVE

Substance	System	ω_D	ϵ_D
$Al_2O_3 \cdot B_2O_3$	Hex.	1.640	.....
$Ca_5ClP_3O_{12}$	Hex.	1.642	1.637
$CuO \cdot 2UO_3 \cdot As_2O_5 \cdot 8H_2O$ (?)	Tetr.	1.643	1.623
$3Sr_3P_2O_8 \cdot SrCO_3$	Hex.	1.644	1.638
$Hg(CN)_2$	Tetr.	1.645	1.492
$C_6H_5CNBrCN$ (Bromobenzylcyanide)	.....	1.646	1.642
$2KCl \cdot CuCl_2$	Tetr.	1.647	1.612
$10MgO \cdot 6B_2O_3 \cdot 3H_2O$	.....	1.650	1.575
$SrCl_2 \cdot SrF_2$	Tetr.	1.651	1.627
$Fe_2O_3 \cdot P_2O_5 \cdot 6H_2O$	.....	1.655	1.645
$CaCO_3$[a] (Calcite)	Trig.	1.6585	1.4864
Al_2O_3	Hex.	1.67–8	1.63–5
$PtCl_2 \cdot 2NH_3 \cdot 4(PtCl_2 \cdot 4NH_3)$	Tetr.	1.666	1.658
$Ca_5ClP_3O_{12}$	Hex.	1.6668	1.666 ±
$BaF_2 \cdot 3Ba_3P_2O_8$	Hex.	1.669	1.665
$Ca_2Al_2SiO_7$	Tetr.	1.669	1.658
$(NH_4)_2CuCl_4 \cdot 2H_2O$	Tetr.	1.670	1.645
$Ca_2FeSi_2O_7$	Tetr.	1.670	1.658
$MgCl_2$	Hex.	1.675	1.59
$4(NH_4)_2S_2O_8 \cdot AgBr \cdot NH_4Br$	Tetr.	1.6769	1.6294
$V_2O_4 \cdot CaO \cdot P_2O_5 \cdot 5H_2O$[b]	Tetr.	1.680	1.655
$BaO \cdot 2CaO \cdot 3SiO_2$	Hex. (?)	1.681	1.668
$CaO \cdot MgO \cdot 2CO_2$	Trig.	1.681	1.500
$3Ba_3P_2O_8 \cdot BaCO_3$	Hex.	1.691	1.683
$AlClO \cdot 6CuO \cdot 9H_2O$	Trig.	1.694	1.641
$C_6H_{12}O_4N_2S_2$ (*l*-Cystine)	Hex.	1.700	1.640
$MgCO_3$	Trig.	1.700	1.509
$Ba_5ClP_3O_{12}$	Hex.	1.701	1.699
$12MnO \cdot 9SiO_2 \cdot As_2O_3 \cdot 7H_2O$	Hex. (?)	1.704	1.679
$9CaO \cdot 3As_2O_5 \cdot CaF_2$	Hex.	1.706	1.698
$Na_4Zr_2Si_3O_{12}$	Trig.	1.715	1.692
$C_6H_5COC_6H_4CH_3$ (Phenyl *p*-tolylketone)	.....	1.717	1.563
$MnO \cdot H_2O$	Trig.	1.723	1.681
Ca-Al-silicate[c]	.....	1.730	1.726
$LiNO_3$	Trig.	1.735	1.435
$CuCl_2 \cdot 2NH_4Cl \cdot 2H_2O$	Tetr.	1.744	1.724
$Ce_2O_3 \cdot 3CO_2 \cdot BaF_2$	Hex.	1.760	1.577
Al_2O_3	Trig.	1.768	1.760
$Fe_2(SO_4)_3$ (Stable >130°C.)	Rhomb.	1.770	1.760
$Na_2O \cdot 2Al_2O_3 \cdot Sb_2O_5$	Hex.	1.772	1.770
$BaAg_2Cs_3(NCS)_7$	Tetr.	1.7761	1.6788
$Cs_3Tl_2Cl_9$	Hex.	1.784	1.774
$K_2PtI_2(NO_2)_2 \cdot 2H_2O$	Tetr.	1.7909	1.6527
$7(Fe,Mg)O \cdot 3Fe_2O_3 \cdot 4SiO_2 \cdot 8H_2O$	Trig. (?)	1.80	.....
$Fe_2O_3 \cdot WO_3 \cdot 6H_2O$	Hex.	1.80	1.72
CHI_3 (Iodoform)	Hex.	1.800	1.750
$BaCu_2Cs_3(NCS)_7$	Tetr.	1.8013	1.6882
Ag_2HPO_4	Trig.	1.8036	1.7983
$2(Pb,Mg)O \cdot 3Fe_2O_3 \cdot 4SiO_2 \cdot 8H_2O$	Hex.	1.815	1.761
$3Fe_2O_3 \cdot 4SO_3 \cdot 9H_2O$	Rhomb.	1.816	1.728
$MnCO_3$	Trig.	1.817	1.597
$ZnCO_3$	Trig.	1.818	1.618
$K_2O \cdot 3Fe_2O_3 \cdot 4SO_3 \cdot 6H_2O$	Trig.	1.820	1.715
$NaYSiO_4$	Hex.	1.832	1.804
$Na_2O \cdot 3Fe_2O_3 \cdot 4SO_3 \cdot 6H_2O$	Trig.	1.832	1.750

[a] Most stable, low temp. phase.

[b] Alters to a biaxial hydrate.

[c] As found in Portland cement clinker.

INDEX OF REFRACTION—UNIAXIAL NEGATIVE

Substance	System	ω D	ϵ D
$CuO \cdot PbO \cdot Fe_2O_3 \cdot 2SO_3 \cdot 4H_2O$	Hex.	1.85	.....
$SrCu_2Cs_3(NCS)_7$	Tetr.	1.8535	1.6982
$CoCO_3$	Hex.	1.855	1.60
$NaLaSiO_4$	Hex.	1.867	1.840
$KLaSiO_4$	Hex.	1.867	1.840
$6CaO \cdot 4Fe_2O_3 \cdot 3As_2O_5 \cdot 9H_2O$ (?)*	.....	1.870	1.792
$6CaO \cdot 3Fe_2O_3 \cdot 2As_2O_5 \cdot 9H_2O$	Hex.	1.87	1.85
$LiLaSiO_4$	Hex.	1.870	1.843
$FeCO_3$	Trig.	1.875	1.633
$PbO \cdot 3Fe_2O_3 \cdot 4SO_3 \cdot 6H_2O$	Trig.	1.875	1.784
$CaLa_2Si_2O_8$	Hex.	1.880	1.874
$NaPrSiO_4$	Hex.	1.889	1.861
$NaNdSiO_4$	Hex.	1.889	1.861
$NaSmSiO_4$	Hex.	1.898	1.867
$Ag_2O \cdot 3Fe_2O_3 \cdot 4SO_3 \cdot 6H_2O$	Hex.	1.898	1.815
$CaNd_2Si_2O_8$	Hex.	1.903	1.897
$2PbO \cdot 3Fe_2O_3 \cdot P_2O_5 \cdot 2SO_3 \cdot 6H_2O$	Trig.	1.93	.....
$Pb_3(PO_4)_2$	Hex.	1.9702	1.9364
C (Graphite)	Trig.	2.0±	.....
$Pr_2(MoO_4)_3$	Tetr.	2.006±	.....
$3MnO \cdot As_2O_3$	Trig.	2.01	1.99
$Bi_2O_3 \cdot 3H_2O$ (?)	Hex.	2.01	1.82
$Nd_2(MoO_4)_3$	Tetr.	2.023	2.021
$5PbCl_2 \cdot 4CuO \cdot 6H_2O$	Tetr.	2.03	2.00
$Ce_2(MoO_4)_3$ (Stable >900°C.)	Tetr.	2.04	2.028
$4PbCl_2 \cdot 4CuO \cdot 5H_2O$	Tetr.	2.041	1.926
$9PbCl_2 \cdot 8CuO \cdot 3AgCl \cdot 9H_2O$	Tetr.	2.05	2.03
$3PbO \cdot 2SiO_2$	Trig.	2.07	2.05
$Pb_3(OH)_2(CO_3)_2$ (White lead pigment)	Hex.	2.09	1.94
$Bi_2O_3 \cdot CO_2$	.....	2.13	1.94
$H_2K_2TeI_2O_{10} \cdot 2H_2O$	Trig.	2.142	2.030
$9PbO \cdot 3As_2O_5 \cdot PbCl_2$	Hex.	2.16	2.13
PbO_2	Tetr.	2.229	.....
$2ZnO \cdot 2Mn_2O_3 \cdot H_2O$	Tetr.	2.26±	2.10
$PbO \cdot WO_3$	Tetr.	2.269	2.182
$9PbO \cdot 3As_2O_3 \cdot PbCl_2$	Hex.	2.295	2.285
$(Mg,Fe)O \cdot TiO_2$	Trig.	2.31	1.95
$ZnO \cdot Mn_2O_3$	Tetr.	2.34	2.14
$9PbO \cdot 3V_2O_5 \cdot PbCl_2$	Hex.	2.354	2.299
$PbO \cdot MoO_3$	Tetr.	2.40	2.28
Mn_3O_4	Tetr.	2.46Li	2.15Li
$MnO \cdot TiO_2$	Trig.	2.481	2.210
TiO_2	Tetr.	2.554	2.493
$CaO \cdot Fe_2O_3$	.....	2.58	2.43
AsI_3	Trig.	2.59±	2.23±
$AgAsS_2$ (Low temp. phase)	Trig.	2.6Li	.....
PbO	Tetr.	2.665	2.535
HgI_2	Tetr.	2.748	2.455
SbI_3 (Low temp. phase)	Trig.	2.78± Li	2.36± Li
$3Ag_2S \cdot As_2S_3$	Trig.	3.088	2.792
Fe_2O_3	Hex.	3.22	2.94

*Int. Crit. Tab. gives $3CaO \cdot 2Fe_2O_3 \cdot 2As_2O_5 \cdot 6H_2O$

INDEX OF REFRACTION

ANISOTROPIC GROUP—BIAXIAL

Biaxial crystals have three refractive indices, two lying in one plane and the third in another plane of the particle. These indices are indicated by α, β, γ for the least, intermediate and the greatest index respectively of the substance. If $\gamma-\beta>\beta-\alpha$ the crystal is optically positive; if the reverse is true, negative. The indices α, β, γ have directions of vibration X, Y, Z respectively.

The greater part of the substances of this group are chiefly orthorhombic, monoclinic or triclinic.

Arrangement. The substances are listed in the order of increasing values of the β index.

Abbreviations. Ax. pl., axial plane; *a*, front and rear crystal axis; *b*, right and left crystal axis; *c*, vertical crystal axis; Lg., large; Mon., monoclinic; Mod., moderate; Ortho., orthorhombic; *r*, red light; $r>v$ (or $r<v$) signifies that the optic axial angle in red light is greater than (or less than) the optic axial angle in violet light; Sm., small; Tric., triclinic; $2V$, the true axial angle between the optic axes; X, Y, and Z, the vibration directions of the fastest, the intermediate, and the slowest ray respectively; $\wedge$, angle, for example $Z \wedge c$ is the angle between Z and c; 100, 010, 110, etc., the Miller symbols of crystal faces and forms; $=$, to indicate parallel, for example $X=a$ signifies X parallel to a; $\perp$, perpendicular. In monoclinic crystals the extinction angle is commonly measured from the vertical axis c to X, Y, or Z; if this angle lies in the obtuse angle β it is considered positive (+), but if this angle is in the acute angle β between a and c, it is negative (−).

BIAXIAL POSITIVE SUBSTANCES

Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$NaF \cdot AlF_3$	Mon.	.....	1.339	.....	$2V=43°$ $r<v$	Ax. pl. $\perp 010$; $Z \wedge c=-43°54'$
$KF \cdot 2H_2O$	Mon.(?)	1.345±	1.352	1.363±	$2V$ = Lg.	.....
$KH_2Mg_2B_{11}O_{20} \cdot 6H_2O$(?)	Mon.	.....	1.354	.....	.....	Ax. pl. $\perp 010$; $Z \wedge c=64°45'$
$NaF \cdot CaF_2 \cdot AlF_3 \cdot H_2O$	Mon.	1.411	1.413	1.420	$2V=76°$ $r<v$ weak	$X=b$; $Z \wedge c=69°$
$NaH_2PO_3 \cdot 2.5H_2O$	Mon.	1.4193	1.4309	1.4493	$2V=77°38'$ $r<v$ weak	Ax. pl. 010; $Z \wedge c=-54°33'$
NH_4LiSO_4	Orth.	.....	1.437_{Li}	.....	$2V=37°\pm$	Ax. pl. 010; $Z=b$
$(Ca, K_2, Na_2)O \cdot Al_2O_3 \cdot 6SiO_2 \cdot 6H_2O$	Orth.	1.438	1.44	1.452	.....	.....

Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$Na_2O\cdot(NH_4)_2O\cdot P_2O_5\cdot 9H_2O$	Mon.(?)	1.439	1.441	1.469	$2V=36°$ $r>v$ strong	$Z=b$; $Y\wedge c=30°$
$NH_4NaHPO_4\cdot 4H_2O$	Mon.	1.439	1.442	1.469	$2V=35°34'$ $r>v$ strong	Ax. pl. nearly $\perp$ 010; Z nearly $\perp$ 001
$Na_2HPO_4\cdot 7H_2O$	Mon.	1.4412	1.4424	1.4526	$2V=38°50'$ $r>v$	Ax. pl. $\perp$010; $Z\wedge c=-72°$
$Na_2HPO_4\cdot 5H_2O$	Orth.		1.4434		$2V=44°7'$	Ax. pl. 001; $Z=a$
$Na_2CrO_4\cdot 4H_2O$	Mon.	1.321	1.447	1.561	.....	Ax. pl.*; $X\wedge$ elong. $=10°$
$5K_2O\cdot(NH_4)_2O\cdot 6SO_3$	.....	1.447	1.448	1.459	$2V=36°$ $r>v$ strong	.....
$NH_4B_5O_8\cdot 4H_2O$	Orth.	1.44	1.45±	1.485	$2V=32°$	Ax. pl. 010; $Z=b$
$Na_4P_2O_7\cdot 10H_2O$	Mon.	1.4499	1.4525	1.4604	$2V=60°29'$	Ax. pl. $\perp$010; Z $\perp$101
$Na_2SiO_3\cdot 5H_2O$	Tric.	1.447±	1.454±	1.467±	2V = Mod.	.....
$Na_2SiO_3\cdot 9H_2O$	Orth.	1.451	1.455+	1.460	$2V=90°\pm$	Ax. pl. 010; $Z=c$
$NaClO_4$	Orth.	1.4606	1.4617	1.4730	2V = Sm.	.....
$K_2SO_4\cdot MgSO_4\cdot 6H_2O$	Mon.	1.4607	1.4629	1.4755	$2V=47°54'$ $r>v$ weak	Ax. pl. 010; $Z\wedge c=103°38'$ $Z\wedge a=1°10'$
$Al_2O_3\cdot SO_3\cdot 9H_2O$	Mon	1.459	1.464	1.470	2V = Lg.	X = elong.
K_2ZrF_6	Mon.	1.454	1.465	1.498	$2V=60°$	Ax. pl. $\perp$010; $Z\wedge c=45°$
$Na_2HAsO_4\cdot 7H_2O$	Mon.	1.4622	1.4658	1.4782	$2V=57°7'$ $r>v$ weak	Ax. pl. $\perp$010; $Z\wedge c=-65°$
$NH_4NaHAsO_4\cdot 4H_2O$	Mon.	1.4649	1.4663	1.4791	$2V=38°$	Ax. pl. 010; $Z\wedge c=18°$
$K_2S_2O_8$	Tric.	1.4609	1.4669	1.5657	$2V=29°32'$	.....
$Rb_2Mg(SO_4)_2\cdot 6H_2O$	Mon.	1.4672	1.4689	1.4779	$2V=48°46'$ $r>v$	Ax. pl. 010; $Z\wedge c=-68°46'$; $Z\wedge a=5°15'$
SiO_2 (Tridymite)**	Orth.	1.469	1.469	1.473	$2V=35°$	Ax. pl. 100 below 117°C.
$Na_2CO_3\cdot 2Na_2SO_4$	Orth.	1.463	1.469	1.480	2V = Mod.	Ax. pl. 001; $X=a$
$MgCO_3\cdot 5H_2O$	Mon.	1.457	1.470	1.508	$2V=60°37'$	Ax. pl. $\perp$010; $Z\wedge c=$ Sm.
$RbClO_4$	Orth.	1.4692	1.4701	1.4731	$2V=55°4'$ $r>v$ weak	Ax. pl. 100; $Z=b$

*010 for $\lambda<645m\mu$; $\perp$010 for $\lambda>645m\mu$; uniaxial + for $\lambda=645m\mu$.
**Stable between 870° and 1470°C.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$Na_2SiO_3 \cdot 6H_2O$	Mon.	1.465	1.473	1.485	$2V = 75° \pm$	Ax. pl. $\perp 010$; $Z \perp 010$; $X \wedge c = 22°$
$RbHSO_4$	Orth.	.....	1.473	.....	$2V = 55°52'$ $r < v$ weak	Ax. pl. 010; $X = c$
NH_4HSO_4	Orth.	1.463	1.473	1.510	$2V = 60° \pm$	Ax. pl. 010; $Z = c$
$(NH_4)_2SO_4 \cdot MgSO_4 \cdot 6H_2O$	Mon.	1.4716	1.4730	1.4786	$2V = 51°11'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 94°58'$; $Z \wedge a = 12°8'$
$KClO_4$	Orth.	1.4731	1.4737	1.4769	$2V = 49°48'$ $r > v$	Ax. pl. 100; $Z = b$
$KCl \cdot MgCl_2 \cdot 6H_2O$	Orth.	1.467	1.474	1.496	$2V = 70°$ $r < v$	$Z = a$; $X = c$
$Al_2(SO_4)_3 \cdot 16H_2O$*	Mon.	1.474	1.476	1.483	$2V = 69°$	$X = b$; $Z \wedge c = 42°$
Na_2SO_4	Orth.	1.471	1.477	1.484	$2V = 83°35'$ $r > v$ weak	Ax. pl. 001; $Z = a$; $X = b$; $Y = c$
$FeSO_4 \cdot 7H_2O$	Mon.	1.4713	1.4782	1.4856	$2V = 85°27'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -62°28'$; $Y = b$
$(Zn, Fe)SO_4 \cdot 7H_2O$**	Orth. (?)	1.4709	1.4785	1.4867	$2V = 78°48'$	.....
$K_2Si_4O_9$	Mon. (?)	1.477	1.479	1.482	$2V =$ Lg.	.....
$(Fe, Cu)SO_4 \cdot 7H_2O$	Mon.	1.472	1.479	1.487	$2V =$ Lg. weak	Ax. pl. 010; $X \wedge c = 22°$; $Y = b$
$CuSO_4 \cdot 7H_2O$ (Unstable)	Mon.	1.47	1.48	1.49	.....	Ax. pl. 010; Z near a; $Y = b$; X near c
$5MgO \cdot Al_2O_3 \cdot 6SiO_2 \cdot 4H_2O$	.....	1.480	1.48 [a]	1.507	$2V =$ Sm.	$Z =$ elong.
$KHSO_4$	Mon. (?)	1.475	1.480	1.487	$2V =$ Lg.	$Z \wedge$ elong. $= 33°$
$Rb_2SO_4 \cdot MnSO_4 \cdot 6H_2O$	Mon.	1.4767	1.4807	1.4907	$2V = 67°5'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -73°3'$
$K_2Fe(SO_4)_2 \cdot 6H_2O$	Mon.	1.4759	1.4821	1.4969	$2V = 67°7'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 101°57'$; $Z \wedge a = 2°35'$
$Na_4P_2O_6 \cdot 10H_2O$	Mon.	1.4777	1.4822	1.5036	$2V = 48°56'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -39°30'$
NH_4ClO_4	Orth.	1.4818	1.4833	1.4881	$2V = 69°54'$ $r > v$	Ax. pl. 001; $Z = b$

*Int. Crit. Tab. gives $18H_2O$.
**Zn:Fe 2:1

[a] Int. Crit. Tab. gives β 1.52.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$K_2SO_4 \cdot ZnSO_4 \cdot 6H_2O$	Mon.	1.4775	1.4833	1.4969	$2V = 68°14'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 100°18'$; $Z \wedge a = 4°30'$
$(NH_4)_2Mn(SO_4)_2 \cdot 6H_2O$	Mon.	1.4801	1.4840	1.4913	$2V = 69°49'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 97°47'$
$Rb_2Cd(SO_4)_2 \cdot 6H_2O$	Mon.	1.4798	1.4848	1.4948	$2V = 72°26'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 105°53'$; $Z \wedge a = 0°0'$
$Cs_2Mg(SO_4)_2 \cdot 6H_2O$	Mon.	1.4857	1.4858	1.4916	$2V = 16°25'$	Ax. pl. 010; $Z \wedge c = -43°17'$
$K_2SO_4 \cdot CuSO_4 \cdot 6H_2O$	Mon.	1.4836	1.4864	1.5020	$2V = 46°32'$ $r < v$	Ax. pl. 010; $Z \wedge c = -71°27'$ $Y = b$; $X \wedge c = 19°$
$K_2SO_4 \cdot CoSO_4 \cdot 6H_2O$	Mon.	1.4807	1.4865	1.5004	$2V = 68°41'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 100°5'$; $Z \wedge a = 4°50'$
$Rb_2Fe(SO_4)_2 \cdot 6H_2O$	Mon.	1.4815	1.4874	1.4977	$2V = 73°21'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -72°51'$
$NaAl(SO_4)_2 \cdot 6H_2O$	Mon. (?)	1.484	1.488	1.499	$2V = 60°$	Ax. pl. and $Z \perp 010$; $Y \wedge c = 30° \pm$
$Rb_2Zn(SO_4)_2 \cdot 6H_2O$	Mon.	1.4833	1.4884	1.4975	$2V = 73°33'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -73°17'$
$(NH_4)_2Cd(SO_4)_2 \cdot 6H_2O$	Mon.	1.4847	1.4887	1.4959	$2V = 72°51'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 101°27'$
$Rb_2S_2O_8$	Mon.	1.4812	1.4888	1.5719	$2V = 35°4'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 26°30'$
$Na_2H_2P_2O_6 \cdot 6H_2O$	Mon.	1.4855	1.4897	1.5041	$2V = 57°20'$	Ax. pl. 010; $Z \wedge c = 35°17'$
$AlF_3 \cdot H_2O$	Orth.	1.473	1.490	1.511	$2V = 85°$ $r < v$ strong	$Y = a$; $Z = c$
$Rb_2Cu(SO_4)_2 \cdot 6H_2O$	Mon.	1.4886	1.4906	1.5036	$2V = 44°42'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -63°32'$
$MgSO_4 \cdot 4H_2O$	Mon.	1.490	1.491	1.497	$2V = 50°$ $r > v$	Ax. pl. and $Z \perp 010$; $X \wedge c = 81°$
$(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$	Mon.	1.4870	1.4915	1.4989	$2V = 76°52'$ $r > v$ weak	Ax. pl. 010; $X \wedge c = 98°42'$
$K_2Ni(SO_4)_2 \cdot 6H_2O$	Mon.	1.4836	1.4916	1.5051	$2V = 75°16'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 98°42'$ $Z \wedge a = 6°18'$

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$Rb_2Co(SO_4)_2 \cdot 6H_2O$	Mon.	1.4859	1.4916	1.5014	$2V = 75°11'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 106°1'$; $Z \wedge a = 0°$
$NaKC_4H_4O_6 \cdot 4H_2O$	Orth.	1.492	1.493	1.496	$2V = 69°40'$	Ax. pl. 010; $Z = a$
$(NH_4)_2Zn(SO_4)_2 \cdot 6H_2O$	Mon.	1.4888	1.4930	1.4994	$2V = 79°$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 96°59'$ $Z \wedge a = 9°53'$
K_2SO_4	Orth.	1.4935	1.4947	1.4973	$2V = 67°20'$ $r > v$ weak	Ax. pl. 100; $Z = c$; $X = b$
NH_4PO_3	Mon.	1.490	1.495	1.505	$2V =$ Lg.	.....
$Na_2S_2O_6 \cdot 2H_2O$	Orth.	1.4820	1.4953	1.5185	$2V = 75°14'$ $r < v$ strong	Ax. pl. 010; $Z = a$
$(NH_4)_2Co(SO_4)_2 \cdot 6H_2O$	Mon.	1.4902	1.4953	1.5032	$2V = 82°9'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 96°19'$
$Co_3Sm_2(NO_3)_{12} \cdot 24H_2O$	.....	1.495	1.496	1.504	.....	.....
$Rb_2Ni(SO_4)_2 \cdot 6H_2O$	Mon.	1.4895	1.4961	1.5052	$2V = 82°0'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 102°38'$; $Z \wedge a = 3°25'$
$Cs_2Mn(SO_4)_2 \cdot 6H_2O$	Mon.	1.4946	1.4966	1.5025	$2V = 59°57'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -64°33'$
$UO_2(NO_3)_2 \cdot 6H_2O$	Orth.	.....	1.4967	1.555(?)	$2V = 44°$ $r < v$ weak	Ax. pl. 010; $Z = c$
$CaO \cdot Al_2O_3 \cdot 6SiO_2 \cdot 5H_2O$	Mon.	1.498	1.499	1.505	$2V = 34° \pm$ $r > v$	$Z = b$; $Y \wedge c = 6° \pm$
$K_2Mg(SeO_4)_2 \cdot 6H_2O$	Mon.	1.4969	1.4991	1.5139	$2V = 39°38'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 101°18'$; $Z \wedge a = 3°0'$
$KCl \cdot MgCl_2 \cdot 6H_2O$	Orth.	.....	1.4992	.....	$2V = 69°51'$	Ax. pl. 010; $Z = c$
$K_2Si_2O_5 \cdot H_2O$	.....	.....	1.50±	.....	$2V =$ Sm.	.....
$K_2SiO_3 \cdot H_2O$	.....	.....	1.50±	.....	$2V =$ Sm.	.....
$2K_2SiO_3 \cdot H_2O$	Orth.(?)	.....	1.50±	.....	$2V =$ Lg.	.....
$CaSO_4$*	Mon.(?)	1.50	1.50	1.56	.....	.....
$Zn(C_2H_5CO_2)_2$ (Propionate)	Mon.	1.480	1.500	1.530	.....	.....
$Cs_2Cd(SO_4)_2 \cdot 6H_2O$	Mon.	1.4975	1.5000	1.5062	$2V = 67°53'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -63°4'$; $Z \wedge a = 9°45'$

*High temp. phase.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$(NH_4)_2Ni(SO_4)_2 \cdot 6H_2O$	Mon.	1.4949	1.5007	1.5081	$2V = 86°33'$ $r < v$ weak	Ax. pl 010; $Z \wedge c = 95°12'$
$(NH_4)_2S_2O_8$	Mon.	1.4981	1.5016	1.5866	$2V = 24°$ $r < v$ mod.	Ax. pl. 010; $Z \wedge c = 26°45'$
NH_4MgPO_4	Orth.	.....	1.502	.....	.....	Ax. pl. 001; $Z = b$
$Na_2H_2AsO_4 \cdot 2H_2O$	Orth.	1.4794	1.5021	1.5265	$2V = 88°50'$ $r < v$ weak	Ax. pl. 010; $Z = c$
$2CaO \cdot UO_2 \cdot 4CO_2 \cdot 10H_2O$	Orth.	1.499	1.503	1.538	$2V = 42°$ $r > v$	$X = a$
$CaF_2 \cdot 2Al(F,OH)_3 \cdot H_2O$	Mon.	1.501	1.503	1.510	$2V = 63°$ $r > v$ strong	$Y = b$; $Z \wedge c = -50°$
$Rb_2Mg(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5011	1.5031	1.5135	$2V = 47°3'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -73°36'$; $Z \wedge a = 1°10'$
$Cs_2Fe(SO_4)_2 \cdot 6H_2O$	Mon.	1.5003	1.5035	1.5094	$2V = 74°51'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -61°43'$; $Z \wedge a = 11°25'$
$Na_2O \cdot 2CaO \cdot 5B_2O_3 \cdot 16H_2O$	Mon.	1.491	1.504	1.520	$2V =$ Mod.	$X = b$
$Cs_2Zn(SO_4)_2 \cdot 6H_2O$	Mon.	1.5022	1.5048	1.5093	$2V = 74°11'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -59°44'$; $Z \wedge a = 13°15'$
$Na_2O \cdot 2CaO \cdot 3Al_2O_3 \cdot 9SiO_2 \cdot 8H_2O$	Mon.	1.505	1.505	1.506	$2V = 86°$ $r > v$ strong	$Y = b$; Z near c
$(NH_4)_2ZnCl_4$	Orth.	.....	1.5055	.....	$2V = 53°48'$ $r > v$ weak	Ax. pl. 001; $Z = a$
$Cs_2Cu(SO_4)_2 \cdot 6H_2O$	Mon.	1.5048	1.5061	1.5153	$2V = 43°24'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = -47°3'$; $Z \wedge a = 26°47'$
$CaC_8H_{10}O_{10} \cdot 6H_2O$ (Acid malate)	Orth.	1.493	1.507	1.545	.....	Ax. pl. 100; $Z = c$
$MgCl_2 \cdot 6H_2O$	Mon.	1.494	1.507	1.528	$2V = 79°$ $r > v$	$X = b$; $Y = 9.5°$
$Na_2S_2O_3 \cdot 5H_2O$	Mon.	1.4886	1.5079	1.5360	$2V = 80°46'$ $r < v$	Ax. pl. and $Z \perp 010$; $X \wedge c = -41°30'$
$2Na_2O \cdot Al_2O_3 \cdot 6SiO_2 \cdot H_2O$	Tric.	1.504	1.508	1.545	$2V = 39°$	$Z = c$ (?)

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$KAlSi_2O_6$ (β-phase)	Orth. (?)	1.508	1.508	1.509	$2V = Sm.$	.....
$Cs_2Co(SO_4)_2 \cdot 6H_2O$	Mon.	1.5057	1.5085	1.5132	$2V = 81°34'$	Ax. pl. 010; $Z \wedge c = -63°52'$; $Z \wedge a = 9°0'$
$K_2Cd(SO_4)_2 \cdot 1.5H_2O$	Mon.	.....	1.509_{Li}	.....	$2V = 64°$	Ax. pl. and $Z \perp 010$; $X \wedge c = -69°15'$
$(NH_4)_2Mg(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5070	1.5093	1.5169	$2V = 54°47'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 90°13'$; $Z \wedge a = 16°14'$
$Na_2CO_3 \cdot CaCO_3 \cdot 2H_2O$	Orth.	1.5043	1.5093	1.5751	$2V = 31°26'$	Ax. pl. 001; $Z = b$; $X = a$
$3Na_2O \cdot 2SiO_2 \cdot 11H_2O$ (?)	Orth.	1.504	1.510	1.524	$2V = 65° \pm$	Ax. pl. 010; $X = a$
$Li_2O \cdot Al_2O_3 \cdot 8SiO_2$	Mon.	1.504	1.510	1.516	$2V = 83°34'$ $r > v$	Ax. pl. and $Z \perp 010$; $X \wedge a = -5° \pm$; $Z = b$
$3MgO \cdot 2SiO_2 \cdot 2H_2O$	Orth.	1.508	1.512	1.522	$2V = Lg.$	$Z = c$; $X = b$
$K_2Mn(SO_4)_2 \cdot 1.5H_2O$	Mon.	.....	1.512	.....	$2V = 61°48'$ $r < v$	Ax. pl. $\perp 010$; $X \wedge c = 100°$
$Cs_2Ni(SO_4)_2 \cdot 6H_2O$	Mon.	1.5087	1.5129	1.5162	$2V = 87°21'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = -65°53'$
Rb_2SO_4	Orth.	1.5131	1.5133	1.5144	$2V = 33°0'$	Ax. pl.* 001 $< 50°C.$; $Z = a$
$Ca(HCO_2)_2$	Orth.	1.510	1.514	1.578	$2V = 26°47'$	Ax. pl. 010; $Z = a$
$Rb_2Mn(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5094	1.5140	1.5258	$2V = 66°2'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 103°7'$
$Th(SO_4)_2 \cdot 8H_2O$	Mon.	.....	1.5168	.....	$2V = 76°20'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 65°$
$Cs_2Mg(SeO_4)_2 \cdot 6H_2O$**	Mon.	1.5178	1.5179	1.5236	$2V = 18°35'$	Ax. pl. 010; $Z \wedge c = -53°13'$; $Z \wedge a = 20°30'$
$2CaO \cdot P_2O_5 \cdot H_2O$[a]	Trlc.	1.600	1.614	1.631	$2V = Lg.$	$r > v$ weak .....
$2MgO \cdot P_2O_5 \cdot 8H_2O$	Orth.	1.514	1.518	1.533	$2V = 45°$ $r < v$	$X = a$; $Z = c$
$2Al_2O_3 \cdot SO_3 \cdot 10H_2O$	Orth.	1.516	1.518	1.533	$2V = 48°$ $r > v$	$Z = c$; $X =$ elong.

*010 > 50°C.
**Uniaxial at 78°C. for Na light.

[a] Int. Crit. Tab. gives α1.515; β1.518; γ1.525.

Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$K_2Zn(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5121	1.5181	1.5335	$2V = 66°15'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 99°9'$; $Z \wedge a = 5°3'$
$K_2Fe(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5095	1.5182	1.5345	$2V = 64°18'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 100°27'$
$Rb_2Cu(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5153	1.5183	1.5318	$2V = 53°11'$	Ax. pl. 010; $Z \wedge c = -66°55'$
$K_2Co(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5135	1.5195	1.5358	.....	Int. Crit. Tab. gives these values.
$MgHPO_4 \cdot 3H_2O$	Orth.	.....	1.5196	.....	$2V = 44°47'$	Ax. pl. 010; $Z = c$
$5MgO \cdot Al_2O_3 \cdot 6SiO_2 \cdot 4H_2O$	.....	1.480	1.48*	1.507	$2V = Sm.$	$Z =$ elong.
$RbNO_3$	Orth.	1.51	1.52	1.524	$2V = Sm.$ $r > v$	Ax. pl. 010; $Z = c$
$Sr_2Cu(HCO_2)_4 \cdot 8H_2O$	Tric.	1.500	1.520	1.580	$2V = 72°4'$	.....
$3MgO \cdot P_2O_5 \cdot 8H_2O$	Mon.	1.510	1.520	1.543	$2V = 71°$ $r < v$ weak	$Y = b$; $Z \wedge c = 29°$
$Rb_2Fe(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5133	1.5200	1.5328	$2V = 73°32'$ $r > v$ weak	Ax. pl. 001; $Z \wedge c = 103°37'$
$(NH_4)_2Mn(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5160	1.5202	1.5288	$2V = 70°23'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 93°22'$
K_2SiO_3	.....	1.520	1.521 ±	1.528	$2V = 35° \pm$	$r < v$
$K_2Co(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5158	1.5218	1.5380	$2V = 62°19'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 98°54'$
$Rb_2Zn(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5162	1.5222	1.5331	$2V = 75°8'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 103°13'$; $Z \wedge a = 2°3'$
$CaSO_4 \cdot 2H_2O$	Mon.	1.5205	1.5226	1.5296	$2V = 58°5'$ $r > v$	Ax. pl. 010; $Z \wedge c = 52°30'$; $Y = b$
$(NH_4)_2SO_4$	Orth.	1.5209	1.5230	1.5330	$2V = 52°12'$ $r > v$ weak	Ax. pl. 010; $Z = a$; $X = c$
$K_3Cr(CN)_6$	Mon.	1.5221	1.5244	1.5373	$2V = 46°$	Ax. pl. 010; $Z \wedge c = 0° \pm$
$Ca(meso\text{-}C_4H_4O_6) \cdot 3H_2O$**	.....	1.470	1.525	1.555	.....	Ax. pl. 010
$Na_6Si_2O_7$	.....	1.524	1.525	1.529	.....	.....
$2Na_2O \cdot Fe_2O_3 \cdot 4SO_3 \cdot 7H_2O$	Orth.	1.508	1.525	1.586	$2V = 58°$ $r > v$ strong	$Z = c$; $Y = b$

*Int. Crit. Tab. gives 1.52.
**Stated to be +; indices indicate negative.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$NaCaB_5O_9 \cdot 5H_2O$	Mon.	1.515	1.525	1.544	$2V = 73°$ $r > v$	Ax. pl. 010; $Z \wedge c = -12°$; $Y = b$
$Rb_2Co(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5199	1.5256	1.5369	$2V = 73°37'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 102°50'$
$K_2O \cdot 4MgO \cdot 11B_2O_3 \cdot 18H_2O$	Mon.	1.508	1.526	1.550	$2V = 81°$	$Y = b$; $Z \wedge c = 65°$
$NaHSO_3$	.....	1.474	1.526	1.685±	$2V = 65° \pm$	.....
$(NH_4)_2Cd(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5206	1.5260	1.5352	$2V = 76°31'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 96°0'$
$K_2UO_2(SO_4)_2 \cdot 2H_2O$	Orth.	1.5144	1.5266	1.5705	$2V = 60°$	Ax. pl. 100; $X = c$
$4MgO \cdot 3CO_2 \cdot 4H_2O$*	Mon.	1.523	1.527	1.545	2V = Med.	$Z = b$; $Y \wedge c = 43°$
$K_2Ni(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5181	1.5272	1.5427	$2V = 72°48'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 96°59'$
$Cs_2Mn(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5250	1.5279	1.5338	$2V = 68°49'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -67°49'$
$(NH_4)_2Fe(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5216	1.5280	1.5381	$2V = 77°44'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 95°24'$
$Na_2O \cdot Al_2O_3 \cdot 6SiO_2$	Tric.	1.525	1.529	1.536	$2V = 74°$	$r < v$ weak
$LiNH_4(dl\text{-}C_4H_4O_6) \cdot H_2O$	Mon.	.....	1.529	.....	$2V = 81°42'$	Ax. pl. 010; $Z \wedge c = 76°30'$
$2MgO \cdot Fe_2O_3 \cdot 4SO_3 \cdot 15H_2O$	Mon.	1.522	1.529	1.577	$2V = 41°$ $r > v$	$X = b$; $Z \wedge c = -12°$
$Rb_2Ni(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5198	1.5291	1.5390	$2V = 82°13'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 99°59'$
$Na_4Fe(CN)_6 \cdot 12H_2O$	Mon.	1.5193	1.5295	1.5436	$2V = 81°25'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 74°$; $Y > X > Z$
$Cs_2Cu(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5282	1.5298	1.5394	$2V = 48°26'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = -52°48'$
$2CaO \cdot As_2O_5 \cdot 8H_2O$	Tric.	1.525	1.53	1.550	$r < v$	$Z\ ca.\ b$; Ax. pl. $\wedge c = 69°30'$
$4MgO \cdot 3CO_2 \cdot 4H_2O$**	Mon.	1.527	1.530	1.540	2V = Med.	$Z = b$; $Y \wedge c = 43°$
$Ca_3C_{12}H_{10}O_{14} \cdot 4H_2O$ (citrate)	.....	1.515	1.530	1.580	.....	.....
Na_4SiO_4 (High temp. phase)	.....	1.524	1.530	1.537	.....	.....
$KHSi_2O_5$	Orth.	1.495	1.530	1.535	$2V = 40° \pm$	Ax. pl. 001; $Z = a$

*Int. Crit. Tab. gives α1.527; β1.530; γ1.540 and orth.
**Indices also given as α1.523; β1.527; γ1.545.

Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$(NH_4)_2Zn(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5240	1.5300	1.5385	$2V = 82°7'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 93°24'$; $Z \wedge a = 12°50'$
$MgO \cdot Fe_2O_3 \cdot 3SO_3 \cdot 13H_2O$	Mon.	1.527	1.532	1.583	.....	.....
$BaS_2O_6 \cdot 4H_2O$	Mon.	.....	1.532	.....	$2V = 87°$	Ax. pl. $\perp 010$ nearly 201; $Z = b$; $X \wedge c = -45°$
$(NH_4)_2Co(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5261	1.5327	1.5417	$2V = 82°14'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = 92°23'$
$Na_6Be_6Si_{14}O_{37}$	Orth.	1.532	1.533	1.545	$2V = 38°$	.....
$BaCd(HCO_2)_4 \cdot 2H_2O$	Mon.	.....	1.533	.....	$2V = 67°36'$	Ax. pl. $\perp 010$; $Z \wedge c = -46°23'$
$MgCl_2 \cdot 2CdCl_2 \cdot 12H_2O$	Orth.	1.49±	1.5331	1.5769	$2V = Lg.$ $r < v$ weak	Ax. pl. 100; $Z = c$
$CaO \cdot MgO \cdot 3B_2O_3 \cdot 6H_2O$	Mon.	1.523	1.534	1.570	$2V = Lg.$ $r < v$	$Y = b$; $X \wedge c = 33°$
$Ca_3C_{12}H_6O_{12}$ (aconitate)	.....	1.515	1.535	1.575	.....	.....
$Ca(d\text{-}C_4H_4O_6) \cdot 4H_2O$ (?)	Orth.	1.525	1.535 (?)	1.550	.....	.....
$KBr \cdot MgBr_2 \cdot 6H_2O$	Orth.	.....	1.535	.....	$2V = 87°$	Ax. pl. 001; $Z = b$
$MgSO_4 \cdot H_2O$	Mon.	1.523	1.535	1.586	$2V = 57°$ $r > v$	Ax. pl. 010; $Z \wedge c = 76°25'$
$Cs_2Fe(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5306	1.5352	1.5414	$2V = 82°47'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 68°56'$
$Cs_2Zn(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5326	1.5362	1.5412	$2V = 83°6'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -68°3'$; $Z \wedge a = 5°46'$
$(NH_4)_2Ni(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5285	1.5370	1.5460	$2V = 86°21'$ $r < v$ weak	Ax. pl. 100; $Z \wedge c = 92°0'$
$3NH_4Cl \cdot ZnCl_2$	Orth.	.....	1.538	.....	$2V = 46°10'$ $r > v$ weak	Ax. pl. 001; $Z = a$
K_2SeO_4	Orth.	1.5352	1.5390	1.5446	$2V = 76°53'$ $r < v$	Ax. pl. 100; $Z = c$
$Cs_2Co(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5354	1.5399	1.5453	$2V = 86°48'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -70°37'$
CaS_4O_6	.....	1.535±	1.540±	1.675±	$2V = 32°\pm$	.....

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$Na_2O \cdot 2BeO \cdot 6SiO_2 \cdot H_2O$	Orth.	1.544	1.544	1.546	$2V = 23°$ $r > v$	$Z = b$; $Y = c$
$2CaO \cdot P_2O_5 \cdot 5H_2O$	Mon.	1.539	1.545	1.551	$2V = 86°$	$Z = b$
$Na_2O \cdot 2BeO \cdot 6SiO_2 \cdot H_2O$	Mon.	1.545	1.546	1.551	$2V = 30°$ $r > v$	$Y = b$; $Z \wedge c = -58°30'$
$2Fe_2O_3 \cdot 5SO_3 \cdot 17(?)\, H_2O$*	Orth.	1.531	1.546	1.597	$2V = 52°$	Ax. pl. 010; $X = c$
$(Nd,Pr)_2(SO_4)_3 \cdot 8H_2O$	Mon.	1.5392	1.5479	1.5592	$2V = 84°10'$	$Z = b$
$Y_2(SO_4)_3 \cdot 8H_2O$	Mon.	1.5433	1.5490	1.5755	$2V = 50°43'$ $r < v$	Ax. pl. $\perp 010$; X *ca.* $\perp 001$
$Pr_2(SO_4)_3 \cdot 8H_2O$	Mon.	1.5399	1.5494	1.5607	$2V = 85°27'$	Ax. pl. $\perp 010$; $Z = b$; X *ca.* $\perp 001$
$H_2Al_2Si_4O_{12}$	Mon. (?)	1.533	1.55	1.585	.....	.....
$Al_2O_3 \cdot 3H_2O$**	.....	.....	1.55	.....	.....	.....
$Li_2Si_2O_5$	Orth.	1.547	1.550	1.558	$2V = 55° \pm$	.....
$Nd_2(SO_4)_3 \cdot 8H_2O$	Mon.	1.5413	1.5505	1.5621	$2V = 83°57'$	Ax. pl. $\perp 010$; $Z = b$; X *ca.* $\perp 001$
$K_3Rh(CN)_6$	Mon.	1.5498	1.5513	1.5634	$2V = 39°1'$	Ax. pl. 010; $Z \wedge c = 0°$
$Sm_2(SO_4)_3 \cdot 8H_2O$	Mon.	1.5427	1.5519	1.5629	$2V = 85°56'$ $r > v$ weak	Ax. pl. $\perp 010$; $Z = b$; X *ca.* $\perp 001$
$Na_2WO_4 \cdot 2H_2O$	Orth.	1.5526	1.5533	1.5695 ±	$2V = 25°$	Ax. pl. 100; $X = b$
Rb_2SeO_4	Orth.	1.5515	1.5537	1.5582	$2V = 68°53'$ $r > v$ weak	Ax. pl. 100; $Z = c$
$K_3Mn(CN)_6$	Mon.	1.5527	1.5547	1.5710	$2V = 42°53'$	Ax. pl. 010; $Z \wedge c = 0° \pm$
$CaC_4H_4O_3 \cdot 3H_2O$ (Malate)	Orth.	1.545	1.555	1.575	.....	Ax. pl. 010; $Z = a$
$CaC_2O_4 \cdot H_2O$	Mon.	1.491	1.555	1.650	[a] $2V = 84°$	[a] $X = b$; $Z \wedge c = 31°$
$FeO \cdot Al_2O_3 \cdot P_2O_5 \cdot 6H_2O$	Tric.	1.551	1.555	1.562	$2V = 32°$ $r > v$ mod.	Z emerges on 010
$Fe_2O_3 \cdot 4SO_3 \cdot 9H_2O$	Orth.	1.533	1.555	1.635	$2V = Sm.$	Ax. pl. 100; $X = c$; $Z = b$
$FeO \cdot Al_2O_3 \cdot P_2O_5 \cdot 5H_2O$ [b]	Tric.	1.554	1.558	1.573	$2V = Mod.$	.....
$Al_2O_3 \cdot P_2O_5 \cdot 4H_2O$	Orth.	1.551	1.558	1.582	$2V = 55°$	$r < v$ slight; $X = c$
$CaS_2O_3 \cdot 6H_2O$	Mon. (?)	1.545 ±	1.560 ±	1.605 ±	$2V = 60° \pm$	.....
$Li_2S_2O_6 \cdot 2H_2O$	Orth.	1.5487	1.5602	1.5788	$2V = 78°16'$	Ax. pl. 001; $Z = a$

*Int. Crit. Tab. gives $18H_2O$.
**Pptd. from aq. soln. and dried with alcohol and ether.

[a] Int. Crit. Tab. gives $2V = 89°$; Ax. pl. 010; $Z \wedge c = -64°15'$.
[b] Int. Crit. Tab. gives $11H_2O$.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$(NH_4)_2SeO_4$*	Mon.	1.5607	1.5630	1.5846	2V = 37°54′ r < v weak	Ax. pl. ⊥010; Z ∧ c = 13°11′
$2KNO_2 \cdot Cd(NO_2)_2$	Orth.	1.556	1.565	1.608	2V = 48°	Ax. pl. 100; Z = c
$Na_2O \cdot ZrO_2 \cdot 6SiO_2 \cdot 3H_2O$	Orth.	1.560	1.565	1.574	2V = 75° r < v	X = c; Z = a
$Al_2O_3 \cdot 3H_2O$	Mon.	1.566	1.566	1.587	2V = Sm.	Z ∧ c = −25° ±
$LiNH_4(d\text{-}C_4H_4O_6) \cdot H_2O$	Orth.	.....	1.567	.....	2V = 87°6′	.....
$NaC_6H_4(NH_2)SO_3 \cdot 2H_2O$ (Sulfanilate)	Orth.	1.536	1.567	1.649	2V = 65°24′	Ax. pl. 010; Z = c
$HOC_6H_4SO_3K \cdot 2H_2O$ (o-Phenolsulfonate)	Orth.	1.527	1.568	1.647	.....	.....
$4CaO \cdot P_2O_5 \cdot 5H_2O$	Mon.	1.565	1.568	1.580	2V = Med.	X = b; Z ∧ c = Sm.
$K_3Fe(CN)_6$	Mon.	1.5660	1.5689	1.5831	2V = 49°10′	Ax. pl. 010; Z ∧ c = 3°53′
$NiCl_2 \cdot 6H_2O$	Mon.	1.535	1.57 ±	1.61	2V = Lg.	Ax. pl. 010; X ∧ c = 8° ±
$(NH_4)_2UO_2(NO_3)_4 \cdot 2H_2O$	Mon.	1.508	1.57 ±	1.639	.....	Ax. pl. and Z ⊥ 010
$Na_2Ca_3Si_6O_{15}$	Orth.	1.564	1.570	1.579	2V = 75°	.....
$3MgO \cdot P_2O_5 \cdot MgF_2$	Mon.	1.569	1.570	1.582	2V = 26° ± r > v	Z ∧ c = 21°30′; Y = b
$3MgO \cdot As_2O_5 \cdot 8H_2O$	Mon.	1.563	1.571	1.596	2V = 60°	X = b; Z ∧ c = 31° ±
$Sr(HCO_2)_2$	Orth.	1.559	1.574	1.598	2V = 74°14′	Ax. pl. 100; Z = b
$MnCl_2 \cdot 4H_2O$**	Mon.	1.555	1.575	1.607 ±	2V = 78° ±	r < v moderate
$2Al_2O_3 \cdot P_2O_5 \cdot 3H_2O$	Mon.	1.574	1.576	1.588	2V = 51°	Y = b; Z ∧ c = −34°
$CaSO_4$[a]	Orth.	1.571	1.576	1.614	2V = 42°	Ax. pl. 010; Z = a
$Ba(ClO_3)_2 \cdot H_2O$	Mon.	1.562	1.577	1.635	2V = 55°30′ r < v weak	Ax. pl. 010; Z ∧ c = −23°45′
$CuSO_4 \cdot 3H_2O$	Mon.	1.554	1.577	1.618	2V = 75°	.....
$K_2Ca_3Si_6O_{16}$[b]	Orth.	1.575	1.58 ±	1.59	2V = Lg.	.....
$Ca_2Fe(CN)_6 \cdot 12H_2O$	Tric.	1.5700	1.5818	1.5961	2V = 85°12′ r > v	X nearly ⊥001; one optic axis nearly ⊥010
$Al_2O_3 \cdot 3H_2O$[c]	.....	.....	.....	1.583	.....	.....
$BeO \cdot 4CaO \cdot Al_2O_3 \cdot 9SiO_2 \cdot H_2O$	Orth.	1.583	1.585	1.590	2V = 50°	Z = b; Y = a

*Becomes uniaxial at 114°C.
**α-Phase.

[a]Stable low temp. phase.
[b]High temp. or α-phase.

[c]Pptd. from soln. and dried at 110°C.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$Fe_2O_3 \cdot 3SO_3 \cdot 7H_2O$	Mon.	1.572	1.586	1.640	$2V = Sm.$	Ax. pl. and $Z \perp 010$; $X \wedge c = 20°$
$BaO \cdot Al_2O_3 \cdot 2SiO_2$	Mon.	1.584	1.589	1.594	$2V = 87°$	$Y = b$; $Z \wedge a = 28°$
$3CaO \cdot CaF_2 \cdot 2SiO_2 \cdot H_2O$	Mon.	1.586	1.59	1.598	$2V = 60°$ $r > v$ strong	$X = b$; $Y \wedge a = 6°$
$4BeO \cdot B_2O_3 \cdot H_2O$	Orth.	1.5595	1.5908	1.6311	$2V = 87°7'$	Ax. pl. 010; $Z = c$; $X = a$
$K_2Cr_2O_7 \cdot Hg(CN)_2 \cdot 2H_2O$	Orth.	.....	1.591	.....	$2V = 58°$	Ax. pl. 100; $Z = c$
$Fe_3(PO_4)_2 \cdot 8H_2O$	Mon.	.....	1.592	.....	$2V = 73°10'$	Ax. pl. $\perp 010$; $Z \wedge c = 61°30'$
$Ca_2B_6O_{11} \cdot 5H_2O$	Mon.	1.5863	1.5920	1.6139	$2V = 54°52'$	Ax. pl. $\perp 010$; $Z \wedge c = 83°$
$BaAl_2Si_2O_8$	Mon.	1.587	1.593	1.600	$2V = 70° \pm$	Ax. pl. 010; $X \wedge c = 3°$
$Na_2Ru(NO_2)_5 \cdot 2H_2O$*	Mon.	1.5889	1.5943	1.7163	$2V = 25°14'$	Ax. pl. 010; $Z \wedge c = -84°18'$
$SrCl_2 \cdot 2H_2O$	Mon. (?)	1.5942 ±	1.5948 ±	1.6172 ±	$2V = Sm.$	.....
$MnSO_4 \cdot H_2O$	Mon.	1.562	1.595	1.632	$2V = 90°$	Ax. pl. and $Z \perp 010$; $Y \wedge c = Lg.$
$CaSO_3 \cdot 2H_2O$	.....	1.590	1.595	1.628	$2V = 30° \pm$	.....
$BaS_2O_6 \cdot 2H_2O$	Mon.	1.5860	1.5951	1.6072	$2V = 85°$ $r < v$ strong	Ax. pl. 010; $Z \wedge c = -13°15'$
$Ba(HCO_2)_2$	Orth.	1.573	1.597	1.636	$2V = 77°54'$	Ax. pl. 010; $Z = a$
$NH_2C_{10}H_6SO_3Na \cdot 4H_2O$ (1,4-Naphthylamine sulfonate)	Mon.	1.573	1.599	1.657	.....	.....
$Y_2Pt_3(CN)_{12} \cdot 21H_2O$	Orth.	1.59	1.6 ±	2.051	$2V = 15° \pm$	Ax. pl. 010; $Z = c$
$2Li_2O \cdot 7Al_2O_3 \cdot 2B_2O_3 \cdot 6SiO_2 \cdot 12H_2O$	.....	.....	1.6 ±	.....	$2V = 17° \pm$	.....
$NaAuCl_4 \cdot 2H_2O$	Orth.	1.545	1.6 ±	1.75	.....	.....
Li_4SiO_4	Orth. (?)	1.59 ±	1.60 ±	1.61 ±	$2V = Sm.$	.....
$Na_2Pt(CN)_4 \cdot 3H_2O$	Tric.	1.53	1.60	1.61	$2V = Sm.$	$r > v$ strong
$2CaO \cdot As_2O_5 \cdot 3H_2O$	Orth.	1.590	1.602	1.638	$2V = 58°$ $r > v$	$X = b$; $Z = c$
$3FeO \cdot P_2O_5 \cdot 8H_2O$	Mon.	1.579	1.603	1.633	$2V = 83° \pm$ $r < v$ small	$X = b$; $Z \wedge c = 28°30'$
$Na_2O \cdot Al_2O_3 \cdot P_2O_5 \cdot H_2O$	Mon. (?)	1.594	1.603	1.615	$2V = Lg.$	.....
$(AlO)_3BO_3$	Orth.	1.586	1.603	1.623	$2V = 87°$	Ax. pl. 010; $Z = c$
$Na_2O \cdot 4CaO \cdot 6SiO_2 \cdot H_2O$	Mon.	1.595	1.604**	1.633	$2V = 60°$ $r > v$ Sm.	$Z = b$; $X \wedge c = 19°$

* X = yellow; Z = orange.
** Int. Crit. Tab. gives 1.606.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$Mg_2P_2O_7$	Mon.	1.602	1.604	1.615	$2V = 20°30'$	Ax. pl. 010; $X \wedge c = 15°$
$CaCl_2$	Orth. (?)	1.600	1.605	1.613	$2V$ = Mod.	.....
$K_2S_4O_6$	Mon.	1.5896	1.6057 ±	1.6435 ±	$2V = 67°$	Ax. pl. 010; $Z \wedge c = 33°$
$5CaO \cdot 2P_2O_5 \cdot 1.5H_2O$	Mon. (?)	.....	1.606	.....	$2V$ = Mod.	$Y = b$
$NaKPt(CN)_4 \cdot 3H_2O$	Mon.	1.6088	1.61 ±	1.90 ±	$2V$ = Sm.	.....
$CaSiO_3$	Mon.	1.610	1.610	1.654	$2V$ = Sm.	.....
$CaH_4Si_3SnO_{11}$*	Orth.	1.609	1.6125	1.619	$2V = 69°30'$ $r < v$	Ax. pl. 010; $Z = c$
$2CaO \cdot FeO \cdot P_2O_5 \cdot 4H_2O$	Tric.	1.602	1.613	1.649	$2V = 53° \pm$	$r > v$
$4CuO \cdot Al_2O_3 \cdot SO_3 \cdot 8H_2O$	Orth.	1.588	1.617	1.655	$2V = 82°$	$r < v$; $Z = c$
$2ZnO \cdot SiO_2 \cdot H_2O$	Orth.	1.614	1.617	1.636	$2V = 46°$ $r > v$ strong	$X = b$; $Z = c$
$4MgO \cdot 2SiO_2 \cdot Mg(F,OH)_2$	Mon.	1.604	1.617**	1.636	$2V = 72° +$ $r > v$ weak	$X \wedge a = 27°$; $Z = b$
$ZnCl_2 \cdot 2NH_3$	Orth.	.....	1.618 ±	.....	$2V$ = Lg.	Ax. pl. 010; $Z = c$
$KFeSi_2O_6$	.....	.....	1.619	.....	.....	.....
$K_2Pt(CN)_4 \cdot 3H_2O$	Orth.	1.615	1.62 ±	1.62 ±	$2V = 40° \pm$	Ax. pl. 100; $Z = c$
$Rb_2Pt(CN)_4 \cdot 3H_2O$ (?)	Mon.	1.61	1.62 ±	1.696	$2V$ = Mod.	Ax. pl. $\perp 010$; Z nearly $= c$
$CuO \cdot 3Al_2O_3 \cdot 2P_2O_5 \cdot 9H_2O$	Tric.	1.61	1.62	1.65	$2V = 40°$	$r < v$ strong
$CuO \cdot SiO_2 \cdot H_2O$	Orth.	1.61	1.62	1.71	$2V$ = Sm	Z = elong.
$2(Al,F)O \cdot SiO_2$	Orth.	1.619	1.620	1.627	$2V = 49°$ to $66°$ $r > v$	$X = a$; $Z = c$
$3CaO \cdot 5Ce_2O_3 \cdot 6P_2O_5 \cdot 24H_2O$	Orth.	1.620	1.620	1.654	$2V = 0° \pm$	.....
$LiRbPt(CN)_4 \cdot 3H_2O$	Orth.	1.6204	1.6233	1.9310	$2V = 12°40'$ $r > v$	Ax. pl. 100; $Z = c$
$SrSO_4$	Orth.	1.6220	1.6237	1.6309	$2V = 51°45'$	Ax. pl. 010; $Z = a$
$ZnC_{10}H_6O_6S_2 \cdot 6H_2O$ (1,5-Naphthalene disulfonate)	Mon.	1.531	1.625	1.659	$2V = 58°16'$	Ax. pl. 010
$3ZnO \cdot P_2O_5 \cdot 4H_2O$	Tric.	1.614	1.625	1.637	$2V = 90°$	$Y \wedge c = 30°$; X *ca.* a
$2Fe_2O_3 \cdot P_2O_5 \cdot 2SO_3 \cdot 13H_2O$	Tric. (?)	1.615	1.625	1.665	$2V$ = Sm.	$r > v$

*$CaO \cdot SnO_2 \cdot 3SiO_2 \cdot 2H_2O$.
**Int. Crit Tab. gives 1.619.

Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$2BaO \cdot 3SiO_2$	Orth.	1.620	1.625	1.645	$2V = 54°$	Ax. pl. 100; $X = c$
$5CaO \cdot 2MgO \cdot 6SiO_2$	Orth.	1.621	1.627	1.635	$2V = 80° \pm$	.....
$Na_6H_8(MoO_4)_7 \cdot 18H_2O$	Mon.	.....	1.627	.....	$2V = 84°6'$ $r > v$ weak	Ax. pl. and $X \perp 010$; $Z \wedge c = -84°30'$
$LiKPt(CN)_4 \cdot 3H_2O$	Orth.	1.6237	1.6278	2.2916	$2V = 19°$ $r > v$	Ax. pl. 100; $Z = c$
$2CaO \cdot Al_2O_3 \cdot 3SiO_2 \cdot H_2O$	Orth.	1.626	1.629	1.652	$2V =$ Mod. $r > v$	$X = a$; $Z = c$
$BaHPO_4$	Orth.	1.617	1.63 $\pm$	1.635	.....	Ax. pl. 100
$6MgO \cdot 3SiO_2 \cdot Mg(F,OH)_2$	Orth.	1.622	1.632*	1.652	$2V = 68° \pm$ $r > v$ weak	$X = a$; $Z = b$
$8MgO \cdot 4SiO_2 \cdot Mg(F,OH)_2$	Mon.	1.623	1.636**	1.651	$2V$ *ca.* 90° $r < v$	$Z = b$; $X \wedge a = 9° \pm$
$BaSO_4$	Orth.	1.634	1.636	1.647	$2V = 37°28'$	Ax. pl. 010; $Z = a$; $X = c$
$(NH_4)_2Mg(CrO_4)_2 \cdot 6H_2O$	Mon.	1.6363	1.6371	1.6531	$2V = 27°$	Ax. pl. 010; $Z \wedge c = 3°27'$
$BaS_5O_6 \cdot 3.5H_2O$ (?)	Orth.	1.620	1.64	1.670	$2V =$ Lg.	.....
$Ca_3P_2O_8 \cdot CaO$	Mon.	.....	1.64	.....	$2V = 25°$	Ax. pl. 010; $Z = c$ nearly
$3Al_2O_3 \cdot 2SiO_2$	Orth.	1.638	1.642	1.653	$2V = 20° \pm$ $r > v$	$X = b$; $Z = c$
$Cs_2Mg(CrO_4)_2 \cdot 6H_2O$	Mon.	1.6369	1.6425	1.6547	$2V = 67°3'$ $r > v$	Ax. pl. $\perp 010$; $Z \wedge c = -9°22'$
$2CaO \cdot MnO \cdot P_2O_5 \cdot 2H_2O$	Trio.	1.636	1.644	1.654	$2V =$ Lg.	$r > v$
$CaPt(CN)_4 \cdot 5H_2O$	Orth.	1.622	1.644	1.767	$2V = 48°10'$	Ax. pl. 010; $X = c$
$Al_6Si_2O_{13}$	Orth.	1.642	1.644	1.654	$2V = 47° \pm$	Ax. pl. 010; $Z = c$
$Ca_3Si_2O_7$	Orth. (?)	1.641	1.645 $\pm$	1.650	$2V =$ Lg.	.....
Ca_2SiO_4[a]	Mon. (?)	1.642	1.645	1.654	$2V = 60°$	$Z \wedge c = 3°$
$BaCl_2 \cdot 2H_2O$	Mon.	1.635	1.646	1.660	$2V = 83°46'$	Ax. pl. 010; $Z \wedge c = 8°$
$Cs_2MnCl_4 \cdot 2H_2O$	Tric. (?)	1.64 $\pm$	1.65 $\pm$	1.65 $\pm$	.....	.....
$Al_2O_3 \cdot H_2O$[b]	.....	.....	1.65	.....	.....	.....
GeO_2[c]	Orth. (?)	.....	1.650	.....	.....	.....
$2MgO \cdot SiO_2$	Orth.	1.6359	1.6507	1.6688	$2V = 85°16'$	Ax. pl. 001; $Z = a$

*Int. Crit. Tab. gives 1.624.
**Int. Crit. Tab. gives 1.670.

[a] γ-Form; stable below 675°C.
[b] Prepd. by hydration with steam at 125 atm.
[c] Prepd. by hydrolysis of $GeCl_4$.

Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$CdCl_2 \cdot 2.5H_2O$	Mon.	.....	1.6513	.....	$2V = 56°27'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 1°40'$
$MgSiO_3$*	Orth.	1.650	1.653	1.658	$2V = 31°$	Ax. pl. 010; $Z = c$; $Y = b$
$Mg_3(BO_3)_2$	Orth.	1.6527	1.6537	1.6748	$2V = 25°$ $r > v$ weak	Ax. pl. 010; $Z = c$
$MgSiO_3$**	Mon.	1.651	1.654	1.660	$2V = 53°30'$	Ax. pl. $\perp 010$; $Z \wedge c = 22°$
$2BeO \cdot Al_2O_3 \cdot 2SiO_2 \cdot H_2O$	Mon.	1.653	1.656	1.673	$2V = 47°$ $r > v$	$Y = b$; $Z \wedge c = 42°18'$
$Na_2O \cdot 4CuO \cdot 3SO_3 \cdot 3H_2O$	Mon.	1.649	1.656	1.714	$2V = 37°$ $r < v$ strong	$Y = b$; $Z \wedge c = -12°$[c]
$3MnO \cdot P_2O_5 \cdot 3H_2O$	Orth.	1.651	1.656	1.683	$2V = 41°$	$r > v$ strong
$Ag_2CO_3 \cdot 4NH_3 \cdot H_2O$	Orth.	1.66	1.66±	1.68	$2V = 10°$ $r < v$ strong	Ax. pl. 010; $Z = c$
$Ce_2Pt_3(CN)_{12} \cdot 18H_2O$	Mon.	1.65	1.66	1.68	.....	.....
$Fe_2O_3 \cdot 9MnO \cdot 4P_2O_5 \cdot 14H_2O$	Orth.	1.655	1.66	1.670	$2V = Lg.$	$r < v$ strong
$2Na_2O \cdot BaO \cdot 2TiO_2 \cdot 10SiO_2$	Mon.	1.645	1.661	1.688	$2V = 77°$ $r > v$ strong	$Z = b$; $Y \wedge c = 3°$
$3CoO \cdot As_2O_5 \cdot 8H_2O$	Mon.	1.645	1.661	1.688	$2V = 90°\pm$ $r < v$ weak	$X = b$; $Z \wedge c = 31°$
$3NiO \cdot 6CuO \cdot SO_3 \cdot 2As_2O_5 \cdot 7H_2O$	Mon. (?)	1.629	1.662	1.727	$2V = 73°$ $r < v$ strong	$X \wedge$ elong. 26°; $Y = b$
Ca_2ClPO_4	Orth.	1.649	1.665	1.670	$2V = Lg.$	Ax. pl. 010; $Z = c$
$Li_2O \cdot Al_2O_3 \cdot 4SiO_2$[a]	Mon.	1.660	1.665	1.676	$2V = 58°\pm$ $r < v$	$Y = b$; $Z \wedge c = 24°$
$5MgO \cdot 7B_2O_3 \cdot MgCl_2$	Orth.	1.662	1.667	1.673	$2V = Lg.$	.....
$K_2PtBr_2(NO_2)_2 \cdot H_2O$	Tric.	1.626	1.6684	1.757	$2V = 72°21'$	Ax. pl. nearly $\perp 001$
$8MgO \cdot 4SiO_2 \cdot Mg(F,OH)_2$	Mon.	.....	1.670[b]	.....	$2V = ca.\ 90°$ $r < v$	$Z = b$; $X \wedge a = 9°\pm$
$2PbO \cdot 3Al_2O_3 \cdot 2SO_3 \cdot P_2O_5 \cdot 6H_2O$	.....	1.670	1.671	1.689	$2V = 0° - 30°$	$Z = c$
$CaO \cdot MgO \cdot 2SiO_2$	Mon.	1.6646	1.6713	1.6945	$2V = 59°$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 38°30'$; $Y = b$

*β-Phase; changes to α-phase at 1500°C.
**Most stable or α-phase.

[a]Metastable or β-phase.
[b]Also given as 1.636.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$BaSiO_3$	Orth.	1.673	1.674	1.678	$2V = 29°$ $r > v$ strong	Ax. pl. 100; $X = c$
$CaO \cdot Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$	Orth.	1.665	1.674	1.684	$2V = 84°$ $r > v$ strong	$X = a$; $Z = c$
$Na_2O \cdot CaO \cdot MgO \cdot Al_2O_3 \cdot SiO_2$	Mon.	1.666	1.674	1.688	$2V = 70° - 80°$	$Y = b$; $Z \wedge c = 43 - 7°$
$Na_2O \cdot 2MnO \cdot P_2O_5$	Orth.	1.663	1.674	1.699	$2V = Lg.$ $r < v$	$Z = b$; $X = a$
$7FeO \cdot 2P_2O_5 \cdot 9H_2O$	Mon.	1.653	1.675	1.697	$2V = 82°$ $r > v$ weak	$X = b$; $Z \wedge c = -67°$
$3Fe_2O_3 \cdot 2As_2O_5 \cdot 13H_2O$	Mon. (?)	.....	1.676	.....	$2V = Lg.$	$r < v$ strong
$BaPt(CN)_4 \cdot 4H_2O$	Mon.	1.6706	1.677	1.8982	$2V = 18°$ $r > v$	Ax. pl. 010; $Z \wedge c = -1°20'$
$Fe_2O_3 \cdot 2SO_3 \cdot 5H_2O$	Mon.	1.588	1.678	1.749	$2V = Lg.$	Ax. pl. and $Z \perp 010$; $X \wedge c = 19°$
$Li_2O \cdot 2(Mn,Fe)O \cdot P_2O_5$	Orth.	1.676	1.679	1.687	$2V = 63°$ $r < v$	$X = a$; $Z = b$
$Ca_3Al_2SiO_8$	Orth. (?)	1.675	1.68 ±	1.685	$2V = Lg.$	.....
$Zn_3(AsO_4)_2 \cdot 8H_2O$	Mon.	1.662	1.683	1.717	$2V = 77°$ $r < v$	$Z \wedge c = 37°$; $X = b$
$CuCl_2 \cdot 2H_2O$	Orth.	1.644	1.684	1.742	$2V = 80°40'$ $r < v$	Ax. pl. 001
$Na_2O \cdot Fe_2O_3 \cdot FeO \cdot 5SiO_2 \cdot H_2O$	Mon.	.....	1.687	.....	$2V = Lg.$	$Y = b$; $X \wedge c = 1°$ to $8°$
$MnCl_2 \cdot 3MnO_2 \cdot 3H_2O$	Orth.	1.684	1.695	1.698	$2V = Sm.$	$X = c$; $Y = b$
$2BeO \cdot BaO \cdot 2SiO_2$	Orth.	1.691	1.696	1.703	$2V = 81°$ $r > v$ weak	$Y = a$; $X = b$
$4CuO \cdot As_2O_5 \cdot 7H_2O$	Orth.	1.695	1.698	1.733	$2V = 29°$ $r > v$	$X = b$; $Z = c$
$Na_2Cr_2O_7 \cdot 2H_2O$	Mon.	1.6610	1.6994	1.7510	$2V = 83°42'$ $r < v$	Ax. pl. $\perp 010$; $Z \wedge c = 13°$
$Na_2O \cdot 2FeO \cdot Fe_2O_3 \cdot 6SiO_2$	Mon. (?)	1.697	1.700	1.703	$2V = Lg.$	$Z = b$; $Y \wedge c = 0° \pm$

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$4CaO{\cdot}3Al_2O_3{\cdot}6SiO_2{\cdot}H_2O$	Orth.	1.700	1.702	1.706	$2V = 0° - 60°$ $r < v$ or $r > v$	$X = c$; $Y = b$; or, $X = b$; $Y = c$
$Mn_2P_2O_7$	Mon.	1.695	1.704	1.710	$2V = 90° \pm$	Ax. pl. 010; $X \wedge c = -4°$
$MgO{\cdot}3CaO{\cdot}2SiO_2$	Mon.	1.708	1.711	1.718	$2V = 67°$ $r > v$ weak	$Z = b$; $X \wedge c = 36°$
$2CaO{\cdot}MnO{\cdot}As_2O_3{\cdot}2H_2O$	Mon.	1.709	1.711	1.724	$2V = 23°$ $r < v$	$X = b$; $Y \wedge c = 8°$
$4CuO{\cdot}N_2O_5{\cdot}3H_2O$	Orth.	1.703	1.713	1.722	$2V =$ Lg. $r > v$	$X = a$; $Z = c$
Ca_2SiO_4**	.....	.....	1.715	.....	$2V =$ Sm.	.....
$4CaO{\cdot}3Al_2O_3{\cdot}6SiO_2{\cdot}H_2O$	Mon.	1.715*	1.717*	1.719*	$2V = 66°$ $r < v$	$Y = b$; $Z \wedge a = 32°$
$SrCr_2O_7{\cdot}3H_2O$	Mon.	1.7146	1.7174	1.812	$2V = 20°28'$ $r < v$	Ax. pl. 010; $Z \wedge c = 78°8'$
Ca-Al-silicate[a]	.....	1.718	1.720	1.733	$2V = 20° \pm$	$r < v$ extreme
Ca_2SiO_4[b]	Mon.(?)	1.715	1.720	1.737	$2V =$ Lg.	Ax. pl. and $Z \perp 010$; $X \wedge c = 14°$
$2MgO{\cdot}2CaO{\cdot}As_2O_5{\cdot}H_2O$	Mon.	1.712	1.721	1.731	$2V =$ Lg. $r < v$	$Y = b$; $Z \wedge c = 39°$
$Al_2O_3{\cdot}H_2O$	Orth.	1.702	1.722	1.750	$2V = 84°$ $r < v$ weak	$Z = a$; $X = c$
Ca_2SiO_4[c]	Orth.	1.717	1.726 ±	1.735	$2V =$ Lg.	Ax. pl. 100; $X = c$
$BaBr_2{\cdot}2H_2O$	Mon.	1.7129	1.7266	1.7441	$2V = 83°49'$	Ax. pl. 010; $Z \wedge c = 89°35'$
$Fe_2O_3{\cdot}P_2O_5{\cdot}4H_2O$	Orth.	1.730	1.732	1.762	$2V = 29°$ $r < v$	$X = a$(?); $Z = b$(?)
Sr_2SiO_4	Mon.(?)	1.7275	1.732	1.756	$2V = 32°30'$	Ax. pl. $\perp 010$; $X \wedge c = 17°$
$Fe_2O_3{\cdot}MoO_3{\cdot}7.5H_2O$	.....	1.720	1.733	1.935	$2V = 28°$ $r < v$	$Y = a$; $Z = c$
$MnSiO_3$	Tric.	1.733 ±	1.735 ±	1.739 ±	.....	.....
$BaCl_2$	.....	1.7302	1.7361	1.7420	$2V = 90° \pm$	.....

**Unstable or β'-phase.
**Int. Crit. Tab. gives α1.724; β1.729; γ1.734.

[a] In Portland cement clinker.
[b] α-Phase; stable above 1420°C.

[c] β-Phase; stable 675° to 1420°C.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$CuSO_4 \cdot 2CuO \cdot 2H_2O$	Orth.	1.726	1.738	1.789	$2V = 53°$ $r < v$	Ax. pl. 001; $X = b$
$K_2Cr_2O_7$	Tric.	1.7202	1.7380	1.8197	$2V = 51°53'$ $r > v$	Ax. pl. nearly $\perp 001$
$FeO \cdot CaO \cdot 2SiO_2$	Mon.	1.732	1.740	1.757	$2V = 70°$ $r > v$	$Y = b$; $Z \wedge c = 45° \pm$
$MgW_4O_{13} \cdot 8H_2O$	Mon.	.....	1.74	.....	$2V = 77°50'$ $r < v$ weak	Ax. pl. and $Z \perp 010$; $X \wedge c = -66°$
$2FeO \cdot 5Al_2O_3 \cdot 4SiO_2 \cdot H_2O$	Orth.	1.736	1.741	1.746	$2V = 88° \pm$ $r > v$ weak	$X = b$; $Z = c$
$AgNO_3$	Orth.	1.729	1.744	1.788	$2V = 62°16'$ $r < v$	Ax. pl. 100; $Z = c$
$BeO \cdot Al_2O_3$	Orth.	1.747	1.748	1.757	$2V = 45°$ $r > v$	$X = a$; $Y = b$
$Sr_2W_{12}SiO_{40} \cdot 16H_2O$	Mon.	.....	1.749	.....	$2V = 86°50'$ $r < v$	Ax. pl. and $X \perp 010$; $Z \wedge c = -17°$
$Fe_2O_3 \cdot 3MoO_3 \cdot 7.5H_2O$	Orth.	1.74	1.75±	1.95	$2V =$ Sm. $r < v$	$Y = a$; $Z = c$
CaC_2	Orth. (?)	.....	1.75	.....	$2V = 30° \pm$	$r < v$
$3CuO \cdot 2CO \cdot H_2O$	Mon.	1.730	1.758	1.838	$2v = 68°$ $r > v$	$X = b$; $Z \wedge c = -13°$
$CaFeSi_2O_6$	Mon.	.....	1.76±	.....	$2V = 60°$	Ax. pl. 010; $Z \wedge c = 46°$
$5CuO \cdot P_2O_5 \cdot 2H_2O$	Mon. or Tric.	1.719	1.762	1.805	$2V$ *ca.* 90° $r < v$	$X \wedge c = 22°$; Z *ca.* b
$CaV_2O_6 \cdot 4H_2O$	Tric.	1.710	1.770	1.840	$2V =$ Lg.	$Z = c \pm$
$4BaO \cdot FeO \cdot 2Fe_2O_3 \cdot 10SiO_2$	Orth.	1.770	1.774	1.83	$2V = 40°$ $r > v$	$X = a$; $Z = c$
$4CaO \cdot 2Mn_2O_3 \cdot 5SiO_2 \cdot 4H_2O$	Orth.	1.758	1.776	1.795	$2V = 67°$ $r < v$	$X = a$; $Y = c$
$FeAsO_4$	Mon.	.....	1.78±	.....	.....	.....

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$2BeO \cdot FeO \cdot 2Y_2O_3 \cdot 2SiO_2$	Mon.	1.78	1.78±	1.785	2V = Med. r < v	Y = *b*; Z ∧ c = 4° − 13°
$2CuO \cdot 2SiO_2 \cdot H_2O$	Mon.	1.752	1.782	1.815	2V = Lg.	X = *b*; Z ∧ *c* = small
$3Fe_2O_3 \cdot 2P_2O_5 \cdot 8H_2O$	Mon.	1.775	1.786	1.815	2V = Med.	Z = *b*; Y ∧ *c* = 1°30′
$4CuO \cdot As_2O_5 \cdot H_2O$	Orth.	1.747	1.788±	1.829	2V *ca.* 90° r < v	X = *b*; Z = *a*
$4PbO \cdot 9Fe_2O_3 \cdot 6As_2O_5 \cdot 4SO_3 \cdot 33H_2O$	Orth.	1.783	1.788	1.818	2V = 51° r > v	Y = *a*; Z = *c*
$Fe_2O_3 \cdot 3MoO_3 \cdot 7.5H_2O$	Orth.	1.78	1.79±	2.04±	2V = Sm. r < v	Y = *a*; Z = *c*
$CsHgCl_3$	Orth.	.....	1.791	.....	.....	.....
Tl_2 (*dl*-$C_4H_4O_6$)	Mon.	.....	1.80	.....	2V = 88°22′	Ax. pl. 010; Z ∧ *c* = 84°44′
$Mn_2O_3 \cdot 4MnO \cdot As_2O_5 \cdot 4H_2O$	Orth.	1.783	1.801	1.834	2V = Lg.	Z = *a*; X = *b*
$Fe_2O_3 \cdot 2SO_3 \cdot H_2O$	Orth.	1.783	1.804	1.918	2V = Sm.	.....
$4CuO \cdot As_2O_5 \cdot 3H_2O$	Orth.	1.79	1.807	1.84	2V = Lg.	r < v; Y = *c*
Ba_2SiO_4	.....	1.81	1.82±	1.83	.....	.....
$4MgO \cdot B_2O_3 \cdot Fe_2O_3$	Orth.	1.99	1.85	1.85	.....	.....
$3MgO \cdot B_2O_3 \cdot FeO \cdot Fe_2O_3$	Orth.	1.85	1.85	2.02	2V = Sm.	r > v; Z = *c*
Tl_2SO_4	Orth.	1.8600	1.8671	1.8853	2V = 68°4′ r > v weak	Ax. pl. 010; Z = *a*; X = *c*
$2UO_3 \cdot 3V_2O_5 \cdot 15H_2O$	Orth.	1.817	1.879	2.057	2V = 52°	.....
$6MnO \cdot As_2O_5 \cdot 5H_2O$	Orth.	1.87	1.88	1.93	2V = 35° r > v	X = *b*; Z = *c*
$PbSO_4$	Orth.	1.8771	1.8823	1.8937	2V = 75°24′ r < v	Ax. pl. 010; Z = *a*; X = *c*
$CaO \cdot TiO_2 \cdot SiO_2$	Mon.	1.900	1.907±	2.034	2V = 27° ± r > v	Y = *b*; Z ∧ *c* = 51°
$PbHAsO_4$	Mon.	1.8903	1.9097	1.9765	2V = 58°	Ax. pl. and X ⊥ 010; Y ∧ *c* = −24°
$6PbO \cdot 4CaO \cdot 6SiO_2 \cdot H_2O$	Hex.*	1.910	1.91	1.945	2V = Sm.	.....
As_2O_3	Mon.	1.87	1.92	2.01	2V = 58° r < v	Ax. pl. 010; Z ∧ *c* = 6°

*Int. Crit. Tab. gives tet.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$4PbO \cdot 2CuO \cdot P_2O_5 \cdot nH_2O$	Orth.	1.885	1.920	1.956	$2V = 89°$	$r < v$
$6Na_2O \cdot 4Fe_2O_3 \cdot 5SiO_2$	.....	.....	1.96	.....	.....	.....
$Bi_2O_3 \cdot 2UO_3 \cdot 3H_2O$	Orth.(?)	1.955	1.985	1.205	$2V = Lg.$ $r < v$	$X = a$; $Z = c$
$2Bi_2O_3 \cdot 3SiO_2$	Mon.	.....	1.99	.....	$2V = Lg.$	.....
$3Bi_2O_3 \cdot As_2O_5 \cdot 2H_2O$	Mon.	2.14	2.15	2.18	$2V = 44°$	$r < v$
$3PbO \cdot 2Fe_2O_3 \cdot 3SiO_2$	Orth.	2.12	2.17	2.31	$2V = 67°$	$r < v$
$Fe_2O_3 \cdot H_2O$	Orth.	1.94	2.20	2.51	$2V = 90°$	$X = a$; $Y = c$
$3PbO \cdot 2Mn_2O_3 \cdot 3SiO_2$	Orth.	2.10	2.20	2.31	$2V = 88°$ $r < v$	$X = a$; $Y = b$
$2FeO \cdot Sb_2O_5$	.....	2.19	2.20	2.33	$2V = Sm.$	$r < v$
$Pb_2As_2O_7$	.....	.....	2.03	.....	.....	.....
S	Orth.	1.9579	2.0377	2.2452	$2V = 68°58'$ $r < v$	Ax. pl. 010; $Z = c$; $X = a$
$PbCl_2$	Orth.	2.1992	2.2172	2.2596	$2V = 66°12'$	Ax. pl. 010; $Z = c$
$MnO \cdot WO_3$	Mon.	2.17	2.22	2.32	$2V = 73°$	$X = b$; $Z \wedge c = 19°$
$Ca_2Fe_2O_5$	Mon.(?)	.....	2.25	.....	$2V = Mod.$	.....
$MnO \cdot Ta_2O_5$	Orth.	2.22	2.25	2.29	$2V = Lg.$ $r < v$	$Y = a$; $Z = c$
$4(Pb,Zn)O \cdot V_2O_5 \cdot H_2O$	Orth.	2.17	2.27	2.32	$2V = 90° \pm$ $r > v$	$X = c$; $Z = a$
$2PbO \cdot PbCl_2$	Orth.	2.24	2.27	2.31	$2V = 90° \pm$ $r < v$	$Z = c$; $X = a$
$PbO \cdot WO_3$	Orth.	2.24	2.27	2.31	$2V = 0° \pm$ $r < v$	$Z = c$; $X = a$
$CaO \cdot TiO_2$	Orth.	.....	2.38	.....	$2V = 90° \pm$	$Z = a$; $Y = b$
$PbCrO_4$	Mon.	.....	2.42	.....	$2V = 54°$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 5°30'$*
HgO	Orth.	2.37	2.5	2.65	$2V = Lg.$	$Z =$ elong.
TiO_2	Orth.	2.583	2.586	2.741	$2V = 30°$	$Z = a$
PbO	Orth.	2.51_{Li}	2.61_{Li}	2.71_{Li}	$2V = 90° \pm$	$Y = a$(?)

*Also given as $Y = b$; $Z \wedge c = -5°30'$.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
Na_2SiF_6	Orth.	1.3089	1.3125	1.3125	2V = Sm.	X = *c*
KBF_4	Orth.	1.3239	1.3245	1.3247	2V = Mod.	Ax. pl. 010 (100?); X = *c*
NH_4HF_2	Orth.	1.385	1.390	1.394	2V = Sm.	Ax. pl. 100; X = *c*
$Na_2SO_4 \cdot 10H_2O$	Mon.	1.394	1.396	1.398	2V = 76°	Ax. pl. ⊥010; Z ∧ *c* = 30°
$Co(NO_3)_2 \cdot 6H_2O$	Mon.	1.38 (?)	1.4 ±	1.52 (?)	2V = 40° ±	.....
$NaF \cdot CaF_2 \cdot AlF_3 \cdot H_2O$	Mon.	1.407	1.414	1.415	2V = 50° r < v weak	X ∧ *c* = −52°; Z = *b*
$Na_2CO_3 \cdot 10H_2O$	Mon.	1.405	1.425	1.440	2V = 71°	Ax. pl. ⊥010; Z ∧ *c* = 41°
$Na_2HPO_4 \cdot 12H_2O$	Mon.	1.4321	1.4361	1.4373	2V = 56°43′ r < v	Ax. pl. 010; X ∧ *c* = −31°
$CuF_2 \cdot 5HF \cdot 6H_2O$	Mon.	1.395	1.440	1.444	2V = 32°	.....
$Na_2HAsO_4 \cdot 12H_2O$	Mon.	1.4453	1.4496	1.4513	2V = 65°13′	Ax. pl. ⊥010; X ∧ *c* = −1°
$KAl(SO_4)_2 \cdot 12H_2O$	Mon. (?)	1.430	1.452	1.458	2V = 52°	Y ∧ *c* = 13°; Z = *b*
$(Na, NH_4, K)_2O \cdot SO_3 \cdot 2H_2O$	Orth.	1.440	1.452	1.453	2V = 40°	r < v strong
$CaF_2 \cdot Al(F,OH)_3 \cdot H_2O$	Mon.	1.448	1.454	1.456	2V = Mod.	X = *b*; Y ∧ *c* = large
$Na_2O \cdot CaO \cdot 2SO_3 \cdot 4H_2O$	Mon.	1.435	1.455	1.459	2V = 48°	.....
$MgSO_4 \cdot 7H_2O$	Orth.	1.4326	1.4554	1.4608	2V = 51°21′	Ax. pl. 001; X = *b*
$B_2O_3 \cdot 3H_2O$	Tric.	1.340	1.456	1.459	2V = 7°	Ax. pl. *ca. b*; X *ca.* ⊥001
$NaHSO_4 \cdot H_2O$	Mon.	1.43 ±	1.46 ±	1.47 ±	2V = Sm.	.....
$NaAl(SO_4)_2 \cdot 12H_2O$	Mon.	1.449	1.461	1.463	2V = 56°	Ax. pl. ⊥010; Y ∧ *c* = 30°
$NaH_2PO_4 \cdot 2H_2O$	Orth.	1.4401	1.4629	1.4815	2V = 82°50′	Ax. pl. 010; X = *c*
$MgSO_4 \cdot 6H_2O$	Mon.	1.438	1.463	1.465	2V = 29° ± r > v	Ax. pl. 010; X ∧ *c* = −25°
$Na_2SiO_3 \cdot 8H_2O$	Mon.	1.457 +	1.463	1.465 +	2V = 63°	Ax. pl. 010; X ∧ *c* = 12°
$NaC_2H_3O_2$	Mon.	.....	1.464	.....	2V = 62°50′	Ax. pl. ⊥010; X ∧ *c* = −44°
$Na_2H_2P_2O_7 \cdot 6H_2O$	Mon.	1.4599	1.4645	1.4649	2V = 31°10′	Ax. pl. ⊥010; X ∧ *c* = −42°30′
Li_2SO_4	Mon.	.....	1.465	.....	2V = 72°58′ r > v weak	Ax. pl. ⊥010; X ∧ *c* = −31°
$Na_2B_4O_7 \cdot 10H_2O$	Mon.	1.4467	1.4694	1.4724	2V = 39°10′ r > v strong	Ax. pl. ⊥010; Z ∧ *c* = −56°; X = *b*
$2Al_2O_3 \cdot SO_3 \cdot 15H_2O$	.....	1.462	1.470	1.471	2V = Sm.	X = elong.

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INDEX OF REFRACTION—BIAXIAL NEGATIVE

Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$Na_2B_4O_7 \cdot 4H_2O$	Mon.	1.455	1.472	1.487	$2V = 80°$ $r > v$	Ax. pl. $\perp 010$; $X \wedge c = 70°30'$; $Z = b$
$Na_3HP_2O_6 \cdot 9H_2O$	Mon.	1.4653	1.4738	1.4804	$2V = 82°$ $r > v$ weak.	Ax. pl. $\perp 010$; $X \wedge c = -11°$
$Li_2SO_4 \cdot H_2O$	Mon.	1.459	1.477	1.488	$2V = 78°24'$ $r < v$ weak	Ax. pl. $\perp 010$; $X \wedge c = -36°32'$
$CaO \cdot 2CaF_2 \cdot 2Al(F,OH)_3SO_3 \cdot 2H_2O$	Mon.	1.461	1.478	1.485	$2V = 63°$ $r > v$	$Y = b$; $Z \wedge c = 41°$
$CsClO_4$	Orth.	1.4752	1.4788	1.4804	$2V = 62°30'$	Ax. pl. 100; $Z = b$
$NaPO_3$	Mon.	1.473	1.480±	1.486	$2V =$ Lg.	.....
$MgO \cdot Al_2O_3 \cdot 4SO_3 \cdot 22 \pm H_2O$	Mon.	1.476	1.480	1.483	$2V =$ Med.	$Y = b$; $Z \wedge c = 37°$
$ZnSO_4 \cdot 7H_2O$	Orth.	1.4568	1.4801	1.4836	$2V = 46°14'$ $r > v$ weak	Ax. pl. 001; $X = b$; $Z = a$
$3Na_2O \cdot N_2O_5 \cdot 2SO_3 \cdot 2H_2O$	Mon. (?)	1.391	1.481	1.486	$2V = 26°$ $r > v$ strong	$X = b$; $Z \wedge c = 12°$
$KHCO_3$	Mon.	1.380	1.482	1.573	$2V = 81°30'$	Ax. pl. 010; $X \wedge c = 30°$; $Y = b$
$MnO \cdot Al_2O_3 \cdot 4SO_3 \cdot 24H_2O$	Mon.	1.478	1.482	1.482	$2V =$ Sm.	$Y = b$; $Z \wedge c = 29°$
$CoSO_4 \cdot 7H_2O$	Mon.	1.477	1.483	1.489	$2V = 88°$ $r < v$ weak	Ax. pl. 010; $X \wedge c = 29°18'$; $Z = b$
$K_2H_2P_2O_6 \cdot 3H_2O$	Orth.	1.4768	1.4843	1.4870	$2V = 62°$ $r < v$ weak	Ax. pl. 100; $X = c$
$NaH_2PO_4 \cdot H_2O$	Orth.	1.4557	1.4852	1.4873	$2V = 29°22'$ $r < v$ weak	Ax. pl. 010; $X = a$
$K_2O \cdot MgO \cdot 2SO_3 \cdot 4H_2O$	Mon.	1.483	1.487	1.490	$2V = 86°$ $r < v$	$Y = b$; $Z \wedge c =$ small
$Na_2SO_4 \cdot MgSO_4 \cdot 4H_2O$	Mon.	1.486	1.488	1.489	$2V = 71°$ $r < v$	Ax. pl. 010; $X \wedge c = -44° \pm$; $Y = b$
$Rb_2(meso\text{-}C_4H_4O_6) \cdot 2H_2O$	Mon.	.....	1.488	.....	.....	.....
$FeO \cdot Al_2O_3 \cdot 4SO_3 \cdot 24H_2O$	Mon.	1.480	1.488	1.490	$2V =$ Sm.	$Z \wedge c = 38°$; $Y = b$
$3Na_2SO_4 \cdot MgSO_4$	Mon. (?)	1.485	1.488	1.489	$2V = 84° \pm$	$r < v$

Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$MgSeO_4 \cdot 6H_2O$	Mon.	1.4856	1.4892	1.4911	$2V = 28°12'$ $r > v$ strong	Ax. pl. 010; $X \wedge c = -27°$
$NiSO_4 \cdot 7H_2O$	Orth.	1.4693	1.4893	1.4923	$2V = 41°54'$ $r > v$	Ax. pl. 001; $X = b$; $Z = a$
$K_3H(SO_4)_2$	Mon.	1.4793	1.4899	1.5259	$2V = 60°$	Ax. pl. $\perp 010$; $X \wedge c = -35°$
$(NH_4)_2MnF_5$	Orth.	1.46	1.49±	1.50	.....	Ax. pl. 010; $X = c$
$NaLi(dl\text{-}C_4H_4O_6) \cdot 2H_2O$	Mon.	.....	1.490	.....	$2V = 69°_{Li}$	Ax. pl. 010; $X \wedge c = 34°30'$
$Mg(C_2H_3O_2)_2 \cdot 4H_2O$	Mon.	.....	1.491	.....	$2V = 56°34'$	Ax. pl. 010; $Z \wedge c = -48°15'$
$CaO \cdot Al_2O_3 \cdot 7SiO_2 \cdot 7H_2O$	Orth.	1.484	1.492	1.495	$2V = 44°$ $r < v$ weak	$X = c$; $Z = a$
$MgSO_4 \cdot 5H_2O$	Tric.	1.482	1.492	1.493	$2V = 45°8'$ $r < v$	Ax. pl. *ca.* $\perp 010$
$Na_2CO_3 \cdot 2.5H_2O$	Orth.	1.435	1.492	1.547	$2V$ = Lg.	$X = c$
$MgSO_4 \cdot 2H_2O$	.....	.....	1.493	.....	.....	.....
$Zn(C_2H_3O_2)_2 \cdot 2H_2O$	Mon.	.....	1.494	.....	.....	.....
$NaNH_4(d\text{-}C_4H_4O_6) \cdot 4H_2O$	Orth.	1.495	1.498	1.499	$2V = 59°52'$	Ax. pl. 100; $X = c$
$Ca(NO_3)_2 \cdot 4H_2O$ (α)	Mon.	1.465	1.498	1.504	$2V = 50°$	.....
$6NaNO_3 \cdot 2Na_2SO_4 \cdot 3H_2O$	Orth.	1.418	1.500	1.543	.....	.....
$NaHCO_3$	Mon.	1.380	1.500	1.586	$2V = 75°$ $r > v$	Ax. pl. 010; $X \wedge c = 27°30'$; $Y = b$
$BeSeO_4 \cdot 4H_2O$	Orth.	1.4664	1.5007	1.5027	$2V = 26°43'$	Ax. pl. 100; $X = c$
$(NH_4)_2SO_4 \cdot CuSO_4 \cdot 6H_2O$	Mon.	1.4910	1.5007	1.5054	$2V = 68°31'$ $r > v$	Ax. pl. 010; $Z \wedge c = -71°13'$
$MgCO_3 \cdot 3H_2O$	Orth.	1.412	1.501	1.526	$2V = 53°5'$	Ax. pl. 001; $X = a$; $Z = b$
$2CaO \cdot 3Al_2O_3 \cdot 9SiO_2$	Mon.	1.493	1.501	1.508	$2V = 81°$ $r > v$	$Y = b$; $X \wedge c = 40°$
$Ba(OH)_2 \cdot 8H_2O$	Mon.	1.4710	1.5017	1.502	$2V = 8°33'$	Ax. pl. $\perp 010$; X *ca.* $\perp 001$
$3MgO \cdot 2SiO_2 \cdot 2H_2O$	Orth.	1.490	1.502±	1.511	$2V$ = Lg.	$Z = b$; $X = c$
$(NH_4)_3H(SO_4)_2$	Mon.	1.4959	1.5021	1.5276	$2V = 52°$	Ax. pl. $\perp 010$; $X \wedge c = 17°30'$
KNO_3*	Orth.	1.3320	1.5038	1.5042	$2V = 7°12'$ $r < v$	Ax. pl. 100; $X = c$; $Z = b$

*Also given as α1.3346; β1.5056; γ1.5064.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$MgO \cdot SO_3 \cdot KCl \cdot 3H_2O$	Mon.	1.494	1.505	1.516	$2V = 85°$ $r > v$	$Y = b$; $X \wedge c = -8°$
$2CaO \cdot 3B_2O_3 \cdot 13H_2O$	Mon.	1.495	1.505±	1.520	$2V = 70°$	$Y = b$; $r < v$
$Sr(C_2H_5SO_4)_2 \cdot H_2O$*	Mon.	1.497	1.505	1.509	.....	.....
$Na_2Si_2O_5$	Orth.	1.497	1.505	1.508	$2V = 52° \pm$	Ax. pl. 010; $X = a$
$Na_2CO_3 \cdot H_2O$**	Orth.	1.420	1.506	1.524	$2V = 48°$ $r < v$ weak	Ax. pl. 001; $X = a$
$2MgO \cdot 3SiO_2 \cdot 4H_2O$	Orth.	1.498	1.506	1.508	$2V = 50°$	Z = elong.
$MgO \cdot N_2O_5 \cdot nH_2O$	.....	1.344	1.506	1.506	$2V = 5°$	$r < v$
$Ce_2(S_2O_6)_3 \cdot 15H_2O$	Tric.	.....	1.507	.....	$2V = 88°52'$ $r > v$ weak	Both axial figures visible through 001[a]
$NaHCO_3 \cdot Na_2CO_3 \cdot 2H_2O$	Mon.	.....	1.5073	.....	$2V = 72°$ $r < v$	Ax. pl. $\perp 010$; $X \perp 010$; $Y \wedge c = 6°$
$MnSO_4 \cdot 5H_2O$	Tric.	1.495	1.508	1.514	$2V$ = Lg. $r > v$	
$K_2Si_2O_5$	Orth.	1.503	1.509±	1.513	$2V$ = Lg.	Ax. pl. 010; $X = c$
$Rb_2(meso\text{-}C_4H_4O_6) \cdot H_2O$	Tric.	.....	1.510	.....	$2V = 75°18'$	Ax. pl. 19° with c
$Ca(UO_2)_2P_2O_8 \cdot 12H_2O$	Orth.	1.488	1.510	1.521	$2V = 69°$	Ax. pl. 010; $X = c$
$CaO \cdot Al_2O_3 \cdot 6SiO_2 \cdot 5H_2O$	Mon.	1.502	1.510	1.512	$2V = 44°$ $r < v$ strong	$Y = b$; $Z \wedge c = 9°$
$CaO \cdot 2SiO_2 \cdot 2H_2O$	Orth.	1.512	1.514	1.515	$2V$ = Lg.	$Z = c$
$NaAlSiO_4$	Tric.	1.509	1.514	1.514	$2V = 12°$-$15°$	.....
$Na_2Si_2O_5$	Orth.	1.504	1.514	1.518	$2V = 50°$-$55°$	Ax. pl. 010; $X = a$
$KClO_3$[b]	Mon.	1.4084	1.5167	1.5234	$2V = 27°$ $r > v$	Ax. pl. $\perp 010$; $X \wedge c = 48°$
$Na_2O \cdot CaO \cdot 2CO_2 \cdot 5H_2O$	Mon.	1.444	1.516	1.523	$2V = 34°$ $r < v$ strong	$X = b$; $Z \wedge c = -14°$
$Ba(C_2H_3O_2)_2 \cdot H_2O$	Tric.	1.500	1.517	1.525	.....	.....
$K_2O \cdot CaO \cdot 2SO_3 \cdot H_2O$	Mon.	1.500	1.5170	1.5183	$2V = 27°$ $r < v$ strong	$Z = b$; $Y \wedge c = -2°18'$
$MnSO_4 \cdot 4H_2O$	Mon.	1.508	1.518	1.522	$2V = 63°$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 5°$

*Ethyl sulfate.
**Also given as α1.420; β1.509; γ1.525; $X = b$.

[a] Acute bisectrix inclined to left; unsym. dispersion.
[b] Also given as α1.440; β1.515; γ1.525; $2V = 28°15'$; $r > v$; $X \wedge c = 57°30'$.

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INDEX OF REFRACTION—BIAXIAL NEGATIVE

Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$2K_2C_2O_4 \cdot H_2C_2O_4 \cdot 2H_2O$	Orth.	1.48	1.52	1.55	.....	.....
$KCl \cdot CaCl_2$	.....	.....	1.52	.....	.....	.....
$Na_2O \cdot Al_2O_3 \cdot 2SiO_2$	Tric.	1.516	1.52	1.520	$2V = 36°$	.....
Na_2SiO_3	Orth.	1.513	1.520	1.528	$2V = Lg.$	.....
$Sr(HCO_2)_2 \cdot 2H_2O$	Orth.	1.484	1.521	1.538	$2V = 66°59'$	Ax. pl. 010; $X = c$
$CoSeO_4 \cdot 6H_2O$	Mon.	1.47 ±	1.5225	1.5227	$2V = 7°13'$ $r > v$	Ax. pl. 010; $X \wedge c = -34°42'$
$K_2Cu(SeO_4)_2 \cdot 6H_2O$*	Mon.	1.5101	1.5228	1.5349	$2V = 88°27'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = -76°26'$
$LiK(d\text{-}C_4H_4O_6) \cdot H_2O$	Orth.	.....	1.523	.....	$2V = 73°58'$	Ax. pl. 010; $X = a$
$KAlSi_3O_8$**	Mon.	1.519	1.523	1.525	$2V = 62°$	Ax. pl. $\perp 010$; $X \wedge a = 3°$
$NaHC_3H_2O_4 \cdot H_2O$[a]	Orth.	1.407	1.524	1.541	$2V = 39°20'$	Ax. pl. 100; $X = c$
$CaO \cdot Al_2O_3 \cdot 4SiO_2 \cdot 4H_2O$	Mon.	1.513	1.524	1.525	$2V = 25° \pm$ $r < v$ strong	$Y = b$; $Z \wedge c = 20°\text{-}30°$
$Ca(meso\text{-}C_4H_4O_6) \cdot 3H_2O$[b]	.....	1.470	1.525	1.555	.....	Ax. pl. 010
$K_2(d\text{-}C_4H_4O_6) \cdot 0.5H_2O$	Mon.	.....	1.526	.....	$2V = 62°$	Ax. pl. $\perp 010$
$K_2O \cdot Al_2O_3 \cdot 6SiO_2$	Tric.	1.522	1.526	1.530	$2V = 83°$	$r > v$ weak
$2NH_4NO_3 \cdot (NH_4)_2SO_4$[c]	Orth.	1.469	1.528	1.543	$2V = 55°$	Ax. pl. 100; $X = c$
$K_2Ca_2Si_9O_{21}$	Mon. (?)	1.515	1.53 ±	1.535	$2V = Lg.$	.....
$KC_4H_5O_4 \cdot 2H_2O$[d]	Orth.	1.417	1.530	1.533	.....	Ax. pl. 001; $Z = a$
$V_2O_4 \cdot 3SO_3 \cdot 16H_2O$	Mon.	1.518	1.530	1.542	$2V = Lg.$	$X = b$
K_2CO_3	.....	1.426	1.531	1.541	$2V = 35° \pm$	.....
$2NH_4NO_3 \cdot (NH_4)_2SO_4$[e]	Orth.	1.521	1.531	1.536	$2V = 64°$	Ax. pl. 100; $X = c$
$K_2H_2P_2O_6 \cdot 2H_2O$	Mon.	1.4893	1.5314	1.5363	$2V = 36°9'$ $r < v$ weak	Ax. pl. $\perp 010$; $X \wedge c = -36°30'$
$4CaO \cdot CaCl_2 \cdot 14H_2O$	Orth.	1.517	1.533	1.537	$2V = 45°$	Ax. pl. 100; $X = a$
$2MgO \cdot CO_2 \cdot 4H_2O$	Orth.	1.489	1.534	1.557	$2V = Lg.$	.....
$(NH_4)_2Cu(SeO_4)_2 \cdot 6H_2O$[f]	Mon.	1.5201	1.5344*	1.5387	$2V = 55°7'$ $r > v$ weak	Ax. pl. 010; $Z \wedge c = 102°42'$
$Na_2O \cdot CaO \cdot 2SO_3$	Mon.	1.515	1.535	1.536	$2V = 7°$ $r > v$ strong	$Z = b$; $Y \wedge c = 12°$

*Also given as α1.5096; β1.5235; γ1.5387; $2V = 88°12'$.
**Stable below 600°C.
[a]Acid malonate.
[b]Stated to be +; indices indicate negative.
[c]See also values given under β1.531.
[d]Acid succinate.
[e]See also values given under β1.528.
[f]See also values given under β1.5395.

INDEX OF REFRACTION—BIAXIAL NEGATIVE

Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$2CaO \cdot 3B_2O_3 \cdot 7H_2O$	Tric.	1.500	1.535	1.560	$2V = 79°$	$r > v$
Na_2CO_3	.....	1.415	1.535	1.546	$2V = 34° \pm$	.....
$FeSO_4 \cdot 4H_2O$	Mon.	1.533	1.535	.....	$2V = Lg.$	Ax. pl. $\perp 010$; $Z \perp 010$
$CaCO_3 \cdot 6H_2O$	Mon.	1.460	1.535	1.545	$2V = 38°$	Ax. pl. 010; $Z \wedge c = 17°$
NH_4HCO_3	Orth.	1.4227	1.5358	1.5545	$2V = 41°38'$ $r < v$ weak	Ax. pl. 010; $X = a$; $Y = b$
Na_4SiO_4*	.....	.....	1.536 ±	.....	.....	.....
$FeSO_4 \cdot 5H_2O$	Tric.	1.526	1.536	1.542	$2V =$ Mod.	$r > v$ weak
$CuSO_4 \cdot 5H_2O$	Tric.	1.5141	1.5368	1.5434	$2V = 56°2'$	$r < v$ weak, crossed and strong inclined dispersion.
$CaO \cdot Al_2O_3 \cdot 4SiO_2 \cdot 4H_2O$	Mon.	.....	1.539	.....	$2V = 83°$ $r < v$ weak	$X = b$; $Y \wedge c = Sm.$
$(NH_4)_2Cu(SeO_4)_2 \cdot 6H_2O$**	Mon.	1.5213	1.5395	1.5363	$2V = 55°24'$	Ax. pl. 010; $X \wedge c = 12°21'$; $X \wedge a = 93°12'$
$CaC_4H_4O_4 \cdot 3H_2O$[a]	.....	1.460	1.540	1.610	.....	.....
$6MgO \cdot 2B_2O_3 \cdot 2SO_3 \cdot 9H_2O$	Orth.	1.527	1.540	1.544	$2V = 70° \pm$	$X = c$; $Z = a$
$3MgO \cdot B_2O_3 \cdot P_2O_5 \cdot 8H_2O$	Mon.	1.520	1.541	1.545	$2V =$ Mod.	$Y = b$
$K_4CaSi_6O_{15}$	Mon. (?)	1.535	1.541	1.543	$2V = 60° \pm$	.....
$Cu(HCO_2)_2 \cdot 4H_2O$	Mon.	1.413	1.542	1.557	$2V = 34°54'$	Ax. pl. 010; $X \wedge c = 23°35'$
$Co(C_2H_3O_2)_2 \cdot 4H_2O$	Mon.	.....	1.542	.....	$2V = 30°43'$	Ax. pl. 010; $X \wedge c = -53°30'$
$Na_2O \cdot Al_2O_3 \cdot 2CO_2 \cdot 2H_2O$	Orth.	1.466	1.542	1.596	$2V = 77°$ $r < v$ weak	$Y = c$; $X = a$
KHC_2O_4	Mon.	1.415	1.545	1.565	$2V = 40°$	Ax. pl. 010; $X \perp 100$
$Cs_2Ni(SeO_4)_2 \cdot 6H_2O$	Mon.	1.5395	1.5450	1.5489	$2V = 83°8'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = -73°9'$
$BaSiO_3 \cdot 6H_2O$	Orth.	1.542	1.547	1.548	$2V = 39°40'$ $r > v$ strong	Ax. pl. 010; $X = a$
$CoSO_4 \cdot 5H_2O$	Tric.	1.530	1.548	1.550	$2V =$ Mod.	.....
$BaO \cdot Al_2O_3 \cdot 3SiO_2 3H_2O$	Orth.	1.538	1.549	1.554	$2V = 53°$ $r < v$ weak	$X = c$; $Z = a$
$2MgO \cdot B_2O_3 \cdot H_2O$	.....	1.53	1.55	1.55	$2V = Sm.$	.....

*Low temp. phase.
**See also values given under β 1.5344.

[a] Succinate.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$MgCrO_4 \cdot 7H_2O$	Orth.	1.5211	1.5500	1.5680	$2V = 75°28'$ $r < v$	Ax. pl. 001; $X = b$
$RbLi(d\text{-}C_4H_4O_6) \cdot H_2O$	Orth.	.....	1.552	.....	$2V = 57°10'_{Li}$	Ax. pl. 001; $X = a$
$NaH_2AsO_4 \cdot H_2O$	Orth.	1.5382	1.5535	1.5607	$2V = 67°57'$ $r < v$	Ax. pl. 010; $X = c$
$Rb_2S_3O_6$	Orth.	1.4874	1.5580	1.5867	$2V = 62°33'$	Ax. pl. 010; $X = c$
$Na_2O \cdot 2BeO \cdot P_2O_5$	Orth.	1.552	1.558	1.561	$2V = 68°$	$X = c$; $Z = b$
$(NH_4)_2SeO_4$	Orth.	.....	1.56±	.....	$2V = 56° \pm$	Ax. pl. 010; $X = c$
$CuSeO_4 \cdot 5H_2O$	Tric.	.....	1.56±	1.565 (?)	.....	.....
$H_4Al_2Si_2O_9$	Mon.	1.556	1.56±	1.564	$2V = Sm.$ $r > v$	Ax. pl. $\perp 010$; $Z \perp 010$
$2CaO \cdot MgO \cdot K_2O \cdot 4SO_3 \cdot 2H_2O$*	Tric.	1.547	1.560	1.567*	$2V = 62°$	.....
$LiHC_4H_4O_5 \cdot 6H_2O$**	Mon.	1.530	1.560	1.590	.....	Ax. pl. 010
$K_2S_3O_6$	Orth.	1.4934	1.5641	1.602	$2V = 70° \pm$	Ax. pl. 010; $X = c$
Cs_2SO_4	Orth.	1.5598	1.5644	1.5662	$2V = 65°20'$ $r < v$ weak	Ax. pl. 010; $X = c$
$Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$	Mon.	1.561	1.565	1.566	$2V = 10°\text{-}57°$	X *ca.* $\perp 001$
$K_2Ca_3Si_6O_{16}$ (β)	Orth.	1.56	1.565	1.57	.....	.....
$CdSO_4 \cdot 2.6H_2O$	Mon.	.....	1.565	.....	$2V = 88°9'$ $r > v$ weak	Ax. pl. $\perp 010$; $X \perp 010$
$Ca(C_4H_5O_2)_2$[a]	.....	1.536	1.567	1.649	.....	.....
Li_2CO_3	Mon.	1.428	1.567	1.572	$2V = 15° \pm$	Ax. pl. $\perp 010$; $X \wedge c = 0° \pm$
$Al_2O_3 \cdot P_2O_5 \cdot 4H_2O$	.....	1.554	1.571	1.576	$2V = Mod.$	$r > v$; $Z = elong.$
$3MgO \cdot (NH_4)_2O \cdot 2P_2O_5 \cdot 10H_2O$	Tric.	1.555	1.572	1.575	$2V = 42°$	.....
$CaO \cdot 2UO_3 \cdot P_2O_5 \cdot 8H_2O$	Mon.	1.56	1.574	1.580	$2V = 62°$	$X = b$
$CaC_4H_2O_4$[b]	Orth.	1.495	1.575	1.640	$2V = 77°36'$	$X = c$; $Y = a$; $Z = b$
$Ca(UO_2)_2P_2O_8 \cdot 8H_2O$	Orth.	1.553	1.575	1.577	$2V = 33°$ $r > v$	Ax. pl. 010; $X = c$; $Z = a$
$(Pt(NH_3)Cl_3)K \cdot H_2O$	Orth.	1.5438	1.5754	1.588±	$2V = 64° \pm$	Ax. pl. 100; $X = c$
$5Al_2O_3 \cdot 2P_2O_5 \cdot 16H_2O$[c]	Orth.	1.562	1.576	1.588	$2V = Lg.$	$Z = c$

*Also given as α1.548; β1.562; γ1.567; orth.
**Acid malate.

[a] Crotonate.
[b] Maleate.
[c] Int. Crit. Tab. gives $9H_2O$.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$K_4Fe(CN)_6 \cdot 3H_2O$	Mon.	.....	1.5772	.....	$2V = 78°10'$ $r > v$ weak	Ax. pl. $\perp 010$; $X \wedge c = 31°50'$
$CuO \cdot Na_2O \cdot 2SO_3 \cdot 2H_2O$	Mon.	1.544	1.578	1.601	$2V = 79°$ $r < v$ weak	$Y = b$; $X \wedge c = -48°$
$CsCeCl_4$	Mon.	.....	1.58±	.....	.....	.....
$CaO \cdot 2UO_3 \cdot As_2O_5 \cdot 8H_2O$	Orth.	1.560	1.582	1.587	$2V = 46°$	$r > v$ strong; $X = c$
$3ZnO \cdot P_2O_5 \cdot 4H_2O$	Orth.	1.560	1.582	1.587	$2V = 0°$ ±	$X = b$; $Y = a$ or c
$SrAl_2Si_2O_8$	Tric.	1.574	1.582	1.586	$2V$ = Mod.	.....
$CaAl_2Si_2O_8$	Tric.	1.5755	1.5832	1.5885	$2V = 77°$	.....
$K_4Ru(CN)_6 \cdot 3H_2O$	Mon.	.....	1.5837	.....	$2V = 54°$	Ax. pl. $\perp 010$; $X \wedge c = 32°10'$
$MgPt(CN)_4 \cdot C_3H_8O_3 \cdot 5H_2O$	Mon.	.....	1.584	.....	$2V = 17°38'$	Ax. pl. 010; $X \wedge c = 30°$
$Al_2O_3 \cdot 4SiO_2 \cdot H_2O$	Orth.	1.552	1.588	1.600	$2V = 57°$	$r > v$ weak; $X = c$
$Tl_2Mg(SO_4)_2 \cdot 6H_2O$	Mon.	1.5705	1.5884	1.5949	$2V = 74°57'$	Ax. pl. 010; $Z \wedge c = -9°4'$
$3MgO \cdot 4SiO_2 \cdot H_2O$	.....	1.539	1.589	1.589	$2V = 6°$-$30°$	$r > v$; $X = c$
$2CaO \cdot As_2O_5 \cdot 5H_2O$	Mon.	1.583	1.589	1.594	$2V = 77°$ $r < v$ strong	$Z = b$; $X \wedge c = 70°$
$4CaO \cdot 5B_2O_3 \cdot 7H_2O$*	Tric.	1.572	1.591	1.594	$2V = 32°$	$r < v$ strong
$CuO \cdot 2UO_3 \cdot P_2O_5 \cdot 12H_2O$**	Orth.	1.582	1.592	1.592	$2V$ = Sm.	$r > v$; $X = c$
$Al_2O_3 \cdot P_2O_5 \cdot 2LiF$	Tric.	1.578	1.595	1.598	$2V = 52°$-$90°$	$r > v$ weak
$BeO \cdot CaO \cdot 2SiO_2 \cdot NaF$	Orth.	1.571	1.595	1.598	$2V = 39°$ $r > v$ weak	$X = c$; $Z = b$
$Na_2Ca_2(SiO_3)_3$	.....	1.596	1.597±	1.599	.....	.....
$4CaO \cdot 5B_2O_3 \cdot 2SiO_2 \cdot 5H_2O$	Mon.	1.586	1.598	1.605	$2V$ = Lg.	$X = b$; $Z \wedge c = 44°$ ±
$Tl_2Mn(SO_4)_2 \cdot 6H_2O$	Mon.	1.5861	1.5996	1.6084	$2V = 71°26'$	Ax. pl. 010; $Z \wedge c = -14°15'$
Cs_2SeO_4	Orth.	1.5989	1.5999	1.6003	$2V = 71°49'$[a] $r > v$	Ax. pl. 001; $X = b$
$Ca_2P_2O_7$	.....	1.585	1.60±	1.605	$2V$ = Sm.	.....
$Na_2O \cdot 3Al_2O_3 \cdot 6SiO_2 \cdot 2H_2O$	Mon.	.....	1.60	.....	$2V = 40°$ ±	.....
$K_2Li_2Fe(CN)_6 \cdot 3H_2O$	Mon.	1.5883	1.6007[b]	1.6316	$2V = 65°56'$ $r > v$ weak	Ax. pl. 010; $X \wedge c = -44°10'$

*Int. Crit. Tab. gives $5CaO \cdot 6B_2O_3 \cdot 9H_2O$.
**Int. Crit. Tab. gives $CuO \cdot 2UO_3 \cdot P_2O_5 \cdot 8H_2O$; tetr.

[a] Increases with rise in temp.; + at 60°C.; uniaxial at 95°C.; + at 150°C., ax. pl. 010; − at 280°C., $X = c$.

[b] Given as negative; indices indicate positive.

INDEX OF REFRACTION—BIAXIAL NEGATIVE

INDEX OF REFRACTION—BIAXIAL NEGATIVE

Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$4ZnO \cdot P_2O_5 \cdot 4H_2O$	Mon.	1.586	1.602	1.606	$2V = 49°$ $r > v$	$Z = b$; $X \; c\alpha. = a$
$CaC_4H_2O_4 \cdot 2H_2O$*	Orth.	1.413	1.602	1.611	$2V = 22°24'$	$X = a$; $Y = b$; $Z = c$
$7MnO \cdot Al_2O_3 \cdot 8SiO_2 \cdot 6H_2O$	Mon.	1.573**	1.603**	1.604**	$2V = 26°$ $r < v$	$X \wedge c$ = small; $Y = b$
$Sr(ClO_3)_2$	Orth.	1.5670	1.6047	1.6257	$2V = 72°21'$ $r > v$	Ax. pl. 100; $X = c$
$KFeSi_3O_8$	Mon.	1.601	1.605±	1.609	.....	Ax. pl. 010
$Fe_2O_3 \cdot 2SO_3 \cdot 7H_2O$	Tric.	1.51	1.605	1.611	$2V = 28°$	$r < v$ strong
$4BeO \cdot 2SiO_2 \cdot H_2O$	Orth.	1.591	1.605	1.614	$2V = 75°$ $r < v$ weak	$X = a$; $Z = c$
$KC_6H_4O_7S_2 \cdot H_2O$[a]	Orth.	.....	1.607	.....	$2V = 65°35'$	Ax. pl. 010; $X = a$
$K_4Os(CN)_6 \cdot 3H_2O$	Mon.	.....	1.6071	.....	$2V = 47°$	Ax. pl. $\perp 010$; $X \wedge c = 30°10'$
$Tl_2Fe(SO_4)_2 \cdot 6H_2O$	Mon.	1.5929	1.6093	1.6162	$2V = 69°$	Ax. pl. 010; $Z \wedge c = -16°15'$
$Tl_2Zn(SO_4)_2 \cdot 6H_2O$	Mon.	1.5931	1.6093	1.6168	$2V = 69°24'$ $r < v$ weak	Ax. pl. 010; $Z \wedge c = -13°29'$
$Tl_2Cu(SO_4)_2 \cdot 6H_2O$	Mon.	1.5996	1.6096	1.6190	$2V = 85°16'$	Ax. pl. 010; $Z \wedge c = -17°20'$
$2CaO \cdot SiO_2 \cdot H_2O$	Orth.	1.605	1.61±	1.612	$2V = 70°$ (?)	$Z = c$; $Y = b$ (?)
NH_4NO_3[b]	Orth.	1.413	1.611	1.637	$2V = 35°$ $r < v$ weak	Ax. pl. 100; $X = b$
$CaO \cdot 2BeO \cdot P_2O_5 \cdot Ca(F,OH)_2$	Mon.	1.592	1.612	1.621	$2V = 74°$ $r > v$	$Y = b$; $Z \wedge c = 2°30'$
$BaO \cdot 2SiO_2$	Orth. (?)	1.597	1.612	1.621	$2V = 75°$	Ax. pl. 100; $X = c$
$MgC_{10}H_6O_6S_2 \cdot 6H_2O$[c]	Mon.	1.520	1.613	1.639	$2V = 52°20'$	Ax. pl. 010
$2CaO \cdot 5MgO \cdot 8SiO_2 \cdot H_2O$	Mon.	1.600	1.616	1.627	$2V = 80°$	$Y = b$; $Z \wedge c = 15°$
$Tl_2Co(SO_4)_2 \cdot 6H_2O$	Mon.	1.6009	1.6176	1.6238	$2V = 66°39'$ $r < v$	Ax. pl. 010; $Z \wedge c = -15°40'$
$Tl_2Ni(SO_4)_2 \cdot 6H_2O$	Mon.	1.6024	1.6183	1.6224	$2V = 61°37'$ $r < v$ strong	Ax. pl. 010; $Z \wedge c = -14°40'$
$CaHPO_4$	Tric.	1.61	1.62±	1.63	.....	.....
$SrHPO_4$	Orth.	1.608	1.62±	1.625	.....	Ax. pl. 100

*Fumarate.
**Also given as α1.705; β1.729; γ1.730.

[a]Phenol-2,4-disulfonate.
[b]Stable between −16° and 32°C.

[c]Naphthalene-1,5-disulfonate.

INDEX OF REFRACTION—BIAXIAL NEGATIVE

INDEX OF REFRACTION—BIAXIAL NEGATIVE

Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$(NH_4)_4UO_2(CO_3)_3$	Mon.	1.60	1.62±	1.625	.....	.....
$BaO \cdot 2UO_3 \cdot P_2O_5 \cdot 8H_2O$	Orth.	1.610	1.623	1.623	$2V = 10°$	$X = c$; $Z = a$
$CuO \cdot 2CuSO_4 \cdot 5H_2O$	Tric.	1.601	1.623	1.641	$2V = 87°$	$r > v$ extreme
$Zn_2(OH)PO_4$	Orth. (?)	1.608	1.624	1.629	$2V$ = Lg.	Ax. pl. 010; $X = a$
$CuC_{10}H_6O_6S_2 \cdot 6H_2O$*	Mon.	1.541	1.625	1.660	.....	Ax. pl. 010
NaCNS	Orth. (?)	1.545±	1.625±	1.695±	$2V = 82° \pm$	.....
$Pb(UO_2)_2P_2O_8 \cdot 8H_2O$	Tetr. (?)	.....	1.626 (?)	.....	.....	.....
$CoC_{10}H_6O_6S_2 \cdot 6H_2O$*	Mon.	1.532	1.628	1.665	$2V = 61°40'$	Ax. pl. 010
$MnO \cdot Al_2O_3 \cdot 2SiO_2 \cdot 2H_2O$	Orth.	1.611	1.628	1.630	$2V = 50°$ $r > v$ strong	$X = b$; $Z = c$
$CaSiO_3$[a]	Mon.	1.616	1.629	1.631	$2V = 39°$	.....
$K_2S_5O_6 \cdot 1.5H_2O$	Orth.	1.570**	1.63±	1.658**	$2V = 65° \pm$ $r > v$	Ax. pl. 010; $X = a$
$SrPt(CN)_4 \cdot 5H_2O$	Mon.	1.5800	1.63±	1.6331	$2V = 20° \pm$	Ax. pl. 010; $X \wedge c = 19°30'$
$10CaO \cdot 3P_2O_5 \cdot CO_2$	.....	1.622	1.630	1.630	$2V$ = Sm.	$Z = c$
$3UO_3 \cdot As_2O_5 \cdot 12H_2O$	Mon. (?)	1.585	1.630	1.630	$2V = 0° \pm$	$X = c$
$8MnO \cdot 7SiO_2 \cdot 5H_2O$	Orth.	1.602	1.632	1.632	$2V = 0° \pm$	$X = c$
$(NH_4)_2UO_2Cl_4 \cdot 2H_2O$	Tric.	1.57±	1.633±	1.637±	$2V$ = Sm.	.....
$CaO \cdot 2SiO_2 \cdot B_2O_3$	Orth.	1.630	1.633[b]	1.636	$2V = 88°$ $r < v$ strong	$X = b$; $Z = a$
$Rb_2Mg(CrO_4)_2 \cdot 6H_2O$	Mon.	1.6217	1.6330	1.6435	$2V = 86°32'$ $r > v$ strong	Ax. pl. $\perp 010$; $Z \wedge c = -48°10'$
$Tl_2Mg(SeO_4)_2 \cdot 6H_2O$	Mon.	1.6250	1.6337	1.6404	$2V = 77°33'$	Ax. pl. 010; $Z \wedge c = -4°27'$
$(Mg,Fe)O \cdot Al_2O_3 \cdot P_2O_5 \cdot H_2O$	Mon.	1.612	1.634[c]	1.643	$2V$ = Lg. $r < v$	$Y = b$; $X \wedge c = -9°$
$Fe_2O_3 \cdot 3SO_3 \cdot 6H_2O$[d]	Mon.	1.605	1.635	1.657	$2V$ = Lg.	Ax. pl. 010; $X \wedge c = 24° \pm$
$NiC_{10}H_6O_6S_2 \cdot 6H_2O$*	Mon.	1.541	1.636	1.669	$2V = 59°56'$	Ax. pl. 010
$Na_2C_{10}H_6O_6S_2 \cdot 2H_2O$*	Mon.	1.577	1.636	1.639	.....	.....
$K(SbO)(d\text{-}C_4H_4O_6) \cdot O.5H_2O$[e]	Orth.	1.620	1.636	1.638	$2V = 42°34'$	Ax. pl. 001; $X = b$
$Li_2C_{10}H_6O_6S_2 \cdot 2H_2O$*	Mon.	1.507	1.638	1.698	$2V = 23°$	Ax. pl. $\perp 010$

* Naphthalene-1,5-disulfonate.

[a] β-Phase; inverts at 1200°C. to α-phase.

** Also given as α1.565; γ1.655±.

[b] Also given as α1.623; β1.634; γ1.636.

[c] Int. Crit. Tab. gives α1.603; β1.632; γ1.639.

[d] Stable from 50° to 160°C.

[e] Tartar emetic.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$Al_2O_3 \cdot SiO_2$	Orth.	1.634	1.639	1.643	$2V = 85°$ $r > v$ weak	$X = c$; $Z = a$
$CoSO_4 \cdot H_2O$	Mon. (?)	1.603	1.639	1.683	$2V$ = Lg.	.....
$K_2Pt(NO_2)_2 \cdot C_2O_4 \cdot H_2O$	Mon.	1.545	1.641	1.760	.....	.....
$Na_2O \cdot 5MoO_3 \cdot P_2O_5 \cdot 14H_2O$	Orth.	1.5962	1.6411	1.6520	$2V = 51°18'$ $r < v$ weak	Ax. pl. 100; $X = b$
$Tl_2Mn(SeO_4)_2 \cdot 6H_2O$	Mon.	1.6276	1.6429	1.6531	$2V = 72°27'$	Ax. pl. 010; $Z \wedge c = -8°21'$
$CaO \cdot 2Al_2O_3 \cdot 2SiO_2 \cdot H_2O$	Mon.	1.632	1.643	1.645	$r < v$	$Z = b$; $X \wedge c = 6° \pm$
$3FeO \cdot Al_2O_3 \cdot 2SiO_2 \cdot 3H_2O$	Mon.	1.643	1.649	1.649	$2V$ = Sm.	$X = c$
$Tl_2Ni(SeO_4)_2 \cdot 6H_2O$	Mon.	1.6378	1.6498	1.6560	$2V = 58°59'$	Ax. pl. 010; $Z \wedge c = 10°19'$
$BaCdCl_4 \cdot 4H_2O$	Tric.	.....	1.651	.....	$2V = 61°1'$ $r < v$	X nearly $\perp 110$
$Tl_2Fe(SeO_4)_2 \cdot 6H_2O$	Mon.	1.6532	1.6514	1.6589	$2V = 69°36'$	Ax. pl. 010; $Z \wedge c = -9°9'$
$18CuO \cdot 4Al_2O_3 \cdot 5As_2O_3 \cdot 55H_2O$	Mon.	1.612	1.652	1.675	$2V = 67°$ $r < v$	$X = b$; $Z \wedge c = -25°$
$Tl_2Co(SeO_4)_2 \cdot 6H_2O$	Mon.	1.6442	1.6535	1.6590	$2V = 66°42'$	Ax. pl. 010; $Z \wedge c = -8°22'$
$Tl_2Zn(SeO_4)_2 \cdot 6H_2O$	Mon.	1.6414	1.6539	1.6615	$2V = 68°34'$	Ax. pl. 010; $Z \wedge c = -6°46'$
$2CaO \cdot 2SiO_2 \cdot B_2O_3 \cdot H_2O$	Mon.	1.626	1.654	1.670	$2V = 74°$	$r > v$ weak; $Y = b$
$5MnO \cdot 2P_2O_5 \cdot 5H_2O$	Mon.	1.647	1.654	1.660	$2V = 74°$ $r < v$ strong	$X = b$; $Z \wedge c = 75°$
$CaO \cdot Al_2O_3$	Mon.	1.643	1.655	1.663	$2V = 36°$	Ax. pl. 010; $X = c$
$2MnO \cdot Al_2O_3 \cdot P_2O_5 \cdot 4H_2O$	Orth.	1.633	1.655	1.662	$2V = 51° \pm$	$X = b$; $Z = c$
$5MnO \cdot 2P_2O_5 \cdot 4H_2O$	Mon.	1.652	1.656	1.660	$2V$ = Lg.	.....
CaB_2O_4	Orth.	1.540	1.656	1.682	$2V = 51°$	Ax. pl. 001; $X = a$
$Zn_3P_2O_8 \cdot ZnO$	Orth. (?)	1.630	1.656	1.660	$2V = 30° \pm$	Ax. pl. $\perp 010$; $X = a$
$Tl_2Cu(SeO_4)_2 \cdot 6H_2O$	Mon.	1.6396	1.6565	1.6720	$2V = 85°9'$	Ax. pl. 010; $Z \wedge c = -14°25'$
$3NiO \cdot As_2O_5 \cdot 8H_2O$	Mon.	1.622	1.658	1.687	$2V = 84°$	$r > v$ strong; $X = b$
$3MnO \cdot P_2O_5 \cdot 4H_2O$ (?)	Tric.	1.63	1.66	1.69	$2V$ = Lg.	X *ca.* $\perp 100$
KCNS	Mon.	1.532±	1.660±	1.730±	$2V = 68° \pm$	$Z \wedge c = 16° \pm$
$2CaO \cdot MgO \cdot As_2O_5 \cdot MgF_2$	Mon.	1.640	1.660	1.675	$2V = 83°$	$Z = b$
$Ag_2S_2O_6 \cdot 2H_2O$	Orth.	1.632±	1.662±	1.665±	$2V = 33°$	Ax. pl. 001; $X = b$

INDEX OF REFRACTION—BIAXIAL NEGATIVE

Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$CaO \cdot MgO \cdot SiO_2$	Orth.	1.651	1.662	1.668	$2V = 76°$ $r > v$	$X = b$; $Z = a$
$SrO \cdot CO_2$	Orth.	1.516	1.664	1.666	$2V = 7°$ $r < v$ weak	$X = c$; $Z = a$
$CaO \cdot ZnO \cdot SiO_2 \cdot H_2O$	Mon.	1.662	1.667	1.669	$2V$ = Med. $r > v$	$Z = b$; $Y \wedge c = -28°$
$CaO \cdot 2UO_3 \cdot 2SiO_2 \cdot 6H_2O$	Tric. (?)	1.642	1.667	1.669	$2V = 32$ $r < v$	X *ca.* a; $Z \wedge c = 2°$
$3FeO \cdot As_2O_5 \cdot 8H_2O$*	Mon.	1.635	1.668	1.702	$2V = 87°$ $r > v$ strong	$X = b$; $Z \wedge c = 32°$
$K_2C_{10}H_6O_6S_2 \cdot 2H_2O$**	Mon.	1.485	1.669	1.697	$2V = 38°50'$	Ax. pl. $\perp 010$
$ZnSO_4$	Orth.	1.658	1.669	1.670	$2V$ = Sm. $r < v$ strong	Ax. pl. 010 (?); $Z = c$
$CoCl_2 \cdot 2H_2O$	Tric. (?)	1.625	1.671	1.67	.....	.....
$Ca_3Al_{10}O_{18}$[a]	Orth. (?)	1.662	1.671	1.674	$2V = 35°$	$r > v$ strong
$CuSO_4 \cdot H_2O$	.....	1.626	1.671	1.699	$2V = 75°$	$r < v$
$Na_2O \cdot 2AlFO \cdot As_2O_5$	Mon.	1.634	1.673	1.685	$2V = 45°$ $r < v$ weak	$Y = b$; $X \wedge c = 25°$
$4CaO \cdot 2SiO_2 \cdot CaCO_3$[b]	Orth.	1.665	1.674 ±	1.680	$2V$ = Lg.	Ax. pl. 100
$4CaSiO_3 \cdot 3MnSiO_2$	Tric.	1.662	1.674	1.676	$2V = 52° \pm$	.....
$BaCO_3$	Orth.	1.529	1.676	1.677	$2V = 16°$ $r > v$ weak	$X = c$; $Z = b$
$2FeO \cdot Al_2O_3 \cdot P_2O_5 \cdot 4H_2O$	Orth.	1.643	1.678	1.684	$2V = 45° \pm$ $r > v$ strong	$X = b$; $Z = c$
$2KCl \cdot HgCl_2 \cdot H_2O$	Orth.	1.648	1.678	1.699	$2V = 78°21'$ $r > v$ strong	Ax. pl. 001; $X = a$
$Na_3AsS_4 \cdot 8H_2O$	Mon.	.....	1.6802	.....	$2V = 87°44'$	Ax. pl. 010; $X \wedge c = 81°11'$
$CaCO_3$[c]	Orth.	1.5300	1.6809	1.6854	$2V = 18°11'$	Ax. pl. 100; $X = c$; $Z = b$
$BaO \cdot CaO \cdot 2CO_2$	Mon.	1.525	1.684	1.686	$2V = 15°$ $r > v$	$Z = b$; $X \wedge c = 64°24'$
NH_4CNS	Mon.	1.546 ±	1.685 ±	1.692	$2V = 23° \pm$	Ax. pl. 010; $Z \wedge c = 22°$

*Given as negative; indices indicate positive.
**Naphthalene-1,5-disulfonate.
[a] Unstable phase.
[b] High temp. or α-phase; stable above 1200°C., 90 atm.
[c] λ-Phase; metastable above 0°C.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$3CuO \cdot As_2O_5 \cdot 5H_2O$	Orth.	1.67	1.686	1.698	$2V = Lg.$	.....
$8Al_2O_3 \cdot B_2O_3 \cdot 6SiO_2 \cdot H_2O$	Orth.	1.678	1.686	1.689	$2V = 35° \pm$ $r < v$	$X \wedge c = 0° \pm$; $Z = a$
$Ca_5Al_6O_{14}$*	Orth.(?)	1.687	1.69 ±	1.692	$2V = Lg.$	.....
$Li_2O \cdot 2FeO \cdot P_2O_5$	Orth.	1.691	1.695	1.696	$2V = Med.$ $r < v$ strong	$X = c$; $Z = b$
$7FeO \cdot 8SiO_2 \cdot H_2O$**	Mon.	1.672	1.697	1.717	$2V = 82°$	$r < v$; $Y = b$
$Na_2Z \cdot Si_2O_7$	Mon.(?)	1.688	1.7 ±	1.710	.....	.....
$2Ce_2O_3 \cdot 3SrO \cdot 7CO_2 \cdot 5H_2O$	Orth.	1.625	1.700	1.735	$2V = 66°$	$X = a$; $Y = b$
$Ca(Fe,Mn,Mg)_2Si_2O_6$	Tric.	1.69 ±	1.701	1.708 ±	$2V = 65°30'$	Extinction: $\perp$ X at 5° and $\perp$Z at nearly 0°.
$2BeO \cdot BaO \cdot 2SiO_2$[a]	Orth.	1.695	1.702	1.708	$2V = 70°$	.....
$BaBr_2 \cdot CdBr_2 \cdot 4H_2O$	Tric.	.....	1.702	.....	$2V = 70°13'$	$r < v$
$4ZnO \cdot P_2O_5 \cdot H_2O$	Tric.	1.660	1.705	1.713	$2V = 50°$	.....
$5MgO \cdot Al_2O_3 \cdot 2SiO_2$	Mon.	1.705	1.709	1.711	$2V = 69°$ $r < v$	$Y = b$; $Z \wedge c = -8°30'$
Rb_2CrO_4	Orth.	.....	1.71 ±	1.72 ±	$2V = 74° \pm$ $r < v$	Ax. pl. 010; $X = c$
$3(NH_4)_2O \cdot TeO_2 \cdot 6MoO_2 \cdot 7H_2O$	Tric.	1.689 ±	1.7102	1.755 ±	$2V = 74° \pm$	.....
$BaC_{10}H_6O_6S_2 \cdot H_2O$[b]	Orth.	1.614	1.714	1.729	.....	.....
$CaO \cdot MnO \cdot SiO_2$[c]	Orth.	1.679	1.716[c]	1.729	$2V = Med.$ $r > v$	$X = b$; $Z = a$
$3UO_3 \cdot P_2O_5 \cdot 6H_2O$	Mon.(?)	1.691	1.720	1.720	$2V = 0° \pm$	$X = b$
$Al_2O_3 \cdot SiO_2$	Tric.	1.712	1.720	1.728	$2V = 82°$ $r > v$	X *ca.* $\perp 100$; $Z \wedge c = -30° \pm$
$5CuO \cdot As_2O_5 \cdot 9H_2O$	Orth.	1.694	1.726	1.730	$2V = 36°$ $r > v$ strong	$X = c$; $Z = a$
K_2CrO_4	Orth.	1.7087	1.7261	1.7304	$2V = 57°47'$ $r > v$ weak	Ax. pl. 100; $X = b$
$7MnO \cdot Al_2O_3 \cdot 8SiO_2 \cdot 6H_2O$	Mon.	1.705	1.729[d]	1.730	.....	.....
$CuO \cdot SeO_2 \cdot 2H_2O$	Mon.	1.710	1.731	1.732	$2V = 34°_{Li}$	$r > v$; $Y = b$

*Unstable phase; fibrous.
**Int. Crit. Tab. gives $FeO \cdot SiO_2$.

[a]Also sometimes positive, β1.696.
[b]Naphthalene-1 5-disulfonate.

[c]Int. Crit. Tab. gives α1.686; β1.722; γ1.735.
[d]Also given as α1.573; β1.603; γ1.604.

INDEX OF REFRACTION—BIAXIAL NEGATIVE

Subetance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$4ZnO \cdot As_2O_5 \cdot H_2O$	Orth.	1.708*	1.733*	1.758*	.....	.....
$CuSO_4$	Orth.	1.724	1.733	1.739	2V = Lg.	r > v extreme
$CaFeSiO_4$	Orth.	1.696	1.734	1.743	2V = 48°40′ r > v	Ax. pl. 001; X = *b*; Z = *c*
$7ZnO \cdot 3CO_2 \cdot 4H_2O$**	Mon. (?)	1.640	1.736	1.750	2V = 40°	r < v strong; X = *b*
$2Y_2O_3 \cdot 4SiO_2 \cdot H_2O$	Mon.	1.731	1.738	1.744	2V = 68° r < v weak	Z = *b* or X = *b*; Y ∧ *c* = Sm.
$Mn_3B_4O_9$	Tric.	1.617	1.738	1.776	2V = 55°47′	X ∧ ⊥001 = 27°43′; X ∧ ⊥100 = 29°11′
$Na_8Ti_5O_{14}$	Mon. (?)	.....	1.74+	.....	2V = Lg.	.....
$K_2Ti_2O_5$	Orth.	.....	1.74+	.....	2V = Lg.	.....
$SbBr_3$	Orth.	.....	1.74+	.....	.....	.....
$Cu_2(OH)PO_4$	Orth.	1.702	1.745	1.789	2V = 85° r > v strong	Ax. pl. 001; X = *b*; Y = *c*
$MgO \cdot Fe_2O_3 \cdot 3SiO_2 \cdot 4H_2O$	Orth.	1.723	1.745	1.765	2V = Lg. r < v strong	X = *a*; Y = *b*
$Na_2O \cdot SO_3 \cdot Pb(OH)Cl$	Orth.	1.743	1.754	1.764	2V *ca.* 90°	r > v strong
Na_2ZrO_3	Orth. (?)	1.720	1.76±	1.8+	.....	.....
$4CuO \cdot SO_3 \cdot 3H_2O$[a]	Orth.	1.728	1.771[a]	1.800	2V = 77° r < v	Ax. pl. 100; X = *b*; Z = *c*
$CuO \cdot CuSO_4$	Mon.	.....	1.777	.....	2V = Lg. r > v	Ax. pl. 010; X nearly ⊥001
$7MnO \cdot As_2O_5 \cdot 4H_2O$	Mon.	1.760	1.779	1.779	2V = 4°	r > v strong
Na_2ZrSiO_5	Orth.	1.741	1.788±	1.790	2V = Sm.	.....
$4CuO \cdot As_2O_5 \cdot H_2O$	Orth.	1.747	1.788	1.829	2V = 90° ± r < v strong	X = *b*; Z = *a*
$(Sc, Y)_2O_3 \cdot 2SiO_2$	Mon.	1.756	1.793	1.809	2V = 50°-65° r < v	X ∧ *c* = 5°; Y = *b*
$2CaO \cdot PbO \cdot 3SiO_2$	.....	.....	1.795	.....	.....	.....
Mn_2SiO_4	Orth.	1.778	1.804	1.815	2V = 65° r > v	Ax. pl. 001; X = *b*; Z = *c*

*Also given as α1.708; β1.744; γ1.773.
**Int. Crit. Tab. gives $5ZnO \cdot 2CO_2 \cdot 3H_2O$.

[a] Int. Crit. Tab. gives α1.730; β1.778; γ1.803.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$4MnO \cdot As_2O_5 \cdot H_2O$	Mon.	1.793*	1.807*	1.809*	$2V = 83°$	$Y = b$; $X \wedge c = -54°$
$KFeSi_2O_6$	Mon.	.....	1.81	.....	$2V$ = Lg.	Ax. pl. 010; $X \wedge c = 1° \pm$
$Fe_2(SO_4)_3$**	Orth.	1.802	1.814	1.818	$2V = 60°$	Ax. pl. 100; $X = c$
$3V_2O_5 \cdot 2CaO \cdot 11H_2O$	Mon.	1.775	1.815	1.825	$2V = 50°$	$r > v$ strong; $X = b$
$Ba_2W_{12}SiO_{40} \cdot 16H_2O$	Mon.	.....	1.816	.....	$2V = 78°44'$ $r > v$ strong	Ax. pl. and $X \perp 010$; $Z \wedge c = -14°$
$NaFeSi_2O_6$	Mon.	1.776	1.816[a]	1.836	$2V = 60° \pm$ $r > v$ strong	Ax. pl. 010; $X \wedge c = 9° \pm$; $Y = b$
$Pb(H_2AsO_4)_2$	Tric.	1.74	1.82	.....	.....	.....
$TlNO_3$	Orth.	1.817	$1.82 \pm$	.....	$2V$ = Lg.	Ax. pl. 010; $X = c$
$2CuO \cdot 2CaO \cdot As_2O_5 \cdot H_2O$	Orth.	1.800	1.831	1.846	$2V$ *ca.* 90° $r > v$ strong	$X = a$; $Y = b$
$Na_2O \cdot 3Fe_2O_3 \cdot 4SO_3 \cdot 6H_2O$	Orth.	1.750	1.832	1.832	$2V$ = Sm.	$X = c$
$PbO \cdot CuO \cdot SO_3 \cdot H_2O$[b]	Mon.	1.809	1.838	1.859	$2V = 80°$ $r < v$	$Z = b$; $X \wedge a = -24°$
$4CuO \cdot P_2O_5 \cdot 3H_2O$	Mon.	1.69	1.84	1.85	$2V$ = Sm.	.....
$CuO \cdot 3Fe_2O_3 \cdot 2P_2O_5 \cdot 8H_2O$	Tric.	1.773	1.840	1.845	$2V = 24°$	$r > v$ strong; X *ca.* b
$2CaO \cdot I_2O_5 \cdot CrO_3$[c]	Mon.	1.825	1.842	1.857	$2V = 86°$	$r < v$ strong; $Y = b$
$KHg(CNS)_3$	Orth.	1.730	1.843	$1.880 \pm$	$2V = 67° \pm$ $r < v$ strong	Ax. pl. 100; $X = c$
$Pb(HCO_2)_2$	Orth.	1.789	1.852	1.877	$2V = 70°34'$	Ax. pl. 010; $X = c$
$HgCl_2$	Orth.	1.725	1.859	1.965	$2V = 85°$	Ax. pl. 100; $X = c$
$5CuO \cdot As_2O_5 \cdot 2H_2O$	.....	1.820	1.86	1.88	$2V$ = Sm. $r < v$	$Z \perp$ elong.; Y = elong.
$6CuO \cdot As_2O_5 \cdot 3H_2O$	Mon.	1.73	1.870	1.91	$2V = 53°$ $r < v$ strong	$Y = b$; Z *ca.* a
$2CuO \cdot CO_2 \cdot H_2O$	Mon.	1.655	1.875	1.909	$2V = 43°$ $r < v$	$Y = b$; $X \wedge c = 23°$
Fe_2SiO_4	Orth.	1.835	1.877	1.886	$2V = 47°$ $r > v$ strong	Ax. pl. 001; $X = b$; $Z = a$
$KC_6H_2O_7N_3$[d]	Orth.	1.527	1.903	1.952	$2V = 33°34'$	Ax. pl. 100; $X = c$

*Int. Crit. Tab. gives α1.780; β1.793; γ1.802.
**Also uniaxial.

[a] Int. Crit. Tab. gives α1.763; β1.799; γ1.813.
[b] Int. Crit. Tab. gives $5PbO \cdot 2CuO \cdot 3SO_3 \cdot 3H_2O$.
[c] Int. Crit. Tab. gives $15CaO \cdot 7I_2O_5 \cdot 8CrO_3$.
[d] Picrate.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
$2CaO \cdot 4FeO \cdot Fe_2O_3 \cdot 4SiO_2 \cdot H_2O$	Orth.	.....	1.91	1.91	2V = Sm. r < v strong	Z = c; X = b
$K_2O \cdot 2UO_3 \cdot V_2O_5 \cdot 8 \pm H_2O$	Orth.	1.750	1.925	1.95	2V = 39°-44°	r < v weak; X = c
$10MnO \cdot Sb_2O_5$	Mon.	1.92	1.95	1.96	2V = Sm.	r > v
$Fe_2O_3 \cdot 3TeO_2 \cdot 4H_2O$	Orth.	1.702	1.955	1.965	2V = 22° r > v strong	X ⊥ cleav.
Tl_2SeO_4	Orth.	1.9493	1.9592	1.9640	2V = 72°58' r > v weak	Ax. pl. 001; X = b; Z = a
S*	Mon.	.....	1.96 ±	.....	2V = 58° ±	Ax. pl. 010; X ∧ c = 44°
$PbSiO_3$	Mon.	1.947	1.961	1.968	2V = 65°	r < v strong
$2PbO \cdot SO_3$	Mon.	1.93	1.99	2.02	2V = 47°	r > v; Y = b
$4PbO \cdot SO_3 \cdot 2CO_2 \cdot H_2O$	Mon.	1.87	2.00	2.01	2V = 10° r < v strong	X ∧ c = 5°30'; Z = b
$5Bi_2O_3 \cdot 3UO_3 \cdot 2As_2O_5 \cdot 12H_2O$	Tric.	1.90	2.00 ±	2.05 ±	2V = Lg.	X ca. ⊥ 010
$Pb_2As_2O_7$	.....	.....	2.03		.....	.....
$4CaO \cdot Al_2O_3 \cdot Fe_2O_3$	.....	1.97	2.04	2.07	2V = Mod.	.....
$3MgO \cdot B_2O_3 \cdot MnO \cdot Mn_2O_3$	Orth.	1.908	2.05	2.065	2V = 32°	X = b; Z = a
$9PbO \cdot 3P_2O_5 \cdot PbCl_2$	.....	2.042	2.050	2.050	2V = Sm.	.....
$PbO \cdot CO_2$	Orth.	1.8037	2.0763	2.0780	2V = 8°14' r > v	Ax. pl. 010; X = c; Z = a
$Bi_2TeO_6 \cdot 2H_2O$	.....	.....	2.09 ±	.....	2V = Sm.	r < v extreme
$CaO \cdot 3V_2O_5 \cdot 9H_2O$	Orth. (?)	1.70	2.10	2.23 ±	2V = 52°	Z = elong.
$6PbO \cdot 2MnO \cdot 3As_2O_5 \cdot H_2O$	Mon.	2.07	2.10	2.12	2V = Lg.	r < v; Y = b
$PbO \cdot 2PbCl_2 \cdot H_2O$	Mon.	1.816	2.102	2.126	.....	Z = b
$PbCl_2 \cdot PbO \cdot H_2O$	Mon.	2.077	2.116	2.158	2V = 82°	X = a; Z = c
$PbO \cdot PbCl_2$	.....	2.04	2.15	2.15	2V = 0° ±	X = c
$CaO \cdot 3V_2O_5 \cdot 9H_2O$	Orth.	1.77	2.18	2.35	2V = Med.	Z = elong.
ZrO_2	Mon.	2.13	2.19	2.20	2V = 30° r > v strong	X ∧ c = 12°; Y = b
$WO_3 \cdot H_2O$	Orth.	2.09	2.24	2.26	2V = Sm.	r < v strong
$2PbO \cdot 2CuO \cdot V_2O_5 \cdot H_2O$	Orth.	2.17	2.26	2.32	2V = 73° ±	r > v strong

*Stable above 98°C.

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Substance	System	α_D	β_D	γ_D	Axial Angle and Dispersion	Optical Orientation
Sb_2O_3	Orth.	2.18	2.35	2.35	2V = Sm. r < v	X = *a*; Z_{Li} = *b*
$Fe_2O_3 \cdot H_2O$	Orth.	2.260	2.394	2.400	2V = Sm. r > v	Ax. pl.* 001; X = *b*; Z = *c*
$PbO \cdot 2PbCrO_4$	Orth.(?)	2.42	2.7	2.75±	2V = Sm.	.....
CuO	Mon.	.....	2.84	.....	r < v	.....
$HgS \cdot 2Sb_2S_3$	Orth.(?)	.....	3	.....	.....	.....
$3Ag_2S \cdot As_2S_5$	Mon.	.....	3	.....	2V = 34°	Y *ca. a*; Z = *b*
$9(Ag,Cu)_2S \cdot Sb_2S_3$**	Mon.	.....	3	.....	2V = 22°	X = *c*; Y = *a*
Sb_2S_3	Orth.	3.194	4.046	4.303	2V = 26°	X = *c*; Z = *b*

*Ax. pl. 100 for Li; uniaxial for λ612mμ.
**Int. Crit. Tab. gives $8Ag_2S \cdot Sb_2S_3$.

INDEX OF REFRACTION (LIQUIDS)

Arrangement. The substances are arranged in the order of increasing values of refractive index (n_D) to facilitate use of the table as a means of identification of pure liquids. No substance is listed more than once. To ascertain if a desired compound is listed in the table and to find its position in the table reference must be made to the formula index at the end of the table. When possible, values were selected at or near 20°C. In using the table for identification of an unknown pure liquid, consideration must be given to the effect of temperature. The index of refraction of a liquid decreases with rise in temperature and this thermal variation differs with various substances but is approximately 0.0004 per 1°C.

Specific Gravity. As an aid in applying formulas for calculation of refractive index (*q. v.*) the specific gravity is given at the same temperature as used in the refractive index determination.

Beil. Ref. In the column so headed will be found the reference to the volume and page numbers of the 4th edition of Beilstein: *Handbuch der Organischen Chemie.* Where the Roman numeral, which indicates the volume number, is preceded by an asterisk, reference is to the first supplementary volumes.

It is to be noted that the symbols α, β, γ which are often employed in reporting refractive index of liquids, refer to the wave length of light used and signify the wave length corresponding to the Hα, Hβ and Hγ spectrum lines. In the case of refractive index of biaxial crystals the symbols α, β and γ have a different significance (*q. v.*).

References. The information in the table has been collected mainly from the following sources:

Beilstein: *Handbuch der Organischen Chemie*, 4th edition. Published by Springer, Berlin.

International Critical Tables, Vol. VII. Published by McGraw-Hill Book Co., New York.

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1	Nitrous oxide	N_2O	16	.....	1.193	.....
2	Hydrocyanic acid	HCN	19	0.698	1.254	II–29
3	Hydrogen chloride	HCl	?	.....	1.256	.....
4	Ethyl trifluoroacetate	$F_3CCO_2C_2H_5$	20	1.19	1.306	.....
5	Phosphine	PH_3	17.5	.....	1.317	.....
6	Hydrogen bromide	HBr	10	.....	1.325	.....
7	Ammonia	NH_3	16.5	.....	1.325	.....
8	Methyl alcohol	CH_3OH	20	0.791	1.3288	I–274
9	Nitrogen dioxide	NO_2	−90	.....	1.330	.....
10	Hydrogen peroxide	H_2O_2	?	.....	1.333	.....
11	Water*	H_2O	20	.....	1.3330	.....
12	Acetaldehyde	CH_3CHO	18	0.783	1.3392	I–594
13	Difluoroacetic acid	F_2CHCO_2H	20	1.526	1.3419	II–193
14	Methyl formate	HCO_2CH_3	20	0.974	1.344	II–18
15	Acetonitrile	CH_3CN	16.5	0.78	1.3460	II–183
16	Ether	$(C_2H_5)_2O$	24.8	0.708	1.3497	I–314
17	Methylal	$CH_2(OCH_3)_2$	20	0.88	1.3534	I–574
18	Pentane (*iso*)	$(CH_3)_2CHC_2H_5$	20	0.62	1.3549	I–134
19	Amyl fluoride (*n*)	$CH_3(CH_2)_4F$	20	0.788	1.3574	.....
20	Methyl *iso*-propyl ether	$CH_3OCH(CH_3)_2$	20	0.735	1.3576	I–362
21	Acetone	$(CH_3)_2CO$	20	0.791	1.3591	I–635
22	Silicon methyl	$(CH_3)_4Si$	18.7	0.648	1.3591	IV–625
23	Methyl acetate	$CH_3CO_2CH_3$	20	0.934	1.3594	II–124
24	Ethyl formate	$HCO_2C_2H_5$	20	0.906	1.3598	II–19
25	Ethylene oxide	$(CH_2)_2O$	8.4	0.886	1.3599	XVII–4
26	Ethyl isocyanide	C_2H_5NC	25	0.744	1.36	IV–107

*See special table.

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Boil. Ref.
27	Pentane (*n*)	$(C_2H_5)_2CH_2$	18	0.630	1.3601	I-130
28	Methyl propyl ether (*n*)	$CH_3OCH_2C_2H_5$	14.3	0.74	1.3602	I-354
29	Ethyl alcohol*	C_2H_5OH	20.5	0.788	1.3610	I-292
30	Propyl nitrite (*n*)	$C_2H_5CH_2ONO$	20	0.935	1.3613	I-355
31	Propionaldehyde	C_2H_5CHO	20	0.807	1.3636	I-629
32	Ethylene fluorohydrin	FCH_2CH_2OH	20	1.114	1.3639	*I-170
33	Isopropyl ether	$[(CH_3)_2CH]_2O$	23	0.72	1.3678	I-362
34	Silicon methoxide	$Si(OCH_3)_4$	?	.....	1.368	.....
35	Propionitrile	C_2H_5CN	19	0.78	1.3681	II-245
36	Ethyl *n*-propyl ether	$C_2H_5OCH_2C_2H_5$	20	0.739	1.3695	I-354
37	Dimethyl acetal	$CH_3CH(OCH_3)_2$	20	0.850	1.37	I-603
38	Dimethylbutane (2,2)	$(CH_3)_3CC_2H_5$	20	0.649	1.3704	I-150
39	Formic acid [4]	HCO_2H	20	1.220	1.3714	II-8
40	Acetic acid	CH_3CO_2H	22.9	1.046	1.3715	II-96
41	Butyl nitrite (*iso*)	$(CH_3)_2CHCH_2ONO$	22.1	0.87	1.3715	I-377
42	Ethyl acetate	$CH_3CO_2C_2H_5$	19.2	0.901	1.3728	II-125
43	Butyric aldehyde (*iso*)	$(CH_3)_2CHCHO$	20	0.794	1.3730	I-671
44	Hexane (*iso*)	$CH_3(CH_2)_2CH\cdot(CH_3)_2$	20	0.654	1.3735	I-148
45	Dimethyl butane (2,3)	$[(CH_3)_2CH]_2$	20	0.662	1.3749	I-151
46	Hydrogen sulfide	H_2S	.....	.....	1.374	.....
47	Cyclobutane (b.p. 12°)	$CH_2CH_2CH_2CH_2$	0	0.703	1.3752	V-17
48	Hexane (*n*)	$CH_3(CH_2)_4CH_3$	20	0.661	1.3754	I-142
49	Amylene	$C_2H_5CH_2CH{:}CH_2$	20	0.6	1.3758	I-210
50	Ethyl fluoroacetate	$FCH_2CO_2C_2H_5$	20	1.093	1.3767	.....
51	Methyl pentane (3)	$(C_2H_5)_2CHCH_3$	20	0.677	1.3769	I-149
52	Propylamine (*iso*)	$(CH_3)_2CHNH_2$	15.4	0.694	1.3770	IV-152
53	Methyl propionate	$C_2H_5CO_2CH_3$	18.9	0.917	1.3770	II-239
54	Propyl acetate (*iso*)	$CH_3CO_2CH(CH_3)_2$	20	0.872	1.3770	II-130
55	Propyl formate (*n*)	$HCO_2CH_2C_2H_5$	20	0.901	1.3771	II-21
56	Propyl alcohol (*iso*)	$(CH_3)_2CHOH$	20	0.785	1.3776	I-360
57	Methyl-2-butene-1	$(C_2H_5)(CH_3)C{:}CH_2$	16	0.66	1.378	I-211
58	Butylamine (*tert*)	$(CH_3)_3CNH_2$	18	0.698	1.3794	IV-173
59	Ethyl butyl ether (*tert*)	$C_2H_5OC(CH_3)_3$	20	0.752	1.3794	I-381
60	Methyl allyl ether	$CH_3OCH_2CH{:}CH_2$	?	0.7	1.38±	I-437
61	Methyl butyl ether (*n*)	$CH_3OCH_2CH_2C_2H_5$	20	0.744	1.38	I-369
62	Methyl ethyl ketone	$CH_3COC_2H_5$	15.9	0.81	1.3807	I-666
63	Triethyl borate	$(C_2H_5)_3BO_3$	20	0.88	1.3808	I-335
64	Butyronitrile	$C_2H_5CH_2CN$	24	0.78	1.3816	II-275
65	Pentene-2	$C_2H_5CH{:}CHCH_3$	17.2	0.65	1.3817	I-210
66	Acetal	$CH_3CH(OC_2H_5)_3$	20	0.831	1.3819	I-603
67	Ethyl cyanoformate	$NCCO_2C_2H_5$	20	1.003	1.3821	II-547

*See special tables.

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
68	Hexene-1	$CH_3(CH_2)_3CH{:}CH_2$	20	0.683	1.3821	I-215
69	Dimethyl pentane (2,4)	$[(CH_3)_2CH]_2CH_2$	20	0.681	1.3827	I-158
70	Glyoxal	$(CHO)_2$	20	1.14	1.3828	I-759
71	Propyl ether (*n*)	$(C_2H_5CH_2)_2O$	14.5	0.75	1.3832	I-354
72	Ethyl propionate	$C_2H_5CO_2C_2H_5$	20	0.891	1.3839	I-240
73	Methyl butyrate (*iso*)	$(CH_3)_2CHCO_2CH_3$	20	0.891	1.3840	II-290
74	Butyric aldehyde (*n*)	$C_2H_5CH_2CHO$	20	0.817	1.3843	I-662
75	Propyl acetate	$CH_3CO_2CH_2C_2H_5$	20	0.886	1.3844	II-129
76	Diethyl carbonate	$CO(OC_2H_5)_2$	20	0.975	1.3846	III-5
77	Methyl cyclobutane	$CH_3CH\underset{\vert\_\_\_\_\vert}{CH_2CH_2}CH_2$	18	0.69	1.3847	V-20
78	Ethyl nitrate	$C_2H_5ONO_2$	21.5	1.104	1.3848	I-329
79	Methyl amyl ether (*n*)	$CH_3OC_5H_{11}$	20	0.754	1.3849	.....
80	Amyl nitrite (*n*)	$CH_3(CH_2)_3CH_2ONO$	20(?)	0.853	1.3851	I-384
81	Propyl alcohol (*n*)	$C_2H_5CH_2OH$	20	0.804	1.3854	I-350
82	Methyl-2-butene-2	$(CH_3)_2C{:}CHCH_3$	19	0.663	1.3855	I-211
83	Butyl formate (*iso*)	$HCO_2CH_2CH(CH_3)_2$	20	0.885	1.3857	II-21
84	Heptyl fluoride (*n*)	$CH_3(CH_2)_5CH_2F$	20	0.804	1.3861	I-56
85	Fluorotrichloro-methane	CCl_3F	18.5	1.494	1.3865	I-64
86	Methyl chloroformate	$ClCO_2CH_3$	20	1.223	1.3868	III-9
87	Butyl chloride (*tert*)	$(CH_3)_3CCl$	17.8	0.843	1.3869	I-125
88	Propiolic nitrile	$HC{:}CCN$	17	0.816	1.3870	*II-208
89	Diethylamine	$(C_2H_5)_2NH$	19	0.712	1.3871	IV-95
90	Amyl nitrite (*iso*)	$(CH_3)_2CHCH_2\cdot CH_2ONO$	20.7	0.871	1.3871	I-402
91	Dimethyl sulfate	$(CH_3O)_2SO_2$	20	1.33	1.3874	I-283
92	Propionic acid	$C_2H_5CO_2H$	19.9	0.992	1.3874	II-234
93	Butyl acetate (*sec*)	$CH_3CO_2CH(CH_3)\cdot C_2H_5$	20	0.870	1.3877	II-131
94	Butyl alcohol (*tert*)	$(CH_3)_3COH$	20	0.786	1.3878	I-379
95	Methyl propyl ketone (*iso*)	$CH_3COCH(CH_3)_2$	16.0	0.805	1.3879	I-682
96	Heptane (*n*)	$CH_3(CH_2)_5CH_3$	20	0.684	1.3876	I-154
97	Ethyl allyl ether	$C_2H_5OCH_2CH{:}CH_2$	20	0.765	1.3881	I-438
98	Valeric aldehyde (*n*)	$C_2H_5CH_2CH_2CHO$	20	0.82	1.3882	I-676
99	Propyl chloride (*n*)	$C_2H_5CH_2Cl$	20	0.890	1.3884	I-104
100	Butyl formate (*n*)	$HCO_2CH_2CH_2C_2H_5$	20	0.89	1.3891	II-21
101	Methyl propyl ketone (*n*)	$CH_3COCH_2C_2H_5$	20.2	0.81	1.3895	I-676
102	Acetyl chloride	CH_3COCl	20	1.105	1.3898	II-173
103	Difluoro-2,2-bromo-1 ethane	CHF_2CH_2Br	20	1.8	1.39	I-89
104	Methyl butyrate (*n*)	$C_2H_5CH_2CO_2CH_3$	20	0.898	1.39	II-270
105	Ethyl valerate (*n*)	$CH_3(CH_2)_3CO_2C_2H_5$	20	0.877	1.39	II-301

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
106	Trimethylbutane (2,2,3)	$(CH_3)_3CCH(CH_3)_2$	20	0.690	1.389	.....
107	Nitroethane	$CH_3CH_2NO_2$	24.3	1.047	1.3901	I-100
108	Propylamine (*n*)	$C_2H_5CH_2NH_2$	16.6	0.72	1.3901	IV-136
109	Acetic anhydride	$(CH_3CO)_2O$	20	1.082	1.3901	II-166
110	Diethyl sulfate	$(C_2H_5O)_2SO_2$	20	1.178	1.3902	I-327
111	Valeric aldehyde (*iso*)	$(CH_3)_2CH_2CH_2CHO$	20	0.802	1.3902	I-684
112	Ethyl butyrate (*iso*)	$(CH_3)_2CHCO_2C_2H_5$	20	0.871	1.3903	II-291
113	Butyl acetate (*iso*)	$CH_3CO_2CH_2CH\cdot(CH_3)_2$	18.8	0.870	1.3907	II-131
114	Dimethyl oxalate (m.p. 54°)	$(CO_2CH_3)_2$	56.6	1.14	1.3915	II-534
115	Valeronitrile (*n*)	$CH_3(CH_2)_3CN$	18	0.801	1.3917	II-301
116	Ethyl orthoformate	$HC(OC_2H_5)_3$	18.8	0.897	1.3922	II-20
117	Butyl alcohol (*sec*)	$CH_3CHOHC_2H_5$	22	0.806	1.3924	I-371
118	Ethylpentane (3)	$(C_2H_5)_3CH$	20	0.698	1.393	I-157
119	Butyric acid (*iso*)	$(CH_3)_2CHCO_2H$	20	0.949	1.3930	II-288
120	Ethyl butyrate (*n*)	$C_2H_5CH_2CO_2C_2H_5$	18	0.88	1.3930	II-270
121	Trimethylacetic acid (m.p. 35.5°)	$(CH_3)_3CCO_2H$	36.5	0.91	1.3931	II-319
122	Diacetyl	$(CH_3CO)_2$	18.5	0.981	1.3933	I-769
123	Propyl propionate (*n*)	$C_2H_5CO_2CH_2C_2H_5$	20	0.883	1.3933	II-240
124	Nitromethane	CH_3NO_2	20	1.139	1.3935	I-74
125	Dimethylhexane (2,5)	$[(CH_3)_2CHCH_2]_2$	25	0.7	1.3935	I-162
126	Ethyl orthocarbonate	$C(OC_2H_5)_4$	18.5	0.919	1.3935	III-5
127	Diethyl ketone	$(C_2H_5)_2CO$	16.6	0.82	1.3939	I-679
128	Butylamine (*sec*)	$(C_2H_5)(CH_3):CHNH_2$	20	0.724	1.394	IV-160
129	Butyl acetate (*tert*)	$CH_3CO_2C(CH_3)_3$	20(?)	0.896	1.3947	II-131
130	Octyl fluoride (*n*)	$CH_3(CH_2)_6CH_2F$	20	0.803	1.3947	I-159
131	Butyl acetate (*n*)	$CH_3CO_2CH_2CH_2C_2H_5$	20	0.881	1.3951	II-130
132	Butyl propionate (*sec*)	$C_2H_5CO_2CH(CH_3)\cdot C_2H_5$	20	0.866	1.3952	II-241
133	Butyl chloride (*sec*)	$C_2H_5CHClCH_3$	25.2	0.87	1.3953	I-119
134	Ethyl chloroformate	$ClCO_2C_2H_5$	20	1.138	1.3955	III-10
135	Methyl butyl ketone (*iso*)	$CH_3COCH_2CH:(CH_3)_2$	20	0.800	1.3959	I-691
136	Propyl *iso*-butyrate (*n*)	$(CH_3)_2CHCO_2CH_2\cdot C_2H_5$	20	0.87	1.3959	II-291
137	Butine-1 (b.p. 18°)	$C_2H_5C{:}CH$	(?)	0.7	1.3962	I-248
138	Butylene (α) (b.p. −5°)	$C_2H_5CH:CH_2$	20	.....	1.3962	I-203
139	Butyl alcohol (*iso*)	$(CH_3)_2CHCH_2OH$	17.5	0.805	1.3968	I-373
140	Nitric acid	HNO_3	16.4	.....	1.397	.....
141	Propyl *iso*-valerate (*iso*)	$(CH_3)_2CHCH_2CO_2\cdot CH(CH_3)_2$	20(?)	0.85	1.397	II-312
142	Butyl chloride (*iso*)	$(CH_3)_2CHCH_2Cl$	17.8	0.879	1.3970	I-124

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
143	Propyl nitrate (*n*)	$C_2H_5CH_2ONO_2$	20	1.058	1.3972	I–355
144	Amyl alcohol (*iso*) (*sec*)	$(CH_3)_2CHCHOHCH_3$	20	0.818	1.3973	I–391
145	Chloromethyl methyl ether	$ClCH_2OCH_3$	20	1.070	1.3974	I–580
146	Ethyl valerate (*iso*)	$(CH_3)_2CHCH_2CO_2 \cdot C_2H_5$	18.4	0.87	1.3974	II–312
147	Butyl propionate (*iso*)	$C_2H_5CO_2CH_2 \cdot CH(CH_3)_2$	20	0.869	1.3975	II–241
148	Amyl formate (*iso*)	$HCO_2CH_2CH_2 \cdot CH(CH_3)_2$	20	0.871	1.3977	II–22
149	Methylheptane (4)	$(C_2H_5CH_2)_2CH(CH_3)$	25	0.7	1.3978	I–162
150	Butyric acid (*n*)	$C_2H_5CH_2CO_2H$	20	0.964	1.3979	II–264
151	Octane (*iso*)	$(CH_3)_2CH(CH_2)_4 \cdot CH_3$	20	0.70	1.3981	I–161
152	Dimethylhexane (2,4)	$C_2H_5CH(CH_3)CH_2 \cdot CH(CH_3)_2$	25	0.7	1.3986	I–162
153	Butylamine (*iso*)	$(CH_3)_2CHCH_2NH_2$	17	0.74	1.3988	IV–163
154	Octane (*n*)	$CH_3(CH_2)_6CH_3$	17.6	0.71	1.3988	I–159
155	Ethyl propyl ketone (*n*)	$C_2H_5COCH_2C_2H_5$	22	0.813	1.3990	I–690
156	Butyl alcohol (*n*)	$C_2H_5CH_2CH_2OH$	20	0.810	1.3991	I–367
157	Butyl ether (*n*)	$(C_2H_5CH_2CH_2)_2O$	20	0.769	1.3992	I–369
158	Ethylhexane (3)	$(C_2H_5)_2CHCH_2C_2H_5$	25	0.7	1.3993	*I–62
159	Methyl-2-ethyl-3-pentane	$(C_2H_5)_2CHCH \cdot (CH_3)_2$	25	0.7	1.3996	I–164
160	Acrolein	$CH_2{:}CHCHO$	20	0.841	1.3998	I–725
161	Butyl *iso*-butyrate (*iso*)	$(CH_3)_2CHCO_2CH_2 \cdot CH(CH_3)_2$	20	0.87	1.3999	II–291
162	Ethylene-ethylidene oxide	$CH_3CH{:}(OCH_2)_2$	20	0.981	1.40	XIX–8
163	Germanium tetraethyl	$Ge(C_2H_5)_4$	20(?)	.....	1.400	IV–631
164	Acetone cyanohydrin	$(CH_3)_2C(OH)CN$	19	0.932	1.4000	III–316
165	Methyl butyl ketone (*sec*)	$CH_3COCH(CH_3) \cdot (C_2H_5)$	18	0.815	1.4002	I–693
166	Nitropropane (1)	$CH_3CH_2CH_2NO_2$	24.3	1.002	1.4003	I–115
167	Triethylamine	$(C_2H_5)_3N$	20	0.728	1.4003	IV–99
168	Pentine-2	$C_2H_5C{:}CCH_3$	20	0.687	1.4004	I–250
169	Propyl *n*-butyrate (*n*)	$C_2H_5CH_2CO_2CH_2 \cdot C_2H_5$	20	0.87	1.4005	II–271
170	Methyl-4-pentanol-2 acetate	$CH_3CO_2CH(CH_3) \cdot CH_2CH(CH_3)_2$	20	0.858	1.4008	.....
171	Butyl (*d*) amyl ether (*iso*)*	$(CH_3)_2CHCH_2O \cdot C_5H_{11}$	20.2	0.77	1.4008	I–387
172	Butylamine (*n*)	$C_2H_5CH_2CH_2NH_2$	20	0.740	1.401	IV–156
173	Methyl-3-pentene-2	$(C_2H_5)(CH_3)C{:}CH \cdot CH_3$	20	0.693	1.401	I–217
174	Hexadiene-1,5	$(CH_2{:}CHCH_2)_2$	20	0.688	1.4010	I–253
175	Amyl acetate**	$CH_3CO_2CH_2CH \cdot (CH_3)C_2H_5$	20	0.88	1.4012	II–131
176	Amyl acetate (*n*)	$CH_3CO_2CH_2(CH_2)_3 \cdot CH_3$	20	0.879	1.4012	II–131
177	Methyl-2-pentene-2	$(CH_3)_2C{:}CHC_2H_5$	16	0.69	1.4013	I–217

*Mixture of isomers?
**From *l*-amyl alcohol.

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
178	Pentadione-2,3	$CH_3COCOCH_2CH_3$	19	0.957	1.4014	I-776
179	Amyl acetate (*iso*)*	$CH_3CO_2CH_2CH_2CH\cdot(CH_3)_2$	18.1	0.87	1.4014	II-132
180	Dimethylheptane (2,4)	$(CH_3)_2CHCH_2CH\cdot(CH_3)CH_2C_2H_5$	25	0.71	1.4014	*I-64
181	Butyl chloride (*n*)	$C_2H_5CH_2CH_2Cl$	20	0.884	1.4015	I-118
182	Dimethyl-2,4-pentene-2	$(CH_3)_2C{:}CHCH{:}(CH_3)_2$	22	0.696	1.4017	I-220
183	Methyl butylamine	$CH_3NHC_4H_9$	18.1	0.736	1.4018	IV-157
184	Hexyl nitrite (*n*)	$CH_3(CH_2)_4CH_2ONO$	20	0.885	1.4018	I-407
185	Methylheptane (3)	$C_2H_5CH(CH_3)\cdot(CH_2)_3CH_3$	25	0.69	1.402†	I-162
186	Dimethylheptane (2,5)	$(CH_3)_2CH(CH_2)_2\cdot CH(CH_3)C_2H_5$	25	0.71	1.4020	I-167
187	Nonane (*n*)	$CH_3(CH_2)_7CH_3$	25	0.71	1.4025	I-165
188	Methyloctane (4)	$CH_3(CH_2)_2C(CH_3)\cdot(CH_2)_3CH_3$	25	0.72	1.4027	*I-63
189	"Methyl cellosolve"	$CH_3OCH_2CH_2OH$	20	0.964	1.4028	.....
190	Butyl nitrate (*iso*)	$(CH_3)_2CHCH_2ONO_2$	20	1.015	1.4028	I-377
191	Dimethylheptane (2,6)	$[(CH_3)_2CHCH_2]_2CH_2$	20(?)	0.712	1.4028	I-167
192	"Cellosolve acetate"	$C_2H_5OCH_2CH_2O_2C\cdot CH_3$	20	0.973	1.4030	.....
193	Butyl *n*-butyrate (*iso*)	$C_2H_5CH_2CO_2CH_2\cdot CH(CH_3)_2$	18.4	0.862	1.4030	II-271
194	Propyl chloroformate (*n*)	$ClCO_2CH_2C_2H_5$	20	1.090	1.4035	III-11
195	Acetimidoethyl ether	$HN{:}C(CH_3)OC_2H_5$	18.8	0.873	1.4035	II-182
196	Propionic anhydride	$(C_2H_5CO)_2O$	20	1.012	1.4038	II-242
197	Dimethylhexane (3,4)	$[CH_3CH_2CH(CH_3)]_2$	25	0.72	1.4038	I-163
198	Cyclopentane	$CH_2CH_2CH_2CH_2CH_2$	20.5	0.750	1.4039	V-19
199	Ethyl propargyl ether	$CH{:}CCH_2OC_2H_5$	20	0.833	1.4039	I-454
200	Propyl *iso*-valerate	$(CH_3)_2CHCH_2CO_2\cdot CH_2C_2H_5$	17.8	0.87	1.4041	II-312
201	Valeric acid (*iso*)	$(CH_3)_2CHCH_2CO_2H$	20	0.93	1.4043	II-309
202	Allyl acetate	$CH_3CO_2CH_2CH{:}CH_2$	20	0.928	1.4045	II-136
203	Dipropylamine (*n*)	$(C_2H_5CH_2)_2NH$	19.5	0.739	1.4046	IV-138
204	Amyl cyanide (*iso*)	$(CH_3)_2CH(CH_2)_2CN$	22.2	0.80	1.4048	II-329
205	Paraldehyde	$(C_2H_4O)_3$	20	0.994	1.4049	XIX-385
206	Butyl *n*-butyrate (*n*)	$C_2H_5CH_2CO_2CH_2\cdot CH_2C_2H_5$	20	0.872	1.4049	II-271
207	Propionyl chloride	C_2H_5COCl	20	1.065	1.4051	II-243
208	Methyl butyric acid (α)	$(C_2H_5)(CH_3){:}CH\cdot CO_2H$	20	0.941	1.4051	II-304
209	Amyl alcohol (*sec*) (*n*)	$C_2H_5CH_2CHOHCH_3$	20	0.809	1.4053	I-384
210	Butyl *iso*-valerate (*iso*)	$(CH_3)_2CHCH_2CO_2\cdot CH_2CH(CH_3)_2$	20	0.854	1.4057	II-312
211	Lactonitrile	$CH_3CHOHCN$	18.4	0.992	1.4058	III-284
212	Amyl alcohol (*tert*)	$(CH_3)_2COHC_2H_5$	20	0.809	1.406	I-388
213	Chloropentane (2)	$CH_3(CH_2)_2CHClCH_3$	19.5	0.870	1.4062	I-131

*Commonly called amyl acetate.

† U. S. Bu. Standards found n^{20} 1.4029 for 2,2,3,-trimethyl-pentane.

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
214	Amyl propionate (*iso*)	$C_2H_5CO_2CH_2CH_2 \cdot CH(CH_3)_2$	20	0.870	1.4065	II–241
215	Triethyl phosphate	$(C_2H_5O)_3PO$	17.1	1.07	1.4067	I–332
216	Amyl chloride (*tert*)	$(CH_3)_2CClC_2H_5$	18	0.869	1.407	I–134
217	Butyl valerate (*sec*)	$C_4H_9CO_2CH(CH_3) \cdot (C_2H_5)$	20	0.860	1.4070	II–131
218	Dipropyl ketone (*n*)	$(C_2H_5CH_2)_2CO$	22	0.82	1.4073	I–699
219	Dimethyl-hydrazine (*uns*)	$(CH_3)_2NNH_2$	22.3	0.791	1.4075	IV–547
220	Dimethylhexane (2,3)	$(CH_3)_2CHCH(CH_3) \cdot CH_2C_2H_5$	25	0.7	1.4075	*I–62
221	Amyl *iso*-butyrate	$(CH_3)_2CHCO_2C_5H_{11}$	20	0.859	1.4076	.....
222	Allyl cyanide	$CH_2{:}CHCH_2CN$	16	0.837	1.4079	II–408
223	Butyryl chloride (*iso*)	$(CH_3)_2CHCOCl$	20	1.017	1.4079	II–293
224	Pentine-1	$C_2H_5CH_2C{:}CH$	18	0.70	1.4079	I–250
225	Methylnonane (2)	$(CH_3)_2CH(CH_2)_6 \cdot CH_3$	20	0.72	1.408	I–168
226	Amyl ether (*iso*)	$[(CH_3)_2CHCH_2 \cdot CH_2]_2O$	20	0.78	1.408	I–401
227	Ethyl glycol ether	$HOCH_2CH_2OC_2H_5$	20	0.930	1.4080	I–467
228	Diethyl phosphite	$(C_2H_5O)_2POH$	20	1.074	1.4082	*I–166
229	Ethyl pyruvate	$CH_3COCO_2C_2H_5$	15.6	1.060	1.4083	III–616
230	Methyl *n*-amyl ketone	$CH_3(CH_2)_4COCH_3$	20	0.817	1.4083	I–699
231	Amyl alcohol (*iso*) (*prim*)	$(CH_3)_2CHCH_2 \cdot CH_2OH$	15	0.813	1.4085	I–392
232	Amyl cyanide (*n*)	$CH_3(CH_2)_4CN$	14.3	0.80	1.4085	II–324
233	Tributyl borate (*iso*)	$(C_4H_9)_3BO_3$	20	0.858	1.4086	I–377
234	Methyl-2-pentanol-4	$CH_3CHOHCH_2 \cdot CH(CH_3)_2$	20	0.806	1.4087	I–410
235	Valeric acid (*n*)	$C_2H_5CH_2CH_2CO_2H$	19.1	0.94	1.409 ±	II–299
236	Tributyl citrate (*n*)	$C_6H_5O_7(C_4H_9)_3$	20	1.04	1.4091	.....
237	Dimethyloctane (2,7)	$[(CH_3)_2CHCH_2CH_2]_2$	18.1	0.72	1.4092	I–169
238	Dichloropropane (2,2)	$(CH_3)_2CCl_2$	20	1.093	1.4093	I–105
239	Dibutylamine (*iso*)	$(C_4H_9)_2NH$	19.6	0.747	1.4093	IV–166
240	Methyl-2-butadiene-2,3	$(CH_3)_2C{:}C{:}CH$	20	0.683	1.4094	I–252
241	Amylamine (*iso*)	$(CH_3)_2CH \cdot (CH_2)_2NH_2$	17.9	0.751	1.4096	IV–180
242	Dibutylamine (*n*)	$(CH_3CH_2CH_2 \cdot CH_2)_2NH$	20	0.76	1.4097	IV–157
243	Butyl chloro-formate (*n*)	$ClCO_2CH_2CH_2C_2H_5$	20	1.078	1.41	.....
244	Dimethyl-2,3-butene-2	$[(CH_3)_2C{:}]_2$	20	0.709	1.4121	I–218
245	Sulfur dioxide	SO_2	20(?)	.....	1.410	.....
246	Amyl alcohol (*n*)	$CH_3(CH_2)_3CH_2OH$	20	0.817	1.4101	I–383
247	Methyl cyclopentane	$CH_3(CHC_4H_8)$	20	0.749	1.4101	V–27
248	Diethyl oxalate	$(CO_2C_2H_5)_2$	20	1.079	1.4101	II–535

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
249	Propionimido ethyl ether	$HN{:}C(C_2H_5)OC_2H_5$	16.9	0.871	1.4103	II–245
250	Ethyl-2-butyl acetate	$CH_3CO_2CH_2{\cdot}CH(C_2H_5)_2$	20	0.879	1.4103	.....
251	Diethyl dimethyl-malonate	$(CH_3)_2C(CO_2C_2H_5)_2$	24.1	0.995	1.4105	II–648
252	Decane (*n*)	$CH_3(CH_2)_8CH_3$	14.9	0.73	1.4108	I–168
253	Amyl *n*-butyrate	$C_2H_5CH_2CO_2C_5H_{11}$	20	0.87	1.4110	.....
254	Methyl β-chloro-ethyl ether	$CH_3OCH_2CH_2Cl$	20	1.046	1.4111	I–337
255	Amyl chloride (*iso*)	$(CH_3)_2CHCH_2CH_2Cl$	18	0.800	1.4112	I–135
256	Chlorodiethyl ether (β)	$C_2H_5OCH_2CH_2Cl$	20	0.989	1.4113	I–337
257	Methyl-3-hexene-2 (or 3)	C_7H_{14}	20	0.718	1.4114	I–220
258	Methyl *n*-heptylate	$CH_3(CH_2)_5CO_2CH_3$	20	0.88	1.4114	II–339
259	Methylnonane (5)	$(C_4H_9)_2CHCH_3$	20	0.732	1.4116	I–168
260	Glycolic nitrile	$HOCH_2CN$	19	1.104	1.4117	III–242
261	Chloroethyl acetate	$CH_3CO_2C_2H_4Cl$	20	1.112	1.4118	.....
262	Amyl chloride (*n*)	$CH_3(CH_2)_3CH_2Cl$	20	0.878	1.4119	I–130
263	Ethyl-3-pentene-2	$(C_2H_5)_2C{:}CHCH_3$	20	0.72	1.412	I–220
264	Dibutyl ketone (*iso*)	$(C_4H_9)_2CO$	21	0.805	1.412	I–710
265	Butyryl chloride (*n*)	$C_2H_5CH_2COCl$	20	1.028	1.4121	II–274
266	Amyl nitrate (*iso*)	$(CH_3)_2CH{\cdot}(CH_2)_2ONO_2$	21.7	0.996	1.4122	I–403
267	Methyl α,α-dimeth-oxypropionate	$CH_3C(OCH_3)_2CO_2{\cdot}CH_3$	17.6	1.068	1.4122	*III–219
268	Pentanol-3	$(C_2H_5)_2CHOH$	14.7	0.808	1.4124	I–385
269	Methyl carbamate (m.p. 54°)	$NH_2CO_2CH_3$	55.6	1.136	1.4125	III–21
270	Ethyl lactate	$CH_3CHOHCO_2C_2H_5$	20	1.031	1.4125	III–280
271	Heptaldehyde	$CH_3(CH_2)_5CHO$	19.9	0.817	1.4125	I–695
272	Diethyl cyanamide	$(C_2H_5)_2NCN$	48	0.8	1.4126	IV–121
273	Methylnonane (3)	$C_2H_5(CH_3)CHC_6H_{13}$	20	0.735	1.4126	.....
274	Propyl-propyl-ideneamine	$CH_3CH_2CH{:}NHC_3H_7$	17.5	0.760	1.4127	IV–141
275	Triamylamine*	$(C_5H_{11})_3N$	22	0.845	1.4128	.....
276	Triamyl borate* (*iso*)	$(C_5H_{11}O)_3B$	22	0.845	1.4128	I–404
277	Amyl *iso*-valerate (*iso*)	$C_4H_9CO_2CH_2CH_2{\cdot}CH(CH_3)_2$	18.7	0.86	1.4130	II–312
278	Triethyl phosphite	$(C_2H_5O)_3P$	10	0.97	1.4131	I–330
279	Dimethyl dimethyl-malonate	$CH_3O_2CC(CH_3)_2CO_2{\cdot}CH_3$	24.2	1.059	1.4131	II–648
280	Diethyl *iso*-succinate	$CH_3CH(CO_2C_2H_5)_2$	20	1.018	1.4131	II–629
281	Hexyl alcohol (*n*)	$CH_3(CH_2)_4CH_2OH$	20	0.820	1.4133	I–407
282	Octene-1	$CH_3(CH_2)_5CH{:}CH_2$	18	0.721	1.4133	I–221
283	Allyl alcohol	$CH_2{:}CHCH_2OH$	20	0.854	1.4135	I–436
284	Hexanol-2	$CH_3CHOHCH_2CH_2{\cdot}C_2H_5$	20	0.814	1.4135	I–408
285	Methyl-2-pentanol-3	$(CH_3)_2CHCHOH{\cdot}C_2H_5$	20	0.824	1.4135	I–410

*Contains amyl group in its various isomeric forms.

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
286	Dimethyloctane (2,6)	$(CH_3)_2CH(CH_2)_3 \cdot CH(CH_3)C_2H_5$	15	0.74	1.4135	I–168
287	Diethyl ketene	$(C_2H_5)_2C{:}CO$	14.9	0.834	1.4136	I–740
288	Heptine-1	$CH_3(CH_2)_4C{\vdots}CH$	12.6	0.738	1.4136	I–256
289	Hydrogen peroxide	$H_2O_2 \cdot 2H_2O$	22	.....	1.414	.....
290	Octyl formate	$HCO_2C_8H_{17}$	20	0.87	1.414	II–22
291	Tripropylmethane	$(C_3H_7)_3CH$	20	0.73	1.414	.....
292	Dimethyl malonate	$CH_2(CO_2CH_3)_2$	20	1.154	1.4140	II–572
293	Dimethyl-2,3-butanol-2	$(CH_3)_2CHC \cdot (CH_3)_2OH$	20(?)	0.821	1.4140	I–413
294	Hexanol-3	$C_2H_5CHOHCH_2C_2H_5$	20	0.818	1.4141	I–408
295	Chlorohexane (2)	$CH_3(CH_2)_3CHClCH_3$	21	0.869	1.4142	I–144
296	Methyl-2-pentanol-5	$(CH_3)_2CH(CH_2)_2 \cdot CH_2OH$	20	0.816	1.4142	I–411
297	Diethyl malonate	$CH_2(CO_2C_2H_5)_2$	20	1.055	1.4143	II–573
298	Urethane (m.p. 49°)	$NH_2CO_2C_2H_5$	52	0.9	1.4144	III–22
299	Ethyl oenanthylate	$C_6H_{13}CO_2C_2H_5$	15	0.88	1.4144	II–340
300	Trifluoro-1,1,2-dibromoethane-1,2	$CBrF_2CHBrF$	14	2.254	1.4145	I–92
301	Caproic acid (*n*)	$CH_3(CH_2)_4CO_2H$	19.6	0.921	1.4145	II–321
302	Amyl valerate (*n*)	$C_4H_9CO_2C_5H_{11}$	20	0.87	1.4145	II–301
303	Malonic nitrile (m.p. 30°)	$CH_2(CN)_2$	34.2	1.049	1.4146	II–589
304	Vinyl-ethyl alcohol	$C_3H_5CH_2OH$	17.5	0.838	1.4146	I–441
305	Dimethyl-2,2-butanol-3	$(CH_3)_3CCHOHCH_3$	20	0.82	1.4146	I–412
306	Valeric anhydride (*iso*)	$(C_4H_9CO)_2O$	26	0.93	1.4147	II–314
307	Acetoxy acetone	$CH_3CO_2CH_2COCH_3$	20	1.075	1.4150	II–155
308	Caproic acid (*iso*)	$(CH_3)_2CHC_2H_4CO_2H$	20	0.925	1.4150	II–327
309	Ethyl α,α-diethoxy-propionate	$CH_3C(OC_2H_5)_2CO_2 \cdot C_2H_5$	17.1	0.979	1.4151	III–617
310	Ethylhydroxyl-amine (m.p. 59°)	C_2H_5NHOH	63.9	0.9	1.4152	IV–535
311	Heptyl acetate (*n*)	$CH_3CO_2C_7H_{15}$	20	0.87	1.4153	II–134
312	Allyl chloride	$CH_2{:}CHCH_2Cl$	20	0.938	1.4154	I–198
313	Isoprene	$CH_2{:}CHC(CH_3){:}CH_2$	20	0.681	1.4154	I–252
314	Crotonic nitrile	$CH_3CH{:}CHCN$	20	0.822	1.4156	II–412
315	Methyl lactate	$CH_3CHOHCO_2CH_3$	16	1.08	1.4156	III–280
316	Valeryl chloride (*iso*)	$(CH_3)_2CHCH_2COCl$	20	0.989	1.4156	II–315
317	Ethyl *n*-amyl ketone	$C_2H_5COC_5H_{11}$	20	0.8	1.4156	I–706
318	Ethylheptane (4)	$C_2H_5CH(CH_2CH_2 \cdot CH_3)_2$	20	0.741	1.4156	I–167
319	Undecane (*n*)	$CH_3(CH_2)_9CH_3$	20(?)	0.741	1.4158	I–170
320	Methyl-2-hexanol-2	$(CH_3)_2COH(CH_2)_3 \cdot CH_3$	20(?)	0.816	1.4159	I–415
321	Ethyl-2-hexanal-1	$C_4H_9CH(C_2H_5)CHO$	20	0.823	1.4160	.....
322	Methyl *n*-hexyl ketone	$CH_3(CH_2)_5COCH_3$	20	0.819	1.4161	I–704
323	Methyl α-methyl-acetoacetate	$CH_3COCH(CH_3)CO_2 \cdot CH_3$	23.8	1.031	1.4163	III–679
324	Methyl hydroxyl-amine (β)	CH_3NHOH	20	1.000	1.4164	IV–534

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
325	Trimethylpentane (2,2,3)	$(CH_3)_3CC(CH_3)C_2H_5$	25	0.712	1.4164†	*I–62
326	Succinic nitrile (m.p. 55°)	$(CH_2CN)_2$	63.1	0.985	1.4165	II–615
327	Dichloroethane (1,1)	CH_3CHCl_2	20	1.175	1.4166	I–83
328	Heptanol-4	$(CH_3CH_2CH_2)_2$·CHOH	20	0.820	1.4166	I–415
329	Methoxy acetic acid	$CH_3OCH_2CO_2H$	20	1.177	1.4168	III–232
330	Methyl-2-heptene-2	$(CH_3)_2C{:}CH(CH_2)_3$·CH_3	20	0.725	1.4169	I–222
331	Dipropyl ketone (*iso*)	$[(CH_3)_2CH]_2CO$	20(?)	0.806	1.417	I–703
332	Dimethyl-undecyl carbinol	$(CH_3)_2COHC_{11}H_{23}$	81.8	.....	1.417	I–429
333	Diethyl imido-carbonate	$(C_2H_5O)_2C{:}NH$	18.2	0.964	1.4170	III–37
334	Methyl-4-heptene-3	$C_2H_5CH{:}C(CH_3)$·C_3H_7	25	0.741	1.4171	I–222
335	Dimethyl-2,4-pentanol-2	$(CH_3)_2COHCH_2$·$CH(CH_3)_2$	20	0.82	1.4172	I–417
336	Amyl carbamate (*iso*) (m.p. 64°)	$NH_2CO_2C_5H_{11}$	70.6	0.944	1.4175	III–30
337	Methyl palmitate (m.p. 30°)	$C_{15}H_{31}CO_2CH_3$	80.7	.....	1.4175	II–372
338	Tripropylamine (*n*)	$(C_2H_5CH_2)_3N$	19.4	0.757	1.4176	IV–139
339	Methyl-2-pentanol-1	$C_2H_5CH_2CH(CH_3)$·CH_2OH	20	0.829	1.4178	I–409
340	Ethyl cyanoacetate	$NCCH_2CO_2C_2H_5$	20.5	1.062	1.4179	II–585
341	Diethyl acetic acid	$(C_2H_5)_2CHCO_2H$	10.2	0.933	1.4179	II–333
342	Diethyl ethyl-malonate	$C_2H_5CH(CO_2C_2H_5)_2$	14.8	1.01	1.4180	II–644
343	Nitro-4-methyl-2-butane	$(CH_3)_2CHCH_2$·CH_2NO_2	20.6	0.960	1.4181	I–140
344	Glycol diacetate	$(CH_3CO_2CH_2)_2$	15	1.108	1.4183	II–142
345	Dimethyl aceto-acetic ester	$CH_3COC(CH_3)_2CO_2$·C_2H_5	18.8	0.98	1.4183	III–695
346	Ethyl α-ohloro-propionate	$CH_3CHClCO_2C_2H_5$	20	1.087	1.4185	II–249
347	Diethyl mesoxalate	$CO(CO_2C_2H_5)_2$	15.6	1.136	1.4187	III–769
348	Glutaric acid (m.p. 97.5°)	$CH_2(CH_2CO_2H)_2$	106.4	1.192	1.4188	II–631
349	Diethyl methyl-ethyl-malonate	$C_2H_5C(CH_3)(CO_2$·$C_2H_5)_2$	18.2	0.99	1.4190	II–664
350	"Butyl cellosolve"	$C_4H_9OCH_2CH_2OH$	20	0.900	1.4191	.....
351	Allylamine	$CH_2{:}CHCH_2NH_2$	21.8	0.761	1.4194	IV–205
352	Acetoin	$CH_3CHOHCOCH_3$	15	1.002	1.4194	I–827
353	Ethoxy acetic acid	$C_2H_5OCH_2CO_2H$	20	1.102	1.4194	III–233
354	Chlorohexane (1)	$CH_3(CH_2)_4CH_2Cl$	20	0.876	1.4194	I–143
355	Hexyl cyanide (*n*)	$CH_3(CH_2)_5CN$	20(?)	0.81	1.4195	II–341
356	Ethyl ethyl-sulfonate	$C_2H_5SO_2OC_2H_5$	22	1.145	1.4196	IV–6
357	Methyl aceto-acetate	$CH_3COCH_2CO_2CH_3$	20	1.076	1.4196	III–632
358	Methyl-3-pentanol-3	$C_2H_5C(CH_3)(OH)$·C_2H_5	20	0.824	1.4196	I–411

† U. S. Bu. Standards found 1.4000.

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
359	Methyl-ethyl pyrotartrate	$C_5H_6O_4(CH_3)(C_2H_5)$	21.9	1.029	1.4196	II–639
360	Propyleneglycol-α monoacetate	$CH_3CO_2CH_2CHOH\cdot CH_3$	20(?)	1.055	1.4197	II–142
361	Diethyl sulfite	$(C_2H_5O)_2SO$	11	1.08	1.4198	I–325
362	Ethyl acetoacetate	$CH_3COCH_2CO_2C_2H_5$	20	1.025	1.4198	III–632
363	Dimethyl succinate	$(CH_2CO_2CH_3)_2$	20	1.121	1.4198	II–609
364	Diethyl pyrotartrate	$CH_3CH(CO_2C_2H_5)\cdot CH_2CO_2C_2H_5$	19.1	1.012	1.4198	II–639
365	Acetoxime (m.p. 60°)	$(CH_3)_2C{:}NOH$	75	.....	1.42	I–649
366	Ethyl propiolate	$CH{\equiv}CCO_2C_2H_5$	15	0.968	1.42	II–477
367	Valeryl chloride (*n*)	$CH_3(CH_2)_3COCl$	20	1.01	1.42	II–301
368	Heptylamine (*n*)	$CH_3(CH_2)_5CH_2NH_2$	26.5	0.77	1.42	IV–193
369	Sebacic acid (m.p. 134°)	$(CH_2)_8(CO_2H)_2$	133	.....	1.42	II–718
370	Diamyl oxalate (*iso*)	$(CO_2C_5H_{11})_2$	11	0.968	1.42	II–540
371	Methyl urethane	$CH_3NHCO_2C_2H_5$	18.9	1.009	1.4200	IV–64
372	Caproimido ethyl ether (*iso*)	$C_5H_{11}CH(:NH)O\cdot C_2H_5$	17.9	0.858	1.4200	II–329
373	Diethyl succinate	$(CH_2CO_2C_2H_5)_2$	20	1.040	1.4201	II–609
374	Methyl-2-heptanol-5	$(CH_3)_2CH(CH_2)_2\cdot CHOHC_2H_5$	20	0.808	1.4201	I–421
375	Methyl-2-heptanol-4	$(CH_3)_2CHCH_2\cdot CHOHC_3H_7$	20	0.821	1.4203	I–421
376	Dimethyl pyrotartrate	$CH_3CH(CO_2CH_3)\cdot CH_2CO_2CH_3$	19.6	1.069	1.4204	II–639
377	Methyl-2-heptanol-3	$(CH_3)_2CHCHOH\cdot C_4H_9$	20	0.825	1.4204	I–421
378	Octyl acetate (*n*)	$CH_3CO_2C_8H_{17}$	20	0.88	1.4204	II–134
379	Ethyl-2-hexanol-1 acetate	$C_4H_9CH(C_2H_5)\cdot CH_2O_2CCH_3$	20	0.871	1.4204	.....
380	Propargyl acetate	$CH_3CO_2CH_2C{\equiv}CH$	20	1.005	1.4205	II–140
381	Methyl-3-pentanol-2	$CH_3CHOHCH(CH_3)\cdot C_2H_5$	18	0.831	1.4205	I–411
382	Heptanol-3	$CH_3(CH_2)_3CHOH\cdot C_2H_5$	20	0.823	1.4206	*I–205
383	Ethyl methyl-acetoacetate	$CH_3COCH(CH_3)CO_2\cdot C_2H_5$	17.8	1.02	1.4207	III–679
384	Cyclopentene	$CH{:}CHCH_2CH_2CH_2$	14	0.775	1.4208	V–61
385	Ethyl-2-butanol-1	$(C_2H_5)_2CHCH_2OH$	20	0.831	1.4208	.....
386	Octine-1	$CH_3(CH_2)_5C{\equiv}CH$	12.5	0.753	1.4208	I–258
387	Dimethyl hydrazine (*sym*)	$CH_3NHNHCH_3$	20	0.827	1.4209	IV–547
388	Amyl acetic acid (*iso*)	$(CH_3)_2C_4H_7CO_2H$	19(?)	0.912	1.4209	II–342
389	Heptanol-2	$C_5H_{11}CHOHCH_3$	20	0.819	1.4209	I–415
390	Dimethyl-2,5-hexanol-2	$(CH_3)_2CH(CH_2)_2\cdot C(CH_3)_2OH$	20	0.823	1.4209	I–422
391	Dodecane (*n*)	$CH_3(CH_2)_{10}CH_3$	20(?)	0.751	1.4209	I–171
392	Heptaldoxime (m.p. 58°)	$CH_3(CH_2)_5CH{:}NOH$	83.9	0.833	1.421	I–698
393	Diethyl dimethyl-succinate (*uns*)	$(CH_3)_2C\cdot CH_2(CO_2\cdot C_2H_5)_2$	20	0.993	1.421	II–663

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
394	Diethyl dimethyl-succinate (*fum.*) (*sym*)	$(CH_3CHCO_2C_2H_5)_2$	20	0.995	1.421	II–667
395	Nonyl formate (γ)	$HCO_2C_9H_{19}$	20	0.869	1.421	.....
396	Allyl acetone	$C_3H_5CH_2COCH_3$	15.4	0.848	1.4213	I–734
397	Methyl-2-hexanol-3	$(CH_3)_2CHCHOH\cdot CH_2C_2H_5$	20	0.82	1.4215	I–416
398	Furan	$(CH{:}CH)_2O$	20	0.937	1.4216	XVII–27
399	Ethyl chloroacetate	$ClCH_2CO_2C_2H_5$	20	1.159	1.4216	II–197
400	Heptanoic acid	$CH_3(CH_2)_5CO_2H$	19.8	0.918	1.4216	II–338
401	Methyl α,α-dimethylacetoacetate	$CH_3COC(CH_3)_2CO_2\cdot CH_3$	16.8	1.012	1.4217	III–695
402	Caprylic aldehyde (*n*)	$CH_3(CH_2)_6CHO$	20	0.821	1.4217	I–704
403	Nitropentane (1)	$CH_3(CH_2)_3CH_2NO_2$	20(?)	0.948	1.4218	I–133
404	Methyl *n*-decyl ether	$C_{10}H_{21}OCH_3$	20	0.797	1.4218	.....
405	Ethyl urethane	$C_2H_5NHCO_2C_2H_5$	20	0.981	1.4219	IV–114
406	Tetramethyl-butenediol (*trans*)	$[(CH_3)_2C(OH)CH{:}]_2$ (m.p. 69°)	99.2	0.863	1.422	.....
407	Diethyl α,α'-dimethylglutarate	$CH_2(CH(CH_3)CO_2\cdot C_2H_5)_2$	20	0.977	1.422	.....
408	Dimethylpiperidylamine (γ)	$C_7H_{15}N$	19.2	0.759	1.4220	IV–222
409	Methyl chloroacetate	$ClCH_2CO_2CH_3$	20	1.236	1.4221	II–197
410	Dioxan (1,4)	$O{:}(CH_2)_4{:}O$	20	1.033	1.4221	XIX–3
411	Ethyl *n*-decyl ether	$C_2H_5OC_{10}H_{21}$	20	0.794	1.4223	.....
412	Acrylic acid	$CH_2{:}CHCO_2H$	20	1.051	1.4224	II–397
413	Methyl-2-hexanol-1	$CH_3(CH_2)_3CH\cdot(CH_3)CH_2OH$	20	0.82	1.4226	I–415
414	Dimethyl-2,4-pentanol-3	$[(CH_3)_2CH]_2CHOH$	20	0.829	1.4226	I–417
415	Ethyl acetoacetic ester	$CH_3COCH(C_2H_5)\cdot CO_2C_2H_5$	18.7	0.99	1.4226	III–691
416	Propylnonane (5)	$(C_4H_9)_2CHC_3H_7$	20	0.756	1.4228	.....
417	Dibutyl oxalate (*n*)	$(CO_2C_4H_9)_2$	20	1.0	1.4229	II–540
418	Diamylamine (*iso*)	$(C_5H_{11})_2NH$	21.1	0.767	1.4229	IV–182
419	Pentenonitrile (β,γ)	$CH_3CH{:}CHCH_2CN$	20	0.841	1.423	II–427
420	Methyl-3-hexanol-3	$C_2H_5CH_2C\cdot(CH_3)(OH)C_2H_5$	20	0.82	1.423	I–416
421	Tetramethyl-butenediol (*cis*)	$[(CH_3)_2C(OH)CH{:}]_2$ (m.p. 76°)	98.9	0.869	1.423	.....
422	Dimethyl-2,6-heptanol-4	$[(CH_3)_2CHCH_2]_2\cdot CHOH$	21	0.81	1.423	I–425
423	Diethyl dimethyl-succinate (*mal.*) (*sym*)	$(CH_3CHCO_2C_2H_5)_2$	20	0.996	1.423	II–668
424	Diethyl α,α'-dimethylglutarate (*mal.*)	$CH_2(CH(CH_3)CO_2\cdot C_2H_5)_2$	20	0.980	1.423	.....
425	Methylcyclohexane	$CH_3(CHC_5H_{10})$	20	0.769	1.4230	V–29
426	Acetonyl acetone	$(CH_3COCH_2)_2$	20	0.974	1.4232	I–788
427	Octylamine (*sec*) (*n*)	$CH_3(CH_2)_5\cdot CH(NH_2)CH_3$	24.5	0.771	1.4232	IV–196

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
428	Ethyl-2-hexanol-1 formate	$HCO_2CH_2CH(C_2H_5)\cdot C_4H_9$	20	0.88	1.4232	.....
429	Diethyl methyl-cyanomalonate	$NCC(CH_3)(CO_2\cdot C_2H_5)_2$	20	1.070	1.4232	II-814
430	Heptyl alcohol (*n*)	$CH_3(CH_2)_5CH_2OH$	22.4	0.817	1.4233	I-414
431	Nitro-2-dimethyl-2, 4-pentane	$(CH_3)_2C(NO_2)CH_2\cdot CH(CH_3)_2$	30	0.94	1.4235	I-158
432	Acetoxy-γ-valero-lactone (γ)	$CH_3CO_2C(CH_3)CH_2\cdot CH_2COO$ (m.p. 78°)	78.6	1.123	1.4236	XVIII-2
433	Tricosane (*n*) (m.p. 47°)	$CH_3(CH_2)_{21}CH_3$	80.8	0.7	1.4236	I-175
434	Methylene chloride	CH_2Cl_2	20	1.336	1.4237	I-60
435	Methyl-2-heptanol-6	$(CH_3)_2CH(CH_2)_3\cdot CHOHCH_3$	20	0.813	1.4238	I-421
436	Ethyl-2-hexanol-1 propionate	$C_2H_5CO_2C_8H_{17}$	20	0.87	1.4238	.....
437	Dibutyl succinate (*sec*)	$(CH_2CO_2C_4H_9)_2$	25.3	0.97	1.4238	II-611
438	Ethyl bromide	C_2H_5Br	20	1.431	1.4239	I-88
439	Crotonyl alcohol	$CH_3CH{:}CHCH_2OH$	20	0.854	1.4240	I-442
440	Pentene-1-ol-3	$CH_2{:}CHCHOHC_2H_5$	20	0.837	1.4240	I-443
441	Diethyl glutarate	$CH_2(CH_2CO_2C_2H_5)_2$	20	1.025	1.4241	II-633
442	Ethyl glycinate	$H_2NCH_2CO_2C_2H_5$	20	1.028	1.4242	IV-340
443	Ethyl levulinate	$CH_3CO(CH_2)_2CO_2\cdot C_2H_5$	16.2	1.017	1.4242	III-675
444	Ethyl *n*-butyl malonate	$CH_2(CO_2C_2H_5)(CO_2\cdot C_4H_9)$	20	0.98	1.4242	.....
445	Pelargonic aldehyde	$CH_3(CH_2)_7CHO$	18.6	0.827	1.4242	I-708
446	Heptaldoxime *O*-methyl ether	$CH_3(CH_2)_5CH{:}NO\cdot CH_3$	19.4	0.838	1.4243	I-698
447	"Carbitol"	$C_2H_5O(CH_2)_2O\cdot (CH_2)_2OH$	26	0.98	1.4244	.....
448	Hexahydroxylene (*p*)	$(CH_3)_2C_6H_{10}$	20	0.769	1.4244	V-38
449	Octanol-2*	$CH_3(CH_2)_5CHOH\cdot CH_3$	20	0.822	1.4244	I-419
450	Tributyl phosphate (*n*)	$(C_4H_9O)_3PO$	20	0.977	1.4245	.....
451	Ethyl crotonate (α)	$C_3H_5CO_2C_2H_5$	20	0.919	1.4246	II-411
452	Ethyl *iso*-crotonate	$CH_3CH{:}CHCO_2C_2H_5$	20	0.925	1.4246	II-411
453	Ethyl β-chlorobutyrate	$CH_3CHClCH_2CO_2\cdot C_2H_5$	20	1.052	1.4246	II-277
454	Silicon tetraethyl	$(C_2H_5)_4Si$	25.1	0.76	1.4246	IV-625
455	Chloroethyl-2 acetate	$CH_3CO_2CH_2CH_2Cl$	20	1.17	1.4247	II-128
456	Ethyl *iso*-butyl malonate	$CH_2(CO_2C_2H_5)(CO_2\cdot C_4H_9)$	20	0.97	1.4248	.....
457	Propyl *n*-decyl ether	$CH_3CH_2CH_2OC_{10}H_{21}$	20	0.797	1.4249	.....
458	Methyl allyl carbinol	$(CH_3)(CH_2{:}CH\cdot CH_2)CHOH$	20	0.834	1.425	I-443
459	Hexahydroxylene (*m*)	$(CH_3)_2C_6H_{10}$	20.8	0.770	1.4250	V-36

*Mixture of *l* and *dl*.

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref
460	Methyl-1-*iso*propyl-3-cyclopentane	$(CH_3)_2CH\cdot CH(CH_2)_2CH\cdot (CH_3)CH$	19	0.773	1.4250	*V-18
461	Propyl bromide (*iso*)	$(CH_3)_2CHBr$	20	1.310	1.4251	I-108
462	Diethyl diethylmalonate	$(C_2H_5)_2C(CO_2C_2H_5)_2$	16.6	0.99	1.4252	II-686
463	Tributylamine (*iso*)	$(C_4H_9)_3N$	17.3	0.771	1.4252	IV-666
464	Dimethyl diethylmalonate	$(C_2H_5)_2C(CO_2CH_3)_2$	24.5	1.031	1.4253	II-686
465	Ethyl β-chloropropionate	$ClCH_2CH_2CO_2C_2H_5$	20	1.109	1.4254	II-250
466	Methyl-2-hexanol-6	$(CH_3)_2CH(CH_2)_3\cdot CH_2OH$	20(?)	0.82	1.4254	I-416
467	Octanol-2	$CH_3(CH_2)_5CHOH\cdot CH_3$	20	0.822	1.4256	I-419
468	Acetaldoxime	$CH_3CH{:}NOH$	20.4	0.965	1.4257	I-608
469	Vinyl acetic acid	$CH_2{:}CHCH_2CO_2H$	15	1.013	1.4257	II-407
470	Levulinic aldehyde	$CH_3CO(CH_2)_2CHO$	21.5	1.02	1.4257	I-774
471	Amyl *iso*-amylideneamine* (*iso*)	$(CH_3)_2CH(CH_2)_2N{:}CHCH_2CH(CH_3)_2$	18.9	0.772	1.4258	.....
472	Methyl *n*-butylhydrazine (*uns*)	$CH_3(C_4H_9)NNH_2$	21.3	0.804	1.4259	IV-552
473	Methyl α, β-butyleneoxide-δ-carboxylate	$CH_3O_2CCH_2CH_2\cdot CHCH_2O$	24.7	1.073	1.4259	.....
474	Propyl *iso*-propyl malonate	$CH_2(CO_2C_3H_7)$	20	0.98	1.4259	.....
475	Ethyl methylethylacetoacetate	$CH_3COC(CH_3)\cdot(C_2H_5)CO_2C_2H_5$	17.7	0.973	1.426	III-703
476	Succinic aldehyde	$(CH_2CHO)_2$	18	1.069	1.4262	I-767
477	Dimethylacetylacetone	$CH_3COC(CH_3)_2CO\cdot CH_3$	27.8	0.950	1.4262	I-794
478	Pentacosane (m.p. 55°)	$C_{25}H_{52}$	80	0.8	1.4262	I-175
479	Methyl *sec*-butylcarbamate	$C_2H_5CH(CH_3)NH\cdot CO_2CH_3$	24.9	0.965	1.4263	IV-162
480	Diethyl cyanomalonate	$NCCH(CO_2C_2H_5)_2$	20	1.093	1.4263	II-811
481	"Methyl carbitol"	$CH_3O(CH_2)_2O\cdot(CH_2)_2OH$	27	1.03	1.4264	.....
482	Cyclohexane	$CH_2(CH_2)_4CH_2$	19.5	0.779	1.4266	V-20
483	Ethyl-2-hexanol-1 butyrate	$C_3H_7CO_2C_8H_{17}$	20	0.87	1.4266	.....
484	Ethyl *sec*-butylcarbamate	$C_2H_5CH(CH_3)NH\cdot CO_2C_2H_5$	26	0.940	1.4267	IV-162
485	Diethyl ethylcyanomalonate	$NCC(C_2H_5)(CO_2\cdot C_2H_5)_2$	20	1.052	1.4267	II-818
486	Lauric acid (m.p. 48°)	$CH_3(CH_2)_{10}CO_2H$	60	0.8	1.4267	II-359
487	Caprylic acid (*n*)	$CH_3(CH_2)_6CO_2H$	21	0.91	1.4268	II-347

*Probably not a pure material.

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
488	Cycloacetobutyl methyl ether	$C_7H_{14}O_2$	20	0.946	1.427	.....
489	Diethyl trimethyl-succinate	$(CH_3)_2CC(CH_3)\cdot(CO_2C_2H_5)_2$	20	0.993	1.427	.....
490	Ethyl α-hydroxy-methylene propionate	$HOCH{:}C(CH_3)CO_2\cdot C_2H_5$	20	1.024	1.4270	III-669
491	Dimethylfurazan	$CH_3C{:}NON{:}CCH_3$	18.9	1.050	1.4271	XXVII-565
492	Ethyl hydrogen malonate	$CH_2(CO_2H)(CO_2\cdot C_2H_5)$	20	1.176	1.4271	II-573
493	Ethyl hydracrylate	$HOCH_2CH_2CO_2C_2H_5$	23	1.07	1.4271	III-297
494	Methyl-2-ethyl-5-heptene-5	$(CH_3)_2CH(CH_2)_2\cdot C(C_2H_5){:}CHCH_3$	20(?)	0.75	1.4271	I-224
495	Decyl formate (*n*)	$HCO_2CH_2(CH_2)_8CH_3$	20	0.873	1.4271	.....
496	Capric aldehyde (*n*)	$CH_3(CH_2)_8CHO$	22	0.82	1.4273	I-711
497	Decyl acetate (*n*)	$CH_3CO_2CH_2(CH_2)_8\cdot CH_3$	20	.....	1.4273	II-135
498	Methyl-3-heptanol-3	$(CH_3)(C_2H_5)COH\cdot(C_4H_9)$	19	0.827	1.4274	I-421
499	Methyl *iso*-butylcarbamate	$C_4H_9NHCO_2CH_3$	21.6	0.965	1.4275	IV-168
500	Triethyl methane-tricarboxylate	$HC(CO_2C_2H_5)_3$	16.2	1.108	1.4275	II-810
501	Ethyl *iso*-amyl malonate	$CH_2(CO_2C_2H_5)(CO_2\cdot C_5H_{11})$	20	0.95	1.4275	.....
502	Ethyl *n*-butyl-carbamate	$C_4H_9NHCO_2C_2H_5$	25.6	0.943	1.4278	IV-158
503	Butyl decyl ether	$C_4H_9OC_{10}H_{21}$	20	0.801	1.4278	.....
504	Caproic aldehyde (*n*)	$CH_3(CH_2)_4CHO$	20	0.834	1.4279	I-688
505	Methyl *n*-heptyl ketone	$CH_3(CH_2)_6COCH_3$	20(?)	0.832	1.4279	I-709
506	Isoxazole	$OCH{:}CHCH{:}N$	20	1.078	1.428	XXVII-14
507	Butyl bromide (*tert*)	$(CH_3)_3CBr$	20.5	1.211	1.428	I-127
508	Dimethyl-hexa-decyl-ethylene	$(CH_3)_2C{:}CHC_{16}H_{33}$	79.1	.....	1.428	.....
509	Ethyl α-ethylcrotonate	$CH_3CH{:}C(C_2H_5)\cdot CO_2C_2H_5$	20	0.899	1.428*	II-440
510	Diethyl adipate	$(CH_2CH_2CO_2C_2H_5)_2$	20	1.009	1.4281	II-652
511	Pentene-2-ol-4	$CH_3CH{:}CHCHOH\cdot CH_3$	18	0.839	1.4282	I-443
512	Laurone (m.p. 69°)	$(C_{11}H_{23})_2CO$	79.5	0.8	1.4283	I-719
513	Ethyl *sec*-butyl malonate	$CH_2(CO_2C_2H_5)(CO_2\cdot C_4H_9)$	20	0.99	1.4284	.....
514	Undecene-1	$CH_3(CH_2)_8CH{:}CH_2$	20	0.763	1.4284	I-225
515	Dimethyl adipate	$(CH_2CH_2CO_2CH_3)_2$	20	1.063	1.4286	II-652
516	Dimethyl-2,4-hexanol-4	$(CH_3)_2CHCH_2COH\cdot(CH_3)(C_2H_5)$	18	0.83	1.4286	I-422
517	Propionaldoxime	$C_2H_5CH{:}NOH$	20	0.926	1.4287	I-631
518	Ethyl *iso*butyl-carbamate	$C_4H_9NHCO_2C_2H_5$	20	0.943	1.4288	IV-168

*For ester of the liquid acid variety.

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
519	Methyl *n*-butyl-carbamate	$C_4H_9NHCO_2CH_3$	23.3	0.969	1.4289	IV–158
520	Sulfuric acid	H_2SO_4	20(?)	.....	1.429	.....
521	"Butyl carbitol"	$C_4H_9O(CH_2)_2O\cdot(CH_2)_2OH$	27	0.95	1.4290	.....
522	Diethyl propyl-cyanomalonate	$NCC(C_3H_7)(CO_2\cdot C_2H_5)_2$	20	1.033	1.4291	II–820
523	Tributylamine (*n*)	$(C_4H_9)_3N$	20	0.778	1.4291	IV–157
524	Decyl propionate (*n*)	$C_2H_5CO_2C_{10}H_{21}$	20	0.864	1.4291	.....
525	Propylene glycol (α)	$CH_3CHOHCH_2OH$	27	1.03	1.4293	I–472
526	Amyl *iso*-propyl malonate (*iso*)	$CH_2(CO_2C_5H_{11})\cdot(CO_2C_3H_7)$	20	0.96	1.4293	.....
527	Dimethyl formamide	$HCON(CH_3)_2$	22.4	0.948	1.4294	IV–58
528	Undecylic acid (m.p. 29°)	$CH_3(CH_2)_9CO_2H$	45.2	.....	1.4294	II–358
529	Acetol	CH_3COCH_2OH	20	1.082	1.4295	I–821
530	Chloroacetic acid (m.p. 63°)	$ClCH_2CO_2H$	65	1.370	1.4297	II–194
531	Palmitone (m.p. 83°)	$(C_{15}H_{31})_2CO$	93.5	0.79	1.4297	I–719
532	Dipropyl cyanamide	$(C_2H_5CH_2)_2NCN$	24.4	0.857	1.4298	IV–144
533	Ethyl trimethyl-acrylate	$(CH_3)_2C{:}C(CH_3)\cdot CO_2C_2H_5$	19.3	0.907	1.4299	II–443
534	Propionamide	$C_2H_5CONH_2$	20	1.042	1.43	II–243
535	Crotonic acid (α) (m.p. 72°)	$CH_3CH{:}CHCO_2H$	72	0.96	1.43	II–408
536	Dimethylamino-ethanol	$(CH_3)_2NCH_2CH_2OH$	20	0.887	1.43	IV–276
537	Allyl acetic acid	$CH_2{:}CHCH_2CH_2\cdot CO_2H$	17.7	0.984	1.43	II–425
538	Angelic acid (*cis*) (m.p. 45°)	$CH_3CH{:}C(CH_3)\cdot CO_2H$	76	0.954	1.43	II–428
539	Octylamine (*n*)	$CH_3(CH_2)_7NH_2$	26.8	0.777	1.43	IV–196
540	Azelaic acid (m.p. 107°)	$(CH_2)_7(CO_2H)_2$	107.3	1.0	1.43	II–707
541	Cetyl alcohol (m.p. 50°)	$CH_3(CH_2)_{14}CH_2OH$	79	0.798	1.43	I–429
542	Dotriacontane (*n*)	$CH_3(CH_2)_{30}CH_3$	79.4	0.775	1.43	I–177
543	Heptenonitrile (Δ^2) (*iso*)	$(CH_3)_2CHCH_2CH{:}CHCN$	20	0.826	1.430	.....
544	Nonanol-5	$(C_4H_9)_2CHOH$	20	0.823	1.430	I–424
545	Ethyl-2-hexanol-1	$C_4H_9CH(C_2H_5)\cdot CH_2OH$	20	0.833	1.4300	.....
546	Methyl *n*-nonyl ketone	$CH_3(CH_2)_8COCH_3$	17.3	0.83	1.4300	I–713
547	Butyraldoxime (*iso*)	$(CH_3)_2CHCH{:}NOH$	20.5	0.902	1.4302	*I–350
548	Methyl-2-penten-3-ol-2	$CH_3CH{:}CHCOH\cdot(CH_3)_2$	20	0.835	1.4302	I–445
549	Hexahydroxylene (*o*)	$(CH_3)_2C_6H_{10}$	17.9	0.78	1.4302	V–36
550	Pyruvic acid	CH_3COCO_2H	15.3	1.3	1.4303	III–608

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
551	Methyl-2-heptanol-2	$CH_3(CH_2)_4COH\cdot(CH_3)_2$	20(?)	0.879	1.4303	I-420
552	Dimethyl-2,6-octene-2	$(CH_3)_2C{:}CH(CH_2)_2\cdot CH(CH_3)C_2H_5$	20	0.75	1.4303	I-224
553	Tetracosane (*n*) (m.p. 54°)	$CH_3(CH_2)_{22}CH_3$	65	0.77	1.4303	I-175
554	Octanol-1	$CH_3(CH_2)_6CH_2OH$	20.5	0.826	1.4304	I-418
555	Dimethyl-2,7-octene-2	$(CH_3)_2CH(CH_2)_3\cdot CH{:}C(CH_3)_2$	20	0.75	1.4304	I-224
556	Palmitic acid (m.p. 64°)	$CH_3(CH_2)_{14}CO_2H$	70	0.849	1.4304	II-370
557	Diethyl pimelate	$(CH_2)_5(CO_2C_2H_5)_2$	20	0.99	1.4305	II-671
558	Ethyl mercaptan	C_2H_5SH	20	0.839	1.4306	I-340
559	Propargyl alcohol	$CH{:}CCH_2OH$	20	0.972	1.4306	I-454
560	Glyceryl triacetate	$(CH_3CO_2)_3C_3H_5$	20	1.16	1.4306	II-147
561	Pelargonic acid	$CH_3(CH_2)_7CO_2H$	20(?)	0.906	1.4306	II-352
562	Nonanol-3	$C_2H_5CHOHC_6H_{13}$	20	0.825	1.4308	I-424
563	Capric acid (m.p. 31°)	$CH_3(CH_2)_8CO_2H$	30	0.895	1.4308	II-355
564	Myristic acid (m.p. 58°)	$CH_3(CH_2)_{12}CO_2H$	60	0.858	1.4308	II-365
565	Decyl butyrate (*n*)	$C_2H_5CH_2CO_2CH_2\cdot(CH_2)_8CH_3$	20	0.862	1.4308	.....
566	Dimethyl-2,5-hexadiene-1,5	$[CH_2{:}C(CH_3)CH_2]_2$	20	0.75	1.4309	I-259
567	Ethyl α,β-pentenate	$CH_3CH_2CH{:}CHCO_2\cdot C_2H_5$	20	0.909	1.431	*II-191
568	Ethyl angelate	$C_4H_7CO_2C_2H_5$	19.5	0.918	1.431	II-429
569	Trimethyl-1,2,4-cyclohexane	$(CH_3)_3C_6H_9$	16.9	0.780	1.431	V-42
570	Dimethyl-2,5-heptanol-5	$(CH_3)_2CH(CH_2)_2\cdot COH(CH_3)C_2H_5$	20	0.829	1.4310	I-425
571	Nonanol-1	$CH_3(CH_2)_7CH_2OH$	20	0.828	1.4311	I-423
572	Butyl-*n* propyl-*iso* malonate	$CH_2(CO_2C_4H_9)(CO_2\cdot C_3H_7)$	20	0.97	1.4311	.....
573	Propyl silicon trichloride	$(C_3H_7)SiCl_3$	20.3	1.196	1.4312	IV-630
574	Hexene-2-ol-4	$CH_3CH{:}CHCHOH\cdot C_2H_5$	25	0.841	1.4312	I-445
575	Ethyl hydrogen pyrotartrate	$CH_3CH(CO_2C_2H_5)\cdot CH_2CO_2H$*	20.2	1.098	1.4312	II-639
576	Cyclopropyl carbinol	$(CH_2)_2CHCH_2OH$	15.1	0.90	1.4313	VI-4
577	Decene-1	$CH_2{:}CH(CH_2)_7CH_3$	16	0.75	1.4313	I-223
578	Methyl acrylic acid (α)	$CH_2{:}C(CH_3)CO_2H$	20	1.015	1.4314	II-421
579	Ethyl-3-pentanol-3	$(C_2H_5)_3COH$	20	0.839	1.4314	I-417
580	Methyl α-methoxy-acrylate	$CH_2{:}C(OCH_3)CO_2\cdot CH_3$	20	1.068	1.4316	*III-134
581	Nitro-2-dimethyl-2,5-hexane	$(CH_3)_2C(NO_2)\cdot(CH_2)_2CH(CH_3)_2$	20	0.921	1.4316	I-163
582	Dimethyl acetonyl-acetone (ω,ω)	$(CH_3)_2CHCOCH_2\cdot CH_2COCH_3$	23	0.934	1.4317	I-796
583	Methyl-3-octanol-4	$C_2H_5(CH_2)_2CHOH\cdot CH(CH_3)C_2H_5$	20	0.834	1.4317	.....
584	Glycol	$(CH_2OH)_2$	20	1.114	1.4318	I-465

*Or $CH_3CH(CO_2H)CH_2CO_2C_2H_5$

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
585	Amino hexahydrobenzene	$C_6H_{11}NH_2$	20	0.865	1.4318	XII–5
586	Hexahydromesitylene	$(CH_3)_3C_6H_9$ (1,3,5)	13.1	0.778	1.4318	V–45
587	Dimethyl-2,4-heptanol-4	$(CH_3)_2CHCH_2COH\cdot(CH_3)CH_2C_2H_5$	18	0.827	1.4318	I–425
588	Heptyl *n*-heptylate	$CH_3(CH_2)_5CO_2CH_2\cdot(CH_2)_5CH_3$	18.8	0.865	1.4318	II–340
589	Aluminum triethyl	$(CH_3)_3Al$	12	.....	1.432	IV–643
590	Methyl hydracrylate	$HOCH_2CH_2CO_2CH_3$	20	1.12	1.432	*III–112
591	Hexenonitrile (β,γ)	$C_2H_5CH{:}CHCH_2CN$	20	0.841	1.432	.....
592	Ethyl α,β-*iso*-hexenate	$(CH_3)_2CHCH{:}CH\cdot CO_2C_2H_5$	20	0.896	1.432	II–439
593	Methyl β,β-dimethylacrylate	$(CH_3)_2C{:}CHCO_2CH_3$	19.8	0.934	1.4321	II–433
594	Nitrosoethylurethane	$C_2H_5N(NO)CO_2\cdot C_2H_5$	20	1.071	1.4322	IV–129
595	Ethyl-3-hexanol-3	$(C_2H_5)_2COHCH_2\cdot C_2H_5$	13	0.84	1.4322	I–421
596	Dimethyl-3,5-heptanol-4	$(C_2H_5(CH_3)CH)_2\cdot CHOH$	20	0.836	1.4322	.....
597	Undecylic aldehyde	$CH_3(CH_2)_9CHO$	23	0.825	1.4322	I–712
598	Methyl hydrogen pyrotartrate	$CH_3CH(CO_2CH_3)\cdot CH_2CO_2H$*	20.7	1.144	1.4323	II–639
599	Ethyl α-ethoxyacrylate	$CH_2{:}C(OC_2H_5)CO_2\cdot C_2H_5$	17.2	0.996	1.4324	III–370
600	Ethylmethylfurazan	$C_2H_5C{:}N{\cdot}O{\cdot}N{:}CCH_3$	18.8	1.018	1.4326	XXVII–565
601	Nitro-2-dimethyl-2,6-heptane	$(CH_3)_2C(NO_2)\cdot(CH_2)_3CH(CH_3)_2$	18	0.915	1.4326	I–167
602	Diethyl acetoacetic ester	$CH_3COC(C_2H_5)_2CO_2\cdot C_2H_5$	17	0.971	1.4326	III–710
603	Bis-diethylacetal	$[(C_2H_5O)_2CHC{:}]_2$	26	0.953	1.4328	I–805
604	Diethyl subefate	$[(CH_2)_3CO_2C_2H_5]_2$	20	0.982	1.4328	II–693
605	Pentenonitrile (α,β)	$CH_3CH_2CH{:}CHCN$	20	0.828	1.433	II–426
606	Dimethylangelolactone	$(CH_3)C{:}CHC(CH_3)_2\cdot COO$	20	0.976	1.433	.....
607	Hydroxy valeric lactone (γ)	$CH_3CHCH_2CH_2COO$	22.4	1.050	1.4331	XVII–235
608	Undecene-2	$CH_3(CH_2)_7CH{:}CH\cdot CH_3$	15(?)	0.774	1.4333	I–225
609	Dimethyl-diethyl methanetetracarboxylate	$C(CO_2CH_3)_2(CO_2\cdot C_2H_5)_2$	17.2	1.183	1.4333	*II–331
610	Hexacosane (*n*) (m.p. 60°)	$CH_3(CH_2)_{24}CH_3$	65	0.8	1.4333	I–175
611	Cyclobutanol	$CH_2CH_2CH_2CHOH$	20	0.92	1.4335	VI–4
612	Heptanoic anhydride	$(C_6H_{13}CO)_2O$	15	0.94	1.4335	II–340
613	Stearic acid (m.p. 69°)	$CH_3(CH_2)_{16}CO_2H$	70	0.847	1.4335	II–377

*Or $CH_3CH(CO_2H)CH_2CO_2CH_3$

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
614	Diethyl ethyl-acetylmalonate	$CH_3COC(C_2H_5)\cdot(CO_2C_2H_5)_2$	19.3	1.054	1.4338	III-812
615	Trimethylcyclo-hexane (1,1,3)	$(CH_3)_3C_6H_9$	25.3	0.787	1.4339	V-42
616	Amyl chloroacetate	$ClCH_2CO_2C_5H_{11}$	20	1.055	1.434	II-198
617	Ethyl α, β-hexenate	$CH_3(CH_2)_2CH{:}CH\cdot CO_2C_2H_5$	20	0.901	1.434	II-434
618	Diethyl hydrazo-*iso*-butyrate	$[HNC(CH_3)_2CO_2\cdot C_2H_5]_2$	20.5	0.999	1.434	IV-560
619	Eicosane (*n*) (m.p. 38°)	$CH_3(CH_2)_{18}CH_3$	42.9	0.77	1.434	I-174
620	Oxalyl chloride	$(COCl)_2$	12.9	1.489	1.4340	II-542
621	Propyl bromide (*n*)	$C_2H_5CH_2Br$	20	1.354	1.4341	I-108
622	Ethyl *n*-hexyl-carbamate	$C_6H_{13}NHCO_2C_2H_5$	26.8	0.923	1.4341	IV-188
623	Butyl bromide (*sec*)	$C_2H_5CHBrCH_3$	25.3	1.251	1.4344	I-119
624	Methyl furan (2)	$CH_3C_4H_3O$	20	0.913	1.4344	XVII-36
625	Heneicosane (*n*) (m.p. 40°)	$CH_3(CH_2)_{19}CH_3$	45.3	0.775	1.4344	I-174
626	Butenyl-dimethyl carbinol	$(CH_3)_2C(OH)C_4H_7$	16.2	0.838	1.4345	.....
627	Methyl-2-hexene-5-ol-2	$CH_2{:}CH(CH_2)_2COH\cdot(CH_3)_2$	16.2	0.838	1.4345	I-447
628	Trimethyl-3,3,4-hexanol-4	$(C_2H_5)(CH_3)_2CCOH\cdot(CH_3)C_2H_5$	20	0.832	1.4345	I-425
629	Heptacosane (*n*) (m.p. 60°)	$CH_3(CH_2)_{25}CH_3$	65	0.77	1.4345	I-176
630	Dichloromethyl ether (*sym*)	$(ClCH_2)_2O$	20	1.315	1.4346	I-582
631	Butyroin	$C_2H_5CH_2CHOHCO\cdot CH_2C_2H_5$	16.7	0.911	1.4346	I-840
632	Methyl-2-ethyl-4-hexanol-4	$(C_2H_5)_2COHCH_2CH\cdot(CH_3)_2$	13	0.8	1.4346	I-425
633	Ethyl palmitate	$CH_3(CH_2)_{14}CO_2C_2H_5$	34.3	.....	1.4347	II-372
634	Erucic anhydride (m.p. 48°)	$(C_{21}H_{41}CO)_2O$	100	.....	1.4347	II-474
635	Ethyl triazoacetate	$N_3CH_2CO_2C_2H_5$	24.9	1.13	1.4349	II-229
636	Octadecane (*n*)	$CH_3(CH_2)_{16}CH_3$	35.2	0.77	1.4349	I-173
637	Cyclo-γ-hydroxy-valeric aldehyde	$CH_3CHCH_2CH_2\cdot$ | CHOH·O |	20	1.019	1.435	*I-421
638	Ethyl β,β-dimethyl-acrylate	$(CH_3)_2C{:}CHCO_2\cdot C_2H_5$	20	0.913	1.435	II-433
639	Ethyl α-ethyl-crotonate	$CH_3CH{:}C(C_2H_5)\cdot CO_2C_2H_5$	20	0.908	1.435*	II-440
640	Dimethylfuran (2,5)	$CH_3C{:}CHCH{:}C\cdot$ | $(CH_3)\cdot O$ |	21.6	0.887	1.4351	XVII-41
641	Diethyl chloro-malonate	$ClCH(CO_2C_2H_5)_2$	19.3	1.205	1.4353	II-593
642	Nonanol-2	$CH_3(CH_2)_6CHOH\cdot CH_3$	20(?)	0.823	1.4353	I-423

*For ester of the solid acid variety.

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
643	Octacosane (m.p. 65°)	$C_{28}H_{58}$	65	0.77	1.4354	I–176
644	Propyl-4-heptanol-4	$(C_2H_5CH_2)_3COH$	21	0.834	1.4356	I–426
645	Pentenic acid (β,γ)	$CH_3CH{:}CHCH_2CO_2H$	18.8	0.99	1.4357	II–426
646	Nitro-2-dimethyl-2,7-octane	$(CH_3)_2C(NO_2)\cdot(CH_2)_4CH(CH_3)_2$	20	0.909	1.4357	I–169
647	Cetyl acetate	$CH_3CO_2C_{16}H_{33}$	33.9	0.85	1.4358	II–136
648	Glyceryl tributyrate	$(C_3H_7CO_2)_3C_3H_5$	20	1.032	1.4359	II–273
649	Butyl bromide (*iso*)	$(CH_3)_2CHCH_2Br$	20	1.264	1.436	I–126
650	Ethyl tiglate	$CH_3CH{:}C(CH_3)CO_2\cdot C_2H_5$	19.5	0.924	1.436	II–431
651	Ethyl α,β-*iso*-heptenate	$(CH_3)_2CHCH_2CH{:}CHCO_2C_2H_5$	20	0.889	1.436	.....
652	Diethyl tetramethylsuccinate	$[(CH_3)_2CCO_2C_2H_5]_2$	20	0.995	1.436	II–707
653	Tetraethyl methanetetracarboxylate	$C(CO_2C_2H_5)_4$	17	1.136	1.436	*II–331
654	Nondecane (n) (m.p. 32°)	$CH_3(CH_2)_{17}CH_3$	34.6	0.775	1.436	I–174
655	Chloropropyl alcohol (2)	$CH_3CHClCH_2OH$	20	1.103	1.4362	I–356
656	Crotonic aldehyde (α)	$CH_3CH{:}CHCHO$	20.5	0.852	1.4362	I–728
657	Diethyl malate	$(CHOHCH_2)(CO_2\cdot C_2H_5)_2$	20	1.128	1.4362	III–437
658	Ethyl methylnitrosocarbamate	$CH_3N(NO)CO_2\cdot C_2H_5$	20	1.122	1.4363	IV–85
659	Ethyl diallylacetate	$(CH_2{:}CHCH_2)_2CH.CO_2C_2H_5$	19.1	0.897	1.4364	II–489
660	Nonacosane (m.p. 64°)	$C_{29}H_{60}$	65	0.77	1.4364	I–176
661	Glutaric nitrile	$CH_2(CH_2CN)_2$	23.2	0.99	1.4365	II–635
662	Cyclopentanone	$CH_2(CH_2)_3CO$	20	0.948	1.4366	VII–5
663	Triethyl acetylmethanetricarboxylate	$CH_3COC(CO_2C_2H_5)_3$	13.5	1.128	1.4366	*III–294
664	Brassidic anhydride (m.p. 64°)	$C_{44}H_{82}O_3$	100	0.8	1.4366	.....
665	Valeric aldehyde oxime (*iso*)	$C_4H_9CH{:}NOH$	20	0.893	1.4367	I–686
666	Bromo-1-dimethyl-2,2-propane	$(CH_3)_3CCH_2Br$	20	1.260	1.4369	I–141
667	Undecanol-2	$CH_3(CH_2)_8CHOH\cdot CH_3$	20	0.827	1.4369	I–427
668	Chlorosulfonic acid	$HOSO_2Cl$	14	.....	1.437	.....
669	Cyclopropane carboxylic acid	$CH_2CH_2CHCO_2H$	20.9	1.087	1.4370	IX–4
670	Dimethylacetamide (*N,N*)	$CH_3CON(CH_3)_2$	22.5	0.94	1.4371	IV–59
671	Amyl α-crotonate	$C_9H_{16}O_2$	20	0.896	1.4371	II–411

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
672	Tetramethylcyclohexane (1,2,4,5)	$(CH_3)_4C_6H_8$	13.1	0.791	1.4372	*V–23
673	Decyl alcohol (*n*)	$CH_3(CH_2)_8CH_2OH$	20	0.830	1.4372	I–425
674	Heptene-2-ol-4	$CH_3CH{:}CHCHOH{\cdot}CH_2C_2H_5$	20	0.845	1.4373	I–447
675	Dimethylnitrosoamine	$(CH_3)_2NNO$	18.4	1.01	1.4374	IV–84
676	Hexenonitrile-α,β (*iso*)	$(CH_3)_2CHCH{:}CHCN$	20	0.855	1.4374	.....
677	Diethyl acetylmalonate	$CH_3COCH(CO_2{\cdot}C_2H_5)_2$	26	1.083	1.4374	III–796
678	Difluorobenzene (*p*)	$C_6H_4F_2$	20	1.164	1.4375	V–199
679	Methyl-4-heptene-1-ol-4	$CH_2{:}CHCH_2COH{\cdot}(CH_3)CH_2C_2H_5$	21.3	0.834	1.4376	I–449
680	Thujane	$C_{10}H_{18}$	20	0.814	1.4376	V–93
681	Dimethyl-1,3-cyclohexanyl-5 acetate	$(CH_3)_2C_6H_9O_2CCH_3$	20.2	0.928	1.4376	VI–18
682	Trichloroethane (1,1,1)	CH_3CCl_3	21	1.32	1.4377	I–85
683	Dipropenyl (*iso*)	$[CH_2{:}C(CH_3)]_2$	20	0.727	1.4377	I–256
684	Methylpiperidine (4)	$CH_2CH_2NHCH_2{\cdot}$ / CH_2CHCH_3	21.6	0.845	1.4378	XX–101
685	Diethyl acetonedicarboxylate	$CO(CH_2CO_2C_2H_5)_2$	23.6	1.107	1.4378	III–791
686	Diethyl acetylsuccinate	$CH_3COC_2H_3(CO_2{\cdot}C_2H_5)_2$	16	1.09	1.438	III–801
687	Dimethyl-2,6-octanol-8	$C_{10}H_{22}O$	18	0.830	1.438	I–426
688	Methylacetylacetone	$CH_3COCH(CH_3)CO{\cdot}CH_3$	13.5	0.978	1.4380	I–791
689	Pulegene	C_9H_{16}	22	0.791	1.4380	V–80
690	Hexahydrocymene (*p*)	$CH_3C_6H_{10}C_3H_7$	20	0.793	1.4380	V–47
691	Dipropyl malate (*l*)	$(CHOHCH_2){:}(CO_2{\cdot}C_3H_7)_2$	20	1.075	1.4380	III–432
692	Decyl chloride (*n*)	$CH_3(CH_2)_8CH_2Cl$	20	0.887	1.4380	I–168
693	Glyceryl tripalmitate (m.p. 65°)	$(C_{15}H_{31}CO_2)_3C_3H_5$	80	0.866	1.4381	II–373
694	Methylaminoethanol (β)	$CH_3NHCH_2CH_2OH$	20	0.937	1.4385	IV–276
695	Butyl mercaptan (*iso*)	$(CH_3)_2CHCH_2SH$	20	0.836	1.4386	I–378
696	Ethyl dichloroacetate	$Cl_2CHCO_2C_2H_5$	20	1.282	1.4386	II–203
697	Diethylnitrosoamine	$(C_2H_5)_2NNO$	19.9	0.943	1.4386	IV–129
698	Dichloropropane (1,2)	$CH_3CHClCH_2Cl$	20	1.157	1.4387	I–105
699	Ethyl allylacetoacetate	$CH_3COCH(CH_2CH{:}CH_2)CO_2C_2H_5$	17.6	0.992	1.4388	III–738
700	Diethyl itaconate	$C_3H_4(CO_2C_2H_5)_2$	20.2	1.045	1.4388	II–762

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
701	Dimethyl-2,6-octanol-6	$C_{10}H_{22}O$	15	0.836	1.4388	I–426
702	Ethylidene acetone	$CH_3CH{:}CHCOCH_3$	19.6	0.862	1.4390	I–732
703	Dimethyl-2,4-pentadiene-1,3	$(CH_3)_2C{:}CHC\cdot(CH_3){:}CH_2$	23	0.734	1.4390	I–257
704	Chloro-1-propanol-2	$CH_3CHOHCH_2Cl$	20	1.114	1.4392	I–363
705	Di-*iso*-amyl-cyanamide	$[(CH_3)_2CHCH_2\cdot CH_2]_2NCN$	23.7	0.846	1.4392	IV–186
706	Undecyl alcohol (*n*)	$CH_3(CH_2)_9CH_2OH$	23	0.833	1.4392	I–427
707	Methyl-Δ^2-hexenic acid (α)	$C_2H_5CH{:}CHCH\cdot(CH_3)CO_2H$	20	0.942	1.4395	.....
708	Epichlorohydrin (α)	OCH_2CHCH_2Cl	16.1	1.18	1.4397	XVII–6
709	Ethyl acetylacetone	$CH_3COCH(C_2H_5)CO\cdot CH_3$	16.9	0.956	1.4397	I–794
710	Ethyl *sec*-butyl-nitrocarbamate	$C_4H_9N(NO_2)CO_2\cdot C_2H_5$	21.4	1.086	1.4397	.....
711	Trimethylene glycol	$HOCH_2CH_2CH_2OH$	20	1.060	1.4398	I–475
712	Butyl bromide (*n*)	$C_2H_5CH_2CH_2Br$	20	1.279	1.4398	I–119
713	Ethyl α-methyl-β-hydroxy-carb-ethoxy-α, β-crotonate	$C_2H_5O_2COC(CH_3){:}C(CH_3)CO_2C_2H_5$	20	1.078	1.4398	III–378
714	Tetranitromethane	$C(NO_2)_4$	17	1.65	1.4399	I–80
715	Lactic acid	$CH_3CHOHCO_2H$	20	1.24	1.44	III–268
716	Methylisoxazole (α)	$CH_3C{:}CHCH{:}NO$	20	1.023	1.44	XXVII–16
717	Methylisoxazole (γ)	$CH_3CCH{:}CH\cdot O\cdot N$	20	1.022	1.44	XXVII–16
718	Tiglic acid (*trans*) (m.p. 64°)	$CH_3CH{:}C(CH_3)\cdot CO_2H$	76	0.964	1.44	II–430
719	Hexenic acid (β, γ)	$C_2H_5CH{:}CHCH_2\cdot CO_2H$	23	0.964	1.44	II–435
720	Camphene	$C_{10}H_{16}$	78 (?)	0.822	1.44	V–156
721	Ethyl 1-methyl-3-*iso*-propylcyclo-pentane-2-carboxylate	$C_9H_{17}CO_2C_2H_5$	11.8	0.918	1.44	*I X–17
722	Ethyl laurate	$CH_3(CH_2)_{10}CO_2\cdot C_2H_5$	12.9	0.868	1.44	II–361
723	Elaidic acid (m.p. 51°)	$C_{17}H_{33}CO_2H$	79.4	0.851	1.44	II–469
724	Cerotic acid (m.p. 78°)	$C_{25}H_{51}CO_2H$	79	0.836	1.44	II–394
725	Hydroxylamine	NH_2OH	23.5	.....	1.440	.....
726	Dichlorocyclo-propane (1,1)	$CH_2CH_2CCl_2$	17.7	1.211	1.4402	V–17
727	Pentadiene-1,3	$CH_3CH{:}CHCH{:}CH_2$	16.5	0.70	1.4402	I–251
728	Methyl-2-hepten-2-one-6	$(CH_3)_2C{:}CH(CH_2)_2\cdot COCH_3$	20	0.860	1.4403	I–741
729	Diethyl *iso*-butyrylmalonate	$(CH_3)_2CHCOCH\cdot(CO_2C_2H_5)_2$	20	1.050	1.4403	III–811

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
730	Tetraethyl oxalylmethane-tricarboxylate	$C_2H_5O_2CCOC(CO_2 \cdot C_2H_5)_3$	15.5	1.167	1.4403	*III–298
731	Glyceryl trilaurate (m.p. 46°)	$(C_{11}H_{23}CO_2)_3C_3H_5$	60	0.894	1.4404	II–362
732	Heptadecane (*n*)	$CH_3(CH_2)_{15}CH_3$	20(?)	0.778	1.4405	I–173
733	Ethoxy γ-valerolactone (δ)	$C_2H_5OCH_2CHCH_2 \cdot CH_2COO$	24.9	1.072	1.4408	*XVIII–297
734	Diethyl ethylidenemalonate	$CH_3CH{:}C(CO_2 \cdot C_2H_5)_2$	16.1	1.043	1.4408	II–773
735	Ethyl hydrogen fumarate (m.p. 70°)	$HO_2CCH{:}CHCO_2 \cdot C_2H_5$	83	1.115	1.4409	II–741
736	Pentane-1,2-diol	$C_3H_7CHOHCH_2OH$	20	0.980	1.441	.....
737	Tetrahydro-*m*-xylene (1,2,3,4)	$(CH_3)_2C_6H_8$	20	0.798	1.441	V–73
738	Diethyl fumarate	$(CHCO_2C_2H_5)_2$	20.4	1.052	1.4410	II–742
739	Ethyl-3-hexene-5-ol-3	$CH_2{:}CHCH_2COH \cdot (C_2H_5)_2$	21.7	0.847	1.4410	I–449
740	Amyl bromide (*iso*)	$(CH_3)_2CHCH_2CH_2Br$	20	1.215	1.4412	I–136
741	Amyl mercaptan (*iso*)	$(CH_3)_2CHCH_2 \cdot CH_2SH$	20	0.835	1.4412	I–405
742	Glyceryl triformate	$(HCO_2)_3C_3H_5$	18	1.320	1.4412	*II–19
743	Dipropargyl	$(CH{:}CCH_2)_2$	20	0.805	1.4414	I–266
744	Ethyl dimethyloxamate	$(CH_3)_2NCOCO_2C_2H_5$	22.5	1.074	1.4414	IV–61
745	Dimethyl maleate	$(CHCO_2CH_3)_2$	19.9	1.151	1.4416	II–751
746	Diethyl maleate	$(CHCO_2C_2H_5)_2$	20.1	1.067	1.4416	II–751
747	Difluorobenzene (*m*)	$C_6H_4F_2$	20	1.172	1.4417	*V–108
748	Methyl *sec*-butylnitrocarbamate	$C_4H_9N(NO_2)CO_2 \cdot CH_3$	23.3	1.125	1.4417	.....
749	Methyl-4-heptadiene-1,6-ol-4	$(CH_2{:}CHCH_2)_2COH \cdot CH_3$	20.6	0.844	1.4417	I–456
750	Cyanamide (m.p. 44°)	H_2NCN	48	1.073	1.4418	III–75
751	Didecyl ether (*n*)	$(C_{10}H_{21})_2O$	20	0.819	1.4418	.....
752	Ethylene chlorohydrin	CH_2ClCH_2OH	20	1.199	1.4419	I–337
753	Tridecane (*n*)	$CH_3(CH_2)_{11}CH_3$	16.8	0.76	1.4419	I–171
754	Dimethylisoxazole (α, γ)	$CH_3C{:}CHC \cdot (CH_3){:}N \cdot O$	20	0.983	1.442	XXVII–17
755	Ethyl α, β-nonenate	$C_6H_{13}CH{:}CHCO_2 \cdot C_2H_5$	20	0.889	1.442	II–453
756	Menthane (*m*)	$C_{10}H_{20}$	20(?)	0.79	1.4420	V–46
757	Hexadecene-1	$CH_3(CH_2)_{13}CH{:}CH_2$	19	0.782	1.4420	I–226
758	Chlorobutyric acid (β)	$CH_3CHClCH_2CO_2H$	19.9	1.186	1.4421	II–277
759	Amyl bromide (*tert*)	$C_2H_5CBr(CH_3)_2$	20(?)	1.216	1.4421	I–136
760	Ethyl-Δ^2-hexenic acid (α)	$CH_3CH_2CH{:}CHC \cdot (C_2H_5)CO_2H$	20	0.928	1.4421	.....

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
761	Amylpropiolic diethyl acetal	$CH_3(CH_2)_4C{:}CCH(OC_2H_5)_2$	9.5	0.886	1.4421	I–751
762	Decyl caprate (*n*)	$C_9H_{19}CO_2C_{10}H_{21}$	20	0.859	1.4423	II–356
763	Hexylpropiolic diethylacetal	$CH_3(CH_2)_5C{:}CCH(OC_2H_5)_2$	12.1	0.881	1.4424	I–751
764	Diethyl sulfide	$(C_2H_5)_2S$	20.5	0.837	1.4425	I–344
765	Dimethyl malate	$C_2H_4O(CO_2CH_3)_2$	20	1.233	1.4425	III–429
766	Ethylcrotonic acid (α) (m.p. 45°)	$CH_3CH{:}C(C_2H_5)\cdot CO_2H$	56.1	0.948	1.4426*	II–439
767	Nitro-1-dimethyl-2,7-octane	$(CH_3)_2CH(CH_2)_4\cdot CH(CH_3)CH_2NO_2$	21	0.925	1.4426	I–169
768	Glyceryl tricaproate	$(C_5H_{11}CO_2)_3C_3H_5$	20	0.988	1.4427	II–324
769	Methylethyl-ketoxime	$CH_3C(NOH)C_2H_5$	20(?)	0.923	1.4428	I–668
770	Propiolic acid	$CH{:}CCO_2H$	15	1.139	1.4429	II–477
771	Levulinic acid (m.p. 33°)	$CH_3CO(CH_2)_2CO_2H$	17	1.143	1.4429	III–671
772	Propylacetyl-acetone	$CH_3COCH(C_3H_7)\cdot COCH_3$	20	0.935	1.4429	.....
773	Glyceryl trimyristate	$(C_{13}H_{27}CO_2)_3C_3H_5$	60	0.885	1.4429	II–367
774	Tetramethylpiperidine (*N*,2,4,6)	$(CH_3)_4C_5H_7N$	19.7	0.823	1.4430	XX–129
775	Ethyl α-ethyl-β-hydroxycarbethoxy-α, β-crotonate	$C_2H_5O_2C\cdot O\cdot C(CH_3){:}C(C_2H_5)CO_2C_2H_5$	20	1.056	1.4431	III–380
776	Bromoethyl acetate (1)	$CH_3CO_2C_2H_4Br$	20	1.462	1.4433	.....
777	Ethyl *iso*-butyl-nitrocarbamate	$C_4H_9N(NO_2)CO_2\cdot C_2H_5$	20.5	1.094	1.4433	.....
778	Dimethyl-1,3-cyclohexanone-5	$(CH_3)_2C_5H_8CO$	18.2	0.896	1.4433	VII–24
779	Cyclobutanecarboxylic acid	$CH_2(CH_2)_2CHCO_2H$	19	1.053	1.4434	IX–5
780	Trimethylpiperidine (2,4,6)	$(CH_3)_3C_5H_8N$	19	0.830	1.4435	XX–126
781	Ethyl β-hydroxy-carbethoxy-α, β-crotonate	$C_2H_5O_2C\cdot O\cdot C(CH_3){:}CHCO_2C_2H_5$	20	1.093	1.4435	III–374
782	Dipropyl fumarate (*n*)	$(CHCO_2C_3H_7)_2$	20	1.022	1.4435	II–742
783	Ethyl menthyl ether	$C_2H_5OC_{10}H_{19}$	17.1	0.86	1.4435	VI–31
784	Diethyl propionyl-malonate	$C_2H_5COCH(CO_2\cdot C_2H_5)_2$	16.4	1.079	1.4436	III–800
785	Amyl mercaptan (*n*)	$CH_3(CH_2)_3CH_2SH$	20(?)	0.857	1.4437	I–384
786	Dipropyl maleate (*n*)	$(CHCO_2C_3H_7)_2$	20	1.029	1.4437	II–752
787	Butylene chlorohydrin (β, γ)	$CH_3CHClCHOHCH_3$	20(?)	1.105	1.4438	I–373
788	Amyldichloroamine (*iso*)	$(CH_3)_2CHCH_2\cdot CH_2NCl_2$	25.7	1.027	1.4438	.....
789	Laurolene	$(CH_3)_3C_5H_5$ (1,2,3)	20(?)	0.797	1.4438	V–75

*For solid variety.

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
790	Amylene glycol (1,4)	$C_5H_{10}(OH)_2$	16.8	0.996	1.4439	I–480
791	Nitroso di-*iso*butylamine	$[(CH_3)_2CH\cdot CH_2]_2NNO$	21.2	0.892	1.4439	IV–172
792	Sulfuryl chloride	SO_2Cl_2	20(?)	.....	1.444	.....
793	Ethylamino-ethanol (β)	$C_2H_5NHCH_2CH_2OH$	20	0.914	1.444	IV–282
794	Mesityl oxide	$(CH_3)_2C{:}CHCOCH_3$	20	0.858	1.4440	I–736
795	Cycloheptane	$CH_2(CH_2)_5CH_2$	20	0.810	1.4440	V–29
796	Dimethyl itaconate	$C_3H_4(CO_2CH_3)_2$	20	1.122	1.4441	II–762
797	Campholene	C_9H_{16}	20	0.803	1.4441	I–81
798	Glyceryl tristearate (m.p. 70°)	$(C_{17}H_{35}CO_2)_3C_3H_5$	60	0.9	1.4441	II–383
799	Trimethyl-1,1,4-cyclohexene-3	$(CH_3)_3C_6H_7$	23.2	0.802	1.4442	*V–39
800	Ethylene chloride	CH_2ClCH_2Cl	20	1.253	1.4443	I–84
801	Tetrahydrotoluene (1,2,5,6)	$CH_3C_6H_9$	16	0.8	1.4443	V–67
802	Acetoxymethylene-pinacoline (m.p. 44°)	$(CH_3)_3CCOCH{:}CHO_2CCH_3$	53.3	0.965	1.4443	*II–73
803	Amyl bromide (n)	$CH_3(CH_2)_3CH_2Br$	20	1.218	1.4444	I–131
804	Heptenic acid (*iso*) (α, β)	$(CH_3)_2CHCH_2CH{:}CHCO_2H$	20	0.941	1.4444	II–445
805	Ethyl piperidine (N)	$C_5H_{10}NC_2H_5$	18.9	0.826	1.4445	XX–17
806	Propyl-4-heptene-1-ol-4	$(C_3H_7)_2COHCH_2\cdot CH{:}CH_2$	19	0.845	1.4445	I–452
807	Dipropylnitroso-amine	$(C_3H_7)_2NNO$	20	0.916	1.4446	IV–146
808	Diethyl α-chloro-acetylmalonate	$ClCH_2COCH(CO_2\cdot C_2H_5)_2$	12.3	1.195	1.4446	*III–279
809	Tricaprin (m.p. 31°)	$C_{33}H_{62}O_6$	40	0.921	1.4446	II–356
810	Ethyl acetoxy-methylene propionate	$CH_3CO_2C(CH_3){:}CH\cdot CO_2C_2H_5$	20	1.060	1.4447	III–373
811	Tetrahydro-mesitylene	$(CH_3)_3C_6H_7$ (1,3,5)	21	0.797	1.4447	*V–40
812	Diethyl *iso*-valeryl-malonate	$(CH_3)_2CHCH_2CO\cdot CH(CO_2C_2H_5)_2$	20	1.034	1.4447	.....
813	Methyl-*iso*-amyl ketoxime	$CH_3C(NOH)C_5H_{11}$	20(?)	0.888	1.4448	I–701
814	Dichloro-2,3-methyl-2-butane	$(CH_3)_2CClCHClCH_3$	18	1.06	1.445	I–135
815	Nonylenic nitrile (α, β)	$C_6H_{13}CH{:}CHCN$	20	0.833	1.445	.....
816	Methyl-propyl ketoxime	$CH_3C(NOH)C_3H_7$	20	0.910	1.4450	I–677
817	Hexadiene-2,4	$(CH_3CH{:}CH)_2$	20	0.773	1.4450	I–254
818	Tetrahydro-benzene	$CH_2CH{:}CH\cdot$ $(CH_2)_2CH_2$	22.1	0.808	1.4451	V–63
819	Diethyl n-butyryl-malonate	$C_2H_5CH_2COCH\cdot (CO_2C_2H_5)_2$	20	1.055	1.4451	III–807

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
820	Dimethyl-1,1-cyclohexene-3	$(CH_3)_2C_6H_8$	16.2	0.806	1.4452	V-72
821	Methoxy-δ-valerolactone-γ	$CH_3OCH_2CHCH_2\cdot CH_2CO\cdot O$	23.2	1.120	1.4453	* XVIII-297
822	Tetrahydro-*m*-xylene (1,2,3,4)	$(CH_3)_2C_6H_8$	22.4	0.800	1.4453	V-73
823	Geraniolene	C_9H_{16}	21.5	0.768	1.4453	I-260
824	Ethyl amylpropiolate	$C_5H_{11}C{:}CCO_2C_2H_5$	25	0.910	1.4453	II-487
825	Diethylketoxime	$(C_2H_5)_2C{:}NOH$	20	0.914	1.4454	I-680
826	Methyl-α-ethylacrolein-β	$C_2H_5CH{:}C(CH_3)\cdot CHO$	20	0.856	1.4454	I-735
827	Tetrahydro-toluene (1,2,3,4)	$CH_3C_6H_9$	20	0.805	1.4454	V-67
828	Dipropylcarbimide	$C_3H_7N{:}C{:}NC_3H_7$	23	0.838	1.4454	IV-145
829	Diethyl tartrate	$(CHOHCO_2C_2H_5)_2$	25	1.20	1.4454	III-512
830	Ethyl *n*-butyl-nitrocarbamate	$C_4H_9N(NO_2)CO_2\cdot C_2H_5$	20.7	1.099	1.4455	.....
831	Triethyl citrate	$C_3H_5O(CO_2C_2H_5)_3$	20	1.137	1.4455	III-568
832	Citronellyl acetate	$C_{12}H_{22}O_2$	17.5	0.893	1.4456	II-139
833	Chloroform	$CHCl_3$	19	1.490	1.4457	I-61
834	Methyl-1-cyclohexanone-4	$CH_3C_5H_9CO$	20	0.914	1.4458	VII-18
835	Tetrahydro-p-xylene (1,2,3,6)	$(CH_3)_2C_6H_8$	20	0.802	1.4459	V-74
836	Tetradecane (*n*)	$CH_3(CH_2)_{12}CH_3$	20	0.765	1.4459	I-171
837	Crotonic acid (β)	$CH_3CH{:}CHCO_2H$	19.6	1.026	1.446	II-412
838	Diethylenediamine (m.p. 106°)	$NHC_2H_4NHC_2H_4$	113	.....	1.446	XXIII-4
839	Anhydro-δ-aceto-butyl alcohol	$CH_3C{:}CHCH_2CH_2\cdot CH_2O$	20	0.906	1.446	XVII-21
840	Heptanthiol-2	$CH_3(CH_2)_4CH(SH)\cdot CH_3$	20(?)	0.835	1.4460	I-415
841	Methyl *iso*-butyl-nitrocarbamate	$(CH_3)_2CH\cdot CH_2N(NO_2)CO_2\cdot CH_3$	21.9	1.135	1.4461	.....
842	Vinyl bromide	$CH_2{:}CHBr$	20(?)	1.5	1.4462	I-188
843	Dimethylnitro-amine (m.p. 57°)	$(CH_3)_2NNO_2$	72.3	1.109	1.4462	IV-85
844	Diallylacetone (*uns*)	$(CH_2{:}CHCH_2)_2CH\cdot COCH_3$	20.9	0.859	1.4462	I-751
845	Methylpiperidine (3)	$CH_3CH\cdot(CH_2)_3NHCH_2$	24.3	0.845	1.4463	XX-100
846	Dimethyl-3,5-methylene-1-cyclohexane	$(CH_3)_2(CH_2{:})C_6H_8$	14.6	0.792	1.4463	*V-40
847	Dibutyl tartrate (*n*)	$(CHOHCO_2C_4H_9)_2$	20	1.090	1.4463	III-518
848	Methylpiperidine (*N*)	$C_5H_{10}NCH_3$	20	0.818	1.4464	XX-16

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
849	Methylpiperidine (2)	$CH_2(CH_2)_3NHCH\cdot CH_3$	23.6	0.844	1.4464	XX-95
850	Ethyl hexyl propiolate	$C_6H_{13}C{:}CCO_2C_2H_5$	25	0.903	1.4464	II-490
851	Hexenic acid (α, β) (m.p. 32°)	$C_3H_7CH{:}CHCO_2H$	40	0.95	1.4466	II-434
852	Diethyl glutaconate	$C_3H_4(CO_2C_2H_5)_2$	19	1.05	1.4466	II-759
853	Bromopropylene-2	$CH_3CBr{:}CH_2$	15.8	1.397	1.4467	I-200
854	Tetrolic aldehyde	$CH_3C{:}CCHO$	17	0.927	1.4467	*I-388
855	Menthyl acetate	$C_{12}H_{22}O_2$	20	0.919	1.4467	VI-32
856	Dimethyl-2,4-pentadiene-2,4	$(CH_3)_2C{:}CHC\cdot(CH_3){:}CH_2$	12	0.749	1.4468	I-257
857	Ethyl β-ethoxycrotonate (m.p. 31°)	$CH_3C(OC_2H_5){:}CH\cdot CO_2C_2H_5$	37.6	0.966	1.4468	III-373
858	Diethyl citraconate	$CH_3C_2H(CO_2C_2H_5)_2$	20.3	1.062	1.4468	II-771
859	Trimethylene chlorohydrin	$ClCH_2CH_2CH_2OH$	20	1.131	1.4469	I-356
860	Ethyl bromopropionate (α)	$CH_3CHBrCO_2C_2H_5$	20(?)	1.394	1.4469	II-255
861	Cyano-Δ^1-*iso*-heptenic acid (α) (m.p. 53°)	$(CH_3)_2CHCH_2CH{:}C(CN)CO_2H$	99.6	0.972	1.4469	II-792
862	Hexenoyl chloride (β, γ)	$C_2H_5CH{:}CHCH_2\cdot COCl$	20	1.014	1.447	.....
863	Menthane (*o*)	$C_{10}H_{20}$	21	0.814	1.447	V-46
864	Thujene (β)	$C_{10}H_{16}$	20	0.821	1.4471	V-143
865	Formamide	HCO_2NH_2	20	1.139	1.4472	II-26
866	Dipropyl ketoxime	$(C_3H_7)_2C{:}NOH$	24.1	0.888	1.4472	I-700
867	Ethyl acetoxymethylene acetate	$CH_3CO_2CH{:}CHCO_2\cdot C_2H_5$	18.1	1.090	1.4474	III-370
868	Glycol ether	$(HOCH_2CH_2)_2O$	20	1.117	1.4475	I-468
869	Dimethyl citraconate	$CH_3C_2H(CO_2CH_3)_2$	20.1	1.12	1.4475	II-770
870	Diethyl diallylmalonate	$(CH_2{:}CHCH_2)_2\cdot C(CO_2C_2H_5)_2$	17.2	0.996	1.4475	II-807
871	Dimethyl-1,1-cyclohexanone-3	$(CH_3)_2C_5H_8CO$	18.6	0.907	1.4476	VII-22
872	Hexyl bromide (*n*)	$CH_3(CH_2)_4CH_2Br$	20	1.173	1.4478	I-144
873	Methyl-1-cyclohexanone-3	$CH_3C_5H_9CO$	20	0.896	1.4478	VII-17
874	Angelolactone (α)	$CH_3C{:}CHCH_2CO\cdot O$	20	1.084	1.448	XVII-252
875	Pentenoyl chloride (β, γ)	$CH_3CH{:}CHCH_2COCl$	20	1.064	1.448	.....
876	Ethyl β-ethoxyacrylate	$C_2H_5OCH{:}CHCO_2\cdot C_2H_5$	18.1	0.995	1.448	III-370
877	Cyanoheptoic acid (α)	$C_2H_5(CH_2)_3\cdot CH(CN)CO_2H$	20	1.022	1.448	.....
878	Dimethyl-Δ^2-hexenic acid (β, δ)	$(CH_3)_2CHCH_2C\cdot(CH_3){:}CHCO_2H$	15.8	0.936	1.4480	.....

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
879	Difluoro-1,1-dibromo-1,2-ethane	CF_2BrCH_2Br	17.5	2.24	1.4482	I–92
880	Ethyl α,β-dichloropropionate	$CH_2ClCHClCO_2C_2H_5$	20	1.246	1.4482	II–252
881	Pinic acid (m.p. 102°)	$C_9H_{14}O_4$	109.4	1.093	1.4482	IX–743
882	Glyceryl tricaprylate	$(C_7H_{15}CO_2)_3C_3H_5$	20	0.954	1.4482	II–348
883	Ethyl methylnitrocarbamate	$CH_3N(NO_2)CO_2 \cdot C_2H_5$	23	1.229	1.4483	IV–86
884	Butyldichloroamine (*iso*)	$(CH_3)_2CHCH_2NCl_2$	24	1.090	1.4484	IV–171
885	Diethyl *O*-carbethoxy-β-hydroxyethylidenemalonate	$CH_3C(OCO_2C_2H_5):C(CO_2C_2H_5)_2$	20	1.127	1.4484	*III–163
886	Tetraethyl citrate	$C_5H_9O(CO_2C_2H_5)_3$	20	1.102	1.4484	III–568
887	Tetramethyl-1,1,4,4-cyclohexanone-2 (m.p. 18°)	$(CH_3)_4C_5H_6CO$	14.3	0.893	1.4485	*VII–38
888	Menthyl *iso*-valerate	$C_{15}H_{28}O_2$	20	0.906	1.4485	VI–33
889	Methyl *n*-butylnitrocarbamate	$C_4H_9N(NO_2)CO_2 \cdot CH_3$	22	1.139	1.4486	.....
890	Heptadiene-2,4	$CH_3CH:CHCH:CH \cdot C_2H_5$	21.5	0.733	1.4486	I–257
891	Dimethyl-1,1-cyclohexanone-2	$(CH_3)_2C_5H_8CO$	20	0.913	1.4486	*VII–17
892	Diethyl *iso*-propylidenemalonate	$(CH_3)_2C:C(CO_2 \cdot C_2H_5)_2$	17	1.028	1.4486	II–781
893	Dinitro-1,1-ethane	$CH_3CH(NO_2)_2$	20	1.35	1.4488	I–102
894	Acetylene dichloride (*trans*)	$CHCl:CHCl$	15	1.265	1.4490	I–187
895	Hexyl bromide (*iso*)	$(CH_3)_2CH(CH_2)_2 \cdot CH_2Br$	20(?)	1.168	1.4490	I–148
896	Methyl-1-cyclohexanone-2	$(CH_3)C_5H_9CO$	20	0.926	1.4493	VII–14
897	Diethyl mesaconate	$CH_3C_2H(CO_2C_2H_5)_2$	20	1.047	1.4494	II–766
898	Tetrahydrotoluene (Δ^1)	$CH_3C_6H_9$	20	0.810	1.4496	V–66
899	Triethyl oxalylmalonate	$C_2H_5O_2CCOCH \cdot (CO_2C_2H_5)_2$	16.1	1.160	1.4496	III–850
900	Dimethyl-2,6-octadiene-2,6	$C_{10}H_{18}$	19	0.78	1.4497	I–260
901	Allyl tetrahydrofurfuryl ether	$C_3H_5OCH_2OC_4H_7$	20	0.957	1.4498	.....
902	Menthone	$C_{10}H_{18}O$	20	0.896	1.4498	VII–38
903	Amyleneglycol-1,5	$CH_2(CH_2CH_2OH)_2$	20	0.994	1.4499	I–481
904	Tetrahydropseudocumene	$(CH_3)_4C_6H_7$ (1,2,4)	16.2	0.808	1.4499	*V–40
905	Cyclopentadiene	$CH_2CH:CHCH:CH$	20	0.803	1.45	V–112

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
906	Cyclopentylacetic acid	$CH_2(CH_2)_3CHCH_2 \cdot CO_2H$	18	1.022	1.45	I X-10
907	Cyano-2-methyl-1-*iso*-propyl-3-cyclopentane	$C_{10}H_{17}N$	16.2	0.881	1.45	*I X-17
908	Dimethyl-2,6-methylal-3-heptene-3	$(CH_3)_2CHCH_2CH:C(CHO)CH(CH_3)_2$	17.4	0.854	1.45	I-748
909	Fencholamide (m.p. 94°)	$C_{10}H_{19}ON$	108.2	0.907	1.45	I X-32
910	Undecylenic acid (β)	$CH_3(CH)_2C_7H_{14} \cdot CO_2H$	24	0.907	1.45	II-458
911	Brassidic acid (m.p. 60°)	$C_{21}H_{41}CO_2H$	57	0.859	1.45	II-474
912	Erucic acid (m.p. 33°)	$CH_3(CH_2)_7CH:CH \cdot (CH_2)_{11}CO_2H$	55	0.860	1.45	II-472
913	Hexanol-6-one-2	$CH_3COCH_2(CH_2)_2 \cdot CH_2OH$	20	0.990	1.450	I-835
914	Diethyl *trans*-hexahydrophthalate	$C_{12}H_{20}O_4$	20	1.040	1.450	.....
915	Ethylenediamine hydrate	$C_2H_8N_2 \cdot H_2O$	20.5	0.963	1.4500	IV-230
916	Ethyl β-ethoxy-α-methylacrylate	$C_2H_5OCH:C(CH_3) \cdot CO_2C_2H_5$	21.6	0.979	1.4501	III-377
917	Trimethyl-1,2,4-cyclohexanone-5	$(CH_3)_3C_5H_7CO$	17.4	0.899	1.4501	*VII-25
918	Tetrahydrofurfuryl alcohol	$C_4H_7OCH_2OH$	19	1.052	1.4502	.....
919	Fenchylene	$C_{10}H_{16}$	20	0.838	1.4502	*V-80
920	Diethyl diacetylmalonate	$(CH_3CO)_2C(CO_2 \cdot C_2H_5)_2$	20	1.115	1.4502	III-838
921	Cyclohexanone	$CH_2(CH_2)_4CO$	19	0.947	1.4503	VII-8
922	Methyl-Δ^2-hexenic acid (γ)	$CH_3CH_2C(CH_3):CH \cdot CH_2CO_2H$	20	0.966	1.4503	.....
923	Diallylacetone (*sym*)	$(CH_2:CHCH_2CH_2)_2:CO$	14	0.868	1.4504	I-751
924	Methyl-2-heptene-2-ol-6	$(CH_3)_2C:CH(CH_2)_2 \cdot CHOHCH_3$	20	0.854	1.4505	I-448
925	Methyl α-bromopropionate	$CH_3CHBrCO_2CH_3$	20	1.492	1.4506	II-253
926	Hexenic acid (*iso*) (α, β)	$(CH_3)_2CHCH:CH \cdot CO_2H$	16	0.96	1.4506	.....
927	Dimethyl-2,6-heptene-2-ol-6	$(CH_3)_2C:CH(CH_2)_2 \cdot COH(CH_3)_2$	20	0.855	1.4506	I-450
928	Ethyl trichloroacetate	$Cl_3CCO_2C_2H_5$	20	1.383	1.4507	II-209
929	Diallylacetic acid	$(CH_2:CHCH_2)_2CH \cdot CO_2H$	21.6	0.947	1.4508	II-489
930	Dimethyl-1,2-cyclohexanone-4	$(CH_3)_2C_5H_8CO$	12.6	0.912	1.4509	VII-23
931	Methyl amylpropiolate	$C_5H_{11}C:CCO_2CH_3$	12.3	0.934	1.4509	II-487

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
932	Diethyl acetyl-malonate-*O*-acetate	$CH_3CO_2C(CH_3):C(CO_2C_2H_5)_2$	17.7	1.117	1.451	*III–163
933	Ketazine	$[(CH_3)_2C:N]_2$	24.5	0.84	1.4510	I–651
934	Chlorobutyryl chloride (β)	$CH_3CHClCH_2COCl$	20	1.217	1.4511	II–278
935	Ethylcrotonic acid (α)	$CH_3CH:C(C_2H_5)\cdot CO_2H$	20	0.976	1.4511*	II–440
936	Methylhexyl ketoxime	$CH_3C(:NOH)\cdot C_6H_{13}$	20	0.886	1.4511	I–705
937	Diethyl propionyl-malonate-*O*-propionate	$C_2H_5CO_2C(C_2H_5):C(CO_2C_2H_5)_2$	19.1	1.079	1.4511	*III–163
938	Tiglic aldehyde	$CH_3CH:C(CH_3)CHO$	9.6	0.88	1.4512	I–733
939	Coniine (*d*)	$C_8H_{17}N$	21.9	0.84	1.4512	XX–111
940	Apocyclene (m.p. 43°)	C_9H_{14}	40	0.871	1.4514	*V–66
941	Thujene (α)	$C_{10}H_{16}$	20	0.830	1.4515	V–142
942	Propionylacetone	$C_2H_5COCH_2COCH_3$	20	0.959	1.4516	I–788
943	Ethyl cyclo-pentanol-1-car-boxylate-1	$CH_2(CH_2)_3C(OH)CO_2\cdot C_2H_5$	16	1.060	1.4516	*X–3
944	Methylethyl-ketazine	$[CH_3(C_2H_5):N]_2$	26.6	0.834	1.4516	I–669
945	Bromo-2-dimethyl-2,3-butane	$(CH_3)_2CHCBr(CH_3)_2$	20(?)	1.177	1.4517	I–152
946	Acetylacetone	$(CH_3CO)_2CH_2$	18.5	0.977	1.4518	I–777
947	Methyl hexyl-propiolate	$C_6H_{13}C{:}CCO_2CH_3$	12.5	0.924	1.4518	II–490
948	Tetraethyl-1,1,3,3-cyclobutandione-2,4	$(C_2H_5)_4C_2(CO)_2$	17.8	0.946	1.4518	*VII–321
949	Ethyl β-ethoxy-β, *n*-amylacrylate	$C_5H_{11}C(OC_2H_5):CHCO_2C_2H_5$	23.2	0.931	1.4518	III–382
950	Acetylene dichloride	$CHCl:CHCl$	15	1.299	1.4519	I–187
951	Dimethyl-1,3-cyclohexanone-2	$(CH_3)_2C_5H_8CO$	11.9	0.92	1.4519	VII–23
952	Diethyl acetyl-malonate-*O*-propionate	$C_2H_5CO_2C(CH_3):C(CO_2C_2H_5)_2$	18.6	1.098	1.4519	*III–163
953	Trimethylisoxazole	$N:C(CH_3)C(CH_3):C(CH_3)\cdot O$	20	0.981	1.452	XXVII–18
954	Ethyl hexahydro-benzoate	$C_6H_{11}CO_2C_2H_5$	16	0.962	1.452	IX–8
955	Diethyl *cis*-β-methyl-glutaconate	$C_2H_5O_2CCH:C(CH_3)CH_2CO_2\cdot C_2H_5$	20	1.034	1.452	*II–311
956	Diethyl *trans*-β-methyl-glutaconate	$C_2H_5O_2CCH:C(CH_3)CH_2CO_2\cdot C_2H_5$	20	1.034	1.452	*II–311
957	Diethyl propionyl-malonate-*O*-acetate	$C_2H_5CO_2C(CH_3):C(CO_2C_2H_5)_2$	18.6	1.098	1.452	*III–163

*For liquid variety.

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
958	Diethyl *cis*-hexahydro-*iso*-phthalate	$C_6H_{10}(CO_2C_2H_5)_2$ (*m*)	20	1.045	1.452	.....
959	Diethyl *cis*-hexahydro-terephthalate	$C_6H_{10}(CO_2C_2H_5)_2$ (*p*)	20.6	1.052	1.452	.....
960	Dimethylchloro-formamide	$ClCON(CH_3)_2$	22.1	1.166	1.4520	IV–73
961	Cyclofenchene	$C_{10}H_{16}$	20.4	0.859	1.4521	V–165
962	Menthone (*dl*)	$C_{10}H_{18}O$	20(?)	0.898	1.4521	*VII–36
963	Thujone (*β*)	$C_{10}H_{16}O$	17.6	0.92	1.4522	VII–93
964	Butyl oleate (*n*)	$C_{17}H_{33}CO_2C_4H_9$	20	0.864	1.4522	.....
965	Propyl furfuryl ether (*n*)	$C_2H_5CH_2OCH_2C_4H_3O$	20	0.966	1.4523	XXVII–112
966	Ethyl *α-iso*-propylidene-acetoacetate	$CH_3COC(CO_2C_2H_5):C(CH_3)_2$	19.9	1.001	1.4523	III–738
967	Menthene (*d*)	$C_{10}H_{18}$	20	0.81	1.4524	V–87
968	Diamyl sulfide (*iso*)	$(C_5H_{11})_2S$	20	0.843	1.4524	I–405
969	Propyldichloro-amine	$C_2H_5CH_2N(Cl)_2$	23	1.145	1.4525	IV–145
970	Ethyl α-cyano-crotonate	$CH_3CH:C(CN)CO_2 \cdot C_2H_5$	20	1.024	1.4525	.....
971	Hydroxy-methylene-pinacoline	$(CH_3)_3CCOCH:CHOH$	20	0.935	1.4527	I–794
972	Methylene-cyclohexane	$CH_2:C(CH_2)_4CH_2$	20	0.803	1.4528	V–69
973	Ethyl ethylidene-acetoacetate	$CH_3COC(CO_2C_2H_5):CHCH_3$	18	1.023	1.4528	III–736
974	Cyclopentanol	$CH_2(CH_2)_3CHOH$	20	0.947	1.4529	VI–5
975	Ethyl α-cyano-Δ^1-pentenate	$C_2H_5CH:C(CN) \cdot CO_2C_2H_5$	20	1.000	1.4529	.....
976	Ethyl α-chloro-crotonate	$CH_3CH:CClCO_2C_2H_5$	20.1	1.108	1.453	II–415
977	Ethyl α-chloro-*iso*-crotonate	$CH_3CH:CClCO_2C_2H_5$	20	1.100	1.453	.....
978	Ethyl β-acetyl-acrylate	$CH_3COCH:CHCO_2 \cdot C_2H_5$	20	1.037	1.453	III–731
979	Diethyl *trans*-β-methyl-α-ethylglutaconate	$C_2H_5C(CO_2C_2H_5):C(CH_3)CH_2CO_2 \cdot C_2H_5$	20	1.014	1.453	*II–315
980	Diethyl *cis*-hexa-hydrophthalate	$C_6H_{10}(CO_2C_2H_5)_2$ (*m*)	20	1.054	1.453	.....
981	Diethyl *trans*-hexahydro-homophthalate	$C_{13}H_{22}O_4$	20	1.038	1.453	.....
982	Piperidine	$CH_2(CH_2)_4NH$	20	0.860	1.4530	XX–6
983	Cycloheptene	$CH_2(CH_2)_4CH:CH$	20	0.823	1.4530	V–65
984	Ethyl ethyl-oximinocyano-acetate	$NCC(:NOC_2H_5) \cdot CO_2C_2H_5$	20	1.082	1.4530	III–775

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
985	Thujone (α)	$C_{10}H_{16}O$	20	0.912	1.4530	VII–93
986	Ethylpiperidine (β)	$C_7H_{15}N$	23.2	0.857	1.4531	XX–106
987	Methyl-α-pyran	$CH_3CHCH{:}CHCH{:}$ $CH{\cdot}O$	20	0.917	1.4532	.....
988	Cyclopentane carboxylic acid	$CH_2(CH_2)_3CHCO_2H$	20	1.053	1.4532	IX–6
989	Dimethyl-1,1-cyclohexanone-4	$(CH_3)_2C_5H_8CO$	24.2	0.928	1.4533	*VII–17
990	Petroselinic acid (m.p. 34°)	$C_{18}H_{34}O_2$	40	0.870	1.4533	II–462
991	Bromononane (2)	$CH_3(CH_2)_6CHBrCH_3$	20(?)	1.081	1.4536	I–166
992	Acetyl bromide	CH_3COBr	15.8	1.663	1.4537	II–174
993	Dimethyl-1,4-cyclohexyl chloride	$(CH_3)_2C_6H_9Cl$	18.5	0.944	1.4537	*V–16
994	Trimethyl-1,3,5-cyclohexanol-1	$(CH_3)_3C_6H_8OH$	16.3	0.888	1.4537	*VI–17
995	Carbon suboxide	$OC{:}C{:}CO$	0	1.114	1.4538	I–805
996	Ethyl-2-hexene-2-al-1	$C_2H_5CH_2CH{:}C(C_2H_5)CHO$	20	0.852	1.4538	.....
997	Butyl ricinoleate (*iso*)	$HOC_{17}H_{32}CO_2CH_2{\cdot}CH(CH_3)_2$	22	0.903	1.4538	III–388
998	Ethanolamine	$H_2NCH_2CH_2OH$	20	1.022	1.4539	IV–274
999	Ethyl methyl-1-cyclohexene-(1 or 2)-acetate-2	$(CH_3)C_6H_8CH_2CO_2{\cdot}C_2H_5$	18.4	0.948	1.4539	*IX–29
1000	Pentenic acid (α,β)	$C_2H_5CH{:}CHCO_2H$	14.7	0.992	1.454	II–426
1001	Heptadiene-1,5-ol-4	$CH_2{:}CHCH_2CHOH{\cdot}CH{:}CHCH_3$	20	0.861	1.454	*I–235
1002	Nonylenic acid (α,β)	$CH_3(CH_2)_5CH{:}CH{\cdot}CO_2H$	20	0.930	1.454	II–453
1003	Diethyl *cis*-α, β-dimethyl-glutaconate	$CH_3C(CO_2C_2H_5){:}C(CH_3)CH_2CO_2{\cdot}C_2H_5$	20	1.024	1.454	*II–314
1004	Diethyl *trans*-α, β-dimethyl-glutaconate	$CH_3C(CO_2C_2H_5){:}C(CH_3)CH_2CO_2{\cdot}C_2H_5$	20	1.031	1.454	*II–314
1005	Diethyl *cis*-hexahydro-homophthalate	$C_{13}H_{22}O_4$	20	1.040	1.454	.....
1006	Ethylene diamine	$(CH_2NH_2)_2$	26.1	0.892	1.4540	IV–230
1007	Dimethyl-3,5-cyclohexanol (*cis*)	$(CH_3)_2C_6H_9OH$	20	0.911	1.4540	.....
1008	Methyl methyl-1-cyclohexene-1-acetate-4	$CH_3C_6H_8CH_2CO_2{\cdot}CH_3$	16.9	0.961	1.4540	*IX–30
1009	Dimethyl-1,3-cyclohexanol-1	$(CH_3)_2C_6H_9OH$	22.9	0.903	1.4541	VI–17
1010	Ethyl bromoacetate	$BrCH_2CO_2C_2H_5$	13	1.514	1.4542	II–214

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1011	Ethyl β-chloro-*iso*-crotonate	$CH_3CCl{:}CHCO_2C_2H_5$	18.7	1.092	1.4542	II–417
1012	Methyl-2-octadiene-4,6	$CH_3CH{:}(CH)_2{:}CH{\cdot}CH_2CH(CH_3)_2$	18	0.752	1.4543	I–260
1013	Ethyl erucate	$C_{21}H_{41}CO_2C_2H_5$	20	0.865	1.4543	II–473
1014	Linalyl acetate	$CH_3CO_2C_{10}H_{17}$	21	0.89	1.4544	II–141
1015	Methyl-Δ′-angelolactone (β)	$CH_3C{:}C(CH_3)CH_2{\cdot}CO{\cdot}O$	20	1.056	1.4545	*XVII–139
1016	Trimethyl-1,1,3-cyclohexanone-4	$(CH_3)_3C_5H_7CO$	19	0.902	1.4545	VII–29
1017	Diethyl *trans*-camphorate (*l*)	$C_{14}H_{24}O_4$	21.6	1.029	1.4545	*IX–333
1018	Bromopropylene (α)	$CH_3CH{:}CHBr$*	15.8	1.417	1.4549	I–200
1019	Methyl β-amyl-β-methoxy-acrylate	$C_5H_{11}C(OCH_3){:}CH{\cdot}CO_2CH_3$	23.1	0.961	1.4549	III–382
1020	Ethyl α-cyano-Δ¹-*iso*-heptenate	$(CH_3)_2CHCH_2CH{:}C(CN)CO_2C_2H_5$	20	0.966	1.4549	.....
1021	Dimethyl-1,4-cyclohexanol-2	$(CH_3)_2C_6H_9OH$	16	0.907	1.455	VI–19
1022	Dimethyl-2,6-octadiene-2,7	$C_{10}H_{18}$	20(?)	0.788	1.455	I–261
1023	Citronellal (*d*)	$C_9H_{17}CHO$	14	0.86	1.455	I–745
1024	Diethyl *cis*-β-methyl-α-ethyl-glutaconate	$C_2H_5C(CO_2C_2H_5){:}C(CH_3)CH_2CO_2{\cdot}C_2H_5$	20	1.019	1.455	*II–315
1025	Bromoethyl acetate	$CH_3CO_2C_2H_4Br$	20	1.514	1.4550	.....
1026	Trimethyl-1,3,5-cyclohexyl-1-chloride	$(CH_3)_3C_6H_8Cl$	20	0.929	1.4550	*V–18
1027	Decyl bromide (*n*)	$C_{10}H_{21}Br$	20	1.068	1.4550	.....
1028	Amylpropiolic nitrile	$C_5H_{11}C{:}CCN$	13	0.851	1.4553	II–488
1029	Dimethyl-1,4-cyclohexanol-1	$(CH_3)_2C_6H_9OH$	23.9	0.906	1.4553	*VI–13
1030	Butylpiperidine (α) (*iso*)	$C_4H_9CH_2{\cdot}(CH_2)_3NHCH$	21.7	0.851	1.4553	XX–128
1031	Carvomenthone	$C_{10}H_{18}O$	20	0.9	1.4553	VII–34
1032	Bromopropylene (α)	$CH_3CH{:}CHBr$**	20	1.428	1.4554	I–200
1033	Cyclohexyl chloride	$CH_2(CH_2)_4CHCl$	18	0.977	1.4555	V–21
1034	Dimethyl-2,6-octene-2-ol-6	$(CH_3)_2C{:}CH(CH_2)_2{\cdot}COH(CH_3)C_2H_5$	15.9	0.858	1.4555	I–452
1035	Ethyl *d*-bornyl ether	$C_2H_5OC_{10}H_{17}$	24.7	0.9	1.4555	VI–78
1036	Citronellyl formate	$HCO_2C_{10}H_{19}$	20	0.884	1.4556	II–23
1037	Triethyl aconitate	$C_{12}H_{18}O_6$	20	1.106	1.4556	II–852
1038	Chloral	Cl_3CCHO	20	1.512	1.4557	I–616
1039	Dimethyl mesaconate	$CH_3C_2H(CO_2CH_3)_2$	19.9	1.121	1.4557	II–765

*β-form.
**α-form.

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1040	Oleic aldehyde	$C_{17}H_{33}CHO$	20	0.85	1.4557	I–749
1041	Pulenenone (β, γ)	$(CH_3)_3C_6H_5CO$	17.7	0.906	1.4558	VII–66
1042	Methyl erucate	$C_{21}H_{41}CO_2CH_3$	20	0.870	1.4558	.....
1043	Ethyl methyl-1-cyclohexene-(2 or 3)-acetate-3	$(CH_3)C_6H_8CH_2CO_2 \cdot C_2H_5$	15.2	0.951	1.4559	*I X–30
1044	Diethyl *d*-camphorate	$C_{14}H_{24}O_4$	19.1	1.032	1.456	I X–752
1045	Tetrahydro-furfuryl chloride	$C_4H_7OCH_2Cl$	20	1.110	1.4560	.....
1046	Dimethyl-3,5-cyclohexanol-1	$(CH_3)_2C_6H_9OH$	18.6	0.900	1.4560*	VI–18
1047	Trimethyl-1,1,2-cyclohexene-2	$(CH_3)_3C_6H_7$	20.4	0.822	1.4560	*V–39
1048	Methyl *iso*-butyl-nitroamine	$(CH_3)_2CH \cdot CH_2N(NO_2)CH_3$	22.5	1.021	1.4561	IV–172
1049	Diethyl oxalacetate	$CH_3CO(CO_2C_2H_5)_2$	16.6	1.172	1.4561	III–782
1050	Diethyl hydroxy-methylene-malonate	$HOCH{:}C(CO_2C_2H_5)_2$	14.3	1.128	1.4561	III–787
1051	Glyceryl trioleate	$C_3H_5(O_2CC_{17}H_{33})_3$	60	0.9	1.4561	II–468
1052	Bromomethyl methyl ether	$BrCH_2OCH_3$	20	1.598	1.4562	I–582
1053	Dimethylacetylene dibromide	$CH_3CBr{:}CBrCH_3$	25.5	1.318	1.4562	I–206
1054	Hydroxy-Δ^1-crotonolactone (γ) (m.p. 55°)	$CH_2CH{:}CHCO{\cdot}O$	99.3	1.262	1.4563	III–727
1055	Methyl α-chloro-crotonate	$CH_3CH{:}CClCO_2CH_3$	22.6	1.159	1.4563	*II–189
1056	Methyl *n*-butyl-nitroamine	$CH_3N(NO_2)C_4H_9$	23.6	1.023	1.4563	IV–158
1057	Carvomenthene (*d*)	$C_{10}H_{18}$	18	0.83	1.4563	V–84
1058	Hexylpropiolic nitrile	$C_6H_{13}C{\vdots}CCN$	14.4	0.849	1.4564	II–490
1059	Dimethyl-δ-acetylvaleric acid (β, β)	$CH_3CO(CH_2)_2C \cdot (CH_3)_2CH_2CO_2H$	20	1.032	1.4564	.....
1060	Camphene-*d* (*l*) (m.p. 43°)	$C_{10}H_{16}$	50	.....	1.4564	V–156
1061	Trichloromethyl chloroformate	$ClCO_2CCl_3$	22	1.65	1.4566	III–18
1062	Ethyl dimethyl-1,3-cyclohexanol-5-acetate-5	$(CH_3)_2C_6H_8(OH) \cdot CH_2CO_2C_2H_5$	14.9	0.990	1.4566	*X–12
1063	Butyl ricinoleate (*n*)	$HOC_{17}H_{32}CO_2C_4H_9$	22	0.906	1.4566	III–388
1064	Methyl cyclopentanol-1-carboxylate-1	$CH_2(CH_2)_3C(OH) \cdot CO_2CH_3$	17	1.105	1.4567	*X–3
1065	Ethyl-1-cyclohexene-1	$C_2H_5C{:}CH \cdot (CH_2)_3CH_2$	19.1	0.824	1.4567	V–71
1066	Carane	$C_{10}H_{18}$	20	0.838	1.4567	*V–47

*Mixture of stereoisomers.

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1067	Tetraethyl dioxalylmalonate	$(C_2H_5O_2CCO)_2C\cdot(CO_2C_2H_5)_2$	14.9	1.193	1.4567	*III–199
1068	Propyl-4-heptadiene-1,6-ol-4	$(CH_2.CHCH_2)_2COH\cdot CH_2C_2H_5$	21.1	0.865	1.4568	I–462
1069	Chloroethyl ether (2)	$(ClCH_2CH_2)_2O$	20	1.220	1.457	.....
1070	Dimethyl-3,5-cyclohexanol-1 (*trans*)	$(CH_3)_2C_6H_9OH$	16	0.902	1.457	.....
1071	Methyl β-bromopropionate	$BrCH_2CH_2CO_2CH_3$	20	1.519	1.4570	II–256
1072	Methyl furfuryl ether	$CH_3OCH_2C_4H_3O$	20	1.02	1.4570	XVII–112
1073	Methyl ethylnitroamine	$CH_3N(NO_2)C_2H_5$	19.2	1.097	1.4571	IV–130
1074	Tetramethyl-1,1,4,4-cyclohexanol-2 (m.p. 53°)	$(CH_3)_4C_6H_7OH$	30.2	0.894	1.4571	*VI–30
1075	Ethyl diallylacetoacetate	$CH_3COC(CO_2C_2H_5):(CH_2CH:CH_2)_2$	17.4	0.982	1.4572	III–741
1076	Hexahydro-*p*-cresol	$CH_3C_6H_{10}OH$	20	0.918	1.4573	VI–14
1077	Ethyl dimethyl-3,5-cyclohexylideneacetate-5	$(CH_3)_2C_6H_8:CHCO_2\cdot C_2H_5$	20.3	0.937	1.4575	*IX–35
1078	Propionyl bromide	C_2H_5COBr	16.4	1.521	1.4578	II–243
1079	Methyl ethyloximinocyanoacetate	$NCC(:NOC_2H_5)\cdot CO_2CH_3$	20	1.124	1.4578	III–775
1080	Diethyl chlorofumarate	$CH:CCl(CO_2C_2H_5)_2$	18.3	1.19	1.4578	II–745
1081	Hydroxymethylene diethylketone	$C_2H_5COCH(CH_3)\cdot CHO$	48.9	0.965	1.4579	*I–406
1082	Triethylphosphine	$(C_2H_5)_3P$	15	0.800	1.458	IV–582
1083	Dimethyl-1,2-cyclohexanol-4	$(CH_3)_2C_6H_9OH$	16	0.907	1.458	VI–17
1084	Dimethyl-1,3-cyclohexanol-4	$(CH_3)_2C_6H_9OH$	16	0.912	1.458	VI–18
1085	Menthol (*l*) (α)	$C_{10}H_{19}OH$	25	0.88	1.458*	VI–28
1086	Ethyl dimethyl-1,3-cyclohexene-4-acetate-5	$(CH_3)_2C_6H_7CH_2CO_2\cdot C_2H_5$	20.3	0.938	1.458	*IX–35
1087	Butylnitroamine (*sec*)	$C_2H_5CH\cdot(CH_3)NHNO_2$	21.9	1.057	1.4581*	IV–571
1088	Hexahydro-*m*-cresol (*l*)	$CH_3C_6H_{10}OH$	20	0.914	1.4581	VI–12
1089	Methyl methyl-1-cyclohexene-(2 or 3)-acetate-3	$CH_3C_6H_8CH_2CO_2\cdot CH_3$	15.7	0.969	1.4582	*IX–30
1090	Chloroprene	$CH_2:CClCH:CH_2$	20	0.958	1.4583	.....
1091	Bromo-2-butene-2	$CH_3CBr:CHCH_3$	25.4	1.322	1.4583	I–205
1092	Cineol	$C_{10}H_{18}O$	20	0.927	1.4584	XVII–24
1093	Tetrahydrofuroic acid	$C_4H_7OCO_2H$	20	1.193	1.4585	*XVIII–435

*Supercooled.

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1094	Trimethyl-1,2,4-cyclohexanol-5	$(CH_3)_3C_6H_8OH$	19.2	0.899	1.4585	*VI-17
1095	Cyclooctane	$CH_2(CH_2)_6CH_2$	20	0.839	1.4586	V-35
1096	Tetrahydro-*o*-xylene (Δ^1)	$(CH_3)_2C_6H_8$	20	0.823	1.4587	V-72
1097	Ethyl brassidate (m.p. 30°)	$C_{24}H_{46}O$	35	.....	1.4587	II-475
1098	Ethyl diazoacetate	$N_2CHCO_2C_2H_5$	17.6	1.085	1.4588	*III-211
1099	Amyl-β-methoxy-acrylic acid (β) (m.p. 55°)	$C_5H_{11}C(OCH_3):CH\cdot CO_2H$	60.8	0.969	1.4588	III-382
1100	Tetramethyl-1,2,4,5-cyclohexene-1	$(CH_3)_4C_6H_6$	16.5	0.820	1.4588	*V-45
1101	Methyl dimethyl-1,4-cyclohexene-3-carboxylate-2	$(CH_3)_2C_6H_7CO_2CH_3$	20	0.970	1.4588	*IX-31
1102	Methyl ricinolate	$HOC_{17}H_{33}CO_2CH_3$	22	0.924	1.4588	II-387
1103	Dichloroacetyl-acetone (3,3)	$CH_3COCCl_2COCH_3$	16.8	1.307	1.4589	I-785
1104	Dimethyl-1,1-cyclohexanol-3	$(CH_3)_2C_6H_9OH$	19.7	0.909	1.4589	VI-17
1105	Methyl alloethyl-camphorate (*o*)	$C_{13}H_{22}O_4$	17.1	1.049	1.4589	.....
1106	Ethyl β-chloro-crotonate	$CH_3CCl:CHCO_2C_2H_5$	19.6	1.106	1.459*	II-416
1107	Citronellol (*d*)	$C_{10}H_{20}O$	20	0.85	1.459	I-451
1108	Hexahydro-*m*-cresol (*dl*)	$CH_3C_6H_{10}OH$	20	0.923	1.4590	VI-13
1109	Methyl methyl-oximinocyano-acetate	$NCC(:NOCH_3)CO_2\cdot CH_3$	20	1.177	1.4591	III-775
1110	Hexylnitroamine (*N*)	$C_2H_5(CH_2)_3\cdot CH_2NHNO_2$	25.2	1.004	1.4593	IV-572
1111	Heptyl iodide (*n*)	$CH_3(CH_2)_5CH_2I$	20	1.4	1.4594	I-155
1112	Tetramethyl-1,2,4,5-cyclohexanol-1	$(CH_3)_4C_6H_7OH$	18.1	0.898	1.4595	*VI-30
1113	Hexylpropiolic acid	$C_6H_{13}C{:}CCO_2H$	25	0.944	1.4596	II-490
1114	Dichlorocrotonic acid (γ, γ) (m.p. 43°)	$Cl_2CHCH:CHCO_2H$	99.4	1.333	1.4597	.....
1115	Adiponitrile	$(CH_2CH_2CN)_2$	20(?)	0.950	1.4597	II-653
1116	Triformalpropyl-amine	$(H_2C:NC_3H_7)_3$	18.8	0.880	1.4597	XXVI-3
1117	Diethyl *N*-methyl-pyrrolidine-2,5-diacetate	$CH_3NC_4H_6(CH_2CO_2\cdot C_2H_5)_2$	15.5	1.047	1.4597	.....
1118	Cadaverine	$H_2N(CH_2)_5NH_2$	16	0.88	1.46	IV-266
1119	Hexahydrobenzoic acid (m.p. 31°)	$CH_2(CH_2)_4CHCO_2H$	33.8	1.03	1.46	IX-7
1120	Cyclohexylacetic acid (m.p. 32°)	$CH_2(CH_2)_3CH_2CH\cdot CH_2CO_2H$	33.5	1.001	1.46	IX-14
1121	Oleic acid	$CH_3(CH_2)_7CH:CH\cdot (CH_2)_7CO_2H$	17.7	0.895	1.46	II-463

*Ester of acid m.p. 94°.

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1122	Angelolactone (β)	$CH_3CHCH{:}CHCO{\cdot}O$	20	1.074	1.460	XVII–253
1123	Nonylenyl chloride (α,β)	$CH_3(CH_2)_5CH{:}CH{\cdot}COCl$	20	0.967	1.460	*II–194
1124	Phosphorus oxychloride	$POCl_3$	25.1	.....	1.460	.....
1125	Methyl acrylate	$CH_2{:}CHCO_2CH_3$	20	0.95	1.4600*	II–399
1126	Crotonoyl chloride	C_3H_5COCl	17.9	1.09	1.4600	II–411
1127	Bornyl *iso*-valerate	$C_4H_9CO_2C_{10}H_{17}$	22.2	0.95	1.4600	VI–79
1128	Diethyl thiocarbonate	$CS(OC_2H_5)_2$	17.5	1.027	1.4601	III–133
1129	Diethyl α-bromo-acetylmalonate	$BrCH_2COCH(CO_2{\cdot}C_2H_5)_2$	18.1	1.391	1.4602	*III–279
1130	Cycloheptanone	$CH_2(CH_2)_5CO$	21.9	0.95	1.4603	VII–13
1131	Ethyl α-propio-cyanoacetate	$C_2H_5COCH(CN){\cdot}CO_2C_2H_5$	20	1.076	1.4603	III–800
1132	Neomenthol (l)	$C_{10}H_{20}O$	20	0.900	1.4603	*VI–29
1133	Butylnitroamine (n)	$C_2H_5CH_2CH_2NHNO_2$	23	1.058	1.4604	IV–571
1134	Triformalethyl-amine	$(HCH{:}NC_2H_5)_3$	20.2	0.894	1.4604	XXVI–2
1135	Ethyl allomethyl-camphorate (o)	$C_{13}H_{22}O_4$	17.7	1.057	1.4604	.....
1136	Ethoxymethylene-pinacoline	$(CH_3)_3CCOCH{:}CHOC_2H_5$	14.2	0.916	1.4605	*I–427
1137	Ethyl α-*iso*-butyro-α-cyanoacetate	$(CH_3)_2CHCO{\cdot}CH(CN)CO_2C_2H_5$	20	1.054	1.4606	III–811
1138	Menthylamine (l)	$C_{10}H_{21}N$	20	0.860	1.4606	XII–26
1139	Coniceine (γ)	$C_8H_{15}N$	18.4	0.875	1.4607	XX–145
1140	Nitrochloroform	Cl_3CNO_2	22.8	1.651	1.4608	I–76
1141	Pinocamphane	$C_{10}H_{18}$	20	0.855	1.4609	*V–48
1142	Cyclohexanol (m.p. 24°)	$CH_2(CH_2)_4CHOH$	37	0.9	1.461	VI–5
1143	Hexenoyl chloride (α,β) (*iso*)	$(CH_3)_2CHCH{:}CH{\cdot}COCl$	20	1.018	1.461	.....
1144	Hexahydrocresol (o)	$CH_3C_6H_{10}OH$	20	0.933	1.461	VI–11
1145	Heptenoyl chloride (α,β) (*iso*)	$(CH_3)_2CHCH_2CH{:}CHCOCl$	20	0.991	1.461	.....
1146	Methyl-1-cyano-1-cyclohexanone-2	$CH_3C_5H_8(CO)CN$	20	1.015	1.461	.....
1147	Dimethyl-1, 1-cyclohexanol-4	$(CH_3)_2C_6H_9OH$	24.7	0.922	1.4613	*VI–13
1148	Ethyl α-butyro-α-cyanoacetate	$C_2H_5CH_2COCH{\cdot}(CN)CO_2C_2H_5$	20	1.056	1.4614	III–807
1149	Tetrahydrocumene	$(CH_3)_2CHC{:}CH(CH_2)_3CH_2$	15.2	0.83	1.4615	V–77
1150	Methylnitroamine (m.p. 38°)	CH_3NHNO_2	49	1.243	1.4616	IV–567
1151	Malonyl chloride	$H_2C(COCl)_2$	22.1	1.449	1.4617	II–582
1152	Ethyl ricinoleate	$HOC_{17}H_{32}CO_2C_2H_5$	22	0.915	1.4618	II–387

*Liquid polymer.

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1153	Ethyl γ, γ-dichlorocrotonate	$Cl_2CHCH{:}CHCO_2 \cdot C_2H_5$	20	1.229	1.4619	.....
1154	Carvomenthol	$C_{10}H_{19}OH$	20	0.908	1.4619	VI–26
1155	Methyl-1-cyclohexanol-1	$CH_3COH(CH_2)_4CH_2$	20	0.930	1.4620	VI–11
1156	Dimethyl-2, 6-heptadiene-1, 3	C_9H_{16}	10	0.765	1.4620	I–260
1157	Tropinone (m.p. 41°)	$C_8H_{13}ON$	99.6	0.987	1.4621	XXI–258
1158	Difluoro-2, 2-dibromo-1, 1-ethane	Br_2CHCHF_2	20	2.312	1.4622	I–92
1159	Oleic acid ozonide	$C_{18}H_{34}O_5$	20.5	1.028	1.4622	II–466
1160	Linalool (*d*)	$C_{10}H_{18}O$	20	0.868	1.4623	I–461
1161	Ethyl-5-nonadiene-1, 8-ol-5	$[CH_2{:}CHCH_2CH_2]_2 \cdot COHC_2H_5$	20.7	0.866	1.4623	*I–239
1162	Bornyl acetate (*d*)	$CH_3CO_2C_{10}H_{17}$	22.6	0.99	1.4623	VI–78
1163	Pinane (*d*)	$C_{10}H_{18}$	20	0.839	1.4624	V–93
1164	Dimethyl-2, 6-octadiene-2, 7-ol-6	$C_{10}H_{18}O$	20	0.862	1.4624	I–460
1165	Tetramethyl-1, 2, 4, 5-cyclohexyl-1 chloride	$(CH_3)_4C_6H_7Cl$	20	0.936	1.4624	*V–24
1166	Methyl *d*-bornyl ether	$CH_3OC_{10}H_{17}$	23.4	0.914	1.4624	I–78
1167	Dimethyl-1, 2-cyclohexanol-1	$CH_3COHCH(CH_3) \cdot (CH_2)_3CH_2$	13.7	0.925	1.4625	VI–17
1168	Ethylidene cyclohexane	$CH_3CH{:}C(CH_2)_4CH_2$	20	0.822	1.4626	V–71
1169	Geranyl acetate	$CH_3CO_2C_{10}H_{17}$	15	0.917	1.4628	II–140
1170	Bornyl (*d*) *n*-valerate	$C_2H_5(CH_2)_2CO_2 \cdot C_{10}H_{17}$	15	0.956	1.4628	VI–79
1171	Carbon tetrachloride	CCl_4	20	1.595	1.4630	I–65
1172	Trimethyl-1, 2, 3-cyclohexene-1	$(CH_3)_3C_6H_7$	11.8	0.835	1.4630	*V–40
1173	Bornyl (*dl*) acetate	$CH_3CO_2C_{10}H_{17}$	20	0.985	1.4630	VI–85
1174	Diethyl ethoxymethylenemalonate	$C_2H_5OCH{:}C(CO_2 \cdot C_2H_5)_2$	15.3	1.081	1.4631	III–469
1175	Dimethyl-1, 1-diethyl-4, 4-cyclohexanone-2	$(CH_3)_2(C_2H_5)_2 \cdot C_5H_6CO$	15.2	0.911	1.4631	*VII–48
1176	Triformalmethylamine	$(H_2CNCH_3)_3$	19	0.918	1.4632	XXVI–1
1177	Pulenol (*dl*)	$C_9H_{18}O$	16.5	0.91	1.4632	VI–22
1178	Dimethyl camphorate	$C_{12}H_{20}O_4$	16.9	1.077	1.4633	IX–750
1179	Ethyl α-bromoacetoacetate	$CH_3COCHBrCO_2 \cdot C_2H_5$	14.1	1.429	1.4634	III–664
1180	Amylpropiolic acid	$C_2H_5(CH_2)_3C{:}CCO_2H$	12.6	0.962	1.4634	II–487

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1181	Thujyl alcohol	$C_{10}H_{17}OH$	20	0.921	1.4635	VI–68
1182	Fenchone (*d*)	$C_{10}H_{16}O$	18	0.948	1.4636	VII–96
1183	Bornyl (*d*) *n*-butyrate	$C_2H_5CH_2CO_2C_{10}H_{17}$	15	0.966	1.4638	VI–79
1184	Phytol	$C_{20}H_{39}OH$	20	0.852	1.4638	I–453
1185	Nopinane	C_9H_{16}	20(?)	0.86	1.4641	*V–42
1186	Propyl-1-cyclohexanol-1 (*iso*)	$(CH_3)_2CH\cdot COH(CH_2)_4CH_2$	15.5	0.914	1.4642	*VI–15
1187	Menthyl chloride (*sec*)	$C_{10}H_{19}Cl$	20	0.941	1.4642	V–49
1188	Santene	C_9H_{14}	20	0.87	1.4644	V–122
1189	Bornyl (*d*) propionate	$C_2H_5CO_2C_{10}H_{17}$	15	0.979	1.4644	VI–79
1190	Diethyl *dl*-dehydrocamphorate	$(CH_3)_3C_6H_3(CO_2\cdot C_2H_5)_2$	20	1.039	1.4644	*IX–345
1191	Ethyl γ, γ, γ-trichloro-β-acetoxybutyrate	$CH_3CO_2CH(CCl_3)\cdot CH_2CO_2C_2H_5$	14.1	1.340	1.4646	*III–117
1192	Ethyl α-cyclohexene-propionate	$CH_2(CH_2)_3CH{:}C\cdot CH(CH_3)CO_2\cdot C_2H_5$	17.5	0.968	1.4646	IX–51
1193	Acetylene dicyanide	$NCC{:}CCN$	25	0.970	1.4647	*II–317
1194	Dimethyl-2, 6-nonadiene-2, 8-ol-6	$(CH_3)_2C_9H_{13}OH$	16.6	0.866	1.4647	I–462
1195	Dimethyl-1, 1-cyclohexanol-2	$(CH_3)_2CCHOH\cdot (CH_2)_3CH_2$	20	0.923	1.4648	VI–12
1196	Hexahydrobenzyl alcohol	$CH_2(CH_2)_4CH\cdot CH_2OH$	20	0.928	1.4649	VI–14
1197	Acetoxymethyl-enediethyl ketone	$C_2H_5COC(CH_3){:}CHO_2CCH_3$	18.3	1.034	1.4649	*II–73
1198	Bornyl-(*iso*) acetate	$CH_3CO_2C_{10}H_{17}$	20(?)	0.984	1.4649	VI–89
1199	Pentenoyl chloride (α,β)	$C_2H_5CH{:}CHCOCl$	20	1.063	1.465	.....
1200	Ethyl *iso*-lauronolate	$CH_2C(CH_3)_2CH\cdot (CH_3)CH{:}CCO_2\cdot C_2H_5$	20	0.953	1.4650	IX–58
1201	Ethyl thiocyanate	C_2H_5SCN	22.9	0.994	1.4653	III–175
1202	Pinene (α) (*dl*)	$C_{10}H_{16}$	23.5	0.86	1.4653	V–144
1203	Allyl bromide	$CH_2{:}CHCH_2Br$	20	1.398	1.4655	I–201
1204	Menthyl chloride (*tert*)	$C_{10}H_{19}Cl$	18.8	0.948	1.4655	V–49
1205	Dimethylpyrazole (3,4) (m.p. 58°)	$(CH_3)_2C_3H_2N_2$	99.3	0.933	1.4657	XXIII–72
1206	Dichloroacetic acid	Cl_2CHCO_2H	20	1.563	1.4659	II–202
1207	Geranyl formate	$HCO_2C_{10}H_{17}$	20	0.909	1.4659	II–23

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1208	Ethyl-1-cyano-1-cyclohexanone-2	$C_2H_5(CN)\cdot CCO(CH_2)_3CH_2$	20	1.008	1.466	.....
1209	Hydrogen iodide	HI	12	.....	1.466	.....
1210	Benzyl stearate (m.p. 46°)	$C_{17}H_{35}CO_2CH_2C_6H_5$	50	0.908	1.4663	*VI-221
1211	Acetylacetone-*O*-ethyl ether	$CH_3C(OC_2H_5):CH\cdot COCH_3$	16.3	0.948	1.4665	I-844
1212	Methyl α-cyclohexenepropionate	$C_8H_{13}CO_2CH_3$	18.3	0.986	1.4665	*I X-29
1213	Trifluoro-1,2,2-tribromo-1,1,2-ethane	$CFBr_2CBrF_2$	20(?)	2.6	1.4666	I-94
1214	Triethylarsine	$(C_2H_5)_3As$	20	1.150	1.467	IV-602
1215	Propyl-1-cyano-1-cyclohexanone-2	$C_3H_7(CN)\cdot CCO(CH_2)_3CH_2$	20	0.997	1.467	.....
1216	Dimethyl-1,2-cyclohexyl-1 chloride	$CH_3C(Cl)CH(CH_3)\cdot (CH_2)_3CH_2$	13.3	0.971	1.4672	*V-15
1217	Dihydroeucarvone (α)	$C_{10}H_{16}O$	18.9	0.923	1.4674	VII-73
1218	Dihydro-*o*-xylene ($\Delta^{1,5}$)	$(CH_3)_2C_6H_6$	20	0.823	1.4675	V-119
1219	Triallyl tricarballylate	$(CH_2CO_2C_3H_5)_2:CHCO_2C_3H_5$	15.9	1.097	1.4675	*II-322
1220	Amyl α-acetocyanoacetate (*iso*)	$HC:(COCH_3)(CN)\cdot(CO_2C_5H_{11})$	20	1.033	1.4676	III-798
1221	Fluorobenzene	C_6H_5F	20	1.024	1.4677	V-198
1222	Sabinene	$C_{10}H_{16}$	20	0.842	1.4678	V-143
1223	Dimethyl *iso*-dehydrocamphorate	$(CH_3)_3C_5H_3(CO_2\cdot CH_3)_2$	17.5	1.085	1.4678	*I X-345
1224	Trimethyl-1,1,2-cyclohexanol-2	$(CH_3)_3C_6H_8OH$	19.9	0.926	1.4679	*VI-16
1225	Diethyl muconate (m.p. 64°)	$(CH:CHCO_2C_2H_5)_2$	99.1	0.983	1.468	II-804
1226	Methyl thiocyanate	CH_3SCN	23.8	1.069	1.4680	III-175
1227	Dihydrotoluene (2,4)	$CH_3C_6H_7$	20	0.827	1.4680	V-115
1228	Difluoro-2,2-iodo-1-ethane	CHF_2CH_2I	12.2	2.243	1.4681	I-98
1229	Dihydrobenzene (1,4)	C_6H_8	25	0.84	1.4681	V-113
1230	Methyl γ,γ,γ-trichloro-β-acetoxybutyrate	$Cl_3CCH(O_2CCH_3)\cdot CH_2CO_2CH_3$	14.5	1.394	1.4682	*III-117
1231	Sebacyl chloride	$[(CH_2)_4COCl]_2$	18.3	.....	1.4684	II-719
1232	Suberyl chloride	$[(CH_2)_3COCl]_2$	20.6	1.172	1.4685	II-694
1233	Methyl cyclohexeneacetate	$CH_2(CH_2)_3CH:C\cdot CH_2CO_2CH_3$	18.2	1.003	1.4687	*I X-23

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1234	Acetylacetone-*O*-methyl ether	$CH_3COCH{:}C(OCH_3)\cdot CH_3$	20	0.971	1.4688	*I–426
1235	Ethyl acetone-oxalate-*O*-ethyl ether	$CH_3COCH{:}C(O\cdot C_2H_5)\,CO_2C_2H_5$	20	1.060	1.4689	III–877
1236	Benzyl palmitate (m.p. 36°)	$C_{15}H_{31}CO_2CH_2C_6H_5$	50	0.9	1.4689	.....
1237	Ethyl Δ^1-tetrahydrobenzoate	$C_6H_9CO_2C_2H_5$	20	0.998	1.469	IX–41
1238	Methyl *iso*-lauronolate	$(CH_3)_3C_5H_4CO_2CH_3$	20	0.970	1.469	IX–58
1239	Pulegone (*iso*)	$C_{10}H_{16}O$	20	0.919	1.4690	VII–85
1240	Fluorotoluene (*m*)	$CH_3C_6H_4F$	20	0.999	1.4691	V–290
1241	Ethyl cyclohexene-1-acetate	$C_6H_9CH_2CO_2C_2H_5$	16.2	0.989	1.4691	*IX–23
1242	Methyl γ,γ-dichlorocrotonate	$Cl_2CHCH{:}CHCO_2\cdot CH_3$	20	1.302	1.4694	.....
1243	Ethyl diacetoacetate	$(C_2H_3O)_2CHCO_2\cdot C_2H_5$	18.3	1.08	1.4695	III–751
1244	Ethyl furoate (m.p. 34°)	$C_4H_3OCO_2C_2H_5$	40	1.097	1.4699	XVIII–275
1245	Terpineol (γ) (m.p. 69°)	$C_{10}H_{18}O$	80	0.895	1.47	VI–61
1246	Fencholenamide (α) (m.p. 113°)	$CH_3C_5H_6C(CH_3)\cdot CONH_2$	117.9	0.933	1.47	IX–67
1247	Fluorotoluene (p)	$CH_3C_6H_4F$	20	0.99	1.470	V–290
1248	Ethyl Δ^1-tetrahydro-*m*-toluate	$CH_3C_6H_8CO_2C_2H_5$	20	0.975	1.470	IX–47
1249	Hydrazine	H_2NNH_2	22	.....	1.470	.....
1250	Decahydronaphthalene (*trans*)	$C_{10}H_{18}$	20	0.877	1.4701	V–92
1251	Pyrazole (m.p. 70°)	$CH{:}CHCH{:}N\cdot NH$	99.8	1.001	1.4703	XXIII–39
1252	Fluorotoluene (*o*)	$CH_3C_6H_4F$	20	1.001	1.4704	V–290
1253	Fenchene	$C_{10}H_{16}$	20	0.867	1.4705	V–163
1254	Myrcene	$C_{10}H_{16}$	20	0.798	1.4707	I–264
1255	Bornyl (*d*) formate	$HCO_2C_{10}H_{17}$	15	1.017	1.4708	VI–78
1256	Methyl-3-cyano-1-cyclohexanone-2	$CH_3(CN)C_5H_8CO$	20	1.040	1.471	.....
1257	Cyanoacetoacetic ester	$CH_3COCH(CN)CO_2\cdot C_2H_5$	20	1.111	1.4710	III–796
1258	Dihydrocarvone (*l*)	$C_{10}H_{16}O$	20	0.925	1.4711	VII–83
1259	Ethyl dimethyl-1,3-cyclohexene-3-hydroxy-5-acetate-5	$(CH_3)_2C_6H_6(OH)\cdot CH_2CO_2C_2H_5$	17.6	1.012	1.4713	*X–14
1260	Dichloroacetone (β) (*sym*) (m.p. 45°)	$(ClCH_2)_2CO$	46	1.383	1.4714	I–655
1261	Methyl geranate	$C_{11}H_{18}O_2$	19.1	0.923	1.4714	*II–210
1262	Triallyl citrate	$(CH_2CO_2C_3H_5)_2{:}C(OH)CO_2C_3H_5$	17.4	1.136	1.4714	*III–197
1263	Pinol	$C_{10}H_{16}O$	20	0.942	1.4715	XVII–45
1264	Citraconic anhydride	$C_5H_4O_3$	20	1.245	1.4717	.....

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1265	Ethoxymethylene-diethyl ketone	$C_2H_5COC(CH_3):CHOC_2H_5$	18.2	0.945	1.4717	*I–427
1266	Trichloro-1,1,2-ethane	$CH_2ClCHCl_2$	22	1.446	1.4719	I–85
1267	Ethylcamphor (α)	$C_{12}H_{20}O$	20	0.937	1.4719	VII–142
1268	Ethyl-1-methyl-3-pyrazole	$CH{:}CHC(CH_3){:}N{\cdot}N{\cdot}C_2H_5$	20	0.945	1.472	.....
1269	Dihydro-*m*-xylene	$CH_3CHCH_2C(CH_3){:}CHCH{:}CH$	19.7	0.823	1.4721	V–119
1270	Propylidenecyclohexane (*iso*)	$(CH_3)_2C{:}C(CH_2)_4{\cdot}CH_2$	20	0.836	1.4723	V–77
1271	Pulegol (*l*) (*iso*)	$C_{10}H_{18}O$	20	0.911	1.4723	.....
1272	Tin tetraethyl	$(C_2H_5)_4Sn$	19.7	1.199	1.4724	IV–632
1273	Diethyl succinyl-malonate (m.p. 68°)	$COCH_2CH_2COC{\cdot}(CO_2C_2H_5)_2$	73	1.167	1.4725	XVIII–489
1274	Limonene *d* (*l*)	$C_{10}H_{16}$	19.6	0.843	1.4727	V–133
1275	Geranylamine	$C_{10}H_{19}N$	20 (?)	0.83	1.4727	*IV–398
1276	Glutaryl chloride	$CH_2(CH_2COCl)_2$	20.2	1.324	1.4728	II–634
1277	Camphylamine (α)	$C_{10}H_{19}N$	17.8	0.874	1.4728	XII–40
1278	Glycerol	$HOCH_2CHOH{\cdot}CH_2OH$	20	1.26	1.4729	I–502
1279	Pulegol (*iso*)	$C_{10}H_{18}O$	20 (?)	0.914	1.4729	VI–65
1280	Dimethyl-1,3-pyrazole	$CH{:}CH{\cdot}C(CH_3){:}N{\cdot}N{\cdot}CH_3$	20	0.966	1.473	.....
1281	Ethyl *trans-p*-amino-*o,o,o'*-trimethylhexahydrobenzoate	$C_{12}H_{23}O_2N$	20	0.980	1.473	XIV–308
1282	Succinyl chloride	$(CH_2COCl)_2$	15.2	1.39	1.4735	II–613
1283	Trimethyl-1,3,5-cyclohexene-1-ol-3	$(CH_3)_3C_6H_6OH$	19.3	0.913	1.4735	*VI–36
1284	Dimethyl *d*-dehydrocamphorate	$(CH_3)_3C_5H_3(CO_2{\cdot}CH_3)_2$	18.1	1.088	1.4736	*IX–344
1285	Ethyl camphorcarboxylate	$C_{10}H_{15}OCO_2C_2H_5$	24.3	1.053	1.4736	X–644
1286	Ethyl acid-*d*-camphorate (α)	$C_8H_{14}(CO_2H)(CO_2{\cdot}C_2H_5)$	16.8	1.102	1.4737	IX–751
1287	Ethyl hydroxymethyleneacetoacetate	$CH_3COC(:CHOH){\cdot}CO_2C_2H_5$	16.9	1.134	1.4738	III–749
1288	Ethyl methyl-4-cyclohexylideneacetate-1	$CH_3C_5H_9C{:}CHCO_2{\cdot}C_2H_5$	17	0.994	1.4738	*IX–31
1289	Geranylacetic acid	$C_{12}H_{20}O_2$	21 (?)	0.938	1.4739	*II–210
1290	Diethyl camphoric carbonate	$C_8H_{14}C{:}C(OCO_2{\cdot}C_2H_5)(CO_2C_2H_5)$	20	1.076	1.4739	X–38

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1291	Pulenol (β,γ)	$(CH_3)_2CCH{:}CHCH\cdot(CH_3)CH_2CHOH$	18.5	0.921	1.4740	VI–50
1292	Geranyl chloride	$C_{10}H_{17}Cl$	20(?)	0.92	1.4741	*I–123
1293	Propionyltropein	$C_{11}H_{19}O_2N$	19.6	1.040	1.4743	.....
1294	Dihydrobenzene (1,2)	$CH_2CH_2CH{:}CHCH{:}CH$	20	0.842	1.4744	V–113
1295	Dipentene (*dl*)	$C_{10}H_{16}$	20.9	0.840	1.4744	V–137
1296	Crotonic anhydride	$(CH_3CH{:}CHCO)_2O$	20	1.040	1.4745	II–411
1297	Terpineol (β) (m.p. 33°)	$C_{10}H_{18}O$	20	0.919	1.4747	VI–62
1298	Ethyl *cis*-*p*-amino-*o,o,o'*-trimethylhexahydrobenzoate	$(CH_3)_3C_6H_7(NH_2)\cdot CO_2C_2H_5$	20	0.990	1.475	XIV–307
1299	Ethyl acetonoxalate	$CH_3COCH_2COCO_2\cdot C_2H_5$	17.6	1.128	1.4750	III–747
1300	Bromopropionic acid (α) (*dl*)	$CH_3CHBrCO_2H$	20	1.700	1.4753	II–254
1301	Cyclohexene-1-propionic acid (α)	$C_6H_9CH(CH_3)CO_2H$	20.3	1.010	1.4753	IX–51
1302	Terpinene (β)	$C_{10}H_{16}$	22	0.838	1.4754	V–132
1303	Butyrchloral	$CH_3CHClCCl_2CHO$	20	1.396	1.4755	I–664
1304	Methyl dimethyl-1,4-cyclohexadiene-1,3-carboxylate-2	$(CH_3)_2C_6H_5CO_2CH_3$	18.2	0.997	1.4755	IX–83
1305	Propylselenomercaptan	$C_2H_5CH_2SeH$	20	1.302	1.4756	I–360
1306	Ethyl tropane-2-carboxylate	$C_{11}H_{19}O_2N$	20.5	1.041	1.4756	XXII–18
1307	Sylvestrine	$C_{10}H_{16}$	20	0.848	1.4757	V–125
1308	Methyl methyl-4-cyclohexylideneacetate	$CH_3C_6H_9{:}CHCO_2CH_3$	16.9	0.970	1.4758	*IX–31
1309	Dimethyl-1,1-diethyl-4,4-cyclohexanol-2	$(CH_3)_2(C_2H_5)_2\cdot C_6H_7OH$	13.6	0.922	1.4759	*VI–33
1310	Trimethylpyrazole (1,3,4)	$CH{:}C(CH_3)C\cdot(CH_3){:}N\cdot NCH_3$	20	0.951	1.476	.....
1311	Ethyl β-vinylacrylate	$CH_2{:}CHCH{:}CHCO_2\cdot C_2H_5$	20	0.938	1.476	.....
1312	Tetrahydro-Δ^1-*m*-toluic acid	$CH_2(CH_2)_2CH\cdot(CH_3)CH{:}CCO_2H$	69	1.013	1.476	IX–47
1313	Pseudopelletierine (m.p. 49°)	$C_9H_{15}ON$	99.5	1.001	1.4760	XXI–261
1314	Ethyl bornylenecarboxylate	$C_{13}H_{20}O_2$	19.8	0.983	1.4760	*IX–51
1315	Amyl camphorcarboxylate (*iso*)	$C_{16}H_{26}O_3$	17.2	1.014	1.4760	X–645

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1316	Ethyl α-ethoxymethylene-acetoacetate	$C_2H_5OCH{:}C(CO{\cdot}CH_3)CO_2C_2H_5$	16.9	1.071	1.4762	III–878
1317	Terpineol (α) d (l)	$C_{10}H_{18}O$	16	0.93	1.4762	VI–56
1318	Dihydrotoluene (1,3)	$CH_3C_6H_7$	20	0.835	1.4763	V–115
1319	Methyl α-butyrocyanoacetate	$C_2H_5CH_2COCH{\cdot}(CN)CO_2CH_3$	20	1.093	1.4763	III–807
1320	Methyl dimethyl-3,5-cyclohexylideneacetate	$(CH_3)_2C_6H_8{:}CHCO_2{\cdot}CH_3$	15	0.957	1.4763	*I X–35
1321	Methylcamphidine (N)	$C_{11}H_{21}N$	19	0.901	1.4763	.....
1322	Ethyl *iso*-valerylcamphorcarboxylate	$C_{18}H_{28}O_4$	22.7	1.022	1.4764	X–38
1323	Tropane	$C_8H_{15}N$	21.6	0.93	1.4766	XX–141
1324	Diethyl selenide	$(C_2H_5)_2Se$	20	1.24	1.4768	I–349
1325	Ascaridol	$C_{10}H_{16}O_2$	20	0.999	1.4769	XI X–17
1326	Acetyltropein	$C_{10}H_{17}O_2N$	15.4	1.063	1.4769	XXI–18
1327	Cyano-1-cyclohexanone-2	$CH_2(CH_2)_3COCHCN$	20	1.070	1.477	.....
1328	Dimethyl-1,3-cyclohexene-1-ol-3	$(CH_3)_2C_6H_7OH$	17.5	0.933	1.4771	VI–50
1329	Amyl acetylcamphorcarboxylate	$C_{18}H_{28}O_4$	20.5	1.022	1.4772	X–38
1330	Dimethyl-1,3-cyclohexene-4-acetic acid-5	$(CH_3)_2C_6H_7CH_2{\cdot}CO_2H$	20.3	0.995	1.4773	*I X–34
1331	Dimethyl-2,6-octadiene-2,6-ol-8	$C_9H_{15}CH_2OH$	15	0.883	1.4773	I–457
1332	Ethyl methyl-3-cyclohexylidene-1-acetate	$CH_3C_6H_9{:}CHCO_2{\cdot}C_2H_5$	15	0.957	1.4773	*I X–30
1333	Diethanolamine	$HN(CH_2CH_2OH)_2$	20	1.097	1.4776	IV–283
1334	Trichloroethylene	$CHCl{:}CCl_2$	19.8	1.463	1.4777	I–187
1335	Mesityloxideoxime acetate (α)	$(CH_3)_2C{:}CHC(:NO{\cdot}OCCH_3)CH_3$	20	0.990	1.478	II–186
1336	Mesityloxideoxime acetate (β)	$(CH_3)_2C{:}CHC(:NO{\cdot}OCCH_3)CH_3$	20	0.990	1.478	II–186
1337	Terpinene (α)	$C_{10}H_{16}$	19.4	0.836	1.4781	V–126
1338	Terpinenol-4 (d)	$C_{10}H_{18}O$	19	0.93	1.4785	VI–55
1339	Camphoroxime-*d* ethyl ether	$C_8H_{14}CH_2C{:}NOC_2H_5$	17	0.947	1.4785	VII–114
1340	Methylpyrazole-1	$C_4H_6N_2$	13.7	0.993	1.4786	XXIII–40
1341	Diacetylacetone (m.p. 49°)	$(CH_3CO)_2(CH_2CO{\cdot}CH_2)$	60	1.06	1.4787	I–808
1342	Phellandrene (β)	$C_{10}H_{16}$	20	0.852	1.4788	V–131
1343	Carone (d)	$C_{10}H_{16}O$	18.8	0.958	1.4788	VII–91
1344	Ethyl *iso*-phoronecarboxylate	$O{:}C_6H_4(CH_3)_3CO_2{\cdot}C_2H_5$	20.4	1.029	1.4788	*X–303
1345	Dihydro-*o*-xylene ($\Delta^{1,3}$)	$(CH_3)_2C_6H_6$	19.5	0.830	1.4789	V–120
1346	Dimethylacryl chloride (β,β)	$(CH_3)_2C{:}CHCOCl$	12.4	1.065	1.479	*II–193

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1347	Ethyl methyl-2-cyclohexylidene-1-acetate	$(CH_3)C_6H_9{:}CHCO_2{\cdot}C_2H_5$	14.8	0.959	1.4791	*I X-29
1348	Methyl methyl-3-cyclohexylidene-1-acetate	$(CH_3)C_6H_9{:}CHCO_2{\cdot}CH_3$	15.5	0.975	1.4793	*I X-30
1349	Trimethyl-1,1,3-cyclohexene-2-one-4	$(CH_3)_3C_5H_5CO$	16.3	0.933	1.4795	VII-65
1350	Camphoroxime-*d* methyl ether	$C_8H_{14}CH_2C{:}NOCH_3$	22.5	0.958	1.4795	VII-114
1351	Pulenenone (α,β)	$(CH_3)_2CCOCH{:}C{\cdot}(CH_3)CH_2CH_2$	16.5	0.932	1.4796	VII-67
1352	Dihydro-*p*-xylene ($\Delta^{1,3}$)	$(CH_3)_2C_6H_6$	19	0.83	1.4797	V-119
1353	Diazidoethane (1,2)	$(CH_2N_3)_2$	24.9	1.170	1.4798	I-103
1354	Chloro-3-acetylacetone	$CH_3COCHClCOCH_3$	16.7	1.169	1.4798	I-785
1355	Trimethylstibine	$(CH_3)_3Sb$	15	1.52	1.48	IV-617
1356	Hexaethylbenzene (m.p. 129°)	$(C_2H_5)_6C_6$	130	0.831	1.48	V-471
1357	Aluminum triethyl	$(C_2H_5)_3Al$	6.5	.....	1.480	IV-643
1358	Tetramethylpyrazole (1,3,-4,5)	$CH_3C{:}(C{\cdot}CH_3)_2{:}N{\cdot}N{\cdot}CH_3$	20	0.947	1.480	XXIII-82
1359	Terpinolene	$C_{10}H_{16}$	19	0.855	1.480	V-133
1360	Bromo-4-trimethyl-1,1,4-cyclohexane	$(CH_3)_3C_6H_8Br$	17.4	1.170	1.4800	*V-17
1361	Fenchyl alcohol (*l*) (*iso*)	$C_{10}H_{18}O$	15	0.961	1.4801	VI-72
1362	Glycerol dichlorohydrin (1,3) (α)	$CHOH(CH_2Cl)_2$	16.9	1.351	1.4802	I-364
1363	Naphthalene decahydride	$C_{10}H_{18}$	18	0.895	1.4804	V-92
1364	Hydroxy-2-glutaric nitrile	$C_3H_5OH(CN)$	20	1.181	1.4805	*III-157
1365	Carvotanacetone (*dl*)	$(CH_3)_2CHCHCH_2{\cdot}COC(CH_3){:}CHCH_2$	20	0.935	1.4806	VII-77
1366	Cetyl iodide (m.p. 22°)	$CH_3(CH_2)_{14}CH_2I$	20	1.123	1.4806	I-172
1367	Methyl methyl-2-cyclohexylidene-1-acetate	$CH_2(CH_2)_3CH{\cdot}(CH_3)C{:}CHCO_2{\cdot}CH_3$	14.2	0.977	1.4807	*I X-51
1368	Ethyl cyclohexylideneacetate	$CH_2(CH_2)_4C{:}CHCO_2{\cdot}C_2H_5$	16.9	0.983	1.4808	*I X-24
1369	Diethyl crotonylidenemalonate	$CH_3CH{:}CHCH{:}C{\cdot}(CO_2C_2H_5)_2$	20	1.045	1.481	.....

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1370	Diosphenol acetate	$CH_3CO_2C_{10}H_{15}O$	20	1.036	1.481	VIII–9
1371	Glycolic aldehyde (m.p. 97°)	CH_2OHCHO	11	1.4	1.4811*	I–817
1372	Tropine (m.p. 63°)	$C_8H_{15}ON$	99.8	1.016	1.4811	XXI–16
1373	Tetrachloroethane (1,1,1,2)	CH_2ClCCl_3	23.2	1.58	1.4816	I–86
1374	Methyl-2-cyclohexene-(1 or 6)-acetic-2-acid	$CH_3C_6H_8CH_2CO_2H$	15.8	1.028	1.4817	*I X–29
1375	Dihydrocarveol	$C_{10}H_{18}O$	20(?)	0.927	1.4817	VI–63
1376	Ethyl methyl-*iso*-phorone-carboxylate	$(CH_3)_3C_6H_3(OCH_3)\cdot CO_2C_2H_5$	19	1.025	1.4818	*X–18
1377	Dimethyl-1,3-cyclohexene-3-one-5	$(CH_3)_2C_5H_6CO$	22	0.94	1.4819	VII–60
1378	Benzyl myristate (m.p. 20°)	$C_{13}H_{27}CO_2CH_2C_6H_5$	20	0.93	1.482	.....
1379	Methyl-1-cyclohexene-(2 or 3)-acetic-3-acid	$(CH_3)C_6H_8CH_2\cdot CO_2H$	15.4	1.027	1.4824	*I X–30
1380	Tetramethyl-1,1,2,-4-cyclohexadiene-2,5-ol-4	$(CH_3)_4C_6H_3OH$	20	0.925	1.4824	.....
1381	Methyl-1-ethyl-4-cyclohexadiene-1,3	$CH_3C_6H_6C_2H_5$	19.4	0.837	1.4825	V–121
1382	Carvenone (*dl*)	$C_{10}H_{16}O$	20	0.926	1.4825	VII–78
1383	Terpineol (*dl*) (α) (m.p. 35°)	$C_{10}H_{18}O$	20	0.936	1.4827	VI–58
1384	Bromo-1-trimethyl-1,3,5-cyclohexane	$(CH_3)_3C_6H_8Br$	11.1	1.175	1.4828	*V–18
1385	Ethyl ethyl-*iso*-phorone-carboxylate	$(CH_3)_3C_6H_3(OC_2H_5)\cdot CO_2C_2H_5$	19	1.011	1.4829	X–37
1386	Benzyl laurate	$C_{11}H_{23}CO_2CH_2C_6H_5$	20	0.95	1.483	.....
1387	Ethyl γ-bromo-acetoacetate	$BrCH_2COCH_2CO_2\cdot C_2H_5$	18.1	1.528	1.4831	III–664
1388	Methyl cyclohexyl-ideneacetate	$CH_2(CH_2)_4C{:}CHCO_2\cdot$ (CH$_3$ on the ring)	19.7	0.999	1.4831	*I X–24
1389	Bromo-1-dimethyl-3,5-cyclohexane	$(CH_3)_2C_6H_9Br$	18.2	1.207	1.4832	V–38
1390	Methyl campho-carboxylate	$C_{12}H_{18}O_3$	18	1.085	1.4833	X–644
1391	Phellandrene (α)	$C_{10}H_{16}$	20	0.845	1.4835	V–129
1392	Methyl acetyl-camphorcar-boxylate	$C_{14}H_{20}O_4$	19.8	1.082	1.4844	X–37
1393	Acetylmethyl-heptenone	$C_{10}H_{16}O_2$	15	0.945	1.4849	I–804
1394	Diosphenol ethyl ether	$C_2H_5OC_{10}H_{15}O$	20	0.977	1.485	VIII–9
1395	Diosphenol methyl ether	$CH_3OC_{10}H_{15}O$	20	0.988	1.485	VIII–9

*Supercooled.

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1396	Undecyl phenyl-ketone (m.p. 47°)	$CH_3(CH_2)_{10}COC_6H_5$	52.4	0.897	1.4850	VII–345
1397	Furfuryl alcohol	$C_4H_3OCH_2OH$	20	1.129	1.4852	XVII–112
1398	Triethanolamine	$N(CH_2CH_2OH)_3$	20	1.124	1.4852	IV–285
1399	Triazole (1,2,5)	$CH{:}N{\cdot}NH{\cdot}N{:}CH$	25.3	1.186	1.4854	XXVI–11
1400	Decyl iodide (*n*)	$CH_3(CH_2)_8CH_2I$	20	1.256	1.4859	I–168
1401	Methyl furoate	$C_4H_3OCO_2CH_3$	20	1.18	1.4860	XVIII–274
1402	Decyl phenyl ether	$CH_3(CH_2)_9OC_6H_5$	20	0.898	1.4862	.....
1403	Amyl chloro-3-campho-3-carboxylate	$C_{16}H_{25}O_3Cl$	19	1.091	1.4866	X–647
1404	Caproyl chloride (*n*)	$CH_3(CH_2)_4COCl$	20	.....	1.4867	II–324
1405	Amylbenzene (*iso*)	$C_5H_{11}C_6H_5$	15.6	0.863	1.4867	V–434
1406	Ethyl-2-hexanol-1 phthalate	$C_6H_4(CO_2C_8H_{17})_2$	20	0.98	1.4867	.....
1407	Ethyl γ,γ,γ-trichlorocrotonate	$Cl_3CCH{:}CHCO_2{\cdot}C_2H_5$	14.2	1.338	1.4869	*II–190
1408	Trimethyl-1,3,4-chloro-5-pyrazole	$CH_3NCCl{:}C(CH_3){\cdot}(CH_3){:}N$	20	1.108	1.487	.....
1409	Methyl diacetone ether	$(CH_3)_2C(OCH_3){\cdot}CH_2COCH_3$	20	0.909	1.487	.....
1410	Geranic acid	$C_{10}H_{16}O_2$	20.2	0.951	1.4870	II–491
1411	Propylglyoxalidine	$C_3H_7C{:}NCH_2CH_2NH$	17	0.964	1.4871	XXIII–35
1412	Methyl-1-methylene-3-cyclohexene-1	$CH_3C_6H_7{:}CH_2$	17	0.839	1.4872	*V–64
1413	Acetoxymethylene menthone	$CH_3CO_2C_{11}H_{17}O$	16	1.032	1.4875	*VIII–512
1414	Benzyl oleate	$C_{17}H_{33}CO_2CH_2C_6H_5$	25	0.933	1.4875	*VI–221
1415	Diallyl sulfide	$(CH_2{:}CHCH_2)_2S$	26.8	0.888	1.4877	I–440
1416	Methyl *l*-ecgoninate	$C_{10}H_{17}O_3N$	20.5	1.147	1.4877	XXII–198
1417	Sabinol	$C_{10}H_{16}O$	20(?)	0.943	1.488	VI–98
1418	Ethyl β,δ-dimethyl-sorbate	$(CH_3)_2C{:}CHC(CH_3){:}CHCO_2C_2H_5$	18.5	0.934	1.488	II–490
1419	Pulegone	$C_{10}H_{16}O$	20	0.932	1.4880	VII–81
1420	Trimethylene bromohydrin	$BrCH_2CH_2CH_2OH$	20	1.571	1.4883	I–356
1421	Ethylene-dipiperidine (γ)	$C_{12}H_{24}N_2$	17.8	0.921	1.4887	XX–67
1422	Methylpyrrole (1)	$C_4H_4NCH_3$	16	0.915	1.4888	XX–163
1423	Butyl 2-ethyl-hexyl phthalate	$C_6H_4(CO_2C_4H_9){\cdot}CO_2C_8H_{17}$	20	1.01	1.4888	.....
1424	Octyl iodide (*n*)	$CH_3(CH_2)_2CH_2I$	20	1.333	1.489	I–160
1425	Ethyl 1-allyl-3-methylpyrazole-5-carboxylate	$C_3H_5N{\cdot}C(CO_2C_2H_5){:}CHC(CH_3){:}N$	20	1.046	1.489	.....
1426	Iodo-1-methyl-2-hexane	$CH_3(CH_2)_3CH{\cdot}(CH_3)CH_2I$	21	1.366	1.4891	I–157
1427	Ethyl α,p-toloxy-*iso*-butyrate	$(CH_3)_2C(OC_6H_4{\cdot}CH_3)CO_2C_2H_5$	20	1.027	1.4893	VI–399

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1428	Butylbenzene (*sec*)	$C_2H_5CH(CH_3)C_6H_5$	21	0.86	1.4894	V–414
1429	Methyl-1-dichloromethyl-1-cyclohexane	$(CH_3)(CHCl_2)\cdot C(CH_2)_4CH_2$	23.7	1.127	1.4895	*V–14
1430	Citral (α)	$C_9H_{15}CHO$	17	0.890	1.4895	I–753
1431	Ethoxymethylenementhone	$C_2H_5OC_{11}H_{17}O$	15.2	0.970	1.4895	*VIII–512
1432	Ethyl α-(1,3-dimethyl-3,5-cyclohexadiene)-5-*iso*-butyrate	$(CH_3)_2C_6H_5C(CH_3)_2\cdot CO_2C_2H_5$	13.4	0.969	1.4895	*IX–52
1433	Methyl γ,γ,γ-trichlorocrotonate	$Cl_3CCH{:}CHCO_2CH_3$	21.2	1.397	1.4898	*II–190
1434	Nerolidol	$C_{15}H_{26}O$	20	0.87	1.4898	I–464
1435	Farnesol	$C_{15}H_{26}O$	20	0.88	1.4899	I–464
1436	Hexatriene-1,3,5	$H_2C{:}CHCH{:}CHCH{:}CH_2$	16.2	0.741	1.49	I–263
1437	Tetramethylbenzene (1,2,4,5) (m.p. 80°)	$(CH_3)_4C_6H_2$	81.3	0.838	1.49	V–431
1438	Amyl phenyl ether (*iso*)	$(CH_3)_2CHCH_2\cdot CH_2OC_6H_5$	22.1	0.920	1.49	VI–143
1439	Mesityloxide oxime (α) (m.p. 49°)	$C_6H_{10}{:}NOH$	40	0.969	1.4900*	I–739
1440	Citral (β)	$C_{10}H_{16}O$	19	0.888	1.4900	I–755
1441	Tetrahydrobenzoic acid (Δ^1) (m.p. 29°)	$CH_2(CH_2)_3CH{:}C\cdot CO_2H$	47.2	1.072	1.4903	IX–41
1442	Phellandral	$C_{10}H_{16}O$	20	0.93	1.4903	VII–77
1443	Tropidine	$C_8H_{13}N$	18.4	0.95	1.4904	XX–177
1444	Propionyl camphor (3)	$C_{13}H_{20}O_2$	18.1	1.019	1.4905	VII–397
1445	Mesityloxide oxime (α)	$C_6H_{10}{:}NOH$	21	0.942	1.4908**	I–738
1446	Cymene (p)	$CH_3C_6H_4CH(CH_3)_2$	20	0.857	1.4908	V–420
1447	Methyl-1-(β,γ-tetrahydrobenz)-2,3-isoxazole	$CH_3C_6H_7(:CH\cdot O\cdot N:)$	20	1.059	1.491	.....
1448	Tolyl *iso*-butyrate (o)	$(CH_3)_2CHCO_2C_6H_4\cdot CH_3$	20	1.001	1.491	.....
1449	Benzyl *iso*-butyrate	$(CH_3)_2CHCO_2CH_2\cdot C_6H_5$	18(?)	1.016	1.4910	VI–436
1450	Methyl allylcamphorcarboxylate (m.p. 75°)	$C_{15}H_{22}O_3$	20.2	1.067	1.4911	X–653
1451	Trimethylbenzene (1,3,5)	$(CH_3)_3C_6H_3$	20	0.863	1.4912	V–406
1452	Methyl *n*-butylbenzene (p)	$CH_3C_6H_4C_4H_9$	14.2	0.861	1.4912	V–437
1453	Amylbenzene (*tert*)	$C_5H_{11}C_6H_5$	23	0.8	1.4915	V–436

*Melted.
**Labile; alkali stable form.

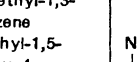
INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1454	Dimethyl-1,3-chloro-4-pyrazole	$CH_3N{\cdot}CH{:}CCl{\cdot}$ $C(CH_3){:}N$	20	1.153	1.492	.....
1455	Methyl-1-(α,β-tetrahydrobenz)-2,3-isoxazole	$CH_3C_6H_7{\cdot}CH{:}N{\cdot}O$	20	1.062	1.492	.....
1456	Tetrachloroethane (1,1,2,2)	$Cl_2CHCHCl_2$	18.5	1.6	1.4921	I–86
1457	Santalene (α)	$C_{15}H_{24}$	15	0.913	1.4921	V–462
1458	Cymene (*m*)	$CH_3C_6H_4CH(CH_3)_2$	20	0.862	1.4922	V–419
1459	Benzyl *d*-valerate	$C_4H_9CO_2CH_2C_6H_5$	20.4	0.98	1.4922	VI–436
1460	Butyrylcamphor (3)	$C_{14}H_{22}O_2$	17.4	1.016	1.4923	VII–598
1461	Propylbenzene	$C_6H_5CH_2C_2H_5$	20	0.862	1.4925	V–390
1462	Dibutyl phthalate (*n*)	$C_6H_4(CO_2C_4H_9)_2$	25	1.045	1.4925	.....
1463	Lead trimethyl-*iso*-amyl	$(CH_3)_3PbC_5H_{11}$	20.3	1.525	1.4926	*IV–595
1464	Hexyl iodide (*n*)	$CH_3(CH_2)_4CH_2I$	20	1.439	1.4929	I–146
1465	Diethyl α-oxalyl-γ-phenyl-butyrate	$C_6H_5(CH_2)_2CH{\cdot}(CO_2C_2H_5)CO{\cdot}CO_2C_2H_5$	20	1.112	1.493	.....
1466	Furylimido ethyl ether	$C_2H_5OC(:NH)CH{:}CHCH{:}CH{\cdot}O$	17.8	1.078	1.4930	XVIII–278
1467	Butyl benzoate (*d*) (β)	$C_6H_5CO_2C_4H_9$	20	1.000	1.4930	*IX–63
1468	Propylidene-1-cyclopentanone (*iso*)	$(CH_3)_2C{:}CCO{\cdot}(CH_2)_2CH_2$	20	0.957	1.4932	*VII–52
1469	Propylbenzene (*iso*)	$C_6H_5CH(CH_3)_2$	20	0.862	1.4932	V–393
1470	Methyl *n*-butyl-benzene (*m*)	$CH_3C_6H_4C_4H_9$	18.4	0.86	1.4932	V–437
1471	Nitrosopiperidine (*N*)	$C_5H_{10}N{\cdot}NO$	18.5	1.063	1.4933	XX–83
1472	Camphenamine	$C_{10}H_{17}N$	20	0.940	1.4935	XII–50
1473	Butylbenzene (*n*)	$C_4H_9C_6H_5$	20	0.862	1.4936	V–413
1474	Dimethyl-1,4-cyclohexadiene-1,3-carboxylic-2 acid (m.p. 41°)	$(CH_3)_2C_6H_5CO_2H$	18.5	1.045	1.4938*	IX–82
1475	Acetylcamphor (3)	$C_{12}H_{18}O_2$	19	1.031	1.4939	VII–596
1476	Cyano-1-ethoxy-2-cyclohexene-1	$C_2H_5OC{:}C(CN)CH_2{\cdot}(CH_2)_2CH_2$	20	1.019	1.494	.....
1477	Ethyl α-ethylsorbate	$CH_3CH{:}CHCH{:}C{\cdot}(C_2H_5)CO_2C_2H_5$	20	0.931	1.494	.....
1478	Ethyl γ-phenyl-butyrate	$C_6H_5(CH_2)_3CO_2{\cdot}C_2H_5$	20	1.001	1.494	*IX–211
1479	Amyl benzoate	$C_6H_5CO_2C_5H_{11}$	20	0.989	1.494	.....
1480	Zingiberene	$C_{15}H_{24}$	20	0.873	1.4940	V–461

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1481	Methylpyrazole (5)	$N{:}C(CH_3)CH{:}$ $CH{\cdot}NH$	13.7	1.023	1.4941	XXIII–50
1482	Furfuryl chloride	$C_4H_3OCH_2Cl$	20	1.178	1.4941	.....
1483	Xylene (*p*)	$(CH_3)_2C_6H_4$	23.4	0.86	1.4942	V–382
1484	Amylbenzene (*n*)	$CH_3(CH_2)_4C_6H_5$	20	0.86	1.4943	V–434
1485	Furfural (3)	C_5H_4O	20	1.111	1.4945	.....
1486	Ethyltoluene (*p*)	$CH_3C_6H_4C_2H_5$	18.5	0.86	1.4946	V–397
1487	Santalene (*β*)	$C_{15}H_{24}$	20	0.894	1.4946	V–463
1488	Tetra-*iso*-amyl lead	$(C_5H_{11})_4Pb$	20.5	1.233	1.4946	.....
1489	Butyltoluene (*p*) (*tert*)	$CH_3C_6H_4C(CH_3)_3$	13.3	0.867	1.4947	V–439
1490	Ethyl tropidine-2-carboxylate	$C_{11}H_{17}O_2N$	21.3	1.063	1.4948	.....
1491	Cymene (*o*)	$CH_3C_6H_4CH(CH_3)_2$	20(?)	0.86	1.495	V–419
1492	Phorone (m.p. 28°)	$[(CH_3)_2C{:}CH]_2CO$	29	0.88	1.4950	I–751
1493	Triethylbenzene (1,3,5)	$(C_2H_5)_3C_6H_3$	17	0.86	1.4951	V–449
1494	Pyrazine (m.p. 53°)	$N{:}CHCH{:}NCH{:}CH$	60.9	1.031	1.4953	XXIII–91
1495	Nitropiperidine (1)	$C_5H_{10}O_2N_2$	26.4	1.152	1.4954	XX–84
1496	Ethyl hydrocinnamate	$C_6H_5(CH_2)_2CO_2{\cdot}C_2H_5$	20	1.015	1.4954	IX–511
1497	Ethyl tropinone-2-carboxylate	$C_{11}H_{17}O_3N$	20.8	1.121	1.4954	.....
1498	Amyl iodide (*n*)	$CH_3(CH_2)_3CH_2I$	20	1.510	1.4955	I–133
1499	Toluene	$CH_3C_6H_5$	20	0.866	1.4955	V–280
1500	Methyl-1-cyclohexene-1-one-3	$CH_3C{:}CHCO{\cdot}(CH_2)_2CH_2$	18.7	0.971	1.4955	VII–54
1501	Dimethyl-1,1-chloro-3-cyclohexene-3-one-5	$(CH_3)_2C_6H_6OCl$	19.7	1.084	1.4955	*VII–49
1502	Ethyl benzyl ether	$C_2H_5OCH_2C_6H_5$	20	0.949	1.4955	VI–431
1503	Propyl-*o*-xylene (*asym*)	$(CH_3)_2C_6H_3C_3H_7$ (1,2,4)	20	0.866	1.4955	V–440
1504	Cyclohexyl bromide	$CH_2(CH_2)_4CHBr$	14.6	1.3	1.4956	V–24
1505	Spinacene	$C_{29}H_{48}$	20	0.862	1.4956	*I–129
1506	Butylbenzene (*iso*)	$(CH_3)_2CHCH_2C_6H_5$	14.5	0.87	1.4957	V–414
1507	Ethylbenzene	$C_2H_5C_6H_5$	20	0.867	1.4959	V–351
1508	Propylcymene (2) (1,2,4)	$(CH_3)(C_3H_7)C_6H_3{\cdot}CH(CH_3)_2$	15	0.869	1.4959	V–452
1509	Ethyl α,β-dibromovalerate	$C_2H_5CHBrCHBr{\cdot}CO_2C_2H_5$	20	1.613	1.496	.....
1510	Mesityl ethyl ether	$(CH_3)_2C_6H_3CH_2O{\cdot}C_2H_5$ (1,3,5)	20	0.930	1.496	.....
1511	Butyl iodide (*iso*)	$(CH_3)_2CHCH_2I$	20	1.606	1.4960	I–128
1512	Dichloro-γ-valerolactone (α,δ)	$ClCH_2CHCH_2CHCl{\cdot}CO{\cdot}O$	24.6	1.436	1.4962	*XVII–131
1513	Methyl tri-*iso*-amyl lead	$CH_3Pb(C_5H_{11})_3$	22	1.313	1.4962	.....

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1514	Butyl tri-*iso*-amyl lead (*iso*)	$(CH_3)_2CHCH_2Pb\cdot(C_5H_{11})_3$	19.5	1.252	1.4962	.....
1515	Methyl propyl-benzene (*m*)	$CH_3C_6H_4C_3H_7$	17	0.86	1.4964	V–418
1516	Methyl *n*-butyl-benzene (*o*)	$CH_3C_6H_4C_4H_9$	18.3	0.870	1.4966	V–437
1517	Ethylene bromohydrin	$BrCH_2CH_2OH$	20	1.772	1.4969	I–338
1518	Butylbenzene (*tert*)	$(CH_3)_3CC_6H_5$	20	0.867	1.4969	V–416
1519	Ethoxy-2-dimethyl-1,3-benzene	$(CH_3)_2C_6H_3OC_2H_5$	13.9	0.942	1.4969	VI–485
1520	Dimethyl-1,5-chloro-4-pyrazole		20	1.166	1.497	.....
1521	Propyltoluene (*p*)	$C_2H_5CH_2C_6H_4CH_3$	15.4	0.864	1.497	V–419
1522	Propyl-tri-*iso*-amyl lead	$C_2H_5CH_2Pb(C_5H_{11})_3$	22	1.274	1.4970	.....
1523	Methylpyrazole (3)	$C_4H_6N_2$	16.3	1.01	1.4971	XXIII–50
1524	Cyclocitral (*β*)	$C_{10}H_{16}O$	13.3	0.96	1.4971	VII–87
1525	Dichlorocrotono-nitrile (γ,γ)	$Cl_2CHCH{:}CHCN$	20	1.305	1.4974	.....
1526	Hydroxymethene-1-dimethyl-4,5-cyclohexanone-2	$(CH_3)_2C_6H_6O{:}CHOH$	20	1.022	1.4977	.....
1527	Methyl-1-dichloromethyl-1-cyclohexanone-4 (m.p. 47°)	$(CH_3)(CHCl_2)C_5H_8{:}CO$	52.8	1.221	1.4978	*VII–18
1528	Tetrahydro-benzisoxazole (β,γ)	$C_6H_8(:CH\cdot O\cdot N:)$	20	1.095	1.498	.....
1529	Ethyltoluene (*m*)	$C_2H_5C_6H_4CH_3$	17.9	0.87	1.498	V–396
1530	Ethyl *α*-methylsorbate	$CH_3CH{:}CHCH{:}C(CH_3)CO_2C_2H_5$	20	0.947	1.498	.....
1531	Amylthiophene (*iso*) (*α*)		20	0.941	1.498	.....
1532	Ethyl *α*-(*β*-phenyl-ethyl)-aceto-acetate	$C_6H_5(CH_2)_2CH(CO\cdot CH_3)CO_2C_2H_5$	20	1.048	1.498	*X–339
1533	Iodo-1-methyl-2-butane	$C_2H_5CH(CH_3)CH_2I$	15	1.53	1.4981	I–138
1534	Bromo-1-chloro-2-ethylene (*cis*)	$BrCH{:}CHCl$	15	1.797	1.4982	I–189
1535	Ethyl tri-*iso*-amyl lead	$C_2H_5Pb(C_5H_{11})_3$	19.6	1.292	1.4983	.....
1536	Xylene (*m*)	$(CH_3)_2C_6H_4$	20	0.865	1.4984	V–370
1537	Ionone (*α*)	$C_{10}H_{16}{:}CHCOCH_3$	22.3	0.93	1.4984	VII–168
1538	Patschoulene	$C_{15}H_{24}$	20	0.930	1.4984	V–470
1539	Verbenene	$C_{10}H_{14}$	20	0.882	1.4986	*V–207
1540	Camphoryl chloride (*trans*) (*l*)	$C_8H_{14}(COCl)_2$	20.7	1.227	1.4988	IX–754
1541	Ethylcymene (2)	$C_6H_3(CH_3)(C_2H_5)\cdot(C_3H_7)$ (1,2,4)	15.6	0.871	1.4988	V–448

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1542	Methyl-5-ethyl-2-cyclohexadiene-1,5-carboxylic-1 acid	$(CH_3)(C_2H_5)C_6H_5 \cdot CO_2H$	14.8	1.028	1.4989	*I X–47
1543	Ethyl γ-methylsorbate	$CH_3CH{:}C(CH_3)CH{:}CHCO_2C_2H_5$	20	0.946	1.499	.....
1544	Diethylbenzene (*p*)	$(C_2H_5)_2C_6H_4$	16	0.87	1.4990	V–426
1545	Dichlorocrotonyl chloride (γ,γ)	$Cl_2CHCH{:}CHCOCl$	20	1.442	1.4991	.....
1546	Cresyl acetate (*p*)	$CH_3CO_2C_6H_4CH_3$	23	1.050	1.4991	VI–397
1547	Dimethylpyrazine (2,5)	$CH_3C{:}CHN{:}C(CH_3)\cdot CH{:}N$	23.6	0.986	1.4992	XXIII–96
1548	Ethyl phenylacetate	$C_6H_5CH_2CO_2C_2H_5$	18.5	1.034	1.4992	I X–434
1549	Santalol (α)	$C_{15}H_{24}O$	20	0.978	1.4992	VI–558
1550	Dimethylpyrrol (2,4)	$C_4H_2(CH_3)_2NH$	13.7	0.927	1.4993	XX–172
1551	Acetoxymethylene-1-cyclohexanone-2	$CH_3CO_2CH{:}C_6H_8O$	15.6	1.115	1.4994	*VIII–509
1552	Carvone (*d*)	$C_{10}H_{14}O$	18.7	0.96	1.4994	VII–153
1553	Propyl iodide (*iso*)	$(CH_3)_2CHI$	20	1.703	1.4997	I–114
1554	Bromo-1-chloro-2-ethylene (*trans*)	$BrCH{:}CHCl$	20	1.77	1.4998	I–189
1555	Butyl iodide (*n*)	$C_2H_5CH_2CH_2I$	20	1.617	1.4998	I–123
1556	Caryophyllene (α)	$C_{15}H_{24}$	20	0.903	1.4998	I–464
1557	Methoxymethylene-*d*-camphor (m.p. 39°)	$C_{12}H_{18}O_2$	47.3	1.002	1.4999	VIII–28
1558	Cresol (*p*) (m.p. 35°)	$CH_3C_6H_4OH$	35	1.03	1.5	VI–389
1559	Hydrocinnamic acid (m.p. 48°)	$C_6H_5CH_2CH_2CO_2H$	80	1.06	1.50	I X–508
1560	Ethyl-2-methyl-5-tetrahydro-indazole	$CH_3C_6H_7(:CHN\cdot(C_2H_5)\cdot N:)$	20	0.987	1.500	.....
1561	Diethyl isoprene-dicarboxylate	$C_2H_5O_2CCH{:}C(CH_3)\cdot CH{:}CHCO_2C_2H_5$	20	1.056	1.500	*II–318
1562	Trichloro-1,1,1-nonine-3-ol-2	$Cl_3CCHOHC{:}C(CH_2)_4CH_3$	9.9	1.234	1.5000	I–456
1563	Propyl benzoate (*n*)	$C_6H_5CO_2CH_2C_2H_5$	20.3	1.027	1.5000	I X–112
1564	Methylcymene (2)	$C_6H_3(CH_3)_2CH\cdot(CH_3)_2(1,2,4)$	15.5	0.874	1.5000	V–440
1565	Formyl-menthone (2)	$C_{11}H_{18}O_2$	15.5	1.001	1.5000	VII–568
1566	Ethyl methyl-5-*iso*-propyl-2-cyclohexadiene-1,5-carboxylate-1	$(CH_3)(C_3H_7)C_6H_5\cdot CO_2C_2H_5$	16.9	0.977	1.5001	*I X–49
1567	Ethoxymethylene-1-cyclohexanone-2	$C_9H_{14}O_2$	10.8	1.029	1.5002	*VIII–509

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1568	Fumaryl chloride	$(CHCOCl)_2$	18.1	1.41	1.5004	II–743
1569	Butyl isothiocyanate (*iso*)	$(CH_3)_2CHCH_2NCS$	14	0.964	1.5005	IV–171
1570	Dimethyl-1,4-dichloromethyl-1-cyclohexene-3	$(CH_3)_2C_6H_7 \cdot CHCl_2$	20	1.125	1.5005	.....
1571	Dimethyl di-*iso*-amyl lead	$(CH_3)_2Pb(C_5H_{11})_2$	20	1.430	1.5005	*IV–596
1572	Guajene	$C_{15}H_{24}$	20	0.909	1.5005	V–468
1573	Ethyl β-aminocrotonate	$CH_3C(NH_2):CH \cdot CO_2C_2H_5$	18.8	1.022	1.5007	III–654
1574	Propionyl-*o*-xylene (*uns*)	$(CH_3)_2C_6H_3CO \cdot C_2H_5$ (1,2,4)	20	0.871	1.5007	*VII–176
1575	Clovene	$C_{15}H_{24}$	18	0.930	1.5007	V–468
1576	Methyl-1-dichloromethyl-1-cyclohexanone-2	$CH_3C_5H_8COCHCl_2$	17.5	1.235	1.5008	*VII–17
1577	Picoline (α)	$CH_3C_5H_4N$	20	0.95	1.501	XX–234
1578	Fluorophenol (p) (m.p. 48°)	FC_6H_4OH	56	1.189	1.5010	VI–183
1579	Tri-*iso*-butyl *iso*-amyl lead	$(C_4H_9)_3Pb(C_5H_{11})$	20.6	1.298	1.5010	.....
1580	Fluoro-2-dibromo-1,2-ethane	$FBrCHCH_2Br$	19	2.26	1.5012	I–92
1581	Methyl-2-menthatriene (p)	$C_{11}H_{16}$	19	0.874	1.5012	V–441
1582	Camphoryl dichloride (*d*) (*cis*)	$C_{10}H_{14}O_2Cl_2$	19.9	1.245	1.5013	IX–754
1583	Dimethyl-2,5-ethyl-3-pyrazine	$C_8H_{12}N_2$	24	0.966	1.5014	XXIII–99
1584	Propyltoluene (*o*)	$CH_3C_6H_4CH_2C_2H_5$	15.8	0.877	1.5014	V–418
1585	Methyl-1-*iso*-propyl-4-dichloromethyl-1-cyclohexene-2-one-6	$(C_3H_7)(CH_3)C_5H_5 \cdot COCHCl_2$	16.8	1.142	1.5014	VII–138
1586	Ethyl dibromoacetate	$Br_2CHCO_2C_2H_5$	12.5	1.91	1.5017	II–219
1587	Benzene	C_6H_6	20	0.879	1.5017	V–179
1588	Irone (β)	$C_{10}H_{16}:CHCOCH_3$	20	0.939	1.5017	VII–169
1589	Methoxy-2-dimethyl-1,3-benzene	$CH_3OC_6H_3(CH_3)_2$	20	0.956	1.502	VI–485
1590	Ethyl-1-methyl-5-tetrahydroindazole	$CH_3C_6H_7 \cdot CH:N \cdot N \cdot (C_2H_5)$	20	0.985	1.502	.....
1591	Ethyl allyl-1-methyl-5-pyrazole-carboxylate-5	$C_3H_5NC(CH_3):CH \cdot C(CO_2C_2H_5):N$	20	1.077	1.502	.....
1592	Dimethyl propyl *iso*-amyl lead	$(CH_3)_2(C_3H_7) \cdot (C_5H_{11})Pb$	22	1.503	1.5020	.....
1593	Ethylpyridine (2)	$C_2H_5C_5H_4N$	22.5	0.94	1.5021	XX–241
1594	Cocaine (*pseudo*) (*dl*) (m.p. 81°)	$C_{17}H_{21}O_4N$	99.5	1.103	1.5021	XXII–211

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1595	Fluoro-1-tribromo-1,1,2-ethane	$CH_2BrCFBr_2$	17.5	2.605	1.5022	I–93
1596	Cocaine (*pseudo*) (*d*) (m.p. 41°)	$C_{17}H_{21}O_4N$	99.6	1.102	1.5022	XXII–206
1597	Ethyl sorbate	$CH_3(CH{:}CH)_2CO_2{\cdot}C_2H_5$	20	0.956	1.5023	II–484
1598	Dimethyl di-*iso*-butyl lead	$(CH_3)_2Pb(C_4H_9)_2$	20	1.505	1.5024	*IV–594
1599	Methyl thymyl ether	$(CH_3)(C_3H_7)C_6H_3{\cdot}OCH_3$	28	0.931	1.5024	VI–536
1600	Pentachloroethane	C_2HCl_5	24	1.67	1.5025	I–87
1601	Trimethyl *iso*-butyl lead	$(CH_3)_3PbC_4H_9$	20	1.672	1.5026	*IV–593
1602	Ethyl-2-*p*-xylene	$(CH_3)_2C_6H_3C_2H_5$ (1,4,2)	17	0.882	1.5026	V–428
1603	Ethyl-4-*o*-xylene	$(CH_3)_2C_6H_3C_2H_5$ (1,2,4)	20	0.874	1.5027	V–427
1604	Propyl-2-menthatriene*	$C_{13}H_{20}$	15	0.880	1.5027	V–452
1605	Methyl-1-dichloromethyl-1-ethyl-4-cyclohexene-2-one-6	$(CH_3)(C_2H_5)C_5H_5{\cdot}COCHCl_2$	17.4	1.167	1.5029	VII–86
1606	Diethyl phthalate (*o*)	$C_6H_4(CO_2C_2H_5)_2$	17.7	1.12	1.5029	IX–798
1607	Phenyl acetate	$CH_3CO_2C_6H_5$	20	1.078	1.503	VI–152
1608	Dimethyl-1,1-methene-4-cyclohexadiene-2,5	$(CH_3)_2C_6H_4{:}CH_2$	15.8	0.836	1.5030	V–399
1609	Elemol (α) (m.p. 46°)	$C_{15}H_{26}O$	20(?)	0.941	1.5030	*VI–66
1610	Methyl tri-*iso*-butyl lead	$(C_4H_9)_3PbCH_3$	19.6	1.398	1.5032	.....
1611	Ethyl-*m*-xylene (4)	$(CH_3)_2(C_2H_5)C_6H_3$ (1,3,4)	16	0.87	1.5033	V–428
1612	Cedrene	$C_{15}H_{24}$	20	0.929	1.5034	V–461
1613	Pyrrole	$(CH{:}CH)_2NH$	20	0.948	1.5035	XX–159
1614	Dimethylpyrrole (2,5)	$CH_3C{:}CHCH{:}C{\cdot}(CH_3)NH$	20	0.935	1.5036	XX–172
1615	Pinylamine	$C_{10}H_{17}N$	20	0.940	1.5036	XII–54
1616	Benzoic acid (m.p. 122°)	$C_6H_5CO_2H$	131.9	1.2	1.504	IX–92
1617	Ethoxy *p*-xylene	$(CH_3)_2(C_2H_5O){:}C_6H_3$	20	0.938	1.504	VI–495
1618	Ethyl-2-menthatriene (*p*)*	$C_{12}H_{18}$	18	0.886	1.5041	V–448
1619	Tetraethylbenzene (1,2,4,5)	$(C_2H_5)_4C_6H_2$	16	0.888	1.5041	V–455
1620	Dimethyl-1,1-propylidene-4-cyclohexadiene-2,5	$(CH_3)_2C_6H_4{:}CHC_2H_5$	20	0.858	1.5042	.....
1621	Santalene (γ)	$C_{15}H_{24}$	20	0.936	1.5042	V–463

*Probably a mixture of isomers.

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1622	Tetra-*iso*-butyl lead	$[(CH_3)_2CHCH_2]_4Pb$	20.2	1.324	1.5042	.....
1623	Picoline (β)	$(CH_3)C_5H_4N$	24	0.95	1.5043	X X–239
1624	Dehydrocamphoryl chloride (*d*) (m.p. 50°)	$(CH_3)_3C_5H_3(COCl)_2$	48	1.219	1.5043	*I X–345
1625	Trimethylbenzene (1,2,4)	$(CH_3)_3C_6H_3$	21.6	0.87	1.5044	V–400
1626	Ethyl methyl-β-phenylglycidate	$C_6H_5C(CH_3)CH{\cdot}O{\cdot}(CO_2C_2H_5)$	20	1.091	1.5045	XVIII–306
1627	Trimethyl *n*-butyl lead	$(CH_3)_3PbC_4H_9$	20	1.678	1.5046	*IV–593
1628	Dimethyl-1,3-chloro-5-cyclohexadiene-3,5	$(CH_3)_2C_6H_5Cl$	15.4	1.007	1.5046	V–119
1629	Iodo-2-dimethyl-2,3-butane	$(CH_3)_2ClCH(CH_3)_2$	20	1.446	1.5047	I–153
1630	Ethylformyl-camphor	$C_{13}H_{20}O_2$	17.9	1.004	1.5047	.....
1631	Tri-*n*-propyl *iso*-amyl lead	$(C_2H_5CH_2)_3PbC_5H_{11}$	21	1.381	1.5047	.....
1632	Pentamethyl-benzene (m.p. 53°)	$(CH_3)_5C_6H$	72.8	0.9	1.5049	V–443
1633	Dimethyl isoprene-dicarboxylate (m.p. 39°)	$CH_3O_2CCH{:}C(CH_3){\cdot}CH{:}CHCO_2CH_3$	42.7	1.096	1.505	*II–319
1634	Ethoxy *m*-xylene (*sym*)	$(CH_3)_2(C_2H_5O)C_6H_3$ (1,3,5)	20	0.939	1.505	VI–493
1635	Xylene (*o*)	$(CH_3)_2C_6H_4$	20	0.881	1.5050	V–362
1636	Dicyclopentadiene (m.p. 33°)	$(CH{:}CHCH_2{\cdot}CH{:}CH)_2$	35	0.976	1.5050	V–495
1637	Ethyl toluate (*m*)	$CH_3C_6H_4CO_2C_2H_5$	21.6	1.03	1.5050	I X–476
1638	Dimethyl ethyl *iso*-amyl lead	$(CH_3)_2(C_2H_5)Pb{\cdot}(C_5H_{11})$	21.7	1.558	1.5052	.....
1639	Tetrachloro-ethylene	$Cl_2C{:}CCl_2$	20	1.619	1.5055	I–187
1640	Propyl iodide (*n*)	$C_2H_5CH_2I$	20	1.743	1.5055	I–113
1641	Mesityl methyl ether	$CH_3OC_6H_2(CH_3)_3$ (1,2,4,6)	14.4	0.953	1.5055	VI–519
1642	Ethyl tri-*iso*-butyl lead	$C_2H_5Pb(C_4H_9)_3$	22.1	1.376	1.5055	.....
1643	Propyl tri-*iso*-butyl lead	$C_2H_5CH_2Pb(C_4H_9)_3$	19.6	1.351	1.5056	.....
1644	Trichlorofuran (2,3,4)	C_4HOCl_3	20	1.547	1.5057	.....
1645	Ethyl benzoate	$C_6H_5CO_2C_2H_5$	18.7	1.046	1.5057	I X–110
1646	Atractylene	$C_{15}H_{24}$	20	0.927	1.5057	V–470
1647	Ethoxy toluene (*p*)	$CH_3C_6H_4OC_2H_5$	17.6	0.8	1.5058	VI–393
1648	Ethyltoluene (*o*)	$CH_3C_6H_4C_2H_5$	15.7	0.89	1.506	V–396
1649	Methyl carvacryl ether	$(CH_3)(OCH_3)C_6H_3{\cdot}CH(CH_3)_2$	20	0.944	1.506	VI–529

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1650	Amyl salicylate (*iso*)	$HOC_6H_4CO_2C_5H_{11}$	20	1.05	1.506	X–76
1651	Carbethoxy-2-methyl-7-tetrahydroindazole	$C_2H_5O_2CCH_2N{\cdot}CH{:}C_6H_7(CH_3){:}N$	20	1.093	1.506	.....
1652	Dibromohexane (1,2)	$CH_3(CH_2)_3CHBr{\cdot}CH_2Br$	13.5	1.596	1.5060	I–144
1653	Ethyl *o*-toloxyacetate	$CH_3C_6H_4OCH_2CO_2{\cdot}C_2H_5$	12.9	1.085	1.5061	*VI–172
1654	Diethyl disulfide	$(C_2H_5S)_2$	20	0.993	1.5063	I–347
1655	Methyl ethyl *n*-propyl *iso*-amyl lead	$(CH_3)(C_2H_5){\cdot}(C_3H_7)PbC_5H_{11}$	21	1.479	1.5064	.....
1656	Ethyl coumalate (m.p. 36°)	$C_2H_5O_2CC{:}CH{\cdot}O{\cdot}COCH{:}CH$	39.2	1.209	1.5066	XVIII–406
1657	Diethyl propyl *iso*-amyl lead	$(C_2H_5)_2(C_3H_7)Pb{\cdot}C_5H_{11}$	22.1	1.439	1.5066	.....
1658	Methyl pyrazine	$CH_3CCHNCHCHN$	18.7	1.030	1.5067	XXIII–94
1659	Tri-*n*-propyl *iso*-butyl lead	$(C_3H_7)_3PbC_4H_9$	22.6	1.403	1.5067	.....
1660	Ethoxy *m*-xylene (*uns*)	$(CH_3)_2C_6H_3OC_2H_5$ (1,3,4)	14	0.949	1.5069	*VI–241
1661	Ethyl α-(1,3-dimethylcyclohexylidene)-5-propionate	$(CH_3)_2C_6H_8{:}C{\cdot}(CH_3)CO_2C_2H_5$	20	0.969	1.5069	.....
1662	Dibromobutane (1,3)	$CH_3CHBrCH_2CH_2Br$	20	1.806	1.507	I–120
1663	Hydroxymethylene-1-methyl-3-cyclohexanone-2	$CH_3C_6H_7O{:}CHOH$	15.4	1.056	1.507	*VII–314
1664	Ethyl-2-methyl-7-tetrahydroindazole	$C_2H_5N{\cdot}CH{:}C_6H_7{\cdot}(CH_3){:}N$	20	0.990	1.507	.....
1665	Trimethylcoumaranone (2,2,7) (m.p. 68°)	$CH_3C_6H_3COC{\cdot}(CH_3)_2{\cdot}O$	100.6	1.001	1.507	.....
1666	Butyl anisate (*iso*)	$C_{12}H_{16}O_3$	20	1.052	1.507	.....
1667	Ethyl toluate (*o*)	$CH_3C_6H_4CO_2C_2H_5$	21.6	1.033	1.5070	IX–463
1668	Cadinene (*l*)	$C_{15}H_{24}$	20	0.918	1.5073	V–459
1669	Dibromopentane (2,3)	$C_2H_5(CHBr)_2CH_3$	20	1.678	1.5078	I–132
1670	Dimethyl ethyl *iso*-butyl lead	$(CH_3)_2(C_2H_5)Pb{\cdot}C_4H_9$	20.7	1.623	1.5078	.....
1671	Methyl diethyl *iso*-amyl lead	$(CH_3)(C_2H_5)_2Pb{\cdot}C_5H_{11}$	20.8	1.523	1.5078	.....
1672	Difluoro-1,2-tribromo-1,1,2-ethane	$CBr_2FCHBrF$	17.5	2.6	1.5079	I–94

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1673	Ethyl iodoacetate	$ICH_2CO_2C_2H_5$	12.7	1.817	1.5079	II-222
1674	Ethoxy toluene (*o*)	$CH_3C_6H_4OC_2H_5$	13.3	0.959	1.5079	VI-352
1675	Butyl anisate	$CH_3OC_6H_4CO_2C_4H_9$ (1,4)	20	1.054	1.508	.....
1676	Allyl thymyl ether	$(CH_3)(CH_2{:}CH{\cdot}CH_2O)C_6H_3(C_3H_7)$	20	0.935	1.508	.....
1677	Chloro-3-camphoryl-(*d*) dichloride (m.p. 26°)	$C_{10}H_{13}O_2Cl_3$	31.3	1.322	1.5080	IX-751
1678	Tropacocaine (m.p. 49°)	$C_{15}H_{19}O_2N$	100	1.043	1.5080	XXI-39
1679	Diethyl isophthalate	$C_6H_4(CO_2C_2H_5)_2$ (1,3)	17.5	1.13	1.5082	IX-834
1680	Ethyl ethylbenzoylacetate	$C_6H_5COCH(C_2H_5){\cdot}CO_2C_2H_5$	20	1.066	1.5082	X-710
1681	Trichlorocrotononitrile (γ,γ,γ)	$Cl_3CCH{:}CHCN$	20	1.420	1.5083	.....
1682	Amyl furylacrylate (*n*)	$C_4H_3OCH{:}CHCO_2{\cdot}(CH_2)_4CH_3$	20	1.032	1.5083	.....
1683	Di-*iso*-amylaniline	$C_6H_5N(C_5H_{11})_2$	24.9	0.889	1.5083	XII-169
1684	Phenetole	$C_6H_5OC_2H_5$	18.8	0.97	1.5084	VI-140
1685	Propyl *iso*-thiocyanate	$C_2H_5CH_2NCS$	16	0.978	1.5085	IV-145
1686	Amyl anisate (*iso*)	$CH_3OC_6H_4CO_2C_5H_{11}$ (*p*)	20	1.040	1.5085	.....
1687	Tetraethylbenzene	$(C_2H_5)_4C_6H_2$ (1,2,3,4)	19.6	0.887	1.5085	V-455
1688	Dimethyl di-*n*-propyl lead	$(CH_3)_2Pb(C_3H_7)_2$	20	1.627	1.5086	*IV-592
1689	Butyl phenyl ketone (*tert*)	$C_6H_5COC(CH_3)_3$	19.2	0.968	1.5086	VII-330
1690	Diethyl di-*iso*-butyl lead	$(C_2H_5)_2Pb(C_4H_9)_2$	20	1.444	1.5086	*IV-594
1691	Eucarvone	$C_{10}H_{14}O$	21.2	0.948	1.5087	VII-151
1692	Diethylphthalide (3,3,) (m.p. 55°)	$C_6H_4CO{\cdot}O{\cdot}C(C_2H_5)_2$	61.6	1.040	1.5087	XVII-325
1693	Difurfuryl ether	$(C_4H_3OCH_2)_2O$	20	1.140	1.5088	.....
1694	Ethyl hydrogen-phthalate	$C_6H_4(CO_2C_2H_5){\cdot}(CO_2H)$ (*o*)	22	.....	1.5088	IX-797
1695	Ethyl toluate (*p*)	$CH_3C_6H_4CO_2C_2H_5$	18.2	1.03	1.5089	IX-484
1696	Phenyl-1-pentene-2	$C_6H_5CH_2CH{:}CHC_2H_5$	16.2	0.888	1.5089	V-497
1697	Dibromo-1,2-methyl-2-propane	$(CH_3)_2CBrCH_2Br$	20	1.759	1.509	I-127
1698	Pyridine	C_5H_5N	20	0.982	1.509	XX-181
1699	Trimethylpyrrole (2,3,5)	$CH_3C{:}CHC(CH_3){:}C(CH_3)NH$	15.8	0.935	1.509	XX-177
1700	Ethyl pseudocumyl ether	$(CH_3)_3C_6H_2OC_2H_5$ (1,2,4,5)	20	0.942	1.509	VI-510
1701	Methyl phenylacetate	$C_6H_5CH_2CO_2CH_3$	16	1.044	1.5091	IX-434
1702	Methyl tri-*n*-propyl lead	$(C_3H_7)_3PbCH_3$	22.3	1.522	1.5091	.....

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1703	Santalol (β)	$C_{15}H_{24}O$	20	0.972	1.5091	VI–558
1704	Trimethyl propyl lead	$(CH_3)_3PbC_3H_7$	20	1.767	1.5095	*IV–592
1705	Triethyl *iso*-amyl lead	$(C_2H_5)_3PbC_5H_{11}$	20	1.484	1.5099	*IV–595
1706	Phenylacetic acid (m.p. 77°)	$C_6H_5CH_2CO_2H$	79.8	1.081	1.51	IX–431
1707	Toluic acid (*m*) (m.p. 110°)	$CH_3C_6H_4CO_2H$	111.6	1.054	1.51	IX–475
1708	Ethoxy *o*-xylene	$(CH_3)_2C_6H_3OC_2H_5$ (1,2,3)	20	0.952	1.510	VI–480
1709	Ethoxy *o*-xylene	$(CH_3)_2C_6H_3OC_2H_5$ (1,2,4)	20	0.950	1.510	VI–481
1710	Ethylbenzoic acid (*o*) (m.p. 68°)	$C_2H_5C_6H_4CO_2H$	99.6	1.042	1.5101	IX–526
1711	Ethyl-pseudo-cumene (*sym*)	$(CH_3)_3C_6H_2C_2H_5$ (1,2,4,5)	15.8	0.887	1.5105	V–442
1712	Dibromohexane (1,6)	$(CH_2CH_2CH_2Br)_2$	15	1.595	1.5111	I–145
1713	Ethyl tri-*n*-propyl lead	$(C_2H_5)Pb(C_3H_7)_3$	21.3	1.485	1.5115	.....
1714	Pentachloro-propane (1,1,2,-3,3)	$HCCl_2CHClCHCl_2$	20	1.6	1.512	*I–34
1715	Toluic acid (*o*) (m.p. 105°)	$CH_3C_6H_4CO_2H$	114.6	1.062	1.512	IX–462
1716	Dimethyl-2,7-tetra-hydroindazole	$CH_3N{\cdot}CH{:}C_6H_7{\cdot}$ $(CH_3){:}N$	20	1.012	1.512	.....
1717	Tetramethyl lead	$(CH_3)_4Pb$	20	1.995	1.5120	IV–639
1718	Methoxy *o*-xylene (*vic*) (m.p. 29°)	$(CH_3)_2C_6H_3OCH_3$ (1,2,3)	39.7	0.960	1.5120	VI–480
1719	Diethyl propyl *iso*-butyl lead	$(C_2H_5)_2(C_3H_7){\cdot}$ $(C_4H_9)Pb$	20	1.489	1.5120	.....
1720	Hydroxymethyl-ene-1-cyclo-hexanone-2	$CH_2(CH_2)_3COC{:}$ $CHOH$	20.5	1.085	1.5122	VII–558
1721	Methyl *p*-cresyl ether	$CH_3OC_6H_4CH_3$	19.3	0.97	1.5124	VI–392
1722	Tetramethyl-1,1,-3,6-ethylidene-4-cyclohexadiene-2,5	$(CH_3)_4C_6H_2{:}CHCH_3$	20	0.880	1.5125	.....
1723	Amyl phenyl ketone (*iso*)	$C_5H_{11}COC_6H_5$	15(?)	0.962	1.5125	VII–334
1724	Methyl *o*-methoxy-hydrocinnamate	$CH_3OC_6H_4CH_2CH_2{\cdot}$ CO_2CH_3	18.4	1.095	1.5126	X–242
1725	Triethyl *iso*-butyl lead	$(C_2H_5)_3PbC_4H_9$	20	1.531	1.5127	*IV–594
1726	Ethylmesitylene	$(CH_3)_3C_6H_2C_2H_5$ (1,3,5,2)	16.4	0.889	1.5127	V–442
1727	Methyl *o*-cresyl di-ketone ethyl ether (m.p. 64°)	$(C_2H_5O)(CH_3)C_6H_3{\cdot}$ $COCOCH_3$	65	1.052	1.5127	*VIII–628

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1728	Dibromoethane (1,1)	CH_3CHBr_2	20	2.055	1.5128	I–90
1729	Eugenol *iso*-amyl ether	$C_5H_{11}OC_{10}H_{11}O$	14.8	0.973	1.5128	VI–964
1730	Butyl furylacrylate (*n*)	$C_4H_3OCH{:}CHCO_2 \cdot C_4H_9$	20	1.048	1.5129	.....
1731	Ethylthiophene (α)	$C_2H_5C{:}CHCH{:}CH{\cdot}S$	20	0.992	1.513	XVII–39
1732	Ethoxytoluene (*m*)	$CH_3C_6H_4OC_2H_5$	20	0.949	1.513	VI–376
1733	Methoxy *m*-xylene (*sym*)	$(CH_3)_2C_6H_3OCH_3$ (1,3,5)	20	0.958	1.513	VI–493
1734	Tolyl α-ethyl-crotonate (p)	$CH_3CH{:}C(C_2H_5) \cdot CO_2C_6H_4CH_3$	20	1.009	1.513	.....
1735	Dimethyl-3,5-diethyl-2,6-phenol methyl ether	$(CH_3)_2(C_2H_5)_2 \cdot C_6HOCH_3$	20	0.946	1.513	*VI–272
1736	Dimethylamino-2-xylene (*m*)	$(CH_3)_2C_6H_3N(CH_3)_2$ (1,3,2)	20	0.915	1.5131	XII–1108
1737	Methyl methyl-β-phenylglycidate	$C_6H_5C(CH_3) \cdot CH \cdot (CO_2CH_3) \cdot O$ *	20	1.123	1.5131	XVIII–306
1738	Ethyl iodide	CH_3CH_2I	18.5	1.93	1.5133	I–96
1739	Trimethylbenzene (1,2,3)	$(CH_3)_3C_6H_3$	19.6	0.894	1.5134	V–399
1740	Dimethyl-1,1-ethylidene-4-cyclohexadiene-2,5	$(CH_3)_2C_6H_4{:}CHCH_3$	20	0.857	1.5135	V–427
1741	Chloromaleyl chloride (*uns*)	$ClC{:}CHCCl_2 \cdot O \cdot CO$	18.1	1.605	1.5136	.....
1742	Trimethyl-1,1,2-methene-4-cyclohexadiene-2,5	$(CH_3)_3C_6H_3{:}CH_2$	20	0.866	1.5139	V–429
1743	Butyl phenyl ketone (*iso*)	$(CH_3)_2CHCH_2CO \cdot C_6H_5$	15.3	0.99	1.5139	VII–329
1744	Fluorophenol (*m*)	FC_6H_4OH	20	1.222	1.514	*VI–97
1745	Allyloxy *m*-xylene (*sym*)	$(CH_3)_2C_6H_3OCH_2 \cdot CH{:}CH_2$	20	0.948	1.514	*VI–244
1746	Propyl anisate	$CH_3OC_6H_4CO_2C_3H_7$ (p)	20	1.09	1.514	.....
1747	Butyro-*o*-cresyl acetate (*o*, *iso*)	$(CH_3)(CH_3CO_2) \cdot (C_3H_7CO)C_6H_3$ (1,2,3)	20	1.074	1.514	.....
1748	Ethyl α,α-diethyl (*o*-methoxybenzoyl) acetate	$(C_2H_5)_2C(CO_2C_2H_5) \cdot COC_6H_4OCH_3$	20	1.086	1.5140	.....
1749	Methyl diethyl *n*-propyl lead	$(CH_3)(C_2H_5)_2 \cdot (C_3H_7)Pb$	22.1	1.640	1.5141	.....
1750	Ethyl isothiocyanate	C_2H_5NCS	18	0.998	1.5142	IV–123
1751	Dimethylthiophene (2,5)	$(CH_3)_2C_4H_2S$	19	0.994	1.5142	XVII–41
1752	Dimethyl-β,β-ethyl-α-styrene	$C_6H_5C(C_2H_5){:}C \cdot (CH_3)_2$	17.5	0.889	1.5142	V–502

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1753	Allylbenzene	$C_6H_5CH_2CH{:}CH_2$	20(?)	0.909	1.5143	V–484
1754	Methyl benzoate	$C_6H_5CO_2CH_3$	18.7	1.092	1.5144	IX–109
1755	Dibromopentane (1,5)	$BrCH_2(CH_2)_3CH_2Br$	15	1.70	1.5146	I–131
1756	Propyl furylacrylate (*iso*)	$C_4H_3OCH{:}CHCO_2{\cdot}CH(CH_3)_2$	20	1.050	1.5146	.....
1757	Tetramethyl-1,1,-3,6-methene-4-cyclohexadiene-2,5	$(CH_3)_4C_6H_2{:}CH_2$	20	0.877	1.5147	.....
1758	Diethyl di-*n*-propyl lead	$(C_2H_5)_2Pb(C_3H_7)_2$	20	1.533	1.5149	*IV–592
1759	Tetramethyl-1,1,-2,6-methene-4-cyclohexadiene-2,5	$(CH_3)_4C_6H_2{:}CH_2$	20	0.879	1.5149	.....
1760	Methoxy *p*-xylene	$CH_3OC_6H_3(CH_3)_2$	20	0.963	1.515	VI–494
1761	Dimethyl-1,3-ethyl-4-methoxy-5-benzene	$(CH_3)_2(C_2H_5){\cdot}(CH_3O)C_6H_2$	20	0.956	1.515	.....
1762	Fluoronitrobenzene (*p*) (m.p. 26°)	$FC_6H_4NO_2$	56	1.30	1.5150	V–241
1763	Dimethyl-1,4-dichloromethyl-4-cyclohexene-1-one-3 (m.p. 40°)	$(CH_3)_2C_5H_5CO{\cdot}CHCl_2$	45.8	1.207	1.5151	VII–67
1764	Acetoxypropiophenone (α)	$C_6H_5COCH(CH_3)O{\cdot}OCCH_3$	19.7	1.113	1.5153	*VIII–547
1765	Trimethyl ethyl lead	$(CH_3)_3PbC_2H_5$	20	1.882	1.5154	*IV–591
1766	Dimethyl phthalate (*o*)	$C_6H_4(CO_2CH_3)_2$	20.8	1.192	1.5155	IX–797
1767	Dihydroxy-2,7-naphthalene diamyl ether	$C_{10}H_6(OC_5H_{11})_2$	99.6	0.934	1.5155	.....
1768	Heptatriene (1,3,5)	$CH_2{:}CHCH{:}CHCH{:}CHCH_3$	20	0.764	1.516	*I–126
1769	Hemimellitenyl ethyl ether	$(CH_3)_3C_6H_2OC_2H_5$ (1,2,3,5)	20	0.956	1.516	.....
1770	Phosphorus trichloride	PCl_3	14	.....	1.516	.....
1771	Trimethyl-1,1,3-ethylidene-4-cyclohexadiene-2,5	$(CH_3)_3C_6H_3{:}CHCH_3$	20	0.879	1.5160	V–442
1772	Dihydroxy-1,5-naphthalene diamyl ether (m.p. 96°)	$C_{10}H_6(OC_5H_{11})_2$	99.9	0.941	1.5160	.....
1773	Dimethyl *p*-tolylcarbinol	$CH_3C_6H_4COH{:}(CH_3)_2$	20	0.977	1.5162	VI–544
1774	Methoxy toluene (*m*)	$CH_3C_6H_4OCH_3$	12.9	0.978	1.5164	VI–376
1775	Trimethylstyrene (α,β,β)	$C_6H_5C(CH_3){:}C{\cdot}(CH_3)_2$	20	0.892	1.5164	V–498

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1776	Bromocrotonaldehyde (α)	$CH_3CH{:}CBrCHO$	23	1.566	1.5165	*I–380
1777	Methyl benzyl ketone	$CH_3COCH_2C_6H_5$	20	1.028	1.5168	VII–303
1778	Triethyl *n*-propyl lead	$(C_2H_5)_3PbC_3H_7$	20	1.589	1.5168	*IV–592
1779	Diethylstyrene (β,β)	$C_6H_5CH{:}C(C_2H_5)_2$	18.7	0.892	1.5168	V–502
1780	Ethyl methyl-3-ethoxy-4-benzoate	$(CH_3)(C_2H_5O)C_6H_3{\cdot}CO_2C_2H_5$	20	1.057	1.5169	*X–98
1781	Methyl-2-tetrahydroindazole	$CH_3N{\cdot}CH{:}C_6H_8{:}N$	20	1.030	1.517	.....
1782	Methoxy *o*-xylene (*uns*)	$(CH_3)_2C_6H_3OCH_3$ (1,2,4)	20	0.969	1.517	VI–481
1783	Allyl *o*-cresyl ether	$CH_3C_6H_4OCH_2CH{:}CH_2$	20	0.965	1.517	*VI–171
1784	Ethyl *m*-methoxybenzoate	$CH_3OC_6H_4CO_2C_2H_5$	16.4	1.103	1.5170	X–139
1785	Anisole	$C_6H_5OCH_3$	20.6	0.994	1.5173	VI–138
1786	Methoxy *m*-xylene (*uns*)	$(CH_3)_2C_6H_3OCH_3$ (1,3,4)	12.9	0.970	1.5173	VI–486
1787	Methyl benzylcarbinol (*d*)	$C_6H_5CH_2CHOHCH_3$	20	0.991	1.5174	VI–503
1788	Tetrahydrofurfuryl benzyl ether	$C_4H_7OCH_2OCH_2{\cdot}C_6H_5$	20	1.048	1.5174	.....
1789	Methyl-1′-acetoxy-2-styrene	$CH_3CO_2C_6H_4CH{:}CHCH_3$	13.5	1.048	1.5175	*VI–284
1790	Trimethylacetophenone (2,4,6)	$(CH_3)_3C_6H_2COCH_3$	20	0.975	1.5175	VII–332
1791	Trichlorocrotonyl chloride (γ,γ,γ)	$Cl_3CCH{:}CHCOCl$	20	1.528	1.5176	.....
1792	Dimethyl diethyl lead	$(CH_3)_2Pb(C_2H_5)_2$	20	1.785	1.5177	*IV–591
1793	Propiophenone-*o*-carboxylic acid (m.p. 93°)	$C_2H_5COC_6H_4CO_2H$	99.1	1.140	1.5177	X–701
1794	Methyl-1-dichloromethyl-1-isopropyl-4-cyclohexene-3-one-2	$(C_3H_7)(CH_3)C_5H_5{\cdot}COCHCl_2$	15.8	1.165	1.5177	VII–138
1795	Ethoxy allylphenol (*p*)	$C_2H_5OC_6H_4CH_2CH{:}CH_2$	12.2	0.961	1.5179	VI–572
1796	Diethyl telluride	$(C_2H_5)_2Te$	15	1.599	1.5182	I–350
1797	Methyl triethyl lead	$CH_3Pb(C_2H_5)_3$	20	1.713	1.5183	*IV–591
1798	Propyl *p*-tolyl ketone (*iso*)	$(CH_3)_2CHCOC_6H_4{\cdot}CH_3$	21.2	0.968	1.5187	VII–331
1799	Methyl *o*-cresyl ether	$CH_3OC_6H_4CH_3$	15.3	0.985	1.5189	VI–352
1800	Dimethyl-1,3-bromo-4-pyrazole	$CH_3N{\cdot}CH{:}CBr{\cdot}C{\cdot}(CH_3){:}N$	20	1.490	1.519	.....
1801	Methyl pseudocumenyl ether	$(CH_3)_3C_6H_2OCH_3$ (1,2,4,5)	20	0.964	1.519	VI–510

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1802	Dichloro-1,2-bromo-1-ethylene	ClBrC:CHCl	16	1.91	1.5190	I-190
1803	Ethyl benzoyl-formate	$C_6H_5COCO_2C_2H_5$	25.1	1.122	1.5190	X-657
1804	Propyl phenyl ketone (*iso*)	$(CH_3)_2CHCOC_6H_5$	16.6	0.99	1.5192	VII-316
1805	Ethyl *p*,*α*,*β*-trimethylcinnamate	$CH_3C_6H_4C(CH_3):C\cdot(CH_3)CO_2C_2H_5$	18.4	1.003	1.5192	*I X-264
1806	Chlorotoluene (*p*)	$CH_3C_6H_4Cl$	24.4	1.06	1.5193	V-292
1807	Tetraethyl lead	$(C_2H_5)_4Pb$	20	1.653	1.5198	IV-639
1808	Ionone (*β*)	$C_{10}H_{16}:CHCOCH_3$	18.9	0.95	1.5198	VII-167
1809	Ethyl-3-methoxy-3-phthalide	$C_6H_4C(C_2H_5)(O\cdot CH_3)OCO$	20.4	1.132	1.5199	*XVIII-305
1810	Methyl-3-bromo-4-pyrazole (m. p. 76°)	$CH:CBrC(CH_3):N\cdot NH$	99.6	1.564	1.52	XXIII-61
1811	Pentaethylbenzene	$(C_2H_5)_5C_6H$	20.3	0.896	1.52	V-471
1812	Dibromovalero-nitrile (*α*,*β*)	$CH_3CH_2CHBrCHBr\cdot CN$	20	1.756	1.520	.....
1813	Ethyl *m*-chloro-benzoate	$ClC_6H_4CO_2C_2H_5$	20	1.181	1.520	I X-338
1814	Ethyl phenyl-carbinol	$C_2H_5CHOHC_6H_5$	20	0.996	1.5200	VI-502
1815	Tetramethyl tin	$(CH_3)_4Sn$	20(?)	1.3	1.5201	IV-632
1816	Dimethylamino-4-xylene (*o*)	$(CH_3)_2C_6H_3N(CH_3)_2$ (1,2,4)	20	0.916	1.5201	XII-1103
1817	Propyl phenyl ketone (*n*)	$C_2H_5CH_2COC_6H_5$	18.3	0.990	1.5202	VII-313
1818	Dibromopropane (1,2)	$CH_3CHBrCH_2Br$	20	1.933	1.5203	I-109
1819	Tetramethyl-benzene (1,2,3,4)	$(CH_3)_4C_6H_2$	16	0.90	1.5203	V-430
1820	Fluoronitro-benzene (*m*)	$FC_6H_4NO_2$	17.2	1.33	1.5207	V-241
1821	Eugenol acetate (m.p. 31°)	$C_{12}H_{14}O_3$	20	1.084	1.5207	VI-965
1822	Acetyl-2-methyl-5-tetrahydro-indazole	$CH_3CON\cdot CH:C_6H_7\cdot(CH_3):N$	20	1.079	1.521	.....
1823	Phenyl ethyl alcohol (*α*)	$C_6H_5CHOHCH_3$	20	1.01	1.5211	VI-475
1824	Ethyl *α*,*β*-dimethylcinnamate	$C_6H_5C(CH_3):C\cdot(CH_3)CO_2C_2H_5$	15.2	1.020	1.5212	*I X-260
1825	Tetraethyldiamino-benzene (*o*)	$C_6H_4[N(C_2H_5)_2]_2$	12.6	0.927	1.5213	.....
1826	Ethyl *β*,*β*-dichloro-*α*(*p*-tolyl)-propionate	$Cl_2CHCH(C_6H_4\cdot CH_3)CO_2C_2H_5$	18.7	1.202	1.5214	*I X-214
1827	Chlorofumaryl chloride	$(ClCCOCl):CHCOCl$	17.6	1.566	1.5217	*II-303
1828	Butyro-*p*-methoxy-toluene (*m*) (*iso*)	$CH_3C_6H_3(OCH_3)CO\cdot CH(CH_3)_2$	13.7	1.024	1.5218	*VIII-556

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1829	Dimethyl disulfide	$(CH_3S)_2$	16	1.057	1.5219	I–291
1830	Dimethyl thiophene (β,β)	$(CH_3)_2C_4H_2S$	15	0.99	1.522	XVII–40
1831	Dimethyl-2,2-chloro-5-coumaranone (m.p. 67°)	$ClC_6H_3COC(CH_3)_2O$	99.6	1.148	1.522	.....
1832	Phenylpropiolic acetal	$C_6H_5C{:}CCH(OC_2H_5)_2$	13	0.994	1.5222	VII–383
1833	Chlorotoluene (m)	$CH_3C_6H_4Cl$	18.7	1.07	1.5225	V–291
1834	Acetylsalicylic aldehyde (o) (m.p. 37°)	$CH_3CO_2C_6H_4CHO$	44.5	1.158	1.5225	VIII–44
1835	Thymol (m.p. 52°)	$(CH_3)(C_3H_7):C_6H_3OH$ (1,4,3)	20	0.969	1.5227	VI–532
1836	Propyl furylacrylate (n)	$C_4H_3OCH{:}CHCO_2C_3H_7$	20	1.074	1.5229	.....
1837	Benzyl chloroacetate	$ClCH_2CO_2CH_2C_6H_5$	20	1.2	1.523	VI–435
1838	Ethyl o-chlorobenzoate	$ClC_6H_4CO_2C_2H_5$	20	1.189	1.523	IX–336
1839	Allyl di-o,o-allylphenyl ether	$(C_3H_5)_2C_6H_3OC_3H_5$	20	0.950	1.523	*VI–301
1840	Estragole	$CH_2{:}CHCH_2C_6H_4OCH_3$ (1,4)	17.5	0.971	1.5230	VI–571
1841	Pyridazine	$CH{:}CHCH{:}CHN{:}N$	23.5	1.104	1.5231	XXIII–89
1842	Ethyl-1-methyl-4-dichloromethyl-4-cyclohexene-1-one-3	$(C_2H_5)(CH_3)C_5H_5COCHCl_2$	17	1.196	1.5233	VII–87
1843	Ethyl α,β-dibromo-γ,γ-dichlorobutyrate	$Cl_2CHCHBrCHBrCO_2C_2H_5$	20	1.830	1.5235	.....
1844	Pyrone (1,4) (m.p. 32.5°)	$C_5H_4O_2$	40.3	1.190	1.5238	XVII–271
1845	Ethyl o-methoxybenzoate	$CH_3OC_6H_4CO_2C_2H_5$	14.6	1.116	1.5238	X–74
1846	Trimethyl-1,4,5-dichloromethyl-1-cyclohexene-3-one-2	$(CH_3)_3C_5H_4COCHCl_2$	20	1.197	1.5238	.....
1847	Methyl-2-*iso*-propyl-6-phenol	$(CH_3)(C_3H_7):C_6H_3OH$	15.2	0.987	1.5239	VI–526
1848	Methylthiophene (2)	$CH_3C_4H_3S$	15.3	1.02(?)	1.524	XVII–38
1849	Methylthiophene (3)	$CH_3C_4H_3S$	14.8	1.02(?)	1.524	XVII–38
1850	Ethyl p-chlorobenzoate	$ClC_6H_4CO_2C_2H_5$	20	1.181	1.524	IX–340
1851	Allylanisole (o)	$CH_3OC_6H_4CH_2CH{:}CH_2$	20	0.972	1.524	*VI–282
1852	Methyl hemimellitenyl ether	$(CH_3)_3C_6H_2OCH_3$ (1,2,3,5)	20	0.976	1.524	.....
1853	Allyl allylphenyl ether (o)	$CH_2{:}CHCH_2C_6H_4OCH_2CH{:}CH_2$	20	0.963	1.524	*VI–282

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1854	Dimethyl allyl-anisole	$(CH_3)_2(C_3H_5)C_6H_2 \cdot OCH_3$ (1,3,4,5)	20	0.960	1.524	*VI-293
1855	Methyl propio-phenone-*o*-carboxylate	$C_2H_5COC_6H_4CO_2 \cdot CH_3$	15.2	1.129	1.5240	*I X-334
1856	Benzyl cyanide	$C_6H_5CH_2CN$	20	1.018	1.5242	I X-441
1857	Methyl *o*-tolyl ketone	$CH_3COC_6H_4CH_3$	16.8	1.001	1.5242	VII-306
1858	Benzyl acetate	$C_6H_5CH_2OCOCH_3$	21	1.06	1.5242	VI-435
1859	Methyl *m*-tolyl-carbinol	$CH_3CHOHC_6H_4CH_3$	20	0.993	1.5243	*VI-254
1860	Dimethyl *o*-toluidine (*N*)	$CH_3C_6H_4N(CH_3)_2$	23.3	0.93	1.5244	XII-785
1861	Methyl isothio-cyanate (m.p. 35°)	CH_3NCS	40	1.07	1.5245	IV-77
1862	Carvacrol	$(CH_3)(C_3H_7)C_6H_3OH$ (1,4,2)	18.6	0.98	1.5245	VI-527
1863	Chlorotoluene (*o*)	$ClC_6H_4CH_3$	20.2	1.081	1.5247	V-290
1864	Triphenylphos-phine (m.p. 79°)	$(C_6H_5)_3P$	69	1.1	1.5248	XVI-759
1865	Dibromopropane (1,3)	$BrCH_2CH_2CH_2Br$	15	1.987	1.5249	I-110
1866	Ethyl anisate (*p*)	$CH_3OC_6H_4CO_2C_2H_5$	20	1.106	1.5249	X-159
1867	Ethyl hydro-coumarilate	$C_6H_4CH_2CH(CO_2 \cdot C_2H_5) \cdot O$	13.9	1.154	1.5250	XVIII-305
1868	Propyl *p*-tolyl ketone	$C_2H_5CH_2COC_6H_4CH_3$	20	0.97	1.5250	VII-330
1869	Chlorobenzene	C_6H_5Cl	20	1.107	1.5251	V-199
1870	Ethyl salicylate (*o*)	$HOC_6H_4CO_2C_2H_5$	14.4	1.14	1.5251	X-73
1871	Benzyl lactate	$CH_3CHOHCO_2CH_2 \cdot C_6H_5$	25	.....	1.5252	.....
1872	Phenylacetal-dehyde	$C_6H_5CH_2CHO$	19.6	1.025	1.5255	VII-292
1873	Ethyl α-thiophene-carboxylate	$SCH:CHCH:CCO_2 \cdot C_2H_5$	20	1.159	1.526	XVIII-289
1874	Benzyl dichloro-acetate	$Cl_2CHCO_2CH_2C_6H_5$	20	1.3	1.526	VI-435
1875	Allylthymol (*o*) (1,2,3,4)	$(CH_3)(C_3H_5)(OH) \cdot (C_3H_7)C_6H_2$	20	0.966	1.526	.....
1876	Dimethyl-4,7-diethyl-2,2-indanedione-1,3 (m.p. 51°)	$(CH_3)_2C_6H_2COC \cdot (C_2H_5)_2CO$	62.4	1.017	1.5260	*VII-382
1877	Furfural (2)	C_4H_3OCHO	20	1.159	1.5261	XVII-272
1878	Tropylidene	$HC:(CH)_5CH_2$	20	0.888	1.5261	V-280
1879	Ethyl atropate	$C_6H_5C(:CH_2)CO_2 \cdot C_2H_5$	16.1	1.051	1.5261	*I X-252
1880	(α-Hydroxypro-pionyl)-*p*-meth-oxytoluene (*m*)	$(CH_3)(CH_3O)C_6H_3 \cdot COCHOHCH_3$	19.2	1.099	1.5263	*VIII-624

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1881	Allyl isothiocyanate	$CH_2{:}CHCH_2NCS$	20	1.013	1.5266	IV–214
1882	Dichlorobenzene (*p*) (m.p. 53°)	$C_6H_4Cl_2$	69.9	1.4	1.5266	V–203
1883	Phenyl ethyl alcohol (*β*)	$C_6H_5CH_2CH_2OH$	18	1.02	1.5267	VI–478
1884	Thionyl chloride	$SOCl_2$	10	.....	1.527	.....
1885	Ethyl phenyl ketone	$C_2H_5COC_6H_5$	20	1.011	1.5270	VII–300
1886	Ethyl *p*-tolyl ketone	$C_2H_5COC_6H_4CH_3$	20.7	0.990	1.5271	VII–317
1887	Tolunitrile (*o*)	$CH_3C_6H_4CN$	23.1	0.99	1.5272	IX–466
1888	Dimethylstyrene (*β*,*β*)	$C_6H_5CH{:}C(CH_3)_2$	19.6	0.899	1.5273	V–489
1889	Methyl allo-*β*-methylcinnamate (m.p. 27°)	$C_6H_5C(CH_3){:}CHCO_2{\cdot}CH_3$	38.1	1.037	1.5276	*IX–253
1890	Ethylchavibetol (1,3,4)	$CH_2{:}CHCH_2C_6H_3(O{\cdot}C_2H_5)(OCH_3)$	11.5	1.013	1.5276	.....
1891	Dimethyl-coumarane (2,5)	$CH_3C_6H_3CH(CH_3){\cdot}CH_2{\cdot}O$	13.7	1.015	1.5279	*XVII–24
1892	Dibromo-3,4-trimethyl-1,1,4-cyclohexane	$(CH_3)_3C_6H_7Br_2$	18.7	1.532	1.5281	*V–17
1893	Methyl-5-*iso*-propyl-2-acetoxy-3-coumarone	$CH_3C_6H_3C(O_2C{\cdot}CH_3){:}C(C_3H_7){\cdot}O$	20	1.081	1.5281	*XVII–69
1894	Methyl *p*-tolyl ketone	$CH_3COC_6H_4CH_3$	22	0.989	1.5283	VII–307
1895	Dichloro-1,1-*p*-tolyl-2-butane	$C_2H_5CH(C_6H_4CH_3){\cdot}CHCl_2$	19.8	1.112	1.5283	*V–209
1896	Elemicin (1,3,4,5)	$CH_2{:}CHCH_2{\cdot}C_6H_2(OH)_3$	20(?)	1.063	1.5285	VI–1131
1897	Ethyl furylacrylate	$C_4H_3OCH{:}CHCO_2{\cdot}C_2H_5$	20	1.09	1.5286	XVIII–300
1898	Nicotine	$C_{10}H_{14}N_2$	20	1.009	1.5286	XXIII–111
1899	Thiophene	$CH{:}CHCH{:}CHS$	19.7	1.065	1.5287	XVII–29
1900	Benzyl trichloro-acetate	$Cl_3CCO_2CH_2C_6H_5$	18.8	1.38	1.5288	VI–436
1901	(*α*-Bromo-*iso*-butyro)-*p*-cresyl acetate (*o*)	$CH_3CO_2C_6H_3(CH_3){\cdot}COCBr(CH_3)_2$	25.7	1.317	1.5288	*VIII–556
1902	Benzonitrile	C_6H_5CN	20	1.005	1.5289	IX–275
1903	Sparteine	$C_{15}H_{26}N_2$	19	1.024	1.5289	.....
1904	Phenyl-Δ^2-angelolactone (*δ*)	$C_6H_5CH_2C{:}CHCH_2{\cdot}CO{\cdot}O$	20	1.113	1.529	.....
1905	Methyl iodide	CH_3I	21	2.277	1.5293	I–70

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1906	Dimethyl-2,7-coumarane	$CH_3C_6H_3CH_2CH\cdot(CH_3)\cdot O$	13.8	1.015	1.5297	*XVII-24
1907	Coumalin	$CH{:}CHCH{:}CH\cdot O\cdot CO$	20	1.198	1.5298	XVII-271
1908	Trichloro-2,2,2-dibromo-1,1-ethane	Br_2CHCCl_3	25.7	2.3	1.5299	I-93
1909	Veratrole (*o*)	$C_6H_4(OCH_3)_2$	21	1.08	1.53	VI-771
1910	Phenyl ethylamine (*β*)	$C_6H_5CH_2CH_2NH_2$	24(?)	0.958	1.53	XII-1096
1911	Ethyl eugenyl ether	$C_2H_5OC_{10}H_{11}O$	18.3	1.014	1.53	VI-964
1912	Trichlorobromomethane	Cl_3CBr	20	1.94	1.5300	I-67
1913	Cuminic aldehyde (*p*)	$(CH_3)_2CHC_6H_4CHO$	20(?)	0.978	1.5301	VII-318
1914	Dimethyl-2,4-acetophenone	$(CH_3)_2C_6H_3COCH_3$	18.6	0.996	1.5301	VII-324
1915	Ethyl-2-dimethyl-4,6-acetoxy-3-coumarone	$(CH_3)_2C_6H_2C(O_2C\cdot CH_3){:}C(C_2H_5)\cdot O$	20	1.078	1.5303	.....
1916	Ethoxystyrene (*α*)	$C_6H_5C(OC_2H_5){:}CH_2$	17.5	0.977	1.5304	VI-563
1917	Mesitylamine (*ω*)	$(CH_3)_2C_6H_3CH_2NH_2$	20.5	0.950	1.5305	XII-1163
1918	Propenyl-3-methoxy-4-toluene (*iso*)	$CH_3C(:CH_2)\cdot C_6H_3(OCH_3)(CH_3)$	17.6	0.966	1.5308	*VI-288
1919	Acetyltetrahydroindazole (2)	$CH_3CON\cdot CH{:}C_6H_8{:}N$	20	1.119	1.531	.....
1920	Diethyl-2,2-methyl-5-coumaranone	$CH_3C_6H_3CO\cdot C(C_2H_5)_2\cdot O$	22.6	1.032	1.531	.....
1921	Ethyl benzoylacetate	$C_6H_5COCH_2CO_2\cdot C_2H_5$	16	1.12	1.5312	X-674
1922	Pseudoionone	$C_{13}H_{20}O$	18.8	0.90	1.5312	I-757
1923	Di-(1-chloroethyl) sulfide	$(CH_3CHCl)_2S$	20	1.27	1.5313	.....
1924	Propio-*p*-methoxytoluene (*m*)	$(CH_3O)(CH_3)C_6H_3\cdot COC_2H_5$ (4,1,3)	20	1.047.	1.5313	VIII-120
1925	Ethyl benzoylformylacetate	$C_6H_5COCH(CHO)\cdot CO_2C_2H_5$	24.9	1.140	1.5313	.....
1926	Dimethyl phenylcarbinol	$C_6H_5COH(CH_3)_2$	18.5	0.972	1.5314	VI-506
1927	Methyl-1'-methoxy-2-styrene	$CH_3OC_6H_4C(CH_3){:}CH_2$	19	0.99	1.5315	VI-572
1928	Ethyl 1-methylcyclohexene-1-methene-3-carboxylate	$CH_3C_6H_7{:}CHCO_2\cdot C_2H_5$	20	0.998	1.5319	IX-82
1929	Valero-*p*-cresol (*o*) (*iso*)	$(CH_3)_2CHCH_2CO\cdot C_6H_3(OH)(CH_3)$	20	1.028	1.5320	*VIII-557

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1930	Dimethyl-2,5-ethoxy-2-coumaranone	$CH_3C_6H_3COC\cdot(CH_3)(OC_2H_5)\cdot O$	14.1	1.103	1.5322	*XVIII-304
1931	Fluoronitrobenzene (*o*)	$FC_6H_4NO_2$	17.2	1.338	1.5323	V-241
1932	Phenylnitromethane	$C_6H_5CH_2NO_2$	20	1.16	1.5323	V-325
1933	Methyl-1'-acetoxy-3-styrene	$CH_3CO_2C_6H_4C\cdot(CH_3):CH_2$	14.1	1.061	1.5325	*VI-285
1934	Dimethyl mercury	$(CH_3)_2Hg$	22.2	2.954	1.5327	IV-678
1935	Methyl *m*-tolyl ketone	$CH_3COC_6H_4CH_3$	15.3	1.011	1.5327	VII-307
1936	Methyl-dichloromethyl-ketodihydrobenzene (*o*) (m.p. 33°)	$(CH_3)(CHCl_2)CCO\cdot CH:CHCH:CH$	33.5	1.270	1.5328	VII-149
1937	Allyl guaiacyl ether	$CH_3OC_6H_4OCH_2\cdot CH:CH_2$ (1,2)	20	1.054	1.533	VI-772
1938	Mesityloxide oxime benzyl ether (α)	$(CH_3)_2C:CH(CH_3):NOC_7H_7$	20	0.987	1.533	VI-441
1939	Hexahydronaphthalene	$C_{10}H_{14}$	18.4	0.94	1.5331	V-433
1940	Methyl *p*-tolylcarbinol	$CH_3CHOHC_6H_4CH_3$	20	1.003	1.5332	VI-508
1941	Sparteine (*iso*)	$C_{15}H_{26}N_2$	17	1.028	1.5332	.....
1942	Dimethyl-1,5-dichloromethyl-1-cyclohexadiene-3,5-one-2	$(CH_3)_2(CHCl_2)\cdot C_5H_3CO$	20	1.225	1.5336	.....
1943	Ethyl β-ethoxycinnamate	$C_6H_5C(OC_2H_5):CH\cdot CO_2C_2H_5$	16	1.074	1.5336	X-301
1944	Dibromopropylene (1,2) (*cis*)	$C_3H_4Br_2$	17.4	2.02	1.5337	.....
1945	Acetophenone	$CH_3COC_6H_5$	18.8	1.03	1.5338	VII-271
1946	Methylcoumarane (2)	$C_6H_4CH_2CH(CH_3)\cdot O$	13.7	1.036	1.5338	*XVII-23
1947	Dimethylstyrene (α,β)	$C_6H_5C(CH_3):CH\cdot CH_3$	19.7	0.910	1.5339	V-488
1948	Benzylazide	$C_6H_5CH_2N_3$	24.9	1.066	1.5341	V-350
1949	Dimethyl-1,3-phenyl-5-cyclohexene-3	$(CH_3)_2(C_6H_5)C_6H_7$	20	0.942	1.5341	.....
1950	Methyl-dichloromethyl-ketodihydrobenzene (*p*) (m.p. 55°)	$(CH_3)(CHCl_2)\cdot CCH:CHCOCH:CH$	56.2	1.26	1.5342	VII-149
1951	Methyl *o*-methoxybenzoate	$CH_3OC_6H_4CO_2CH_3$	19.5	1.157	1.5342	X-71
1952	Ethyl-2-methyl-5-acetoxy-3-coumarone	$CH_3C_6H_3C(O_2C\cdot CH_3):C(C_2H_5)\cdot O$	20	1.107	1.5343	*XVII-68
1953	Ethylbenzoic acid (*m*) (m.p. 47°)	$C_2H_5C_6H_4CO_2H$	100	1.042	1.5345	IX-528

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1954	Methyl α-methyl-styrene (p)	$CH_3C_6H_4C(CH_3):CH_2$	18.7	0.902	1.5345	V–490
1955	Nitrotoluene (p) (m.p. 52°)	$CH_3C_6H_4NO_2$	62.5	1.13	1.5346	V–323
1956	o-(α-Hydroxy-*iso*-butyro)-p-cresol (m.p. 55°)	$(CH_3)_2COHCO\cdot C_6H_3(OH)(CH_3)$ (2,1,4)	54	1.094	1.5347	*VIII–624
1957	Ethyl-2-tetrahydro-5,6,7,8-naphthalene	$C_2H_5C_{10}H_{11}$	17.6	0.950	1.5347	.....
1958	Methylstyrene (α)	$C_6H_5C(CH_3):CH_2$	19.8	0.908	1.5349	V–484
1959	Ethyl Δ^2-dihydro-α-naphthoate (*labile*)	$C_{10}H_9CO_2C_2H_5$	20	1.089	1.535	.....
1960	Benzaldoxime ethyl ether (α)	$C_6H_5CH:NOC_2H_5$	21.7	0.992	1.5350	VII–223
1961	Hydrindene (1,2)	$C_6H_4CH_2CH_2CH_2$	20.8	0.96	1.5351	V–486
1962	Methoxyphthalide (α)	$C_6H_4CO\cdot O\cdot CH(O\cdot CH_3)$	22.8	1.215	1.5352	XVIII–17
1963	Creosol	$CH_3OC_6H_3(CH_3)OH$ (3,1,4)	25	1.09	1.5353	VI–878
1964	Hydroxy-α-dimethoxy-2,5-propiophenone	$(CH_3O)_2C_6H_3CO\cdot CHOHCH_3$	13.4	1.149	1.5353	*VIII–690
1965	Butyro-p-cresol (o) (*iso*)	$(CH_3)_2CHCOC_6H_3\cdot(CH_3)OH$	21.3	1.043	1.5355	*VIII–556
1966	Methyl-2-*tert*-butyl-5-coumarone	$(CH_3)_3CC_6H_3CH:C(CH_3)\cdot O$	20	0.988	1.5355	.....
1967	Phthalide (m.p. 73°)	$C_6H_4CH_2\cdot O\cdot CO$	99.1	1.164	1.5356	XVII–310
1968	Hydroxypropiophenone (α)	$C_6H_5COCHOHCH_3$	22.8	1.104	1.5356	*VIII–547
1969	Hydrocinnamyl alcohol	$C_6H_5CH_2CH_2CH_2OH$	20	1.008	1.5357	VI–503
1970	Dimethyl-coumarane (5,7)	$C_{10}H_{12}O$	18.9	1.026	1.5358	*XVII–24
1971	Ethyl β-chloro-α(p-tolyl)-acrylate	$CH_3C_6H_4C(:CHCl)\cdot CO_2C_2H_5$	19.7	1.136	1.5358	*IX–257
1972	Fluoroaniline (p)	$FC_6H_4NH_2$	20	1.152	1.536	XII–597
1973	Valerothienone (α) (*iso*)	$C_4H_9COC:CHCH:CH\cdot S$	20	1.062	1.536	.....
1974	Ethyl dimethyl-2,5-coumaranone-3-carboxylate-2	$CH_3C_6H_3COC(CH_3)\cdot(CO_2C_2H_5)\cdot O$	20	1.161	1.536	*XVIII–492
1975	Dimethyl-2,5-ethyl-2-coumaranone	$CH_3C_6H_3CO(CH_3)\cdot(C_2H_5)\cdot O$	19.6	1.056	1.5360	*XVII–168

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
1976	Ethyl methyl-2-coumarane carboxylate-5	$C_2H_5O_2CC_6H_3CH_2\cdot CH(CH_3)\cdot O$	14.3	1.118	1.5363	*XVIII-442
1977	Anthracene octahydride (m.p. 71°)	$C_{14}H_{18}$	88.8	0.965	1.5363	V-526
1978	Xylylamine (*p*)	$CH_3C_6H_4CH_2NH_2$	20	0.952	1.5364	XII-1141
1979	Methyl benzoyl-acetate	$C_6H_5COCH_2CO_2CH_3$	24.7	1.15	1.5365	X-673
1980	Ethyl ethyl-2-coumaranone-3-carboxylate-2	$C_6H_4COC(C_2H_5)\cdot(CO_2C_2H_5)\cdot O$	18.6	1.155	1.5366	*XVIII-491
1981	Methoxyaceto-phenone (*m*)	$CH_3OC_6H_4COCH_3$	19	1.094	1.5367	VIII-86
1982	Phenylisocyanate	$C_6H_5N{:}CO$	19.6	1.096	1.5368	XII-437
1983	Dibromopropylene (1,2) (*trans*)	$C_3H_4Br_2$	17.4	2.02	1.5369	.....
1984	Butyro-*o*-cresol (*o*) (*iso*)	$(CH_3)_2CHCOC_6H_3\cdot(CH_3)OH$	20	1.047	1.537	.....
1985	Diethyl dithio-carbonate	$CO(SC_2H_5)_2$	18.2	1.084	1.5370	III-210
1986	Cresol (*o*) (m.p. 30°)	$CH_3C_6H_4OH$	40	1.04	1.5372	VI-349
1987	Methyl-2-tetrahydro-5,6,7,8-naphthalene	$CH_3C_6H_3CH_2CH_2\cdot CH_2CH_2$	15.1	0.954	1.5372	.....
1988	Triethyl tin	$[(C_2H_5)_3Sn]_2$	17.8	1.4	1.5374	IV-638
1989	Ethyl phenyl-carbamate (m.p. 52°)	$C_6H_5NHCO_2C_2H_5$	30.4	1.106	1.5376	XII-320
1990	Methyl salicylate (*o*)	$HOC_6H_4CO_2CH_3$	18.1	1.186	1.5377	X-70
1991	Methoxy-6-methyl-3-acetophenone	$(CH_3O)(CH_3)C_6H_3\cdot COCH_3$	13.8	1.069	1.5377	*VIII-549
1992	Epidibromohydrin (*β*)	$BrCH_2CH{:}CHBr$	25	1.995	1.5378	I-201
1993	Methyl *p*-cresyl diketone methyl ether (m.p. 60°)	$CH_3C_6H_3(OCH_3)\cdot COCOCH_3$	16	1.119	1.5378*	*VIII-628
1994	Ethylene bromide	$BrCH_2CH_2Br$	20	2.182	1.5379	I-90
1995	Methoxyaceto-phenone (*o*)	$CH_3OC_6H_4COCH_3$	23.6	1.085	1.5379	VIII-85
1996	Hydrindone (*β*) (m.p. 58°)	$C_6H_4CH_2COCH_2$	66.3	1.07	1.538	VII-363
1997	Allyl-*o*-cresol (*o*)	$CH_2{:}CHCH_2C_6H_3{:}(CH_3)OH$ (1,2,3)	20	1.000	1.538	*VI-287
1998	Apiol (m.p. 30°)	$C_6H(O_2CH_2)(O\cdot CH_3)_2C_3H_5$	14	1.176	1.5380	*XIX-642
1999	Methyl-α-benzoyl-α-acetone	$C_6H_5COCH(CH_3)\cdot COCH_3$	20	1.079	1.5382	*VII-369

*Supercooled.

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2000	Dimethyl-2,5-methoxy-2-coumaranone	$CH_3C_6H_3COC\cdot(CH_3)OCH_3$	22.6	1.130	1.5383	*XVIII-304
2001	Methyl eugenyl ether	$CH_2{:}CHCH_2C_6H_3(O\cdot CH_3)_2$ (1,3,4)	17	1.036	1.5383	VI-963
2002	Ethylstyrene (β)	$C_6H_5CH{:}CHC_2H_5$	20	0.910	1.5387	V-487
2003	Pyridyl-α-aldehyde	C_6H_5ON	18.5	1.13	1.5389	*XXI-287
2004	Dimethyl-2,5-acetoxy-3-coumarone (m.p. 29°)	$CH_3C_6H_3C(O_2C\cdot CH_3){:}C(CH_3)\cdot O$	20	1.132	1.5389	*XVII-66
2005	Diethyl benzal-malonate (m.p. 32°)	$C_6H_5CH{:}C(CO_2\cdot C_2H_5)_2$	20.4	1.105	1.5389	IX-892
2006	Allylguaiacol (*o*)	$CH_2{:}CHCH_2\cdot C_6H_3(OCH_3)OH$	20	1.066	1.539	*VI-461
2007	Dimethyl-2,6-ethyl-3-chromanone	$CH_3C_6H_3COCH\cdot(C_2H_5)CH(CH_3)\cdot O$	21	1.063	1.539	.....
2008	Safrole	$CH_2{:}O_2{:}C_6H_3C_3H_5$	19	1.097	1.5390	XIX-39
2009	Ethyl methyl-2-coumaranone-3-carboxylate-2	$C_6H_4COC(CH_3)\cdot(CO_2C_2H_5)$	16.7	1.192	1.5390	*XVIII-491
2010	Methyl allo-β-methyl-*o*-methoxy-cinnamate (m.p. 44°)	$CH_3OC_6H_4C(CH_3){:}CHCO_2CH_3$	17	1.098	1.5390	*X-138
2011	Benzyl chloride	$C_6H_5CH_2Cl$	17.4	1.103	1.5391	V-292
2012	Butyroanisole (*p*) (*iso*)	$(CH_3)_2CHCO\cdot C_6H_4OCH_3$	16.6	1.050	1.5393	*VIII-553
2013	Diethyl-2,2-indanedione-1,3	$C_6H_4COC(C_2H_5)_2CO$	20	1.064	1.5393	*VII-381
2014	Tetraethyldiamino-naphthalene (1,4) (m.p. 47°)	$C_{10}H_6[N(C_2H_5)_2]_2$	99.6	0.932	1.5394	.....
2015	Benzyl alcohol	$C_6H_5CH_2OH$	20	1.043	1.5396	VI-428
2016	Chavibetol (1,3,4)	$CH_2{:}CHCH_2\cdot C_6H_3(OH)(OCH_3)$	16	1.065	1.5397	VI-963
2017	Diethyl mercury	$(C_2H_5)_2Hg$	23.2	2.423	1.5399	IV-679
2018	Phenol (m.p. 42°)	C_6H_5OH	45	1.07	1.54	VI-113
2019	Guaiacol (*o*) (m.p. 28°)	$CH_3OC_6H_4OH$	?	1.1	1.54	VI-768
2020	Hydroxyaceto-phenone (*m*) (m.p. 95°)	$HOC_6H_4COCH_3$	109	1.099	1.54	VIII-86
2021	Butyro-*m*-cresol (*o*) (*iso*)	$(CH_3)_2CHCOC_6H_3{:}(CH_3)(OH)$	20	1.042	1.540	.....
2022	Diallylphenol (*o*,*o*)	$(CH_2{:}CHCH_2)_2{:}C_6H_3OH$	20	0.988	1.540	*VI-301
2023	Hydroxydiethyl-aceto-*p*-cresol (α)	$(C_2H_5)_2COHCO\cdot C_6H_3(CH_3)OH$ (1,3,6)	21.1	1.080	1.540	.....

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2024	Propyl-(2, *iso*)-dimethyl-4,6-coumaranone	$(CH_3)_2C_6H_2COCH\cdot(C_3H_7)\cdot O$	20	1.048	1.5400	.....
2025	Dimethyl-2,4-*iso*-propyl-7-coumarone	$(CH_3)(C_3H_7):C_6H_2CH:C(CH_3)\cdot O$	20	0.994	1.5401	.....
2026	Tetrahydro-naphthalene (1,2,3,4)	$C_6H_4CH_2(CH_2)_2CH_2$	20	0.97	1.5402	V–491
2027	Methylcoumaran (5)	$CH_3C_6H_4CH:CH\cdot O$	18.6	1.046	1.5404	XVII–53
2028	Trimethyl coumaranone (2,2,5)	$CH_3C_6H_3COC\cdot(CH_3)_2\cdot O$	19.3	1.073	1.5404	*XVII–166
2029	Ethyl methyl-5-ethoxy-3-coumarilate (m.p. 47°)	$CH_3C_6H_3C(OC_2H_5):C(CO_2C_2H_5)\cdot O$	52.6	1.104	1.5404	*XVIII–460
2030	Fluoroaniline (*o*)	$FC_6H_4NH_2$	20	1.151	1.5407	*XII–296
2031	Tolualdehyde (*m*)	$CH_3C_6H_4CHO$	21.4	1.02	1.5407	VII–296
2032	Dimethylaceto-phenone (3,4)	$(CH_3)_2C_6H_3COCH_3$	15.5	1.007	1.5408	VII–323
2033	Dimethyl-2,2-hydrindone-1 (m.p. 44°)	$C_6H_4CH_2C(CH_3)_2CO$	13.9	1.031	1.5408	*VII–198
2034	Methyl β,*p*-dimethyl-cinnamate (m.p. 45°)	$CH_3C_6H_4C(CH_3):CHCO_2CH_3$	60.2	1.014	1.5408	IX–624
2035	Dimethyl-1,3-tetrahydro-5,6,7,8-naphthalene	$(CH_3)_2C_6H_2CH_2\cdot CH_2CH_2CH_2$	21	0.959	1.5409	.....
2036	Benzal bromide	$C_6H_5CHBr_2$	15(?)	1.51	1.541	V–308
2037	Methyl *o*-phthal-aldehyde-carboxylate	$HCOC_6H_4CO_2CH_3$	20.3	1.195	1.541	*X–316
2038	Methyl-4-allyl-2-phenol	$CH_3C_6H_3(OH)CH_2\cdot CH:CH_2$	20	1.002	1.541	*VI–287
2039	Triallylphenol (*o*,*o*,*p*)	$(C_3H_5)_3C_6H_2OH$	20	0.974	1.541	*VI–322
2040	Hydroxy-6-methyl-3-acetophenone (m.p. 50°)	$CH_3C_6H_3(OH)CO\cdot CH_3$	53	1.080	1.5410	VIII–111
2041	Diethylaniline	$C_6H_5N(C_2H_5)_2$	22.3	0.93	1.5411	XII–164
2042	Trimethyl-2,4,5-acetophenone	$(CH_3)_3C_6H_2COCH_3$	14.9	1.004	1.5411	VII–333
2043	Diethyl phthalyl-malonate (m.p. 75°)	$C_6H_4CO\cdot O\cdot C:C(CO_2\cdot C_2H_5)_2$	84.4	1.189	1.5411	XVIII–498
2044	Eugenol (1,3,4)	$C_6H_3(C_3H_5)(O\cdot CH_3)OH$	19.4	1.07	1.5416	VI–961

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2045	Methyl-1′-methoxy-3-styrene	$CH_3OC_6H_4C(CH_3):CH_2$	20(?)	0.99	1.5417	VI–573
2046	Methyl-4-ethyl-α-chloro-β-styrene	$CH_3C_6H_4C(C_2H_5):CHCl$	19.9	1.036	1.5418	*V–239
2047	Butyrothienone (α)	$C_3H_7COC{:}CHCH{:}CH{\cdot}S$	20	1.098	1.542	.....
2048	Trithioacetone	$(CH_3CSCH_3)_3$	20	1.068	1.542	XIX–389
2049	Coumaran	$C_6H_4CH_2CH_2{\cdot}O$	19	1.057	1.5420	XVII–50
2050	Methylchromane (6)	$CH_3C_6H_3CH_2CH_2{\cdot}CH_2{\cdot}O$	14.3	1.037	1.5421	*XVII–24
2051	Methoxystyrene (α)	$C_6H_5C(OCH_3):CH_2$	20	1.00	1.5422	VI–563
2052	Cresol (*m*)	$CH_3C_6H_4OH$	18	1.04	1.5425	VI–373
2053	Homocatechol (m.p. 65°)	$CH_3C_6H_3(OH)_2$ (1,3,4)	73.6	1.129	1.5425	VI–878
2054	Nitrophenetole (*o*)	$C_2H_5OC_6H_4NO_2$	20	1.19	1.5425	VI–218
2055	Trimethyl-2′,2′,5-methoxy-2-styrene	$CH_3(CH_3O)C_6H_3{\cdot}CH:C(CH_3)_2$	17.1	0.968	1.5425	*VI–293
2056	Ethyl α-ethyl-cinnamate	$C_6H_5CH:C(C_2H_5){\cdot}CO_2C_2H_5$	13.8	1.025	1.5425	*IX–259
2057	Dimethyl-4,6-ethyl-2-coumaranone	$(CH_3)_2C_6H_2COCH{\cdot}(C_2H_5){\cdot}O$	20	1.067	1.5426	.....
2058	Dimethyl-3,3-hydrindone-1	$C_6H_4C(CH_3)_2{\cdot}CH_2CO$	20	1.027	1.5427	.....
2059	Methyl-α-acetoxy-β-styrene	$C_6H_5C(CH_3):CHO{\cdot}OC{\cdot}CH_3$	15.2	1.057	1.5428	*VI–285
2060	Tetramethyl-2,2,4,6-coumaranone (m.p. 41°)	$(CH_3)_2C_6H_2CO{\cdot}C(CH_3)_2{\cdot}O$	20	1.060	1.5428	.....
2061	Methyl-5-*iso*-propyl-2-coumaranone (m.p. 26°)	$CH_3C_6H_3COCH{\cdot}(C_3H_7){\cdot}O$	13.8	1.071	1.5429	*XVII–69
2062	Ethyl *o*-bromo-benzoate	$BrC_6H_4CO_2C_2H_5$	20	1.439	1.543	IX–348
2063	Ethyl *m*-bromo-benzoate	$BrC_6H_4CO_2C_2H_5$	20	1.430	1.543	IX–350
2064	Carvacrylamine (1,2,4)	$C_6H_3(CH_3)(NH_2){\cdot}(C_3H_7)$	19	0.995	1.543	XII–1171

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2065	Amylindazole-carboxylate (2) (*iso*)	$C_6H_4CH{\cdot}N(CO_2{\cdot}C_5H_{11}){\cdot}N$	15.1	1.110	1.543	.....
2066	Acetylene dibromide (*cis*)	$BrCH{:}CHBr$	17.5	2.271	1.5431	I-190
2067	Dimethyl-2,5-ethyl-3-coumarone	$CH_3C_6H_3C(C_2H_5){:}C(CH_3){\cdot}O$	20	1.003	1.5433	.....
2068	Dimethyl-2,6-octatriene-3,5,7	$(CH_3)_2CHCH{:}CH{\cdot}CH{:}C(CH_3)CH{:}CH_2$	20	0.809	1.5436	.....
2069	Ethyl tribromo-acetate	$Br_3CCO_2C_2H_5$	12.5	2.2	1.5438	II-221
2070	Trimethyl-1,2,3-(β,β-dichloro-ethyl)-5-benzene	$(CH_3)_3C_6H_2CH_2CH{:}Cl_2$	20	1.144	1.5439	.....
2071	Chromane	$C_6H_4CH_2CH_2CH_2{\cdot}O$	20	1.059	1.544	XVII-52
2072	Dimethyl-1,3-dichloromethyl-1-cyclohexadiene-2,5-one-4 (m.p. 56°)	$(CH_3)_2C_5H_3COCHCl_2$	20	1.241	1.5440	VII-150
2073	Methyl-5-ethoxy-3-coumarone	$CH_3C_6H_3C(OC_2H_5){:}CH{\cdot}O$	16.6	1.083	1.5440	*XVII-61
2074	Dimethyl-2,5-methoxy-3-coumarone	$CH_3C_6H_3C(OCH_3){:}C(CH_3){\cdot}O$	19	1.081	1.5440	*XVII-65
2075	Benzylamine	$C_6H_5CH_2NH_2$	19.5	0.980	1.5441	XII-1013
2076	Allylphenol (*p*)	$CH_2{:}CHCH_2C_6H_4OH$	18	1.02	1.5441	VI-571
2077	Thiophosgene	$SCCl_2$	15(?)	1.509	1.5442	III-134
2078	Benzyl-1-cyclo-hexene-1	$C_6H_5CH_2C{:}CH{\cdot}(CH_2)_3CH_2$	14.1	0.969	1.5443	V-524
2079	Methylstyrene (*p*)	$CH_3C_6H_4CH{:}CH_2$	16.4	0.900	1.5447	V-485
2080	Methylphthalide	$C_6H_4CO{\cdot}O{\cdot}CH(CH_3)$	20	1.158	1.5447	XVII-318
2081	Styrene	$C_6H_5CH{:}CH_2$	19.9	0.907	1.5449	V-474
2082	Allylphenol (*o*)	$CH_2{:}CHCH_2C_6H_4OH$	20	1.021	1.545	*VI-282
2083	Propyl-α-aceto-α'-thienone	$C_3H_7C{:}CHCH{:}C{\cdot}(COCH_3){\cdot}S$	20	1.061	1.545	XVII-300
2084	Methyl-5-*n*-propyl-2-coumaranone	$CH_3C_6H_3COCH{\cdot}(C_3H_7){\cdot}O$	20	1.064	1.545	.....

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2085	Dihydroxy-2,3-naphthalene diamyl ether	$C_{10}H_6(OC_5H_{11})_2$	20	0.991	1.545	.....
2086	Ethyl allo-cinnamate	$C_6H_5CH{:}CHCO_2C_2H_5$	20	1.048	1.5451	I X–594
2087	Fluoroaniline (*m*)	$FC_6H_4NH_2$	20	1.16	1.5455	XII–597
2088	Benzaldehyde	C_6H_5CHO	19.5	1.049	1.5456	VII–174
2089	Ethyl β-methyl-cinnamate	$C_6H_5C(CH_3){:}CHCO_2{\cdot}C_2H_5$	16.6	1.039	1.5456	I X–614
2090	Amylindazole (1) (*iso*)	$C_6H_4CH{:}N{\cdot}N{\cdot}C_5H_{11}$	20	1.001	1.546	.....
2091	Methyl-β-phenyl-μ-oxazoline	$N{:}C(C_6H_5){\cdot}O{\cdot}CH{\cdot}(CH_3){\cdot}CH_2$	22.9	1.070	1.5460	XXVII–51
2092	Ethyl dimethyl-3,5-coumarilate (m.p. 55°)	$CH_3C_6H_3C(CH_3){:}C{\cdot}(CO_2C_2H_5){\cdot}O$	59	1.093	1.5464	XVIII–310
2093	Homosalicyl-aldehyde (*p*) (m.p. 56°)	$HOC_6H_3(CH_3)CHO$ (6,3,1)	59.2	1.091	1.5466	VIII–100
2094	Methoxyaceto-phenone (*p*) (m.p. 38°)	$CH_3OC_6H_4COCH_3$	41.3	1.082	1.5468	VIII–87
2095	Tolualdehyde (*p*)	$CH_3C_6H_4CHO$	16.6	1.019	1.5469	VII–297
2096	Ethyl *p*-bromo-benzoate	$BrC_6H_4CO_2C_2H_5$	20	1.430	1.547	I X–352
2097	Nitrotoluene (*m*)	$CH_3C_6H_4NO_2$	21	1.16	1.5470	V–321
2098	Dimethyltoluidine (*p*) (*N*)	$CH_3C_6H_4N(CH_3)_2$	20	0.937	1.5471	XII–902
2099	Iodomethyl methyl ether	ICH_2OCH_3	20	2.030	1.5472	I–583
2100	Dichlorobenzene (*m*)	$C_6H_4Cl_2$	17.3	1.28	1.5472	V–202
2101	Methyl methyl-β-methoxy-2-methyl-5-cinnamate (m.p. 36°)	$(CH_3)(CH_3O)C_6H_3{\cdot}C(CH_3){:}CHCO_2{\cdot}CH_3$	12.7	1.087	1.5472	*X–141
2102	Chlorophenol (*o*)	HOC_6H_4Cl	40	1.2	1.5473	VI–183
2103	Benzalpinacoline (m.p. 40°)	$C_{13}H_{16}O$	45.7	0.94	1.5473	VII–378
2104	Nitrotoluene (*o*)	$CH_3C_6H_4NO_2$	20.4	1.163	1.5474	V–318
2105	Ethyl α-methyl-cinnamate	$C_6H_5CH{:}C(CH_3){\cdot}CO_2C_2H_5$	20.6	1.032	1.5475	I X–616
2106	Benzal dipropyl ketone (α)	$C_6H_5CH{:}C(C_2H_5){\cdot}COC_3H_7$	23.9	0.972	1.5476	VII–379
2107	Methylstyrene (*o*)	$CH_3C_6H_4CH{:}CH_2$	14.1	0.916	1.5477	*V–233
2108	Ethoxycoumarone (3)	$C_6H_4C(OC_2H_5){:}CH{\cdot}O$	17.9	1.106	1.5477	*XVII–59
2109	Benzaldoxime *O*-methyl ether (α)	$C_6H_5CH{:}NOCH_3$	20	1.020	1.548	VII–223

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2110	Dimethyl-3,4-ethyl-2-hydroxy-7-hydrindone	$(CH_3)(OH)C_6H_2CH\cdot$ $(CH_3)CH\cdot$ $(C_2H_5)CO$	20	1.073	1.548	.....
2111	Dimethylamino-*m*-xylene (*uns*)	$(CH_3)_2C_6H_3N(CH_3)_2$ (1,3,4)	20	0.939	1.5481	XII–1115
2112	Ethyl indene-β-carboxylate (m.p. 50°)	$C_6H_4CH{:}C(CO_2\cdot$ $C_2H_5)CH_2$	73.9	1.054	1.5481	*I X–268
2113	Ethyl methyl-3-coumarilate (m.p. 51°)	$C_6H_4C(CH_3){:}C(CO_2\cdot$ $C_2H_5)\cdot O$	56.6	1.116	1.5482	XVIII–309
2114	Perchloromethyl mercaptan	Cl_3CSCl	17.5	1.695	1.5484	III–135
2115	Tolualdehyde (*o*)	$CH_3C_6H_4CHO$	19	1.038	1.5485	VII–295
2116	Dimethyl-3,5-coumarone	$CH_3C_6H_3C(CH_3){:}$ $CH\cdot O$	22.2	1.035	1.5485	XVII–62
2117	Propio-*p*-cresol	$(HO)(CH_3)C_6H_3CO\cdot C_2H_5$ (1,4,2)	13.8	1.084	1.5485	VIII–120
2118	Ethoxy-2-bromo-5-toluene	$CH_3C_6H_3(OC_2H_5)Br$	11.4	1.359	1.5486	*VI–176
2119	Methyl β-methyl-*o*-methoxy cinnamate	$CH_3OC_6H_4C(CH_3){:}$ $CHCO_2CH_3$	16.7	1.104	1.5488	* X–137
2120	Trimethylpyrazole (1,3,5)	$CH_3C{:}CHC(CH_3){:}$ $N\cdot N(CH_3)$	20	1.034	1.549	XXIII–75
2121	Benzyl-1-dimethyl-3,5-pyrazole	$CH_3C{:}CHC(CH_3){:}$ $N\cdot N(C_7H_7)$	20	1.034	1.549	.....
2122	Bromotoluene (*p*) (m.p. 28°)	$BrC_6H_4CH_3$	20	1.390	1.5490	V–305
2123	Methyl-1′-hydroxy-2-styrene	$HOC_6H_4C(CH_3){:}CH_2$	18.5	1.030	1.5490	VI–572
2124	Methylstyrene (β)	$C_6H_5CH{:}CHCH_3$	20	0.914	1.5492	V–481
2125	Methyltoluidine (*N*) (*m*)	$CH_3C_6H_4N(CH_3)_2$	20	0.941	1.5492	XII–857
2126	Phenylvinyl acetate	$C_6H_5CH{:}CHO_2CCH_3$	22.9	1.066	1.5494	VI–564
2127	Dibromo-1,3-propanol-2	$BrCH_2CHOHCH_2Br$	25	2.120	1.5495	I–365
2128	Methyl β-methoxy-cinnamate	$C_6H_5C(OCH_3){:}CH\cdot CO_2CH_3$	24.7	1.118	1.5497	* X–133
2129	Ethyl methoxy-3-coumarilate (m.p. 59°)	$C_6H_4C(OCH_3){:}C\cdot$ $(CO_2C_2H_5)\cdot O$	70	1.160	1.5499	* XVIII–456

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2130	Chlorothiophene (α)	ClC:CHCH:CH·S	20	1.278	1.55	XVII-32
2131	Ethyl phenyl-hydrazine (α, β)	$C_6H_5NHNHC_2H_5$	15	1.004	1.55	XV-120
2132	Phenylacetylene	$C_6H_5C{:}CH$	17.4	0.93	1.5501	V-511
2133	Chloro-3-methyl-1-(β,β-dichloro-ethyl)-4-benzene	$(CH_3)(Cl)C_6H_3CH_2\cdot CHCl_2$	20.3	1.287	1.5501	*V-194
2134	Trimethyl-2′,2′,5-hydroxy-2-styrene	$(CH_3)(OH)C_6H_3CH{:}C(CH_3)_2$	21.5	0.991	1.5501	*VI-293
2135	Ethyl styryl ether	$C_6H_5CH{:}CHOC_2H_5$	21.2	0.971	1.5562	VI-564
2136	Methyl-5-methoxy-3-coumarone	$CH_3C_6H_3C(OCH_3)$: CH·O	24.3	1.107	1.5504	*XVII-64
2137	Acetylene di-bromide (*trans*)	BrCH:CHBr	17.5	2.267	1.5505	I-190
2138	Dimethyl-3,6-coumarone	$CH_3C_6H_3C(CH_3)$: CH·O	20	1.046	1.5505	XVII-62
2139	Methyl β-methyl-cinnamate (m.p. 29°)	$C_6H_5C(CH_3){:}CHCO_2\cdot CH_3$	37.8	1.054	1.5505	IX-614
2140	Trimethyl-2,3,5-coumarone	$CH_3C_6H_3C(CH_3){:}C\cdot$ $(CH_3)\cdot O$	20	1.021	1.5506	.....
2141	Bromotoluene (m)	$BrC_6H_4CH_3$	20	1.410	1.551	V-305
2142	Ethyl-α-aceto-α'-thienone	$CH_3COC{:}CHCH{:}C\cdot$ $(C_2H_5)\cdot S$	20	1.079	1.551	XVII-297
2143	Ethyl Δ^3-dihydro-β-naphthoate	$C_{10}H_9CO_2C_2H_5$	20	1.085	1.551	.....
2144	Dimethyl-2,2-chromene (α)	$C_6H_4(CH)_2C(CH_3)_2\cdot O$	20	1.013	1.5512	XVII-64
2145	Trimethyl-2,4,6-chromene (α)	$CH_3C_6H_3C(CH_3)$: CHCH(CH₃)·O	20	1.012	1.5513	.....
2146	Bromo-p-xylene (2,1,4)	$BrC_6H_3(CH_3)_2$	18.5	1.36	1.5514	V-385
2147	Dimethyl-1′,5-hydroxy-2-styrene	$(CH_3)(HO)C_6H_3\cdot C(CH_3){:}CH_2$	20	1.012	1.5514	VI-577
2148	Benzal chloride	$C_6H_5CHCl_2$	19.4	1.3	1.5515	V-297
2149	Benzylmethyl-nitroamine	$C_6H_5CH_2N(NO_2)\cdot CH_3$	25.7	1.171	1.5515	.....
2150	Methyl-2-keto-1-tetrahydro-1,2,-3,4-naphthalene	$C_6H_4COCH(CH_3)\cdot$ CH_2CH_2	20.9	1.060	1.5515	*VII-197
2151	Butyl styryl ketone (n) (m.p. 40°)	$C_4H_9COCH{:}CHC_6H_5$	44.7	0.960	1.5518	VII-377

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2152	Butyro-*p*-chloro-phenol (*o*) (*iso*)	$(HO)(Cl)C_6H_3CO\cdot CH(CH_3)_2$	20	1.192	1.552	.....
2153	Methylindazole (1)	$C_8H_8N_2$	99.2	1.032	1.5522	.....
2154	Coumaranone (*iso*)	$O\cdot C_6H_4CH_2CO$	20	1.217	1.5523	XVII-309
2155	Dichlorobenzene (*o*)	$C_6H_4Cl_2$	17	1.30	1.5524	V-201
2156	Nitrobenzene	$C_6H_5NO_2$	20	1.21	1.5524	V-233
2157	Methylcoumarone (7)	$CH_3C_6H_3CH:CH\cdot O$	17	1.05	1.5525	XVII-61
2158	Methylcoumarone (3)	$C_6H_4C(CH_3):CH\cdot O$	23.4	1.054	1.5526	XVII-60
2159	Chloro-5-dimethyl-1,3-(β,β-di-chloroethyl)-4-benzene	$(CH_3)_2(Cl)C_6H_2\cdot CH_2CHCl_2$	16.1	1.262	1.5528	.....
2160	Amino ethyl-benzene (*p*)	$H_2NC_6H_4C_2H_5$	22	0.975	1.5529	XII-1090
2161	Butylindazole (1) (*n*)	$C_6H_4CH:N\cdot N\cdot C_4H_9$	20	1.019	1.553	.....
2162	Methoxybenz-aldehyde (*m*)	$CH_3OC_6H_4CHO$	20	1.119	1.5530	VIII-59
2163	Toluidine (*p*) (m.p. 45°)	$CH_3C_6H_4NH_2$	59.1	0.97	1.5532	XII-880
2164	Methoxy-*m*-toluic aldehyde (*o*)	$(CH_3)(CH_3O)C_6H_3\cdot CHO$	20	1.098	1.5534	.....
2165	Dimethyl-2,5-coumarone	$CH_3C_6H_3CH:C\cdot (CH_3)\cdot O$	20	1.031	1.5534	XVII-62
2166	Benzoyl chloride	C_6H_5COCl	20	1.212	1.5537	IX-182
2167	Tetraethyl-*m*-phenylene-diamine	$C_6H_4[N(C_2H_5)_2]_2$	11.8	0.952	1.5537	.....
2168	Methylhydrindone (β)	$C_6H_4CH_2CH(CH_3)\cdot CO$	20	1.066	1.5538	VII-372
2169	Anisaldoxime methyl ether (*o*)	$CH_3OC_6H_4CH:NOCH_3$	20	1.092	1.554	VIII-77
2170	Benzyl-1-methyl-3-pyrazole	$CH:CHC(CH_3):N\cdot N\cdot C_7H_7$	20	1.049	1.554	.....
2171	Dimethyl-2,7-coumarone	$CH_3C_6H_3CH:C\cdot (CH_3)\cdot O$	20	1.036	1.5546	XVII-62
2172	Dihydro-naphthalene (Δ^2)	$C_{10}H_{10}$	32.7	0.993	1.5549	V-519
2173	Dimethyl-2,5-chloro-2-coumaranone	$CH_3C_6H_3COC\cdot (Cl,CH_3)\cdot O$	20	1.217	1.555	.....
2174	Valerylindazole (2) (*iso*) (*stable*)	$C_{12}H_{14}ON_2$	16.3	1.088	1.555	.....

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2175	Hydroxyaceto-phenone (*o*)	$HOC_6H_4COCH_3$	21.3	1.131	1.5550	VIII–85
2176	Metanicotine	$C_{10}H_{14}N_2$	19.7	1.002	1.5551	.....
2177	Chlorobenzal-dehyde (*p*) (m.p. 47°)	ClC_6H_4CHO	61	1.196	1.5553	VII–235
2178	Methylchromanone (6) (m.p. 35°)	$CH_3C_6H_3COCH_2\cdot CH_2\cdot O$	57.1	1.125	1.5553	*XVII–163
2179	Ethyl *o*-methyl-cinnamate	$CH_3C_6H_4CH{:}CH\cdot CO_2C_2H_5$	16.3	1.043	1.5555	*IX–256
2180	Nitrobenzyl chloride (*o*) (m.p. 49°)	$NO_2C_6H_4CH_2Cl$	61.5	.....	1.5557	V–327
2181	Propenyl-*p*-methoxytoluene (*o*)	$(CH_3)(CH_3O)C_6H_3\cdot CH{:}CHCH_3$	12.3	0.986	1.5557	*VI–287
2182	Hydroxydihydro-cinnamyl alcohol (*o*)	$HOC_6H_4CH_2CH_2\cdot CH_2OH$	15	1.126	1.5558	VI–928
2183	Ethyl methyl-6-coumarilate (m.p. 42°)	$CH_3C_6H_3CH{:}C(CO_2\cdot C_2H_5)\cdot O$	43.9	1.119	1.5558	*XVIII–443
2184	Anisidine (*p*) (m.p. 58°)	$CH_3OC_6H_4NH_2$	67	1.061	1.5559	XIII–435
2185	Ethylaniline	$C_6H_5NHC_2H_5$	20	0.963	1.5559	XII–159
2186	Butenylanisole (*α*) (*p*)	$CH_3OC_6H_4CH{:}CH\cdot C_2H_5$	19	0.980	1.5559	VI–575
2187	Propiothienone (*α*)	$C_2H_5COC{:}CHCH{:}CH\cdot S$	20	1.131	1.556	XVII–295
2188	Benzyl-1-methyl-3-chloro-4-pyrazole	$CH{:}C(Cl)\cdot C\cdot (CH_3){:}N\cdot N\cdot C_7H_7$	20	1.156	1.556	.....
2189	Tricresyl phosphate (*o*)	$(CH_3C_6H_4O)_3PO$	20	1.17	1.556	VI–358
2190	Sorbyl chloride	$CH_3(CH{:}CH)_2COCl$	20	1.065	1.5562	II–484
2191	Benzyl-*p*-cymene (2)	$(CH_3)(C_7H_7)C_6H_3\cdot CH(CH_3)_2$	20	0.963	1.5564	V–620
2192	Chlorophenol (*m*) (m.p. 28°)	HOC_6H_4Cl	40	1.2	1.5565	VI–185
2193	Ethyl phenyl-propiolate	$C_6H_5C{:}CCO_2C_2H_5$	13	1.063	1.5566	IX–634
2194	Bromo-*iso*-butyro-phenone (*α*)	$(CH_3)_2CBrCOC_6H_5$	20	1.355	1.5567	VII–316
2195	Methyl-7-keto-1-tetrahydro-1,2,-3,4-naphthalene (m.p. 33°)	$CH_3C_6H_3COCH_2\cdot CH_2CH_2$	35	1.057	1.5567	.....
2196	Sulfur dichloride	SCl_2	14	.....	1.557	.....
2197	Methoxystyrene (*o*)	$CH_3OC_6H_4CH{:}CH_2$	17.4	1.003	1.5570	VI–560

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2198	Bromo-*o*-xylene (4)	$BrC_6H_3(CH_3)_2$ (4,1,2)	18.4	1.37	1.5571	V-365
2199	Hydroxystyrene (*o*) (m.p. 29°)	$HOC_6H_4CH{:}CH_2$	17.4	1.06	1.5572	VI-560
2200	Methyl-5-coumarone	$CH_3C_6H_3CH{:}CH{\cdot}O$	19	1.060	1.5573	XVII-61
2201	Trimethyl-2,4,6-coumaranone	$(CH_3)_2C_6H_2COCH{\cdot}(CH_3){\cdot}O$	19.2	1.099	1.5574	*XVII-68
2202	Methyl allo-cinnamate	$C_6H_5CH{:}CHCO_2CH_3$	20	1.078	1.5575	IX-594
2203	Trimethyl-α-chromene (3,4,6)	$CH_3C_6H_3C(CH_3){:}C(CH_3){\cdot}CH_2{\cdot}O$	20	1.029	1.5575	.....
2204	Dibromo-2,3-propanol-1	$BrCH_2CHBrCH_2OH$	25	2.126	1.5577	I-357
2205	Nitrobenzyl chloride (*m*) (m.p. 45°)	$NO_2C_6H_4CH_2Cl$	61.5	.....	1.5577	V-329
2206	Chlorophenol (*p*) (m.p. 41°)	ClC_6H_4OH	40	1.2	1.5579	VI-186
2207	Ethyl β-benzyl-aminoaceto-acetate	$CH_3C(:NC_7H_7)CH_2{\cdot}CO_2C_2H_5$	2 .6	1.060	1.5579	.....
2208	Xylidine (*sym*)	$(CH_3)_2C_6H_3NH_2$ (1,3,5)	20	0.972	1.558	XII-1131
2209	Amylindazole (2) (*iso*)	$N{:}C_6H_4CH{:}N{\cdot}C_5H_{11}$	20	1.007	1.558	.....
2210	Methyl *p*-methyl-cinnamate (m.p. 57°)	$CH_3C_6H_4CH{:}CH{\cdot}CO_2CH_3$	56.6	1.027	1.5581	*IX-256
2211	Benzotrichloride	$C_6H_5CCl_3$	19.2	1.37	1.5584	V-300
2212	Aminoethylbenzene (*o*)	$NH_2C_6H_4C_2H_5$	22	0.983	1.5584	XII-1089
2213	Iodo-3-propanol-1	$ICH_2CH_2CH_2OH$	20	1.998	1.5585	I-358
2214	Diethyl naphthalate (m.p. 58°)	$C_{10}H_6(CO_2C_2H_5)_2$ (1,8)	70	1.140	1.5586	IX-919
2215	Dimethylaniline	$C_6H_5N(CH_3)_2$	20	0.956	1.5587	XII-141
2216	Methyl-2-methoxy-6-hydrindone	$CH_3OC_6H_3COCH{\cdot}(CH_3)CH_2$	16.9	1.119	1.5588	*VIII-560
2217	Methyl-2-coumarone	$C_6H_4CH{:}C(CH_3){\cdot}O$	20	1.054	1.5589	XVII-60
2218	Methoxy-3-coumarone	$C_6H_4C(OCH_3){:}CH{\cdot}O$	19.3	1.144	1.5589	*XVII-59
2219	Tribromo-1,2,3-pentane	$C_2H_5CHBrCHBr{\cdot}CH_2Br$	20	2.09	1.559	.....
2220	Ethyl Δ^1-dihydro-α-naphthoate (*stable*)	$C_6H_4CH_2CH_2CH{:}C{\cdot}CO_2C_2H_5$	20	1.102	1.559	X-642
2221	Xylidine (*p*)	$NH_2C_6H_3(CH_3)_2$ (2,1,4)	21.3	0.979	1.5591	XII-1135

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2222	Methyl-1-indene	$C_6H_4C(CH_3):CHCH_2$	27	0.968	1.5591	V–520
2223	Ethyl ethoxy-3-coumarilate	$C_6H_4C(OC_2H_5):C\cdot(CO_2C_2H_5)\cdot O$	14.3	1.168	1.5592	* XVIII–457
2224	Anisaldehyde (*o*)	$CH_3OC_6H_4CHO$	20.2	1.133	1.5597	VIII–43
2225	Benzoylacetone *O*-methyl ether	$C_6H_5C(OCH_3):CH\cdot COCH_3$	16	1.068	1.5598	VIII–559
2226	Ethyl cinnamate (*trans*)	$C_6H_5CH:CHCO_2C_2H_5$	20	1.049	1.5598	IX–581
2227	Ethyl-7-keto-1-tetrahydro-1,2,-3,4-naphthalene	$C_2H_5C_6H_3COCH_2\cdot CH_2CH_2$	17.2	1.056	1.5599	.....
2228	Trimethyl bismuthine	$(CH_3)_3Bi$	15	2.3	1.56	IV–622
2229	Hydroxyacetophenone (*p*) (m.p. 109°)	$HOC_6H_4COCH_3$	109	1.109	1.56	VIII–87
2230	Osmium tetroxide	OsO_4	45	.....	1.56	.....
2231	Methyl-α-aceto-α′-thienone (m.p. 25°)	$CH_3COC:CHCH:C\cdot(CH_3)\cdot S$	24.7	1.119	1.560	XVII–296
2232	Benzyl-1-methyl-5-chloro-4-pyrazole	$N:CHC(Cl):C\cdot(CH_3)\cdot N(C_7H_7)$	20	1.178	1.560	.....
2233	Ethyl methoxy-3-naphthoate-2	$CH_3OC_{10}H_6CO_2C_2H_5$ (3,2)	20	1.159	1.560	.....
2234	Methyl phenylpropiolate (m.p. 25°)	$C_6H_5C{:}CCO_2CH_3$	30.5	1.077	1.5601	IX–634
2235	Propenyl phenyl ketone	$CH_3CH:CHCOC_6H_5$	20	1.028	1.5601	VII–368
2236	Ethyl *iso*-chavibetol	$CH_3CH:CHC_6H_3(OC_2H_5)(OCH_3)$	11	1.039	1.5602	VI–958
2237	Diethoxydiphenyl (*o,o′*) (m.p. 36°)	$C_2H_5OC_6H_4\cdot C_6H_4O\cdot C_2H_5$	47.4	1.043	1.5602	VI–989
2238	Bromobenzene	C_6H_5Br	20	1.495	1.5604	V–206
2239	Propenylanisole (*o*)	$CH_3OC_6H_4CH:CH\cdot CH_3$	20	0.993	1.5604	VI–565
2240	Tetrahydronaphthylamine (β) (*ar.*) (m.p. 38°)	$NH_2C_6H_3CH_2CH_2\cdot CH_2CH_2$	22.2	1.029	1.5604	XII–1198
2241	Tetrahydronaphthylamine (β) (*ac.*)	$C_6H_4CH_2CH(NH_2)\cdot CH_2CH_2$	22.2	1.03	1.5604	XII–1200
2242	Bromoanisole (*p*)	$BrC_6H_4OCH_3$	20	1.457	1.5605	VI–199
2243	Valerylacetophenone (ω) (*iso*)	$C_6H_5COCH_2COCH_2\cdot CH(CH_3)_2$	20	1.031	1.5605	VII–690
2244	Xylidine (*m*) (*uns*)	$(CH_3)_2C_6H_3NH_2$ (1,3,4)	19.6	0.978	1.5607	XII–1111

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2245	Eugenyl ethyl ether (*iso*)	$CH_3CH{:}CHC_6H_3(O{\cdot}CH_3)(OC_2H_5)$	11	1.044	1.5607	VI–957
2246	Bromotoluene (*o*)	$BrC_6H_4CH_3$	20(?)	1.422	1.5608	V–304
2247	Hydrindone (α) (m.p. 41°)	$C_6H_4CH_2CH_2CO$	45	1.09	1.5608	VII–360
2248	Ethyl methyl-1-indenecarboxylate-2 (m.p. 38°)	$CH_3C_9H_6CO_2C_2H_5$	39.1	1.074	1.5609	IX–644
2249	Xylidine (*m*) (*vic*)	$(CH_3)_2C_6H_3NH_2$ (1,3,2)	20	0.979	1.561	XII–1107
2250	Propyl-1-indazole (*iso*)	$(CH_3)_2CHN{\cdot}C_6H_4{\cdot}CH{:}N$	20	1.037	1.561	.....
2251	Methyl-3-ethyl-1-indazole	$C_2H_5N{\cdot}C_6H_4C{\cdot}(CH_3){:}N$	20	1.035	1.561	XXIII–142
2252	Anethole (*p*)	$CH_3CH{:}CHC_6H_4{\cdot}OCH_3$	21	0.990	1.5614	VI–566
2253	Ethyl coumarilate (m.p. 31°)	$C_6H_4CH{:}C(CO_2{\cdot}C_2H_5){\cdot}O$	32.2	1.162	1.5619	XVIII–308
2254	Ethyl *p*-methoxycinnamate (m.p. 49°)	$CH_3OC_6H_4CH{:}CH{\cdot}CO_2C_2H_5$	59.2	1.066	1.5619	X–299
2255	Bromo-*n*-butyrophenone (α)	$C_2H_5CHBrCOC_6H_5$	20	1.364	1.562	VII–314
2256	Butyl-2-indazole (*n*)	$C_2H_5CH_2CH_2N{:}CH{\cdot}C_6H_4{:}N$	20	1.025	1.562	.....
2257	Butyryl-2-indazole (*iso*) (*stable*)	$(CH_3)_2CHCON{:}CH{\cdot}C_6H_4{:}N$	20	1.112	1.562	.....
2258	Nitroanisole (*o*)	$CH_3OC_6H_4NO_2$	20	1.254	1.5620	VI–217
2259	Methoxystyrene (β)	$C_6H_5CH{:}CHOCH_3$	24.3	1.0	1.5620	VI–564
2260	Chlorostyrene (α)	$C_6H_5CCl{:}CH_2$	16.6	1.10	1.5623	V–476
2261	Dimethoxy-4,6-chromene (α)	$CH_3C_6H_3C(CH_3){:}CHCH_2{\cdot}O$	20	1.042	1.5623	*XVII–29
2262	Propylpropenyl-*o*-phenyleneamidine	$C_3H_7N{\cdot}C_6H_4{\cdot}N{:}C{\cdot}C_2H_5$	20.8	1.034	1.5626	.....
2263	Dihydroamylanthracene (*iso*) (*meso*)	$C_{19}H_{22}$	44.4	0.994	1.5626	.....
2264	Benzyl-1-cyclohexene-1-one-6	$C_6H_5CH_2C{:}CH{\cdot}(CH_2)_3CO$	21.7	1.061	1.5628	*VII–208

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2265	Ethyl methyl-5-methoxy-3-coumarilate (m.p. 29°)	$CH_3C_6H_3C(OCH_3):C(CO_2C_2H_5)\cdot O$	23.8	1.170	1.5628	* XVIII–460
2266	Keto-1-octahydrophenanthrene (m.p. 81°)	$C_{14}H_{16}O$	100	1.064	1.5628	.....
2267	Indoxazene	$C_6H_4CH:N\cdot O$	20	1.170	1.563	XXVII–39
2268	Propyl-1-indazole	$C_2H_5CH_2N\cdot C_6H_4\cdot CH:N$	20	1.039	1.563	.....
2269	Benzyl-$\Delta^{\alpha,\beta}$-crotonolactone (γ)	$C_6H_5CH_2CHCH:CHCO\cdot O$	20	1.149	1.563	XVII–340
2270	Ethyl *p*-methylcinnamate	$CH_3C_6H_4CH:CH\cdot CO_2C_2H_5$	15.9	1.034	1.5630	I X–617
2271	Methyl-2-coumaranone	$C_6H_4COCH(CH_3)\cdot O$	19.7	1.153	1.5632	XVII–122
2272	Phenyl-1-hydroxy-3-pentine-1	$C_6H_5C{\vdots}CCHOHCH_2\cdot CH_3$	13	1.014	1.5633	VI–589
2273	Methyl-2-methoxy-7-coumarone	$CH_3OC_6H_3\cdot CH:C(CH_3)\cdot O$	20	1.119	1.5636	.....
2274	Fluoro-2-tribromo-1,1,2-ethane	$FBrCHCHBr_2$	18	2.674	1.5638	I–93
2275	Methyl α,p-dimethylcinnamate	$CH_3C_6H_4CH:C(CH_3)CO_2CH_3$	18.3	1.051	1.5640	* I X–261
2276	Triazobenzene	$C_6H_5N_3$	22.5	1.086	1.5642	V–276
2277	Methoxystyrene (*p*)	$CH_3OC_6H_4CH:CH_2$	20(?)	1.0	1.5642	VI–561
2278	Methyl α,m-dimethyl-*o*-methoxycinnamate	$(CH_3)(CH_3O)C_6H_3\cdot CH:C(CH_3)CO_2\cdot CH_3$	14.6	1.099	1.5642	* X–141
2279	Coumarone	$C_6H_4CH:CH\cdot O$	22.7	1.09	1.5645	XVII–54
2280	Ethyl anthranilate (*o*)	$NH_2C_6H_4CO_2C_2H_5$	20	1.117	1.5646	XIV–319
2281	Nitrobenzyl chloride (*p*) (m.p. 71°)	$NO_2C_6H_4CH_2Cl$	61.5	.....	1.5647	V–329
2282	Butyryl-2-indazole (*n*) (*stable*)	$C_2H_5CH_2CON:CH\cdot C_6H_4:N$	20	1.120	1.565	.....
2283	Chlorobenzaldehyde (*m*)	ClC_6H_4CHO	20	1.241	1.5650	VII–234

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2284	Dimethyl-5,7-keto-1-tetrahydro-1,2,3,4-naphthalene (m.p. 49°)	$(CH_3)_2C_6H_2CH_2\cdot CH_2CH_2CO$	15.5	1.065	1.5650	.....
2285	Methyl-5-coumaranone (m.p. 54°)	$CH_3C_6H_3COCH_2\cdot O$	53.8	1.151	1.5652	XVII-123
2286	Phenyloxazoline (μ)	$N{:}C(C_6H_5)\cdot O\cdot CH_2\cdot CH_2$	23.4	1.122	1.5655	XXVII-47
2287	Phenyl-1-p-tolyl-1-ethane	$CH_3C_6H_4CH(C_6H_5)\cdot CH_3$	17.2	0.985	1.5659	V-614
2288	Ethyl ethyl-1-indazole-carboxylate-3	$C_2H_5N\cdot C_6H_4\cdot C(CO_2\cdot C_2H_5){:}N$	17.3	1.143	1.566	.....
2289	Acetothienone (α)	$CH_3COC{:}CHCH{:}CH\cdot S$	21.8	1.168	1.5663	XVII-287
2290	Octahydro-phenanthrene	$C_{14}H_{18}$	20	1.025	1.5668	V-527
2291	Propyl styryl ketone (*iso*)	$(CH_3)_2CHCOCH{:}CHC_6H_5$	24.6	0.986	1.5669	VII-376
2292	Tribromo-1,2,3-butane	$CH_3CHBrCHBr\cdot CH_2Br$	20	2.19	1.567	I-121
2293	Chlorobenzaldehyde (o)	ClC_6H_4CHO	20	1.252	1.567	VII-233
2294	Dimethyl-2,5-hydroxy-7-hydrindone	$(CH_3)(HO)C_6H_2\cdot CH_2CH(CH_3)CO$	20	1.123	1.567	.....
2295	Trichlorbenzene (1,2,4)	$C_6H_3Cl_3$	20	1.45	1.5671	V-204
2296	Tetrahydro-1,2,3,4-naphthol (α)	$C_6H_4CH_2CH_2\cdot CH_2CHOH$	17	1.09	1.5671	.....
2297	Phenyl-2-menthatriene (p)	$C_{16}H_{18}$	20(?)	0.971	1.5674	V-619
2298	Dichloro-3,5-methyl-1-(β,β-dichloroethyl)-4-benzene	$(CH_3)Cl_2C_6H_2CH_2\cdot CHCl_2$	19.2	1.397	1.5678	*V-194
2299	Benzoylacetone (m.p. 61°)	$C_6H_5COCH_2COCH_3$	77.8	1.08	1.5678	VII-680
2300	Methyl-5-ethyl-1-indazole	$CH_3C_6H_3CH{:}N\cdot N\cdot C_2H_5$	20	1.043	1.568	.....
2301	Ethyl o-chlorocinnamate	$ClC_6H_4CH{:}CHCO_2\cdot C_2H_5$	20	1.171	1.568	.....
2302	Phenyl-1-tetrahydroindazole	$C_6H_8\cdot CH{:}N\cdot NC_6H_5$	99.9	1.061	1.568	.....
2303	Diethyl cadmium	$(C_2H_5)_2Cd$	18.1	1.65	1.5680	IV-677

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2304	Propyl styryl ketone	$C_2H_5CH_2COCH{:}CH{\cdot}C_6H_5$	24	0.992	1.5680	VII–376
2305	Phenylcymene (2)	$(CH_3)(C_6H_5)C_6H_3{\cdot}CH(CH_3)_2$	15	0.978	1.5680	V–619
2306	Chloro-5-dimethyl-1,3-dichloromethyl-1-methene-4-cyclohexadiene-2,5	$(CH_3)_2C_6H_2(:CH_2){\cdot}CHCl_2$	17.3	1.269	1.5681	*V–206
2307	Ethyl styryl ketone (m.p. 38°)	$C_2H_5COCH{:}CHC_6H_5$	50.3	0.987	1.5684	VII–373
2308	Benzyl benzoate	$C_6H_5CO_2CH_2C_6H_5$	21.5	1.12	1.5685	IX–121
2309	Dihydromethyl-indole (2?)	$C_9H_{11}N$	23.4	1.020	1.5687	.....
2310	Ethyl indazole-2-carboxylate	$N{\cdot}C_6H_4{\cdot}CH{\cdot}N{\cdot}CO_2{\cdot}C_2H_5$	13.2	1.206	1.569	.....
2311	Methyl-benzal-acetone (α,α)	$C_6H_5CH{:}C(CH_3){\cdot}COCH_3$	45.3	1.002	1.5691	VII–373
2312	Ethyl methyl-1-dichloromethyl-1-cyclohexadiene-2,5-methene-4-carboxylate	$(CH_3)(CHCl_2)C_6H_4{:}CHCO_2C_2H_5$	22.1	1.215	1.5691	*IX–214
2313	Phthalyl dichloride (*o*) (*sym*)	$C_6H_4(COCl)_2$	20	1.41	1.5692	IX–805
2314	Methyl *iso*-eugenyl ether	$CH_3CH{:}CH{\cdot}C_6H_3(OCH_3)_2$ (1,3,4)	19.1	1.052	1.57	VI–956
2315	Xylidine (*o*) (*vic*)	$(CH_3)_2C_6H_3NH_2$ (1,2,3)	20	0.99	1.570	XII–1101
2316	Phthalyl dichloride (*m*) (m.p. 41°)	$C_6H_4(COCl)_2$	46.9	.....	1.5700	IX–834
2317	Ethyl α-methyl-*p*-methoxy-cinnamate	$CH_3OC_6H_4CH{:}C{\cdot}(CH_3)CO_2C_2H_5$	15.6	1.089	1.5701	*X–138
2318	Methylaniline	$C_6H_5NHCH_3$	21.5	0.986	1.5702	XII–135
2319	Apiol (*iso*) (m.p. 56°)	$C_{12}H_{14}O_4$	12	1.197	1.5703	XIX–85
2320	Nitroanisole (*p*) (m.p. 54°)	$CH_3OC_6H_4NO_2$	60	1.219	1.5707	VI–230
2321	Octracenone	$C_6H_8{\cdot}CH{:}C_6H_6O{:}CH$	62.4	1.076	1.5707	.....
2322	Ethyl phenyl-hydrazine (α,α)	$C_6H_5N(C_2H_5)NH_2$	20.8	1.018	1.571	XV–119
2323	Phenyl-1-trimethyl-3,4,5-pyrazole	$CH_3C{:}C(CH_3){\cdot}C{\cdot}(CH_3){:}N{\cdot}NC_6H_5$	20	1.044	1.571	XXIII–82
2324	Allylacetylindazole (2) (*stable*)	$C_{12}H_{12}ON_2$	22.6	1.117	1.571	.....

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2325	Ethyl ethyl-2-indazole-carboxylate-3	$N{\cdot}C_6H_4{\cdot}C(CO_2{\cdot}C_2H_5){\cdot}NC_2H_5$	22.8	1.129	1.571	.....
2326	Benzyltoluene (p)	$C_6H_5CH_2C_6H_4CH_3$	19.3	0.99	1.5710	V–607
2327	Toluidine (m)	$CH_3C_6H_4NH_2$	22.4	0.99	1.5711	XII–853
2328	Keto-1-tetrahydro-1,2,3,4-naphthalene	$C_6H_4COCH_2CH_2CH_2$	15.5	1.099	1.5712	VII–370
2329	Butyrylaceto-phenone (ω)	$C_6H_5COCH_2COCH_2{\cdot}C_2H_5$	20	1.049	1.5712	VII–689
2330	Bromo-*iso*-butyro-p-cresol (o) (α)	$(CH_3)(OH)C_6H_3{\cdot}COCBr(CH_3)_2$	22.3	1.367	1.5714	*VIII–556
2331	Bromopropio-phenone (α)	$C_6H_5COCHBrCH_3$	19.6	1.430	1.5718	VII–302
2332	Phenyl-1-cyclohexene-1	$C_6H_5C{:}CH{\cdot}(CH_2)_3CH_2$	20	0.993	1.5718	V–523
2333	Asaron (1,2,4,5)	$CH_3CH{:}CHC_6H_2(O{\cdot}CH_3)_3$	11	1.091	1.5719	VI–1129
2334	Methyl phenyl-hydrazine (β)	$C_6H_5NHNHCH_3$	23.1	1.03	1.572	XV–118
2335	Ethyl Δ^1-α-methyl-β-naphthoate	$C_6H_4CH_2CH_2C(CO_2{\cdot}C_2H_5){:}CCH_3$	20	1.087	1.572	.....
2336	Methyl α-methyl-o-methoxy-cinnamate	$CH_3OC_6H_4CH{:}C(CH_3)CO_2CH_3$	15.2	1.126	1.5721	X–311
2337	Bromoanisole (o)	$BrC_6H_4OCH_3$	20	1.502	1.5725	VI–197
2338	Methyl-2-bromo-5-coumaran	$BrC_6H_3CH_2CH{\cdot}(CH_3){\cdot}O$	14.4	1.458	1.5727	*XVII–23
2339	Methyl-2-tetra-hydroquinoline	$C_{10}H_{13}N$	20	1.02	1.5727	XX–283
2340	Toluidine (o)	$CH_3C_6H_4NH_2$	20	0.999	1.5728	XII–772
2341	Butyro-*uns*-m-xylenol (o) (*iso*)	$(CH_3)_2C_6H_2(OH){\cdot}COCH(CH_3)_2$	20	1.028	1.573	.....
2342	Benzyl-1-tetra-hydroindazole	$C_6H_8{\cdot}CH{:}N{\cdot}NC_7H_7$	20	1.089	1.573	.....
2343	Phenyl-1-hydroxy-3-butine-1	$C_6H_5C{:}CCHOHCH_3$	12.6	1.036	1.5731	VI–588
2344	Methyl-α-hydroxy-3-styrene	$HOC_6H_4C(CH_3){:}CH_2$	13.0	1.048	1.5734	*VI–284
2345	Salicylaldehyde (o)	HOC_6H_4CHO	19.7	1.166	1.5736	VIII–31
2346	Phenyl-1-dimethyl-2,4-pyrazole	$C_6H_5N{\cdot}N{:}C(CH_3){\cdot}CH{:}CCH_3$	19.3	1.057	1.5738	XXIII–75
2347	Indene	$C_6H_4CH_2CH{:}CH$	16.1	1.01	1.5739	V–515
2348	Isoeugenol (1,3,4)	$C_6H_3(C_3H_5)(O{\cdot}CH_3)OH$	19	1.08	1.5739	VI–955

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2349	Phenyl-1-dimethyl-3,5-pyrazole	$CH_3C{:}CHC(CH_3){:}N{\cdot}NC_6H_5$	20	1.055	1.574	XXIII–75
2350	Tetraethyldiamino-naphthalene (1,5) (m.p. 41°)	$C_{10}H_6[N(C_2H_5)_2]_2$	26.8	0.989	1.5742	.....
2351	Dibromobenzene (*p*) (m.p. 88°)	$C_6H_4Br_2$	99.3	1.9	1.5743	V–211
2352	Dibenzylamine	$(C_6H_5CH_2)_2NH$	21.6	1.026	1.5743	XII–1035
2353	Ethyl-1-indazole	$C_2H_5N{\cdot}C_6H_4CH{:}N$	15.7	1.07	1.5747	.....
2354	Nicoteine (*iso*)	$C_{10}H_{12}N_2$	20	1.098	1.5749	.....
2355	Dimethyl-1,3-phenyl-5-cyclo-hexadiene-3,5	$(CH_3)_2C_6H_5C_6H_5$	17	0.972	1.5749	V–572
2356	Phenyl-1-dimethyl-4,5-pyrazole	$CH_3C{:}C(CH_3){\cdot}CH{:}N{\cdot}NC_6H_5$	20	1.065	1.575	.....
2357	Anisidine (*o*)	$CH_3OC_6H_4NH_2$	20	1.093	1.5754	XIII–358
2358	Cinnamyl alcohol (m.p. 33°)	$C_6H_5CH{:}CHCH_2OH$	36.1	1.04	1.5754	VI–570
2359	Safrol (*iso*) (*trans*)	$CH_3CH{:}CHC_6H_3{:}O_2{:}CH_2$	19.3	1.12	1.5759	XIX–35
2360	Allyl-1-methyl-5-indazole	$CH_3C_6H_3CH{:}N{\cdot}N{\cdot}C_3H_5$	20	1.047	1.576	.....
2361	Dibenzylmethane	$(C_6H_5CH_2)_2CH_2$	20	1.007	1.5760	V–613
2362	Diphenylethane (*uns*)	$(C_6H_5)_2CHCH_3$	20	1.004	1.5761	V–605
2363	Nitro-*p*-cresol (2) (m.p. 37°)	$(CH_3)(HO)C_6H_3NO_2$ (1,4,2)	38.6	1.240	1.5763	VI–412
2364	Anisaldehyde (*p*)	$CH_3OC_6H_4CHO$	12.7	1.13	1.5764	VIII–67
2365	Methyl cinnamate (m.p. 33°)	$C_6H_5CH{:}CHCO_2CH_3$	21.4	1.05	1.5766	IX–581
2366	Benzoic anhydride (m.p. 42°)	$(C_6H_5CO)_2O$	15	1.199	1.5767	IX–164
2367	Nitrosomethyl-aniline (*N*)	$C_6H_5N(CH_3)NO$	20	1.124	1.5769	XII–579
2368	Chlorobromo-benzene (*m*)	ClC_6H_4Br	20	1.630	1.577	V–209
2369	Chlorostyrene (ω)	$C_6H_5CH{:}CHCl$	17.8	1.11	1.5774	V–476
2370	Propenyl-*p*-cresol (*o*)	$(CH_3)(HO)C_6H_3CH{:}CHCH_3$	9	1.029	1.5777	*VI–287
2371	Ethyl Δ^1-dihydro-β-naphthoate	$C_6H_4CH_2CH_2C(CO_2{\cdot}C_2H_5){:}CH$	20	1.093	1.578	.....
2372	Phenyl-2-tetra-hydroindazole	$C_6H_5N{\cdot}N{:}C_6H_8{:}CH$	99.6	1.054	1.578	.....
2373	Methylanthranil	$C_6H_4{\cdot}N{\cdot}O{\cdot}CCH_3$	20	1.133	1.5780	XXVII–45
2374	Diphenylmethane (m.p. 27°)	$(C_6H_5)_2CH_2$	16.8	1.01	1.5788	V–588

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No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2375	Diethyl-2,3-indazole	$C_2H_5N{\cdot}N{:}C_6H_4{:}C{\cdot}C_2H_5$	20	1.039	1.579	.....
2376	Benzyl-2-tetrahydroindazole	$C_7H_7N{\cdot}N{:}C_6H_8{:}CH$	20	1.086	1.579	.....
2377	Propyl-3-hydroxy-2-diphenyl	$(C_3H_7)(OH)C_6H_3{\cdot}C_6H_5$	20	1.047	1.579	.....
2378	Phenyl-α-methyl-β-styrene (m.p. 52°)	$(C_6H_5)_2C{:}CHCH_3$	63.5	0.981	1.5791	V-644
2379	Tetrahydro-1,2,3,4-isoquinoline	$C_9H_{11}N$	23.1	1.07	1.5798	XX-275
2380	Propyl-2-indazole (*iso*)	$(CH_3)_2CHN{\cdot}N{:}C_6H_4{:}CH$	20	1.051	1.580	.....
2381	Phenyl-1-methyl-3-chloro-5-pyrazole	$ClC{:}CH{\cdot}C(CH_3){:}N{\cdot}NC_6H_5$	20	1.193	1.580	XXIII-54
2382	Dichloro-1,2-dibromo-1,2-ethylene	$BrClC{:}CClBr$	16	2.4	1.5800	.....
2383	Dichloro-3,5-methyl-1-dichloromethyl-1-methene-4-cyclohexadiene-2,5	$(CH_3)(Cl)_2(CHCl_2){\cdot}C_6H_2{:}CH_2$	16.7	1.408	1.5801	*V-194
2384	Ethyl ethenyl-*o*-phenylene-amidine	$C_6H_4{\cdot}N{:}C(CH_3){\cdot}N{\cdot}C_2H_5$	19.8	1.073	1.5802	XXIII-145
2385	Kairoline	$C_9H_{10}N{\cdot}CH_3$	23.1	1.019	1.5802	X X-264
2386	Methyl-5-ethyl-2-indazole	$C_2H_5N{\cdot}N{:}C_6H_3{\cdot}(CH_3){:}CH$	20	1.050	1.581	.....
2387	Iodopseudocumene (m.p. 37°)	$(CH_3)_3C_6H_2I$ (1,2,4,5)	65.3	1.511	1.5813	V-404
2388	Chlorobromo-benzene (*o*)	ClC_6H_4Br	20	1.644	1.5814	V-209
2389	Allyl-1-indazole	$C_3H_5N{\cdot}C_6H_4{\cdot}CH{:}N$	20	1.067	1.582	.....
2390	Phenyl-1-methyl-5-pyrazole	$CH_3C{:}CH{\cdot}CH{:}N{\cdot}N{\cdot}C_6H_5$	20	1.086	1.582	XXIII-52
2391	Naphthalene (m.p. 80°)	$C_{10}H_8$	98.4	.....	1.5823	V-531
2392	Methyl phenyl-hydrazine (α)	$C_6H_5N(CH_3)NH_2$	21.6	1.038	1.5824	XV-117
2393	Phenyl ether	$(C_6H_5)_2O$	24	1.07	1.5826	VI-146
2394	Butylenephenyl-acetylene (*iso*)	$(CH_3)_2C{:}CHC{:}CC_6H_5$	13	0.930	1.5828	V-568
2395	Nitrobromoform	Br_3CNO_2	12.5	2.811	1.5831	I-77

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2396	Dihydronaphthalene (Δ^1)	$C_{10}H_{10}$	18.3	0.998	1.5832	V–519
2397	Banzalacetone (m.p. 41°)	$C_6H_5CH{:}CHCOCH_3$	45.9	.....	1.5836	VII–364
2398	Propenylphenol (*o*) (m.p. 38°)	$CH_3CH{:}CHC_6H_4OH$	14.3	1.044	1.5837	*VI–279
2399	Phenyl-1-methyl-5-chloro-3-pyrazole	$CH_3C{:}CH{\cdot}C(Cl){:}$ $N{\cdot}NC_6H_5$	20	1.205	1.584	XXIII–55
2400	Methyl aminobenzoate (*o*)	$NH_2C_6H_4CO_2CH_3$	20	1.16	1.5844	XIV–317
2401	Propionylacetophenone (ω)	$C_6H_5COCH_2COC_2H_5$	20	1.078	1.5844	VII–687
2402	Methyl-5-methoxy-2-benzoylacetone	$(CH_3)(CH_3O)C_6H_3{\cdot}$ $COCH_2COCH_3$	20	1.118	1.5847	.....
2403	Dimethyl cadmium	$(CH_3)_2Cd$	17.9	1.984	1.5849	IV–677
2404	Phenylpropiolic nitrile (m.p. 41°)	$C_6H_5C{:}CCN$	41.5	1.005	1.5854	IX–636
2405	Methyl *o*-methoxycinnamate	$CH_3OC_6H_4CH{:}CH{\cdot}$ CO_2CH_3	16.7	1.137	1.5854	X–291
2406	Methyl-6-phenyl-1-heptadiene-1,3	$C_6H_5(CH{:}CH)_2CH_2{\cdot}$ $CH(CH_3)_2$	20	0.951	1.5855	V–525
2407	Methyl-*o*-coumarketone methyl ether (m.p. 48°)	$CH_3OC_6H_4CH{:}CH{\cdot}$ $COCH_3$	61.4	1.053	1.5859	*VIII–559
2408	Anthranil	$O{-}N{:}C_6H_4{:}CH$	20	1.18	1.586	XXVII–39
2409	*o*-Methylbenzylthiophene (α)	$S{\cdot}CH{:}CH{\cdot}CH{:}C{\cdot}$ $CH_2C_6H_4CH_3$	20	1.083	1.586	.....
2410	Thiophenol	C_6H_5SH	23.2	1.074	1.5861	VI–294
2411	Aniline	$C_6H_5NH_2$	20	1.022	1.5863	XII–59
2412	Methyl-3-ethyl-2-indazole	$C_2H_5N{\cdot}N{:}C_6H_4{:}C{\cdot}$ CH_3	20	1.058	1.587	XXIII–142
2413	Acetyl-2-methyl-6-indazole (*stable*)	$CH_3CON{\cdot}N{:}C_6H_3{\cdot}$ $(CH_3){:}CH$	5	1.162	1.587	.....
2414	Crotonylanisole (*p*)	$CH_3CH{:}CHCO{\cdot}$ $C_6H_4OCH_3$	11.7	1.091	1.587	.....
2415	Phenyl-1-dimethyl-3,4-pyrazole	$CH{:}C(CH_3){\cdot}$ $C(CH_3){:}N{\cdot}NC_6H_5$	20	1.061	1.587	XXIII–72
2416	Phenylnitromethane methyl ether (*aci*)	$C_6H_5CH{:}N(OCH_3){:}O$	15	1.124	1.5871	.....
2417	Methyl-5-phenyl-1-hexadiene-1,3	$C_6H_5(CH{:}CH)_2{\cdot}$ $CH(CH_3)_2$	20	0.925	1.5873	V–524
2418	Formanilide (m.p. 47°)	$C_6H_5NHCH{:}O$	25	1.14	1.5876	XII–230
2419	Bromostyrene (α)	$C_6H_5CBr{:}CH_2$	20	1.406	1.588	V–477

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2420	Acetyl-2-indazole (stable)	$CH_3CON{\cdot}N{:}$ $C_6H_4{:}CH$	20	1.186	1.588	*XXIII–33
2421	Ethyl 1-methoxy-2-naphthoate	$CH_3OC_{10}H_6CO_2C_2H_5$	20	1.146	1.588	.....
2422	Ethyl-1-diphenyl-1,4-butene-3	$C_2H_5CH(C_6H_5)CH_2{\cdot}CH{:}CHC_6H_5$	20	0.992	1.5880	*V–317
2423	Diphenyl (m.p. 69°)	$C_6H_5{\cdot}C_6H_5$	77.1	0.99	1.5882	V–576
2424	Ethyl α-benzyl-cinnamate (m.p. 38°)	$C_6H_5CH{:}C(CH_2{\cdot}C_6H_5)CO_2C_2H_5$	16.1	1.08	1.5885	*IX–299
2425	Phenylcyclohexane	$C_6H_5CH(CH_2)_4CH_2$	16	0.955	1.589	V–503
2426	Tribromo-1,1,2-ethane	$BrCH_2CHBr_2$	20	2.579	1.5890	I–93
2427	Diiodo-1,6-hexane	$ICH_2(CH_2)_4CH_2I$	15	2.1	1.5890	I–147
2428	Chloroaniline (*o*)	$ClC_6H_4NH_2$	20	1.213	1.5895	XII–597
2429	Tetrahydro-naphthylamine (α) (*ar*)	$NH_2C_6H_3CH_2{\cdot}(CH_2)_2CH_2$	23.1	1.054	1.5896	XII–1197
2430	Bromothiophene (α)	$BrC{:}CH{\cdot}CH{:}CH{\cdot}S$	20	1.684	1.59	XVII–33
2431	Triphenylmethane (m.p. 94°)	$(C_6H_5)_3CH$	99	1.014	1.59	V–698
2432	Allyl-2-methyl-5-indazole	$C_3H_5N{\cdot}N{:}C_6H_3{\cdot}(CH_3){:}CH$	20	1.050	1.590	.....
2433	Benzaldoxime (*anti*) (m.p. 35°)	$C_6H_5CH{:}NOH$	20	1.111	1.5908	VII–218
2434	Ethyl-2-indazole	$C_2H_5N{\cdot}N{:}C_6H_4{:}CH$	20	1.073	1.591	XXIII–124
2435	Methyl *o*-benzoyl-benzoate (m.p. 52°)	$C_6H_5COC_6H_4CO_2{\cdot}CH_3$	19.7	1.190	1.5913	X–748
2436	Methyl-2-bromo-5-coumarone (m.p. 20°)	$BrC_6H_3{\cdot}CH{:}C(CH_3){\cdot}O$	34.8	1.477	1.5915	.....
2437	Phenyl-1-hydroxy-3-trichloro-4,4,4-butine-1	$C_6H_5C{:}CCHOHCCl_3$	9.5	1.354	1.5917	VI–588
2438	Ethyl thionaphthene-2-carboxylate (m.p. 37°)	$C_{11}H_{10}O_2S$	55.4	1.172	1.592	.....
2439	Diphenyl-acetaldehyde	$(C_6H_5)_2CHCHO$	20	1.100	1.5921	VII–438
2440	Methyl-1-diethyl-2,4-naphthalene	$(CH_3)(C_2H_5)_2C_{10}H_5$	13.3	0.987	1.5923	.....
2441	Chloroaniline (*m*)	$ClC_6H_4NH_2$	20	1.216	1.5931	XII–602
2442	Tetrahydro-1,2,3,4-quinoline	$C_6H_4CH_2CH_2CH_2NH$	23.9	1.05	1.5933	XX–262

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2443	Diethylamino-naphthalene (α)	$C_{10}H_7N(C_2H_5)_2$	18.1	1.007	1.5933	XII–1223
2444	Ethyl naphthoate (α)	$C_{10}H_7CO_2C_2H_5$	20	1.122	1.594	IX–648
2445	Ethyl α-methyl-β-naphthoate	$CH_3C_{10}H_6CO_2C_2H_5$	20	1.113	1.5950	.....
2446	Ethyl naphthoate (β) (m.p. 26°)	$C_{10}H_7CO_2C_2H_5$	22.7	1.114	1.5951	IX–657
2447	Tetraethyldiamino-naphthalene (1,8) (m.p. 31°)	$C_{10}H_6[N(C_2H_5)_2]_2$	18	1.012	1.5951	.....
2448	Iodo-*m*-xylene (*sym*)	$(CH_3)_2C_6H_3I$	20	1.607	1.596	V–376
2449	Phenyl-1-pyrazole	$CH{:}CH{\cdot}CH{:}N{\cdot}N{\cdot}C_6H_5$	20	1.111	1.596	XXIII–40
2450	Benzhydrylamine	$(C_6H_5)_2CHNH_2$	21.5	1.064	1.5963	XII–1323
2451	Diethylnaphtha-lene (1,4)	$C_{10}H_6(C_2H_5)_2$	13.1	0.998	1.5970	.....
2452	Fluoro-2-tetrabromo-1,1,1,2-ethane	$Br_3CCHBrF$	16	1.939	1.5971	I–95
2453	Ethyl α-phenylcinnamate (m.p. 28°)	$C_6H_5CH{:}C(C_6H_5){\cdot}CO_2C_2H_5$	18.6	1.097	1.5972	*IX–294
2454	Ethyl naphthyl ether (β) (m.p. 37°)	$C_2H_5OC_{10}H_7$	35.6	1.05	1.5975	VI–641
2455	Benzophenone (m.p. 48.5°)	$(C_6H_5)_2CO$	45.2	1.089	1.5975	VII–410
2456	Bromonitro-benzene (*m*)	$BrC_6H_4NO_2$	20.1	1.704	1.5979	V–248
2457	Iodo-*p*-xylene	$(CH_3)_2C_6H_3I$	20	1.613	1.598	V–386
2458	Allyl-2-indazole	$C_3H_5N{:}N{:}C_6H_4{:}CH$	20	1.074	1.598	.....
2459	Bromoform	$HCBr_3$	19	2.892	1.5980	I–68
2460	Dichloro-1,2-tribromo-1,1,2-ethane	$Br_2CCl{\cdot}CHBrCl$	15.5	2.63	1.5989	I–94
2461	Phenyl-1-hexadiene-1,3	$C_6H_5{\cdot}(CH{:}CH)_2{\cdot}C_2H_5$	20	0.919	1.5989	V–522
2462	Iodo-*m*-xylene (*uns*)	$(CH_3)_2C_6H_3I$ (1,3,4)	20	1.623	1.599	V–376
2463	Bromostyrene (ω)*	$C_6H_5CH{:}CHBr$	22.5	1.425	1.5990	V–477
2464	Tribromoethylene	$BrCH{:}CBr_2$	20	2.708	1.5992	I–191
2465	Ethyl naphthyl ether (α)	$C_2H_5OC_{10}H_7$	20(?)	1.061	1.5992	VI–606
2466	Tribromo-1,2,3-propane	$BrCH_2CHBrCH_2Br$	23	2.436	1.6	I–112
2467	Allylthiourea (m.p. 78°)	$CH_2{:}CHCH_2NH{\cdot}CSNH_2$	78.1	1.2	1.60	IV–211
2468	Phenyl-1-pentadiene-1,3	$C_6H_5{\cdot}(CH{:}CH)_2{\cdot}CH_3$	15.2	0.933	1.6000	V–521
2469	Ethyl γ-methyl-cinnamylidene-acetate	$C_6H_5CH{:}C(CH_3){\cdot}CH{:}CHCO_2C_2H_5$	20	1.037	1.601	.....

*Isomer 2.

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2470	Allyl-3-hydroxy-2-diphenyl	$C_6H_5C_6H_3(OH)\cdot(CH_2CH{:}CH_2)$	20	1.072	1.601	.....
2471	Antimony pentachloride	$SbCl_5$	14	.....	1.601	.....
2472	Methyl methenyl-*o*-phenylene-amidine	$C_6H_4\cdot N(CH_3)\cdot CH{:}N$	17.1	1.128	1.6013	XXIII-132
2473	Methyl-1-ethyl-2-naphthalene	$CH_3C_{10}H_6C_2H_5$	15.4	1.001	1.6014	.....
2474	Ethyl β-methyl-cinnamylidene-acetate	$C_6H_5CH{:}CH\cdot C\cdot(CH_3){:}CHCO_2\cdot C_2H_5$	20	1.043	1.602	.....
2475	Methylnaphthalene (β) (m.p. 37°)	$C_{10}H_7CH_3$	39.9	0.994	1.6026	V-567
2476	Chloro-1-tribromo-1,2,2-ethane	$ClBrCHCHBr_2$	20	2.65	1.603	.....
2477	Acetylethylamino-naphthalene (β)	$C_{10}H_7N(C_2H_5)CO\cdot CH_3$	23.1	1.089	1.6031	XII-1285
2478	Iodo-*o*-xylene (*uns*)	$(CH_3)_2C_6H_3I$ (1,2,4)	20	1.631	1.604	V-367
2479	Diiodo-1,5-pentane	$ICH_2(CH_2)_3CH_2I$	15	2.20	1.6046	I-133
2480	Acenaphthene (m.p. 95°)	$C_{12}H_{10}$	98.8	1.024	1.6048	V-586
2481	Ethoxy-3-thionaphthene	$C_6H_4C(OC_2H_5){:}CH\cdot S$	17.9	1.159	1.6050	*XVII-61
2482	Phosphenyl chloride	$C_6H_5PCl_2$	7	1.32	1.6053	XVI-763
2483	Methyl-1-ethyl-4-naphthalene	$CH_3C_{10}H_6C_2H_5$	13.1	1.009	1.6057	.....
2484	Methyl 6-methyl-1-naphthoate	$CH_3C_{10}H_6CO_2CH_3$	20	1.135	1.606	*IX-279
2485	Benzophenone (labile) (m.p. 26.5°)	$(C_6H_5)_2CO$	23.4	1.108	1.6060*	VII-410
2486	Dimethylnaphthalene (1,6)	$(CH_3)_2C_{10}H_6$	20	1.002	1.607	*V-268
2487	Iodo-*o*-xylene (*vic*)	$(CH_3)_2C_6H_3I$ (1,2,3)	20	1.639	1.6072	V-367
2488	Tetrabromo-1,1,-4,4-butane	$Br_2CHCH_2CH_2CHBr_2$	20	2.529	1.6077	I-121
2489	Benzophenone (m.p. 48°)	$(C_6H_5)_2CO$	19	1.091	1.6077*	VII-410
2490	Phenylpropiolic aldehyde	$C_6H_5C{:}CCHO$	12.6	1.068	1.6079	VII-383
2491	Chloronaphthalene (β) (m.p. 56°)	$C_{10}H_7Cl$	70.7	1.138	1.6079	V-541
2492	Diphenylene oxide (m.p. 87°)	$C_6H_4\cdot C_6H_4\cdot O$	99.3	1.089	1.6079	XVII-70
2493	Phenylhydrazine	$C_6H_5NHNH_2$	20	1.098	1.6081	XV-67
2494	Dibromobenzene (*m*)	$C_6H_4Br_2$	17.4	1.962	1.6083	V-211
2495	Phenylstyrene (α)	$(C_6H_5)_2C{:}CH_2$	20	1.023	1.6085	V-639
2496	Iodotoluene (*o*)	$CH_3C_6H_4I$	20	1.698	1.609	V-310

*Supercooled.

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2497	Bromostyrene (ω)*	$C_6H_5CH{:}CHBr$	16.6	1.42	1.6091	V–477
2498	Methylquinoline (α)	$C_6H_4{\cdot}CH{:}CH{\cdot}CH{\cdot}(CH_3){:}N$	25.4	1.054	1.6091	XX–388
2499	Dichloronaphthalene (1,7) (m.p. 64°)	$C_{10}H_6Cl_2$	99.5	1.261	1.6092	V–543
2500	Methyl isoquinoline (α)	$C_6H_4{\cdot}CH{:}CH{\cdot}N{:}C{\cdot}CH_3$	20.5	1.076	1.6095	XX–403
2501	Titanium tetrachloride	$TiCl_4$	10.5	.....	1.61	.....
2502	Methylfluorene (9) (m.p. 46°)	$C_6H_4{\cdot}C_6H_4{\cdot}CHCH_3$	66.2	1.026	1.6101	V–642
2503	Dibromobenzene (o)	$C_6H_4Br_2$	17.4	1.964	1.6117	V–210
2504	Benzylaniline (m.p. 37°)	$C_6H_5CH_2NHC_6H_5$	24.8	1.065	1.6118	XII–1023
2505	Methyl-1-ethyl-4-acetyl-2-naphthalene	$C_{10}H_5(CH_3)(C_2H_5){\cdot}(COCH_3)$	15.1	1.074	1.6118	.....
2506	Phenyl-1-butadiene-1,3	$C_6H_5CH{:}CH{\cdot}CH{:}CH_2$	16	0.931	1.6128	V–517
2507	Ethyl cinnamylideneacetate (m.p. 25°)	$C_6H_5CH{:}CH{\cdot}CH{:}CHCO_2C_2H_5$	42.2	1.029	1.613	IX–639
2508	Ethyl dibromo-2,7-fluoreneacetate-9 (m.p. 87°)	$C_{17}H_{14}O_2Br_2$	99.8	1.512	1.6130	.....
2509	Cinnamyl chloride (m.p. 36°)	$C_6H_5CH{:}CHCOCl$	42.5	.....	1.6136	IX–587
2510	Methylthionaphthene (5)	$CH_3C_6H_3{\cdot}CH{:}CH{\cdot}S$	21.7	1.111	1.6148	*XVII–27
2511	Methylquinoline (7)	$CH_3C_6H_3{\cdot}CH{:}CH{\cdot}CH{:}N$	20.8	1.067	1.6149	XX–400
2512	Diphenyl ketene	$(C_6H_5)_2C{:}CO$	14.1	1.11	1.615	VII–471
2513	Ethyl α-methylcinnamylideneacetate	$C_6H_5CH{:}CH{\cdot}CH{:}C(CH_3)CO_2C_2H_5$	20	1.041	1.615	.....
2514	Methylquinoline (6)	$CH_3C_6H_3{\cdot}CH{:}CH{\cdot}CH{:}N$	20	1.065	1.6157	XX–397
2515	Dimethylnaphthalene (1,4)	$(CH_3)_2C_{10}H_6$	16.4	1.02	1.6157	V–570
2516	Dimethylnaphthalene (1,2)	$(CH_3)_2C_{10}H_6$	20	1.019	1.616	*V–267
2517	Methylquinoline (8)	$CH_3C_6H_3{\cdot}CH{:}CH{\cdot}CH{:}N$	20.8	1.072	1.6162	XX–401

*Isomer 1.

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2518	Methylquinoline (3)	$C_6H_4 \cdot CH:C(CH_3) \cdot CH:N$	20	1.067	1.6171	XX-394
2519	Methylnaphthalene (α)	$C_{10}H_7CH_3$	20	1.00	1.618	V-566
2520	Ethyl allocinnamylidene-acetate	$C_6H_5 \cdot (CH:CH)_2 \cdot CO_2C_2H_5$	20	1.043	1.619	.....
2521	Methyldiphenylamine (N)	$(C_6H_5)_2NCH_3$	20	1.048	1.6193	XII-180
2522	Cinnamic aldehyde	$C_6H_5CH:CHCHO$	20	1.110	1.6195	VII-348
2523	Ethyl-1-acetyl-4-naphthalene	$C_2H_5C_{10}H_6COCH_3$	15.7	1.092	1.6198	.....
2524	Naphthol (α) (m.p. 96°)	$C_{10}H_7OH$	98.7	1.099	1.6206	VI-596
2525	Methylquinoline (4)	$C_6H_4 \cdot C(CH_3):CH \cdot CH:N$	20	1.087	1.6206	XX-395
2526	Toluquinoxaline	$CH_3C_6H_3 \cdot N:CH \cdot CH:N$	18.4	1.118	1.6211	XXIII-184
2527	Naphthaldehyde (β) (m.p. 61°)	$C_{10}H_7CHO$	99.4	1.078	1.6211	VII-401
2528	Iodobenzene	C_6H_5I	17.8	1.835	1.6213	V-215
2529	Isoquinoline	$C_6H_4 \cdot CH:CH \cdot N:CH$	25.1	1.09	1.6223	XX-380
2530	Dichloronaphthalene (1,4) (m.p. 68°)	$C_{10}H_6Cl_2$	75.9	1.300	1.6228	V-542
2531	Quinoxaline (m.p. 30°)	$C_6H_4 \cdot N:CH \cdot CH:N$	48	1.133	1.6231	XXIII-176
2532	Methyl naphthyl ether (α)	$CH_3OC_{10}H_7$	13.9	1.096	1.6232	VI-606
2533	Dichloronaphthalene (1,8)	$C_{10}H_6Cl_2$	99.8	1.292	1.6236	V-544
2534	Dimethylnaphthylamine (α)	$C_{10}H_7N(CH_3)_2$	20(?)	1.042	1.624	XII-1221
2535	Methyl-2-acetyl-(5) 8-naphthalene	$CH_3C_{10}H_6COCH_3$	13.3	1.099	1.6244	.....
2536	Bromoaniline (m)	$BrC_6H_4NH_2$	20.4	1.579	1.6260	XII-633
2537	Methyl o-aminophenyl sulfide	$CH_3 \cdot S \cdot C_6H_4NH_2$	17	1.133	1.6263	XIII-399
2538	Methyl-1-acetyl-2-naphthalene	$CH_3C_{10}H_6COCH_3$	16.1	1.105	1.6270	.....
2539	Carbon disulfide	CS_2	20	1.263	1.6276	III-197
2540	Tetrabromo-1,1,-1,2-ethane	Br_3CCH_2Br	20	2.875	1.6277	I-94
2541	Methoxy-3-thionaphthene	$C_6H_4C(OCH_3):CH \cdot S$	13.6	1.209	1.6277	XVII-120
2542	Methyl naphthyl ketone (α)	$CH_3COC_{10}H_7$	21.5	1.117	1.6280	VII-401

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2543	Quinoline	$C_6H_4{\cdot}CH{:}CH{\cdot}CH{:}N$	18.2	1.09	1.6283	XX–339
2544	Naphthonitrile (α) (m.p. 36°)	$C_{10}H_7CN$	17.8	1.11	1.6298	IX–649
2545	Dibromothiophene (α, α')	$BrC{:}CH{\cdot}CH{:}CBr{\cdot}S$	20	2.141	1.63	XVII–33
2546	Methyl *o*-bromomethyl sulfide	$CH_3{\cdot}S{\cdot}C_6H_4Br$	20	1.522	1.6319	.....
2547	Diethylaminonaphthalene (β)	$C_{10}H_7N(C_2H_5)_2$	21.6	1.025	1.6321	XII–1275
2548	Thionaphthene (m.p. 32°)	$C_6H_4{\cdot}CH{:}CH{\cdot}S$	36.2	1.15	1.6332	XVII–59
2549	Chloronaphthalene (α)	$C_{10}H_7Cl$	20	1.194	1.6332	V–541
2550	Dichloronaphthalene (1,2) (m.p. 37°)	$C_{10}H_6Cl_2$	48.5	1.315	1.6338	V–542
2551	Phenylenediamine (*m*) (m.p. 63°)	$C_6H_4(NH_2)_2$	57.7	1.107	1.6339	XIII–33
2552	Chloroquinoline (2) (m.p. 37°)	$C_6H_4{\cdot}CH{:}CH{\cdot}C(Cl){:}N$	24.6	1.246*	1.6342*	XX–359
2553	Diphenyl sulfide	$(C_6H_5)_2S$	18.5	1.117	1.635	VI–299
2554	Diiodopropane (1,3)	$ICH_2CH_2CH_2I$	15	2.576	1.6363	I–115
2555	Methylstilbene (*m*) (m.p. 53°)	$CH_3C_6H_4CH{:}CHC_6H_5$	60.5	0.989	1.6363	*V–311
2556	Amylanthracene (*iso*) (*meso*) (m.p. 58°)	$C_{19}H_{20}$	71.1	1.002	1.6364	.....
2557	Tetrabromo-1,1,-2,2-ethane	$Br_2CHCHBr_2$	20	2.967	1.6380	I–94
2558	Dimethylaminonaphthalene (β) (m.p. 46°)	$C_{10}H_7N(CH_3)_2$	53.2	1.028	1.6443	XII–1273
2559	Methyl-4-naphthaldehyde-1 (m.p. 34°)	$CH_3C_{10}H_6CHO$	38.2	1.125	1.6457	.....
2560	Benzalacetophenone (m.p. 62°)	$C_6H_5CH{:}CHCOC_6H_5$	62.3	1.071	1.6458	VII–478
2561	Cyanotetrabromide (*iso*) (m.p. 38.5°)	$Br_2C{:}N{\cdot}N{:}CBr_2$	55	2.680	1.6465	.....
2562	Ethylaminonaphthalene (α)	$C_{10}H_7NHC_2H_5$	15.1	1.06	1.6477	XII–1222
2563	Phenyl isothiocyanate	$C_6H_5N{:}CS$	23.4	1.126	1.6492	XII–453
2564	Naphthylamine (β) (m.p. 111°)	$C_{10}H_7NH_2$	98.4	1.061	1.6493	XII–1265
2565	Methoxy-4-naphthaldehyde-1 (m.p. 34°)	$CH_3OC_{10}H_6CHO$	43.7	1.183	1.6530	VIII–147
2566	Ethylaminonaphthalene (β)	$C_{10}H_7NHC_2H_5$	21.3	1.06	1.6544	XII–1274

*Supercooled.

INDEX OF REFRACTION—LIQUIDS

No.	Substance	Formula	t,°C.	d_4^t	n_D^t	Beil. Ref.
2567	Naphthaldehyde (α)	$C_{10}H_7CHO$	19.3	1.15	1.6546	VII–400
2568	Phenanthrene	$(C_6H_4CH)_2$	129	.....	1.6567	V–667
2569	Bromonaphthalene (α)	$C_{10}H_7Br$	20	1.482	1.6582	V–547
2570	Azoxybenzene (m.p. 36°)	$C_6H_5 \cdot N(:O) : N \cdot C_6H_5$	26	1.24	1.6644	XVI–622
2571	Sulfur monochloride	S_2Cl_2	14	.....	1.666	.....
2572	Iodonaphthalene (β) (m.p. 54°)	$C_{10}H_7I$	99.4	1.632	1.6662	V–552
2573	Naphthylamine (α) (m.p. 50°)	$C_{10}H_7NH_2$	51	1.1	1.6703	XII–1212
2574	Ethylanthracene (9) (m.p. 59°)	$C_{16}H_{14}$	99.2	1.041	1.6762	V–678
2575	Methylanthracene (α) (m.p. 86°)	$CH_3C_{14}H_9$	99.4	1.047	1.6803	V–674
2576	Naphthylene-diamine (1,8) (m.p. 66°)	$C_{10}H_6(NH_2)_2$	99.4	1.127	1.6828	XIII–205
2577	Diphenyl telluride	$(C_6H_5)_2Te$	15.8	1.603	1.6930	VI–347
2578	Chloroanthracene (1) (m.p. 81°)	$C_{14}H_9Cl$	99.5	1.171	1.6959	*V–324
2579	Methylanthracene (9)	$C_{15}H_{12}$	99.4	1.066	1.6959	.....
2580	Phosphorus tribromide	PBr_3	26.6	.....	1.697	.....
2581	Iodonaphthalene (α)	$C_{10}H_7I$	14	1.747	1.7054	V–550
2582	Acetylene diiodide (*cis*)	ICH:CHI	11.2	3.1	1.706	I–194
2583	Naphthylene-diamine (1,6) (m.p. 78°)	$C_{10}H_6(NH_2)_2$	99.4	1.147	1.7083	XIII–204
2584	Sulfur monobromide	S_2Br_2	?	.....	1.736	.....
2585	Methylene iodide	CH_2I_2	15	3.33	1.7425	I–71
2586	Hydrogen disulfide	H_2S_2	?	.....	1.885	.....

FORMULA INDEX

For finding compounds listed in the table: *INDEX OF REFRACTION (LIQUIDS).*

The system used in this formula index is essentially the same as that employed in *Richter's Lexikon der Kohlenstoff Verbindungen.* The succession of the elements combined with carbon is as follows: H, O, N, S, F, Cl, Br, I. All the other elements are placed in alphabetical order. The arrangement depends (1) on the number of carbon atoms, (2) on the number of the other elements which, in addition to carbon, are contained in the compounds, (3) on the kind of elements, which in addition to carbon are contained in the molecule, in accordance with the order as stated above, and (4) on the number of atoms of each element which, in addition to carbon, is contained in the compound. Thus 2 III means two carbon atoms combined with three other elements; *e. g.*, $C_2H_2O_2F_2$ 13, is a compound with 2 carbon atoms and *3* other elements, and it is the 13th compound in the table to which this formula index is a part.

1 I

CCl_4 1171
CS_2 2539

1 II

CHN 2
$CHCl_3$ 833
$CHBr_3$ 2459
CH_2O_2 39
CH_2N_2 750
CH_2Cl_2 434
CH_2I_2 2585
CH_3I 1905
CH_4O 8
CO_8N_4 714
$CSCl_2$ 2077
$CSCl_4$ 2114
$CFCl_3$ 85
CCl_3Br 1912

1 III

CH_3ON 865
CH_3ON_2 124
$CH_4O_2N_2$ 1150
CH_5ON 324
CO_2NCl_3 1140
CO_2NBr_3 2395

2 I

C_2Cl_4 1639

2 II

C_2HCl_3 1334
C_2HCl_5 1600
C_2HBr_3 2464
$C_2H_2O_2$ 70
$C_2H_2Cl_2$ 894; 950
$C_2H_2Cl_4$ 1373; 1456
$C_2H_2Br_2$ 2066; 2136
$C_2H_2Br_4$ 2540
$C_2H_2I_2$ 2582
C_2H_3N 15
$C_2H_3N_3$ 1399
$C_2H_3Cl_3$ 682; 1266
C_2H_3Br 842
$C_2H_3Br_3$ 2426
C_2H_4O 12; 25
$C_2H_4O_2$ 14; 40; 1371
$C_2H_4N_6$ 1353
$C_2H_4Cl_2$ 327; 800
$C_2H_4Br_2$ 1728; 1994
C_2H_5Br 438
C_2H_5I 1738
C_2H_6O 29
$C_2H_6O_2$ 584
C_2H_6S 558
$C_2H_6S_2$ 1829
C_2H_6Cd 2403
C_2H_6Hg 1934
$C_2H_8N_2$ 219; 387; 1006
$C_2O_2Cl_2$ 620
$C_2O_2Cl_4$ 1061
$C_2N_2Br_4$ 2561
$C_2F_3Br_3$ 1213
$C_2Cl_2Br_2$ 2382

2 III

C_2HOCl_3 1038
C_2HFBr_4 2452
$C_2HF_2Br_3$ 1672
$C_2HF_3Br_2$ 300
C_2HCl_2Br 1802
$C_2HCl_2Br_3$ 2460
$C_2HCl_3Br_2$ 1908
$C_2H_2O_2F_2$ 13
$C_2H_2O_2Cl_2$ 1206
$C_2H_2FBr_3$ 1595; 2274
$C_2H_2F_2Br_2$ 879; 1158
C_2H_2ClBr 1534; 1554
$C_2H_2ClBr_3$ 2476
C_2H_3ON 260
C_2H_3OCl 102
C_2H_3OBr 992
$C_2H_3O_2Cl$ 86; 530
C_2H_3NS 1226; 1861
$C_2H_3FBr_2$ 1580
$C_2H_3F_2Br$ 103
$C_2H_3F_2I$ 1228
$C_2H_4OCl_2$ 630
$C_2H_4O_4N_2$ 893
C_2H_5ON 468
C_2H_5OF 32
C_2H_5OCl 145; 752
C_2H_5OBr 1052; 1517
C_2H_5OI 2099
$C_2H_5O_2N$ 107; 269
$C_2H_5O_3N$ 78
$C_2H_6ON_2$ 675
$C_2H_6O_2N_2$ 843
$C_2H_6O_4S$ 91
C_2H_7ON 310; 998
$C_2H_{10}ON_2$ 915

3 I

C_3O_2 995

3 II

C_3HN 88
$C_3H_2O_2$ 770
$C_3H_2N_2$ 303
$C_3H_3Cl_5$ 1714
C_3H_4O 160; 559
$C_3H_4O_2$ 412
$C_3H_4O_3$ 550
$C_3H_4N_2$ 1251
$C_3H_4Cl_2$ 726
$C_3H_4Br_2$ 1944; 1983; 1992
C_3H_5N 26; 35
C_3H_5Cl 312
C_3H_5Br 853; 1018; 1032; 1203
$C_3H_5Br_3$ 2466
C_3H_6O 21; 31; 283
$C_3H_6O_2$ 23; 24; 92; 529
$C_3H_6O_3$ 329; 715
$C_3H_6Cl_2$ 238; 698
$C_3H_6Br_2$ 1818; 1865
$C_3H_6I_2$ 2554
C_3H_7N 351
C_3H_7Cl 99
C_3H_7Br 461; 621
C_3H_7I 1553; 1640
C_3H_8O 56; 81

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$C_3H_8O_2$ 17; 189; 525; 711
$C_3H_8O_3$ 1278
C_3H_8Se 1305
C_3H_9N 52; 108
C_3H_9Al 589
C_3H_9Bi 2228
C_3H_9Sb 1355

3 III

$C_3H_2O_2Cl_2$ 1151
C_3H_3ON 506
$C_3H_4OCl_2$ 1260
C_3H_5ON 211
C_3H_5OCl 207; 708
C_3H_5OBr 1078
$C_3H_5O_2Cl$ 134; 409
$C_3H_5O_2Br$ 1300
C_3H_5NS 1201; 1750
$C_3H_6OCl_2$ 1362
$C_3H_6OBr_2$ 2127; 2204
C_3H_7ON 517; 527; 534
C_3H_7OCl 254; 655; 704; 859
C_3H_7OBr 1420
C_3H_7OI 2213
$C_3H_7O_2N$ 30; 166; 298
$C_3H_7O_3N$ 143
$C_3H_7NCl_2$ 969
$C_3H_7Cl_3Si$ 573
$C_3H_8O_2N_2$ 1073
C_3H_9ON 694

3 IV

C_3H_6ONCl 960

4 I

C_4H_6 137
C_4H_8 47
C_4N_2 1193

4 II

C_4H_4O 398; 854
$C_4H_4O_3$ 1054
$C_4H_4N_2$ 326; 1494; 1841
C_4H_4S 1899
C_4H_5N 222; 314; 1613
C_4H_5Cl 1090
C_4H_6O 656
$C_4H_6O_2$ 122; 469; 476; 535; 578; 669; 837; 1125
$C_4H_6O_3$ 109
$C_4H_6O_4$ 114
$C_4H_6N_2$ 1340; 1481; 1523
$C_4H_6Br_2$ 1053
$C_4H_6Br_4$ 2488
C_4H_7N 64
C_4H_7Br 1091
$C_4H_7Br_3$ 2292
C_4H_8O 43; 60; 62; 74; 304; 439; 576; 611
$C_4H_8O_2$ 42; 53; 55; 119; 150; 162; 352; 410
$C_4H_8O_3$ 315; 353; 590
$C_4H_8Br_2$ 1662; 1697
C_4H_9Cl 87; 133; 142; 181
C_4H_9Br 507; 623; 649; 712
C_4H_9I 1511; 1555
$C_4H_{10}O$ 16; 20; 28; 94; 117; 139; 156
$C_4H_{10}O_2$ 37; 227
$C_4H_{10}O_3$ 868
$C_4H_{10}S$ 695; 764
$C_4H_{10}S_2$ 1654
$C_4H_{10}Cd$ 2303
$C_4H_{10}Hg$ 2217
$C_4H_{10}Se$ 1324
$C_4H_{10}Te$ 1796
$C_4H_{11}N$ 268; 269; 270; 272
$C_4H_{12}Pb$ 1717
$C_4H_{12}Si$ 22
$C_4H_{12}Sn$ 1815

4 III

C_4HOCl_3 1644
$C_4HO_2Cl_3$ 1741; 1827
$C_4H_2OCl_4$ 1791
$C_4H_2O_2Cl_2$ 1568
$C_4H_2NCl_3$ 1681
$C_4H_2SBr_2$ 2545
$C_4H_3OCl_3$ 1545
$C_4H_3NCl_2$ 1525
C_4H_3SCl 2130
C_4H_3SBr 2430
$C_4H_4O_2Cl_2$ 1114; 1282
C_4H_5ON 716; 717
C_4H_5OCl 1126
$C_4H_5OCl_3$ 1303
C_4H_5OBr 1776
$C_4H_5O_2N$ 67
$C_4H_5O_2F_3$ 4
$C_4H_5O_2Cl_3$ 928
$C_4H_5O_2Br_3$ 2069
C_4H_5NS 1881
$C_4H_5N_2Br$ 1810
$C_4H_6ON_2$ 491
$C_4H_6OCl_2$ 934
$C_4H_6O_2N_2$ 1098
$C_4H_6O_2Cl_2$ 696
$C_4H_6O_2Br_2$ 1586
C_4H_7ON 164
C_4H_7OCl 223; 265
$C_4H_7O_2N_3$ 635
$C_4H_7O_2F$ 50
$C_4H_7O_2Cl$ 194; 261; 399; 455; 758
$C_4H_7O_2Br$ 776; 925; 1010; 1025; 1071
$C_4H_7O_2I$ 1673
C_4H_7NS 1685
$C_4H_8OCl_2$ 1069
$C_4H_8O_3N_2$ 658
$C_4H_8O_4N_2$ 883
$C_4H_8N_2S$ 2467
$C_4H_8SCl_2$ 1924
C_4H_9ON 195; 547; 670; **769**
C_4H_9OCl 256; 787
$C_4H_9O_2N$ 41; 371; 442
$C_4H_9O_3N$ 190
$C_4H_9NCl_2$ 884
$C_4H_{10}ON_2$ 697
$C_4H_{10}O_2N_2$ 1087; 1133
$C_4H_{10}O_3S$ 356; 361
$C_4H_{10}O_4S$ 110
$C_4H_{11}ON$ 536; 794
$C_4H_{11}O_2N$ 1333
$C_4H_{11}O_3P$ 228

5 I

C_5H_6 905
C_5H_8 168; 224; 240; 313; **384**; 727
C_5H_{10} 57; 65; 77; 82; 198
C_5H_{12} 18; 27

5 II

$C_5H_4O_2$ 1485; 1844; 1877; **1907**
$C_5H_4O_3$ 1264
C_5H_5N 1698
C_5H_6O 624
$C_5H_6O_2$ 366; 380; 874; 1122 1397
$C_5H_6N_2$ 661; 1658
C_5H_6S 1848; 1849
C_5H_7N 419; 605; 1422
C_5H_8O 199; 662; 702; 938
$C_5H_8O_2$ 178; 202; 470; **537**; 538; 607; 645; **718**; 779; 946; 1000
$C_5H_8O_3$ 229; 307; 357; **580**; 771; 1093
$C_5H_8O_4$ 292; 348; **492**
$C_5H_8N_2$ 1205; 1280
C_5H_9N 115
$C_5H_9Br_3$ 2219
$C_5H_{10}O$ 95; 97; 98; 101; 111; 127; 440; 458; 511; 974
$C_5H_{10}O_2$ 54; 72; 73; 75; **83**; 100; 104; 121; **201**; 208; 235; 637; **918**
$C_5H_{10}O_3$ 76; 270; 360; 493
$C_5H_{10}N_2$ 272
$C_5H_{10}Cl_2$ 814
$C_5H_{10}Br_2$ 1669; 1755
$C_5H_{10}I_2$ 2479
$C_5H_{11}N$ 982
$C_5H_{11}F$ 19
$C_5H_{11}Cl$ 213; **216**; **255**; **262**

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$C_5H_{11}Br$ 666; 740; 759; 803
$C_5H_{11}I$ 1498; 1533
$C_5H_{12}O$ 36; 61; 144; 209; 212; 231; 246; 268
$C_5H_{12}O_2$ 736; 790; 903
$C_5H_{12}O_3$ 192; 481
$C_5H_{12}S$ 741; 785
$C_5H_{13}N$ 183; 240
$C_5H_{14}N_2$ 472; 1118
$C_5H_{14}Pb$ 1765

5 III

C_5H_5OCl 1482
$C_5H_5O_2Cl_3$ 1433
$C_5H_6ON_2$ 1364
$C_5H_6O_2Cl_2$ 1103; 1242; 1276; 1512
$C_5H_6O_3N_2$ 1109
C_5H_7ON 754
C_5H_7OCl 875; 1199; 1346
$C_5H_7O_2N$ 340
$C_5H_7O_2Cl$ 1055; 1354
$C_5H_7NBr_2$ 1812
$C_4H_7N_2Cl$ 1454; 1520
$C_5H_7N_2Br$ 1800
$C_5H_8ON_2$ 600
$C_5H_8O_2Cl_2$ 880
C_5H_9OCl 316; 367; 1045
$C_5H_9O_2Cl$ 243; 346; 465
$C_5H_9O_2Br$ 860
C_5H_9NS 1569
$C_5H_{10}ON_2$ 1471
$C_5H_{10}OS_2$ 1985
$C_5H_{10}O_2N_2$ 1495
$C_5H_{10}O_2S$ 1128
$C_5H_{10}O_3N_2$ 594
$C_5H_{11}ON$ 249; 665; 816; 825
$C_5H_{11}O_2N$ 80; 90; 333; 343; 403; 405
$C_5H_{11}O_3N$ 266
$C_5H_{11}NCl_2$ 788
$C_5H_{12}O_2N_2$ 1048; 1056

6 I

C_6H_6 743; 1587
C_6H_8 1229; 1294; 1436
C_6H_{10} 174; 683; 817; 818
C_6H_{12} 68; 173; 177; 244; 247; 482
C_6H_{14} 38; 44; 45; 48; 51

6 II

$C_6H_3Cl_3$ 2295
$C_6H_4F_2$ 678; 747
$C_6H_4Cl_2$ 1882; 2100; 2155
$C_6H_4Br_2$ 2351; 2494; 2503
C_6H_5F 1221
C_6H_5Cl 1869
C_6H_5Br 2238
C_6H_5I 2528
$C_6H_5N_3$ 2276
C_6H_5O 2018
$C_6H_6O_3$ 1401
C_6H_6S 2410
C_6H_7N 1577; 1623; 2411
C_6H_8O 640; 987
$C_6H_8O_2$ 1015; 1072
$C_6H_8O_4$ 735; 745
$C_6H_8O_6$ 742
$C_6H_8N_2$ 1115; 1547; 2493; 2551
C_6H_8S 1731; 1751; 1830
C_6H_9N 591; 676; 1550; 1614
$C_6H_{10}O$ 287; 396; 794; 826; 839; 921
$C_6H_{10}O_2$ 426; 451; 452; 593; 688; 719; 766; 851; 926; 935; 942; 988; 1081; 1234
$C_6H_{10}O_3$ 196; 323; 362; 473; 490; 821
$C_6H_{10}O_4$ 248; 344; 363; 598
$C_6H_{10}O_5$ 765
$C_6H_{10}N_2$ 1268; 1310; 2120
$C_6H_{10}S$ 1415
$C_6H_{11}N$ 204; 232
$C_6H_{11}Cl$ 1033
$C_6H_{11}Br$ 1504
$C_6H_{12}O$ 135; 155; 165; 504; 548; 574; 1142
$C_6H_{12}O_2$ 93; 112; 113; 120; 123; 129; 131; 148; 301; 308; 913
$C_6H_{12}O_3$ 205
$C_6H_{12}O_4$ 267
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$C_8H_{14}O_2$ 509; 533; 582; 592; 617; 639; 760; 772; 878; 901; 1120; 1265
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$C_8H_{14}O_4$ 280; 359; 373; 515
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$C_8H_{15}Cl$ 993; 1216
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$C_8H_{17}N$ 780; 939
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$C_8H_{11}O_2N$ 861; 975
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$C_9H_{14}O$ 844; 923; 1041; 1349; 1351; 1492
$C_9H_{14}O_2$ 931; 1113; 1233; 1237; 1301; 1374; 1379; 1388; 1526; 1530; 1543; 1567
$C_9H_{14}O_3$ 699; 802; 966
$C_9H_{14}O_4$ 700; 734; 852; 858; 881; 897; 1235; 1316
$C_9H_{14}O_5$ 677; 685; 781
$C_9H_{14}O_6$ 560
$C_9H_{14}N_2$ 1716
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$C_9H_{16}O_2$ 651; 671; 954; 1002; 1136
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$C_9H_{16}O_4$ 251; 342; 364; 441; 444; 456; 464; 474; 513; 540
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$C_9H_{17}Cl$ 1026
$C_9H_{17}Br$ 1360; 1364
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$C_9H_8ON_2$ 2420
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$C_{10}H_{10}O_4$ 1694; 1766
$C_{10}H_{10}N_2$ 2389; 2390; 2458; 2576; 2583
$C_{10}H_{11}Cl_3$ 2159; 2306
$C_{10}H_{12}O$ 1783; 1804; 1817; 1840; 1851; 1886; 1891; 1906; 1913; 1914; 1916; 1927; 1970; 1997; 2032; 2038; 2045; 2050; 2135; 2147; 2239; 2252; 2296; 2370
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$C_{10}H_{12}O_3$ 1756; 1784; 1836; 1845; 1866; 1871
$C_{10}H_{12}N_2$ 2250; 2251; 2268; 2300; 2354; 2380; 2384; 2386; 2412
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$C_{10}H_{14}O_4$ 1225
$C_{10}H_{14}N_2$ 1898; 2176
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$C_{10}H_{16}O$ 963; 985; 996; 1182; 1217; 1239; 1258; 1263; 1343; 1365; 1380; 1382; 1417; 1419; 1430; 1440; 1442; 1524
$C_{10}H_{16}O_2$ 659; 824; 947; 1008; 1089; 1101; 1212; 1238; 1241; 1248; 1308; 1325; 1330; 1348; 1367; 1368; 1393; 1410; 1418; 1477
$C_{10}H_{16}O_4$ 782; 786; 892; 955; 956
$C_{10}H_{16}O_5$ 686; 713; 784; 1174
$C_{10}H_{16}O_6$ 500
$C_{10}H_{16}N_2$ 1560; 1590; 1664
$C_{10}H_{17}N$ 907; 1472; 1615
$C_{10}H_{17}Cl$ 1292
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$C_{10}H_{18}O_3$ 306; 602; 1019
$C_{10}H_{18}O_4$ 349; 393; 394; 417; 423; 501; 510; 572
$C_{10}H_{18}O_5$ 691
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$C_{10}H_{19}Cl$ 1165; 1187; 1204
$C_{10}H_{20}O$ 496; 806; 1034; 1074; 1085; 1107; 1112; 1132; 1154
$C_{10}H_{20}O_2$ 277; 302; 378; 379; 395; 563
$C_{10}H_{21}N$ 471; 1138
$C_{10}H_{21}Cl$ 692
$C_{10}H_{21}Br$ 1026
$C_{10}H_{21}I$ 1400
$C_{10}H_{22}O$ 226; 644; 673; 687; 701
$C_{10}H_{22}S$ 968
$C_{10}H_{23}N$ 418
$C_{10}H_{24}Pb$ 1592; 1598; 1671; 1702; 1725; 1758

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$C_{10}H_{12}O_2Cl_2$ 1624
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$C_{10}H_{14}ON_2$ 1822
$C_{10}H_{14}OCl_2$ 1605; 1842; 1846
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$C_{10}H_{14}O_2Cl_2$ 1540; 1582
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$C_{10}H_{17}O_2N$ 1326
$C_{10}H_{17}O_3N$ 1416
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$C_{11}H_{16}$ 1405; 1452; 1453; 1470; 1484; 1489; 1503; 1516; 1564; 1581; 1620; 1632; 1711; 1726; 1757; 1759; 1771
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$C_{11}H_{10}O_3$ 2253
$C_{11}H_{12}O$ 2033; 2058; 2140; 2144; 2150; 2195; 2261; 2272; 2307; 2311
$C_{11}H_{12}O_2$ 1665; 1789; 1879; 1889; 1933; 1999; 2028; 2059; 2073; 2074; 2036; 2139; 2201; 2210; 2216; 2225; 2226; 2294; 2401; 2407; 2414
$C_{11}H_{12}O_3$ 1737; 1764; 1809; 1855; 1867; 1921; 1993; 2000; 2128; 2405
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$C_{11}H_{13}Cl$ 2046
$C_{11}H_{14}O$ 1574; 1689; 1743; 1745; 1790; 1795; 1798; 1918; 2042; 2134; 2181; 2186
$C_{11}H_{14}O_2$ 1448; 1449; 1467; 1496; 1924; 1965; 1984; 2001; 2012; 2021; 2314
$C_{11}H_{14}O_3$ 1653; 1724; 1730; 1746; 1880; 1956
$C_{11}H_{14}O_4$ 1964
$C_{11}H_{14}O_6$ 1273
$C_{11}H_{14}N_2$ 2161; 2256; 2375
$C_{11}H_{14}Cl_2$ 1885; 2070
$C_{11}H_{16}O$ 1438; 1510; 1599; 1649; 1700; 1761; 1769
$C_{11}H_{16}O_2$ 1928
$C_{11}H_{16}O_4$ 1369; 1561
$C_{11}H_{16}O_6$ 920; 932
$C_{11}H_{16}O_7$ 899

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$C_{11}H_{16}O_8$ 609
$C_{11}H_{18}O_2$ 850; 999; 1043; 1192; 1200; 1207; 1255; 1261; 1288; 1320; 1332; 1347; 1395; 1565
$C_{11}H_{18}O_4$ 1003; 1004
$C_{11}H_{18}O_5$ 614; 729; 775; 819
$C_{11}H_{20}O$ 1161; 1166; 1194
$C_{11}H_{20}O_2$ 755; 910; 1036
$C_{11}H_{20}O_4$ 407; 424; 462; 489; 526; 557
$C_{11}H_{21}N$ 1321
$C_{11}H_{22}O$ 546; 597
$C_{11}H_{22}O_2$ 436; 495; 528
$C_{11}H_{22}N_2$ 705
$C_{11}H_{24}O$ 404; 667; 706
$C_{11}H_{22}Pb$ 1655; 1705; 1713

11 III

$C_{11}H_{10}O_2S$ 2438
$C_{11}H_{11}O_2Cl$ 2301
$C_{11}H_{11}N_2Cl$ 2188; 2232
$C_{11}H_{12}ON_2$ 2257; 2282
$C_{11}H_{13}O_2Br$ 2330
$C_{11}H_{16}OCl_2$ 1585; 1794
$C_{11}H_{17}O_2N$ 1490
$C_{11}H_{17}O_3N$ 1497
$C_{11}H_{17}O_4N$ 522
$C_{11}H_{19}ON$ 1350
$C_{11}H_{19}O_2N$ 1293; 1306

12 I

$C_{12}H_{10}$ 2423; 2480
$C_{12}H_{12}$ 2394; 2486; 2515; 2516
$C_{12}H_{14}$ 2332; 2461
$C_{12}H_{16}$ 1752; 1779; 1957; 2035; 2425
$C_{12}H_{18}$ 1493; 1541; 1618; 1722
$C_{12}H_{26}$ 391; 416

12 II

$C_{12}H_8O$ 2492
$C_{12}H_{10}O$ 2393; 2542; 2559
$C_{12}H_{10}O_2$ 2565
$C_{12}H_{10}S$ 2553
$C_{12}H_{10}Te$ 2577
$C_{12}H_{12}O$ 2454; 2465
$C_{12}H_{12}O_2$ 2112
$C_{12}H_{12}O_3$ 2004; 2113; 2183
$C_{12}H_{12}O_4$ 1925; 2009; 2129
$C_{12}H_{12}S$ 2409
$C_{12}H_{13}N$ 2534; 2558; 2562; 2566
$C_{12}H_{14}O$ 1853; 2022; 2067; 2145; 2203; 2227; 2284; 2291; 2304
$C_{12}H_{14}O_2$ 1692; 1975; 2034; 2057; 2060; 2061; 2084; 2089; 2105; 2179; 2270; 2275; 2329
$C_{12}H_{14}O_3$ 1626; 1727; 1821; 1930; 1976; 2010; 2119; 2254; 2336; 2402
$C_{12}H_{14}O_4$ 1606; 1679; 1998; 2319
$C_{12}H_{14}N_2$ 2121; 2323
$C_{12}H_{16}O$ 1723; 1854; 2055
$C_{12}H_{16}O_2$ 1459; 1478; 1479; 1788; 1828; 1890; 1911; 1929; 2236; 2245; 2341
$C_{12}H_{16}O_3$ 1650; 1666; 1675; 1682; 1780; 1886; 2333
$C_{12}H_{16}N_2$ 2090; 2209; 2262
$C_{12}H_{18}O_2$ 1475; 1557
$C_{12}H_{18}O_3$ 1075; 1344; 1370; 1390
$C_{12}H_{18}O_4$ 1223; 1284
$C_{12}H_{18}O_6$ 952; 957; 1037
$C_{12}H_{18}O_7$ 663; 885
$C_{12}H_{20}O$ 1267
$C_{12}H_{20}O_2$ 948; 1014; 1077; 1086; 1162; 1169; 1173; 1198; 1289; 1394
$C_{12}H_{20}O_3$ 1259
$C_{12}H_{20}O_4$ 914; 958; 959; 979; 980; 1024; 1178; 1286
$C_{12}H_{20}O_5$ 812
$C_{12}H_{20}O_7$ 831
$C_{12}H_{22}O$ 1035; 1175
$C_{12}H_{22}O_2$ 721; 761; 832; 855
$C_{12}H_{22}O_3$ 949; 1062
$C_{12}H_{22}O_4$ 370; 437; 603; 604; 652
$C_{12}H_{22}N_2$ 1421
$C_{12}H_{24}O$ 783; 1309
$C_{12}H_{24}O_2$ 483; 486; 497
$C_{12}H_{24}N_2$ 1421
$C_{12}H_{26}O$ 411
$C_{12}H_{27}N$ 463; 523
$C_{12}H_{27}N_3$ 1116
$C_{12}H_{28}Pb$ 1571; 1657; 1690
$C_{12}H_{30}Sn_2$ 1988

12 III

$C_{12}H_{10}ON_2$ 2570
$C_{12}H_{12}ON_2$ 2324
$C_{12}H_{13}O_2Cl$ 1971
$C_{12}H_{14}ON_2$ 2174
$C_{12}H_{14}O_2N_2$ 2288; 2325
$C_{12}H_{14}O_2Cl_2$ 1826; 2312
$C_{12}H_{18}O_2N_2$ 1651
$C_{12}H_{21}ON$ 1339
$C_{12}H_{23}O_2N$ 1281; 1298
$C_{12}H_{24}O_4N_2$ 618
$C_{12}H_{27}O_3B$ 233
$C_{12}H_{27}O_4P$ 450

13 I

$C_{13}H_{12}$ 2374
$C_{13}H_{14}$ 2473; 2483
$C_{13}H_{16}$ 2078; 2417
$C_{13}H_{20}$ 1508; 1604
$C_{13}H_{28}$ 753

13 II

$C_{13}H_{10}O$ 2455; 2485; 2489
$C_{13}H_{12}O$ 2535; 2538
$C_{13}H_{12}O_2$ 2444; 2446; 2484
$C_{13}H_{13}N$ 2450; 2504; 2521
$C_{13}H_{14}O$ 2264
$C_{13}H_{14}O_2$ 1959; 2013; 2143; 2220; 2248; 2371; 2507; 2520
$C_{13}H_{14}O_3$ 1952; 2092
$C_{13}H_{14}O_4$ 1974; 1980; 2223; 2265
$C_{13}H_{14}N_2$ 2302; 2372
$C_{13}H_{16}O$ 1966; 2025; 2103; 2151
$C_{13}H_{16}O_2$ 1734; 1824; 1832; 1920; 2007; 2024; 2056; 2110; 2243
$C_{13}H_{16}O_3$ 1680; 1747; 1943; 2101; 2278; 2317
$C_{13}H_{18}O$ 1676; 1875
$C_{13}H_{18}O_3$ 1427; 1686; 2023
$C_{13}H_{20}O$ 1537; 1588; 1735; 1808; 1922
$C_{13}H_{20}O_2$ 1314; 1444; 1566; 1630
$C_{13}H_{20}O_3$ 1285; 1376; 1413
$C_{13}H_{20}O_4$ 870
$C_{13}H_{20}O_6$ 937
$C_{13}H_{20}O_8$ 653
$C_{13}H_{22}O_2$ 1189; 1431; 1661
$C_{13}H_{22}O_4$ 981; 1005; 1105; 1135
$C_{13}H_{24}O_2$ 763
$C_{13}H_{26}O_2$ 524
$C_{13}H_{28}O$ 457
$C_{13}H_{30}Pb$ 1610; 1659

13 III

$C_{13}H_{15}O_3Br$ 1901
$C_{13}H_{16}O_2N_2$ 2065
$C_{13}H_{17}ON$ 1938
$C_{13}H_{17}O_2N$ 2207
$C_{13}H_{23}O_4N$ 1117

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14 I

$C_{14}H_{10}$ 2568
$C_{14}H_{12}$ 2495; 2502
$C_{14}H_{14}$ 2326; 2362
$C_{14}H_{16}$ 2355; 2451
$C_{14}H_{18}$ 1949; 1977; 2290; 2406
$C_{14}H_{22}$ 1619; 1687
$C_{14}H_{30}$ 836

14 II

$C_{14}H_9Cl$ 2578
$C_{14}H_{10}O$ 2512
$C_{14}H_{10}O_3$ 2366
$C_{14}H_{12}O$ 2439
$C_{14}H_{12}O_2$ 2308
$C_{14}H_{14}O$ 2523
$C_{14}H_{14}O_2$ 2445
$C_{14}H_{14}O_3$ 2233; 2421
$C_{14}H_{15}N$ 2352
$C_{14}H_{16}O$ 2266; 2321
$C_{14}H_{16}O_2$ 2335; 2469; 2474; 2513
$C_{14}H_{16}O_3$ 1893; 1915
$C_{14}H_{16}O_4$ 2005; 2029
$C_{14}H_{16}N_2$ 2342; 2376
$C_{14}H_{17}N$ 2443; 2547
$C_{14}H_{18}O$ 2106
$C_{14}H_{18}O_2$ 1805
$C_{14}H_{18}O_3$ 1532
$C_{14}H_{20}O_4$ 1392
$C_{14}H_{20}O_9$ 730
$C_{14}H_{22}O_2$ 1432; 1460
$C_{14}H_{22}O_3$ 1385
$C_{14}H_{24}O_4$ 1017; 1044
$C_{14}H_{24}O_7$ 886
$C_{14}H_{24}N_2$ 1825; 2167
$C_{14}H_{26}O_3$ 612
$C_{14}H_{28}O_2$ 564; 565; 588; 722
$C_{14}H_{30}O$ 332; 503
$C_{14}H_{32}Pb$ 1631; 1642

14 III

$C_{14}H_{15}ON$ 2477

15 I

$C_{15}H_{12}$ 2575; 2579
$C_{15}H_{14}$ 2378; 2556
$C_{15}H_{16}$ 2287; 2361
$C_{15}H_{18}$ 2440
$C_{15}H_{24}$ 1457; 1480; 1487; 1538; 1556; 1572; 1575; 1612; 1621; 1646; 1668

15 II

$C_{15}H_{12}O$ 2560
$C_{15}H_{12}O_3$ 2435
$C_{15}H_{14}O$ 2470
$C_{15}H_{14}O_6$ 2043
$C_{15}H_{16}O$ 2377; 2505
$C_{15}H_{18}O$ 1839; 2039
$C_{15}H_{18}O_2$ 1876
$C_{15}H_{20}O_6$ 1219
$C_{15}H_{20}O_7$ 1262
$C_{15}H_{20}O_{10}$ 1067
$C_{15}H_{22}O_2$ 1729
$C_{15}H_{22}O_3$ 1450
$C_{15}H_{22}O_4$ 1190
$C_{15}H_{24}O$ 1549; 1703
$C_{15}H_{26}O$ 1434; 1435; 1609
$C_{15}H_{26}O_2$ 1127; 1170
$C_{15}H_{26}O_6$ 648
$C_{15}H_{26}N_2$ 1903; 1941
$C_{15}H_{28}O_2$ 888
$C_{15}H_{33}N$ 275
$C_{15}H_{34}Pb$ 1643

15 III

$C_{15}H_{19}O_2N$ 1678
$C_{15}H_{33}O_3B$ 276

16 I

$C_{16}H_{24}$ 2574
$C_{16}H_{18}$ 2297; 2305
$C_{16}H_{26}$ 1811
$C_{16}H_{32}$ 757

16 II

$C_{16}H_{16}O_4$ 2214
$C_{16}H_{18}O_2$ 2237
$C_{16}H_{20}O_5$ 1465
$C_{16}H_{22}O_4$ 1462; 1748
$C_{16}H_{24}O_5$ 1290
$C_{16}H_{26}O$ 1402
$C_{16}H_{26}O_3$ 1315
$C_{16}H_{27}N$ 1683
$C_{16}H_{32}O_2$ 556
$C_{16}H_{33}I$ 1366
$C_{16}H_{34}O$ 541
$C_{16}H_{36}Pb$ 1513; 1622

16 III

$C_{16}H_{25}O_3Cl$ 1403

17 I

$C_{17}H_{20}$ 2191
$C_{17}H_{36}$ 732

17 II

$C_{17}H_{16}O_2$ 2453
$C_{17}H_{38}Pb$ 1535; 1579

17 III

$C_{17}H_{14}O_2Br_2$ 2508
$C_{17}H_{21}O_4N$ 1594; 1596

18 I

$C_{18}H_{20}$ 2422
$C_{18}H_{30}$ 1356
$C_{18}H_{38}$ 636

18 II

$C_{18}H_{15}P$ 1864
$C_{18}H_{18}O_2$ 2424
$C_{18}H_{26}N_2$ 2014; 2350; 2447
$C_{18}H_{28}O$ 1396
$C_{18}H_{28}O_4$ 1322; 1329
$C_{18}H_{32}O_7$ 236
$C_{18}H_{34}O$ 1040
$C_{18}H_{34}O_2$ 723; 990; 1121
$C_{18}H_{34}O_5$ 1159
$C_{18}H_{36}O_2$ 613; 633; 647
$C_{18}H_{40}Pb$ 1522

19 I

$C_{19}H_{16}$ 2431
$C_{19}H_{20}$ 2556
$C_{19}H_{22}$ 2263
$C_{19}H_{40}$ 654

19 II

$C_{19}H_{30}O_2$ 1386
$C_{19}H_{36}O_3$ 1102
$C_{19}H_{42}Pb$ 1514

20 I

$C_{20}H_{40}$ 508
$C_{20}H_{42}$ 619

20 II

$C_{20}H_{28}O_2$ 1767; 1772; 2085
$C_{20}H_{30}O_4$ 1423
$C_{20}H_{38}O_3$ 1152
$C_{20}H_{40}O$ 1184
$C_{20}H_{40}O_2$ 762
$C_{20}H_{42}O$ 751
$C_{20}H_{44}Pb$ 1488

21 I

$C_{21}H_{44}$ 625

21 II

$C_{21}H_{34}O_2$ 1378
$C_{21}H_{38}O_6$ 768

21 III

$C_{21}H_{21}O_4P$ 2189

22 II

$C_{22}H_{42}O_2$ 911; 912; 964
$C_{22}H_{42}O_3$ 997; 1063

23 I

$C_{23}H_{48}$ 433

23 II

$C_{23}H_{38}O_2$ 1236

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$C_{23}H_{44}O_2$ 1042
$C_{23}H_{46}O$ 512

24 I

$C_{24}H_{50}$ 553

24 II

$C_{24}H_{38}O_4$ 1406
$C_{24}H_{46}O_2$ 1013

25 I

$C_{25}H_{52}$ 478

25 II

$C_{25}H_{40}O_2$ 1414
$C_{25}H_{42}O_2$ 1210

26 I

$C_{26}H_{54}$ 610

26 II

$C_{26}H_{52}O_2$ 724

27 I

$C_{27}H_{56}$ 629

27 II

$C_{27}H_{50}O_6$ 882

28 I

$C_{28}H_{58}$ 643

29 I

$C_{29}H_{48}$ 1505
$C_{29}H_{60}$ 660

31 II to 57 II

$C_{31}H_{62}O$ 531
$C_{32}H_{66}$ 542
$C_{33}H_{62}O_6$ 809
$C_{39}H_{74}O_6$ 731
$C_{44}H_{82}O_3$ 634; 664
$C_{45}H_{86}O_{16}$ 773
$C_{51}H_{98}O_6$ 693
$C_{57}H_{104}O_6$ 1051
$C_{57}H_{110}O_6$ 798

INDEX OF REFRACTION OF WATER AT VARIOUS TEMPERATURES AND FOR VARIOUS WAVE LENGTHS OF LIGHT

From Values Given in the *International Critical Tables, Vol. 7, p. 13.*

t°C.	Wave length of light			
	$n_\alpha(C)$	$n_D(D)$	$n_\beta(F)$	$n_\gamma(G')$
0	.....	1.3340	.....	.....
10	1.3318	1.3337	1.3378	1.3411
20	1.33115	1.33300	1.33714	1.34035
30	1.3302	1.3320	1.3360	1.3392
40	1.3288	1.3306	1.3347	1.3379
50	1.3274	1.3290	1.3332	1.3364
60	1.3257	1.3272	1.3315	1.3346
70	1.3237	1.3252	1.3294	1.3325

INDEX OF REFRACTION OF AQUEOUS HALOGEN ACID SOLUTIONS AT 18°C.

n_D^{18}

Acid	Normality of the acid solution				
	0.1	0.5	1.0	2.0	4.0
HCl	.....	1.33753	1.34168	1.34977	1.36480
HBr	1.33452	1.33952	1.34571	1.35805	1.38271
HI	1.33525	1.34346	1.35387	1.37497	.....
$HClO_3$	.....	1.33773	1.34211	1.35078	.....
HIO_3	1.33568	1.34498	1.35642	1.37910	1.42393
HIO_4	.....	1.3445*	.....	.....	.....

*At 26°C.

REFRACTIVE INDEX OF AQUEOUS GLYCEROL SOLUTIONS AT 20.0°C.

L. F. Hoyt, *Ind. Eng. Chem. 26, 329 (1934).*

% Glycerol by weight	$n_D^{20°}$	% Glycerol by weight	$n_D^{20°}$	% Glycerol by weight	$n_D^{20°}$
0	1.33303	35	1.37740	70	1.42789
1	1.33416	36	1.37874	71	1.42938
2	1.33530	37	1.38008	72	1.43087
3	1.33645	38	1.38143	73	1.43236
4	1.33762	39	1.38278	74	1.43385
5	1.33880	40	1.38413	75	1.43534
6	1.33999	41	1.38548	76	1.43683
7	1.34118	42	1.38683	77	1.43832
8	1.34238	43	1.38818	78	1.43982
9	1.34359	44	1.38953	79	1.44135
10	1.34481	45	1.39089	80	1.44290
11	1.34604	46	1.39227	81	1.44450
12	1.34729	47	1.39368	82	1.44612
13	1.34834	48	1.39513	83	1.44770
14	1.34980	49	1.39660	84	1.44930
15	1.35106	50	1.39809	85	1.45085
16	1.35233	51	1.39958	86	1.45237
17	1.35361	52	1.40107	87	1.45389
18	1.35490	53	1.40256	88	1.45539
19	1.35619	54	1.40405	89	1.45689
20	1.35749	55	1.40554	90	1.45839
21	1.35879	56	1.40703	91	1.45989
22	1.36010	57	1.40852	92	1.46139
23	1.36141	58	1.41001	93	1.46290
24	1.36272	59	1.41150	94	1.46443
25	1.36404	60	1.41299	95	1.46597
26	1.36536	61	1.41448	96	1.46752
27	1.36669	62	1.41597	97	1.46909
28	1.36802	63	1.41746	98	1.47071
29	1.36936	64	1.41895	99	1.47234
30	1.37070	65	1.42044	100	1.47399
31	1.37204	66	1.42193		
32	1.37338	67	1.42342		
33	1.37472	68	1.42491		
34	1.37606	69	1.42640		

REFRACTIVE INDEX OF AQUEOUS ALCOHOL SOLUTIONS

The table below gives the readings of the Zeiss Immersion Refractomer for various concentrations of ethyl alcohol in water. The values were calculated by B. H. St. John from the data of Doroshevskii and Dvorzhanchik. Reprinted by permission from the Official and Tentative Methods of Analysis, 3d Edition (1930), published by The Association of Official Agricultural Chemists at Washington, D. C.

Scale Reading	20°C.		23°C.		25°C.	
	% by volume	% by weight	% by volume	% by weight	% by volume	% by weight
13.2	....	....	....	....	0.00	0.00
13.4	....	....	....	....	0.18	0.14
13.6	....	....	....	....	0.35	0.28
13.8	....	....	0.10	0.08	0.53	0.42
14.0	....	....	0.28	0.22	0.70	0.56
14.2	....	....	0.45	0.36	0.88	0.70
14.4	....	....	0.63	0.50	1.06	0.85
14.6	0.16	0.13	0.80	0.64	1.24	0.99
14.8	0.34	0.27	0.98	0.78	1.40	1.11
15.0	0.52	0.41	1.16	0.92	1.55	1.23
15.2	0.69	0.55	1.32	1.05	1.71	1.36
15.4	0.85	0.68	1.47	1.17	1.86	1.48
15.6	1.03	0.82	1.62	1.29	2.01	1.60
15.8	1.21	0.96	1.77	1.41	2.17	1.72
16.0	1.36	1.08	1.92	1.53	2.33	1.85
16.2	1.51	1.20	2.08	1.65	2.48	1.97
16.4	1.66	1.32	2.24	1.78	2.62	2.09
16.6	1.81	1.44	2.39	1.90	2.77	2.21
16.8	1.96	1.56	2.53	2.02	2.92	2.33
17.0	2.11	1.68	2.69	2.14	3.06	2.44
17.2	2.26	1.80	2.82	2.25	3.21	2.56
17.4	2.41	1.92	2.97	2.37	3.36	2.68
17.6	2.56	2.04	3.12	2.49	3.51	2.80
17.8	2.70	2.15	3.27	2.61	3.66	2.92
18.0	2.85	2.27	3.42	2.73	3.81	3.04
18.2	3.00	2.39	3.57	2.85	3.96	3.16
18.4	3.15	2.51	3.71	2.96	4.11	3.28
18.6	3.30	2.63	3.86	3.08	4.26	3.40
18.8	3.45	2.75	4.01	3.20	4.41	3.52
19.0	3.59	2.86	4.16	3.32	4.56	3.64
19.2	3.73	2.98	4.31	3.44	4.70	3.76
19.4	3.88	3.10	4.46	3.56	4.85	3.88
19.6	4.03	3.22	4.61	3.68	5.00	4.00
19.8	4.17	3.33	4.75	3.80	5.15	4.12
20.0	4.32	3.45	4.90	3.92	5.29	4.23
20.2	4.47	3.57	5.05	4.04	5.44	4.35
20.4	4.61	3.68	5.20	4.16	5.58	4.47
20.6	4.75	3.80	5.34	4.27	5.72	4.58
20.8	4.90	3.92	5.48	4.39	5.87	4.70
21.0	5.04	4.03	5.62	4.50	6.02	4.81
21.2	5.19	4.15	5.77	4.62	6.16	4.93
21.4	5.33	4.26	5.91	4.73	6.30	5.05
21.6	5.47	4.38	6.06	4.85	6.44	5.16
21.8	5.61	4.49	6.20	4.97	6.59	5.28
22.0	5.76	4.61	6.34	5.08	6.73	5.39
22.2	5.90	4.72	6.49	5.20	6.87	5.51
22.4	6.05	4.84	6.63	5.31	7.01	5.62
22.6	6.19	4.95	6.77	5.43	7.16	5.74
22.8	6.33	5.07	6.91	5.54	7.31	5.86
23.0	6.47	5.18	7.06	5.66	7.45	5.97
23.2	6.61	5.30	7.20	5.77	7.59	6.08
23.4	6.75	5.41	7.34	5.89	7.73	6.20
23.6	6.90	5.53	7.48	6.00	7.87	6.31
23.8	7.04	5.64	7.62	6.11	8.00	6.42

REFRACTIVE INDEX—ALCOHOL

Scale Reading	20°C.		23°C.		25°C.	
	% by volume	% by weight	% by volume	% by weight	% by volume	% by weight
24.0	7.18	5.76	7.76	6.22	8.14	6.53
24.2	7.32	5.87	7.90	6.34	8.28	6.65
24.4	7.46	5.99	8.04	6.45	8.42	6.76
24.6	7.60	6.10	8.17	6.56	8.55	6.87
24.8	7.74	6.21	8.31	6.67	8.69	6.98
25.0	7.88	6.32	8.45	6.79	8.84	7.10
25.2	8.01	6.43	8.59	6.90	8.98	7.21
25.4	8.14	6.54	8.73	7.01	9.12	7.33
25.6	8.28	6.65	8.86	7.12	9.26	7.44
25.8	8.42	6.76	9.00	7.23	9.39	7.55
26.0	8.55	6.87	9.14	7.35	9.53	7.67
26.2	8.69	6.98	9.28	7.46	9.67	7.78
26.4	8.82	7.09	9.42	7.57	9.81	7.90
26.6	8.96	7.20	9.55	7.68	9.95	8.01
26.8	9.10	7.31	9.69	7.79	10.09	8.12
27.0	9.23	7.42	9.83	7.91	10.23	8.24
27.2	9.37	7.54	9.97	8.02	10.37	8.35
27.4	9.51	7.65	10.10	8.13	10.51	8.46
27.6	9.65	7.76	10.24	8.24	10.65	8.57
27.8	9.79	7.87	10.38	8.35	10.79	8.69
28.0	9.92	7.98	10.51	8.46	10.93	8.80
28.2	10.06	8.09	10.65	8.58	11.06	8.91
28.4	10.19	8.20	10.79	8.69	11.20	9.02
28.6	10.32	8.31	10.93	8.80	11.33	9.13
28.8	10.46	8.42	11.06	8.91	11.47	9.24
29.0	10.59	8.53	11.20	9.02	11.61	9.36
29.2	10.73	8.64	11.33	9.13	11.75	9.47
29.4	10.86	8.74	11.47	9.24	11.88	9.58
29.6	10.99	8.85	11.60	9.35	12.01	9.69
29.8	11.12	8.96	11.74	9.46	12.15	9.80
30.0	11.26	9.07	11.87	9.57	12.29	9.91
30.2	11.38	9.18	12.00	9.68	12.42	10.02
30.4	11.51	9.28	12.13	9.79	12.56	10.13
30.6	11.64	9.39	12.27	9.90	12.70	10.24
30.8	11.78	9.50	12.40	10.01	12.84	10.36
31.0	11.91	9.60	12.54	10.12	12.97	10.47
31.2	12.04	9.71	12.67	10.23	13.11	10.58
31.4	12.17	9.82	12.81	10.34	13.24	10.69
31.6	12.30	9.92	12.94	10.45	13.37	10.80
31.8	12.43	10.03	13.07	10.55	13.51	10.91
32.0	12.57	10.14	13.20	10.66	13.64	11.02
32.2	12.70	10.25	13.34	10.77	13.77	11.13
32.4	12.83	10.35	13.47	10.88	13.91	11.24
32.6	12.96	10.46	13.60	10.99	14.04	11.35
32.8	13.09	10.57	13.73	11.10	14.17	11.46
33.0	13.22	10.68	13.86	11.21	14.31	11.57
33.2	13.35	10.79	13.99	11.31	14.44	11.68
33.4	13.48	10.89	14.13	11.42	14.58	11.79
33.6	13.61	11.00	14.26	11.53	14.71	11.90
33.8	13.74	11.10	14.39	11.64	14.85	12.01
34.0	13.86	11.21	14.52	11.75	14.98	12.12
34.2	13.99	11.31	14.65	11.85	15.11	12.23
34.4	14.12	11.41	14.78	11.96	15.25	12.34
34.6	14.25	11.52	14.91	12.07	15.38	12.45
34.8	14.37	11.62	15.05	12.18	15.51	12.56
35.0	14.50	11.73	15.18	12.28	15.65	12.67
35.2	14.62	11.83	15.31	12.39	15.78	12.78
35.4	14.75	11.93	15.44	12.50	15.91	12.89
35.6	14.87	12.04	15.56	12.60	16.05	13.00
35.8	15.00	12.14	15.69	12.71	16.18	13.11

REFRACTIVE INDEX—ALCOHOL

Scale Reading	20°C.		23°C.		25°C.	
	% by volume	% by weight	% by volume	% by weight	% by volume	% by weight
36.0	15.13	12.24	15.82	12.82	16.31	13.21
36.2	15.25	12.35	15.95	12.92	16.44	13.32
36.4	15.38	12.45	16.08	13.03	16.56	13.43
36.6	15.51	12.56	16.21	13.14	16.69	13.53
36.8	15.63	12.66	16.34	13.24	16.82	13.64
37.0	15.76	12.77	16.47	13.35	16.95	13.75
37.2	15.89	12.87	16.60	13.45	17.08	13.86
37.4	16.01	12.97	16.72	13.56	17.21	13.96
37.6	16.14	13.08	16.85	13.66	17.34	14.07
37.8	16.26	13.18	16.98	13.77	17.46	14.17
38.0	16.39	13.28	17.11	13.87	17.59	14.28
38.2	16.51	13.38	17.23	13.98	17.72	14.38
38.4	16.64	13.49	17.36	14.08	17.85	14.49
38.6	16.76	13.59	17.48	14.19	17.97	14.59
38.8	16.89	13.69	17.61	14.29	18.10	14.70
39.0	17.01	13.79	17.74	14.40	18.23	14.80
39.2	17.14	13.90	17.86	14.50	18.35	14.91
39.4	17.26	14.00	17.99	14.60	18.48	15.01
39.6	17.39	14.10	18.11	14.71	18.61	15.12
39.8	17.51	14.21	18.24	14.81	18.73	15.22
40.0	17.63	14.31	18.36	14.92	18.86	15.32
40.2	17.76	14.41	18.49	15.02	18.99	15.43
40.4	17.88	14.51	18.61	15.12	19.11	15.53
40.6	18.01	14.62	18.74	15.23	19.24	15.64
40.8	18.13	14.72	18.86	15.33	19.37	15.74
41.0	18.25	14.82	18.99	15.43	19.49	15.85
41.2	18.37	14.92	19.11	15.53	19.62	15.95
41.4	18.50	15.03	19.24	15.64	19.75	16.06
41.6	18.62	15.13	19.36	15.74	19.87	16.16
41.8	18.74	15.23	19.48	15.84	20.00	16.27
42.0	18.87	15.33	19.61	15.94	20.13	16.37
42.2	18.99	15.43	19.73	16.05	20.25	16.48
42.4	19.11	15.53	19.86	16.15	20.38	16.58
42.6	19.23	15.63	19.98	16.25	20.50	16.69
42.8	19.36	15.74	20.10	16.35	20.63	16.79
43.0	19.48	15.84	20.23	16.46	20.75	16.90
43.2	19.60	15.94	20.35	16.56	20.88	17.00
43.4	19.72	16.04	20.47	16.66	21.01	17.10
43.6	19.85	16.14	20.60	16.76	21.13	17.21
43.8	19.97	16.24	20.72	16.87	21.25	17.31
44.0	20.09	16.34	20.84	16.97	21.38	17.41
44.2	20.21	16.44	20.96	17.07	21.50	17.52
44.4	20.33	16.55	21.09	17.17	21.63	17.62
44.6	20.45	16.65	21.21	17.28	21.75	17.73
44.8	20.58	16.75	21.33	17.38	21.88	17.83
45.0	20.70	16.85	21.45	17.48	22.00	17.93
45.2	20.82	16.95	21.58	17.58	22.13	18.04
45.4	20.94	17.05	21.70	17.68	22.25	18.14
45.6	21.06	17.15	21.82	17.79	22.38	18.25
45.8	21.18	17.25	21.94	17.89	22.51	18.36
46.0	21.30	17.35	22.07	17.99	22.64	18.47
46.2	21.42	17.45	22.19	18.09	22.76	18.57
46.4	21.54	17.55	22.32	18.20	22.89	18.68
46.6	21.66	17.65	22.44	18.30	23.02	18.79
46.8	21.78	17.75	22.57	18.41	23.15	18.90
47.0	21.90	17.85	22.69	18.51	23.28	19.00
47.2	22.02	17.95	22.82	18.62	23.41	19.11
47.4	22.15	18.06	22.94	18.72	23.54	19.22
47.6	22.27	18.16	23.07	18.83	23.67	19.33
47.8	22.39	18.26	23.20	18.93	23.80	19.43

REFRACTIVE INDEX—ALCOHOL

Scale Reading	20°C.		23°C.		25°C.	
	% by volume	% by weight	% by volume	% by weight	% by volume	% by weight
48.0	22.51	18.36	23.32	19.04	23.93	19.54
48.2	22.63	18.46	23.45	19.14	24.06	19.65
48.4	22.75	18.56	23.58	19.25	24.19	19.76
48.6	22.87	18.66	23.71	19.36	24.32	19.87
48.8	22.99	18.76	23.83	19.47	24.45	19.98
49.0	23.12	18.86	23.96	19.57	24.59	20.09
49.2	23.24	18.96	24.09	19.68	24.72	20.20
49.4	23.36	19.07	24.22	19.79	24.85	20.31
49.6	23.48	19.17	24.35	19.89	24.98	20.42
49.8	23.61	19.27	24.48	20.00	25.11	20.54
50.0	23.73	19.38	24.61	20.11	25.25	20.65
50.2	23.85	19.48	24.74	20.22	25.38	20.76
50.4	23.98	19.58	24.86	20.33	25.51	20.87
50.6	24.10	19.69	24.99	20.44	25.65	20.98
50.8	24.22	19.79	25.12	20.55	25.78	21.10
51.0	24.35	19.89	25.25	20.66	25.91	21.21
51.2	24.47	20.00	25.38	20.77	26.05	21.32
51.4	24.59	20.10	25.51	20.87	26.18	21.44
51.6	24.72	20.20	25.64	20.98	26.32	21.55
51.8	24.84	20.31	25.77	21.09	26.45	21.66
52.0	24.96	20.41	25.90	21.20	26.59	21.78
52.2	25.09	20.52	26.03	21.31	26.72	21.89
52.4	25.21	20.62	26.16	21.42	26.86	22.01
52.6	25.34	20.72	26.29	21.53	26.99	22.12
52.8	25.46	20.83	26.42	21.64	27.13	22.24
53.0	25.59	20.93	26.56	21.75	27.27	22.35
53.2	25.71	21.04	26.69	21.86	27.40	22.47
53.4	25.84	21.14	26.82	21.97	27.54	22.58
53.6	25.96	21.25	26.95	22.08	27.67	22.70
53.8	26.09	21.36	27.08	22.20	27.81	22.81
54.0	26.22	21.47	27.21	22.31	27.95	22.93
54.2	26.34	21.57	27.35	22.42	28.08	23.04
54.4	26.47	21.68	27.48	22.53	28.22	23.16
54.6	26.59	21.79	27.61	22.65	28.36	23.27
54.8	26.72	21.90	27.75	22.76	28.49	23.39
55.0	26.85	22.00	27.88	22.87	28.63	23.51
55.2	26.97	22.11	28.01	22.98	28.77	23.62
55.4	27.10	22.21	28.15	23.10	28.90	23.74
55.6	27.23	22.32	28.28	23.21	29.04	23.86
55.8	27.35	22.42	28.41	23.32	29.18	23.97
56.0	27.48	22.53	28.54	23.43	29.31	24.09
56.2	27.60	22.64	28.68	23.54	29.45	24.20
56.4	27.73	22.74	28.81	23.66	29.58	24.32
56.6	27.85	22.85	28.94	23.77	29.72	24.43
56.8	27.98	22.95	29.07	23.88	29.86	24.55
57.0	28.10	23.06	29.20	23.99	29.99	24.66
57.2	28.23	23.17	29.34	24.11	30.13	24.78
57.4	28.35	23.27	29.47	24.22	30.27	24.90
57.6	28.48	23.38	29.60	24.33	30.41	25.01
57.8	28.60	23.49	29.73	24.44	30.55	25.13
58.0	28.73	23.59	29.87	24.55	30.69	25.25
58.2	28.86	23.70	29.99	24.66	30.83	25.37
58.4	28.98	23.81	30.13	24.78	30.97	25.49
58.6	29.11	23.91	30.26	24.89	31.11	25.61
58.8	29.23	24.02	30.40	25.00	31.25	25.73
59.0	29.36	24.13	30.53	25.12	31.40	25.86
59.2	29.49	24.24	30.67	25.24	31.54	25.98
59.4	29.61	24.34	30.81	25.36	31.68	26.10
59.6	29.74	24.45	30.94	25.47	31.83	26.23
59.8	29.87	24.56	31.08	25.59	31.97	26.35

REFRACTIVE INDEX—ALCOHOL

Scale Reading	20°C.		23°C.		25°C.	
	% by volume	% by weight	% by volume	% by weight	% by volume	% by weight
60.0	29.99	24.67	31.22	25.71	32.12	26.48
60.2	30.12	24.77	31.36	25.83	32.27	26.61
60.4	30.25	24.88	31.50	25.95	32.41	26.73
60.6	30.38	24.99	31.64	26.07	32.56	26.86
60.8	30.51	25.10	31.78	26.19	32.71	26.99
61.0	30.64	25.21	31.92	26.31	32.86	27.12
61.2	30.77	25.32	32.06	26.43	33.01	27.24
61.4	30.90	25.44	32.20	26.55	33.16	27.37
61.6	31.03	25.55	32.34	26.67	33.31	27.50
61.8	31.16	25.66	32.49	26.79	33.46	27.63
62.0	31.29	25.77	32.63	26.92	33.60	27.76
62.2	31.43	25.88	32.77	27.04	33.75	27.88
62.4	31.56	25.99	32.91	27.16	33.90	28.01
62.6	31.69	26.11	33.06	27.29	34.05	28.15
62.8	31.83	26.23	33.20	27.41	34.21	28.28
63.0	31.96	26.35	33.35	27.54	34.36	28.42
63.2	32.10	26.46	33.50	27.66	34.52	28.55
63.4	32.23	26.58	33.64	27.79	34.67	28.69
63.6	32.37	26.70	33.79	27.91	34.83	28.82
63.8	32.51	26.82	33.93	28.04	34.98	28.96
64.0	32.65	26.94	34.08	28.17	35.15	29.10
64.2	32.79	27.05	34.23	28.30	35.31	29.24
64.4	32.92	27.17	34.39	28.43	35.48	29.38
64.6	33.06	27.29	34.54	28.57	35.64	29.52
64.8	33.20	27.41	34.69	28.70	35.80	29.67
65.0	33.34	27.53	34.84	28.83	35.97	29.81
65.2	33.48	27.65	34.99	28.96	36.13	29.95
65.4	33.62	27.77	35.15	29.10	36.30	30.10
65.6	33.76	27.89	35.30	29.23	36.46	30.24
65.8	33.90	28.01	35.46	29.37	36.63	30.39
66.0	34.04	28.13	35.62	29.51	36.79	30.54
66.2	34.18	28.26	35.77	29.64	36.96	30.68
66.4	34.33	28.38	35.93	29.78	37.13	30.83
66.6	34.47	28.51	36.09	29.92	37.30	30.98
66.8	34.62	28.64	36.25	30.06	37.48	31.13
67.0	34.76	28.76	36.41	30.20	37.65	31.28
67.2	34.91	28.89	36.57	30.34	37.83	31.44
67.4	35.05	29.01	36.73	30.49	38.00	31.59
67.6	35.20	29.14	36.90	30.63	38.18	31.74
67.8	35.35	29.27	37.06	30.77	38.35	31.89
68.0	35.50	29.41	37.23	30.91	38.53	32.05
68.2	35.65	29.54	37.39	31.06	38.70	32.21
68.4	35.80	29.67	37.56	31.21	38.88	32.37
68.6	35.95	29.80	37.73	31.35	39.06	32.53
68.8	36.10	29.93	37.90	31.50	39.24	32.69
69.0	36.25	30.06	38.07	31.65	39.43	32.86
69.2	36.41	30.20	38.24	31.79	39.61	33.02
69.4	36.56	30.33	38.41	31.94	39.80	33.18
69.6	36.72	30.47	38.58	32.09	39.98	33.34
69.8	36.87	30.61	38.75	32.25	40.17	33.51
70.0	37.02	30.74	38.92	32.41	40.35	33.67
70.2	37.19	30.88	39.10	32.57	40.53	33.84
70.4	37.35	31.01	39.28	32.72	40.72	34.00
70.6	37.51	31.16	39.46	32.88	40.90	34.17
70.8	37.67	31.30	39.64	33.04	41.08	34.33
71.0	37.83	31.44	39.82	33.20	41.27	34.50
71.2	37.99	31.59	40.00	33.36	41.46	34.67
71.4	38.16	31.73	40.18	33.52	41.64	34.83
71.6	38.32	31.87	40.36	33.68	41.83	35.00
71.8	38.49	32.01	40.54	33.84	42.02	35.17

REFRACTIVE INDEX—ALCOHOL

Scale Reading	20°C.		23°C.		25°C.	
	% by volume	% by weight	% by volume	% by weight	% by volume	% by weight
72.0	38.65	32.17	40.72	34.00	42.21	35.34
72.2	38.82	32.32	40.90	34.16	42.40	35.51
72.4	38.98	32.47	41.08	34.33	42.58	35.68
72.6	39.16	32.62	41.26	34.49	42.77	35.85
72.8	39.33	32.77	41.45	34.65	42.96	36.02
73.0	39.50	32.92	41.63	34.81	43.15	36.18
73.2	39.67	33.07	41.81	34.98	43.33	36.35
73.4	39.84	33.22	41.99	35.14	43.52	36.52
73.6	40.02	33.37	42.17	35.31	43.70	36.68
73.8	40.19	33.53	42.36	35.47	43.89	36.85
74.0	40.36	33.68	42.54	35.64	44.08	37.02
74.2	40.53	33.83	42.72	35.80	44.28	37.20
74.4	40.71	33.98	42.91	35.97	44.48	37.38
74.6	40.88	34.14	43.09	36.13	44.67	37.56
74.8	41.05	34.30	43.28	36.30	44.87	37.75
75.0	41.23	34.46	43.46	36.47	45.07	37.93
75.2	41.41	34.61	43.65	36.64	45.29	38.12
75.4	41.58	34.77	43.83	36.81	45.50	38.31
75.6	41.76	34.93	44.02	36.97	45.71	38.50
75.8	41.94	35.09	44.21	37.15	45.92	38.69
76.0	42.12	35.25	44.41	37.33	46.12	38.88
76.2	42.30	35.41	44.60	37.50	46.34	39.08
76.4	42.48	35.58	44.80	37.68	46.56	39.29
76.6	42.66	35.74	44.99	37.86	46.78	39.49
76.8	42.84	35.90	45.19	38.04	47.00	39.69
77.0	43.02	36.07	45.40	38.23	47.23	39.90
77.2	43.20	36.24	45.60	38.42	47.45	40.11
77.4	43.39	36.40	45.81	38.60	47.68	40.32
77.6	43.57	36.57	46.01	38.79	47.91	40.54
77.8	43.76	36.74	46.23	38.98	48.14	40.75
78.0	43.94	36.91	46.45	39.18	48.37	40.97
78.2	44.13	37.08	46.67	39.39	48.60	41.18
78.4	44.32	37.25	46.89	39.59	48.84	41.40
78.6	44.51	37.42	47.11	39.80	49.07	41.62
78.8	44.70	37.59	47.34	40.00	49.31	41.84
79.0	44.89	37.76	47.56	40.21	49.54	42.05
79.2	45.08	37.94	47.79	40.42	49.77	42.27
79.4	45.28	38.11	48.01	40.63	50.01	42.49
79.6	45.48	38.30	48.23	40.84	50.24	42.71
79.8	45.68	38.48	48.46	41.05	50.48	42.93
80.0	45.88	38.67	48.68	41.26	50.71	43.15

CONVERSION OF SCALE DIVISIONS OF THE IMMERSION REFRACTOMETER TO REFRACTIVE INDEX

Originally the immersion instrument was designed with a single prism (A) of crown glass which allowed only the range from n_D 1.32 to 1.36 to be covered. By a choice of glass and prism angle it has been found possible with a battery of six prisms to extend the upper limit of the range to 1.54. Each prism of the series overlaps the one immediately above so that there is no lost region from 1.32 to 1.54. The ranges covered by these prisms are: A–1.32539 to 1.36674; B–1.36428 to 1.40608; C–1.39860 to 1.43830; D–1.43620 to 1.47562; E–1.47320 to 1.51335; F–1.50969 to 1.54409. Prism A is the standard to which the values in the table below apply. For the other prisms (B to F) the index of refraction is not standardized as between different manufacturers nor for different lots issued by the same manufacturer. For these prisms (B to F) it is necessary to use the table supplied with any particular instrument and impossible to publish any conversion tables which would be universally applicable.

Example: Scale division 25.1 on prism A corresponds to the refractive index $n_D = 1.33705 + 0.000038 = 1.33709$.

Scale Division	n_D	Scale Division	n_D	Scale Division	n_D
−5	1.32539	33	1.34010		
−4	2578	34	4048	70	1.35388
−3	2618			71	5425
−2	2657	35	4086	72	5461
−1	2696	36	4124	73	5497
		37	4162	74	5533
0	2736	38	4199		
1	2775	39	4237	75	5569
2	2814			76	5606
3	2854	40	4275	77	5642
4	2893	41	4313	78	5678
		42	4350	79	5714
5	2932	43	4388		
6	2971	44	4426	80	5750
7	3010			81	5786
8	3049	45	4463	82	5822
9	3087	46	4500	83	5858
		47	4537	84	5894
10	3126	48	4575		
11	3165	49	4612	85	5930
12	3204			86	5966
13	3242	50	4650	87	6002
14	3281	51	4687	88	6038
		52	4724	89	6074
15	3320	53	4761		
16	3358	54	4798	90	6109
17	3397			91	6145
18	3435	55	4836	92	6181
19	3474	56	4873	93	6217
		57	4910	94	6252
20	3513	58	4947		
21	3551	59	4984	95	6287
22	3590			96	6323
23	3628	60	5021	97	6359
24	3667	61	5058	98	6394
		62	5095	99	6429
25	3705	63	5132		
26	3743	64	5169	100	6464
27	3781			101	6500
28	3820	65	5205	102	6535
29	3858	66	5242	103	6570
		67	5279	104	6605
30	3896	68	5316		
31	3934	69	5352	105	6640
32	3972				

INDEX OF REFRACTION CALCULATIONS

For Organic Liquids.

Reference: Smiles, *The Relation between Chemical Constitution and some Physical Properties* (1910). Published by Longmans, Green and Co., London.

In the Lorentz and Lorenz formula:

$$\frac{n^2-1}{n^2+2}\times\frac{1}{d}=k$$

n is the index of refraction of a liquid at a given temperature, d is the density of the substance at the same temperature, and k, which is nearly independent of the temperature, is a constant known as the *specific refraction*. The product $M\times k$, where M is the molecular weight of the substance, is the *molecular refraction;* this quantity (Mk) is additive and can be calculated for most organic liquid compounds from empirically deduced atomic and structural refractive constants. Such refractive constants (k) for sodium (D) light are given in the following table:

	k		k
C	2.418	N	12.45; 23.21; 32.65; 43.59; 53.00; 64.36; 72.48; 82.47; 93.05; 103.79; 113.93; 122.65; 132.27; 142.71; 153.776; 163.901; 174.10; 183.46
H	1.100		
O	(*a*) 1.525; (*b*) 2.211; (*c*) 1.643; (*d*) 1.64		
S	(*e*) 7.69; (*f*) 7.97; (*g*) 7.91; (*h*) 8.11	NO_2	197.59; 207.44; 216.72; 227.30; 237.51
Hal.	(*i*) 5.967; (*j*) 8.865; (*k*) 13.900		
Str.	(*m*) 1.733; (*n*) 2.398; (*p*) 0.71; (*r*) 0.48	NO	245.91; 255.37

In the form of: (a) (OH); (b) C:O; (c) ether OR; (d) ester OR; (e) SH; (f) RSR; (g) RCNS; (h) RSSR; (i) Cl; (j) Br; (k) I; (m) double bond; (n) triple bond; (p) 3-membd. ring; (r) 4-membd. ring; (1) aliph. prim. amine; (2) arom. prim. amine; (3) aliph. sec. amine; (4) arom. sec. amine; (5) aliph. tert. amine; (6) arom. tert. amine; (7) hydroxylamine; (8) hydrazine; (9) aliph. cyanide; (10) arom. cyanide; (11) aliph. oxime; (12) prim. amide; (13) sec. amide; (14) tert. amide; (15) imidine; (16) oximido; (17) carbimido; (18) hydrazone; (19) alkyl nitrate; (20) alkyl nitrite; (21) nitro paraffin; (22) nitro arom.; (23) nitramine; (24) nitrite; (25) nitrosoamine.

Example: Allylacetic acid ($CH_2:CH\cdot CH_2\cdot CH_2\cdot CO\cdot OH$) has the following observed constants: $n_D^{7.5}=1.4341$; $d_4^{7.5}=0.9903$; molecular weight = 100.064. From this the calculated value of Mk is found as follows:

5 C	12.090
8 H	8.800
1 O′	1.525
1 O″	2.211
1 =	1.733
Mk_D	26.359

The observed value of Mk as calculated from the Lorentz and Lorenz formula is:

$$100.064\times\frac{(1.4341)^2-1}{(1.4341)^2+2}\times\frac{1}{0.9903}=26.319$$

Optical exaltation is characteristic of substances containing conjugated double bonds (single bonds alternating with double bonds); *i.e.*, their molecular refractions (Mk) are usually one or more units in excess of the calculated values.

For Minerals.

Reference: Larsen and Berman, *The Microscopic Determination of the Nonopaque Minerals*, 2d edition (1934); U. S. Geological Survey, Bull. 848. Washington, D. C.

In the Gladstone and Dale formula:

$$\frac{n-1}{d}=K,\ and\ K=k_1\frac{p_1}{100}+k_2\frac{p_2}{100}+etc.,$$

n is the mean index of refraction, d is the density, K is the specific refractive energy, k_1, k_2, etc. are the specific refractive energies of the components, and p_1, p_2, etc.

the weight percentages of the components of a mineral. The mean index of refraction is $\frac{2\omega+\epsilon}{3}$ or $\frac{\alpha+\beta+\gamma}{3}$ unless the substance is highly birefringent when the mean index is better expressed by $\sqrt[3]{\omega^2\epsilon}$ or $\sqrt[3]{\alpha\beta\gamma}$. The specific refractive energies of the chief constituents of minerals are given in the following table:

	Molecular weight	k		Molecular weight	k
H_2O	18	[a]0.3355, [b]0.340, [c].354	As_2O_3	198	[g]0.202, [h]0.225
Li_2O	30	.31	Y_2O_3	226	.144
$(NH_4)_2O$	52	.503	Sb_2O_3	228.4	[g].209, [i].232
Na_2O	62	.181	La_2O_3	326	.149
K_2O	94	.189	Ce_2O_3	328.5	.16
Cu_2O	143	.250	Bi_2O_3	464	.163
Rb_2O	187	.129	CO_2	44	.217
Ag_2O	232	.154	SiO_2	60	.207
Cs_2O	282	.124	TiO_2	80	.397
Hg_2O	416	.189 Li	SeO_2	111	.147
Tl_2O	424	.120	ZrO_2	122.5	.201
BeO	25	.238	SnO_2	151	.145
MgO	40.4	.200	SbO_2	152	.198
CaO	56	.225	TeO_2	159.5	[e].200 Li
MnO	71	[d].191, [e].224	ThO_2	264.5	.12
FeO	72	.187	N_2O_5	108	.240
NiO	75	.184	P_2O_5	142	.190
CoO	75	.184	Cl_2O_5	151	.218
CuO	79.6	[d].191, [e].253 Li	V_2O_5	182.4	.43
ZnO	81.4	[d].153, [e].183	As_2O_5	230	.169
SrO	103.6	.143	Br_2O_5	240	.183
CdO	128.4	.134	Cb_2O_5	268	.295
BaO	153.4	.127	Sb_2O_5	320.4	.152, .222(?)
HgO	216	.18	I_2O_5	334	.177
PbO	223	[d].137, [e].175 Li	Ta_2O_5	446	.133
B_2O_3	70	[g].220	SO_3	80	.177
C_2O_3	72	.265	CrO_3	100	.36
Al_2O_3	102	.193, [f].214	SeO_3	127	.165
Cr_2O_3	152	.27	MoO_3	144	.241 Li
Mn_2O_3	158	[d].300, [e].304 Li	TeO_3	175.6	.607
Fe_2O_3	160	[d].308, [e].36 Li	WO_3	235	.133
			UO_3	286.5	.134
	Atomic weight	k		Atomic weight	k
H	1	1.256 or 1.44	S	32	[k]0.502, [m]1.00
C	12	.403	Cl	35.5	.303
O	16	.203	Br	80	.214
F	19	.043	I	127	.226

[a] Water and ice.
[b] Average.
[c] Alums, etc.
[d] Calculated from compounds containing the oxide.
[e] Calculated from the oxide.
[f] Calculated from feldspar, feldspathoids, etc.
[g] Isometric oxide.
[h] Monoclinic oxide.
[i] Orthorhombic oxide.
[k] Calculated from native sulfur.
[m] Calculated from sulfides; values vary.

Example: Sodium tetraborate, $Na_2B_4O_7\cdot5H_2O$, has the following observed constants: formula, $Na_2O\cdot2B_2O_3\cdot5H_2O$; molecular weight, 292; contains, 21.2% Na_2O; 48% B_2O_3; 30.8% H_2O; d, 1.815; $\omega=1.461$; $\epsilon=1.474$. From the table k for Na_2O, 0.181; k for B_2O_3, 0.220; k for H_2O, 0.340. Therefore, $K=0.181\times21.2\%+0.220\times48\%+0.340\times30.8\%=0.24869$. Substituting in the Gladstone Dale formula:

$$\frac{n-1}{1.815}=0.24869, \text{ or } n=1.4514 \text{ by calculation.}$$

$$\text{The observed average value of } n=\frac{2\omega+\epsilon}{3}=\frac{2(1.461)+1.474}{3}=1.465$$

ISOTROPIC CRYSTALS FOR DETERMINING REFRACTIVE INDICES OF LIQUIDS BY IMMERSION METHODS

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Refr. index	Formula
1.326	NaF
1.340	K_2SiF_6
1.361	KF
1.370	$(NH_4)_2SiF_6$
1.439	$Na_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$
1.456	$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$
1.459	$(NH_4)_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$
1.481	$K_2SO_4 \cdot Cr_2(SO_4)_3 \cdot 24H_2O$
1.488	$(NH_4)_2SO_4 \cdot Fe_2(SO_4)_3 \cdot 24H_2O$
1.490	KCl
1.494	$RbCl$
1.504	$NaC_2H_3O_2 \cdot UO_2(C_2H_3O_2)_2$
1.515	$NaClO_3$
1.54	$NaCl$
1.553	$RbBr$
1.559	KBr
1.571	$Ba(NO_3)_2$
1.588	$Sr(NO_3)_2$

Refr. index	Formula
1.617	$NaBrO_3$
1.640	NH_4Cl
1.641	$NaBr$
1.645	$CsCl$
1.650	RbI
1.657	K_2SnCl_6
1.667	KI
1.678	$(NH_4)_2SnCl_6$
1.698	$CsBr$
1.703	NH_4I
1.755	As_2O_3
1.774	NaI
1.782	$Pb(NO_3)_2$
1.787	CsI
1.827	K_2PtCl_6
2.06	$AgCl$
2.25	$AgBr$

LIQUID MIXTURES FOR REFRACTIVE INDEX DETERMINATIONS

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Refr. Index (daylight, 20-22°C.)	Ethyl alcohol $n = 1.362$	Ethylene glycol ethyl ether ("Cellosolve") $n = 1.407$	Kerosene $n = 1.443$
1.370	50 cc.	9 cc.	.....
1.380	50	30	.....
1.390	35	50	.....
1.400	10	50	.....
1.410	.....	50	5 cc.
1.420	.....	50	35
1.430	.....	35	75
1.440	.....	5	75

Refractive indices	Mixtures
1.450-1.475	Kerosene and turpentine.
1.480-1.535	Turpentine and ethylene bromide or clove oil.
1.540-1.635	Clove oil and α-bromonaphthalene.
1.640-1.655	α-Bromonaphthalene and α-chloronaphthalene.
1.650-1.740	α-Bromonaphthalene and methylene iodide.
1.740-1.790	Sulfur dissolved in methylene iodide.
1.790-1.960	Methylene iodide, antimony iodide, arsenic sulfide, antimony sulfide, and sulfur.

REFRACTIVE INDICES (APPROXIMATE) OF VARIOUS SUBSTANCES

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Substance	ω	ϵ
"Acetate silk"	1.48	1.475
"Bakelite"	1.58—1.63	.....
Celluloid	1.53	.....
Cellulose fibers (cotton, flax, ramie, etc.)	1.53	1.59
"Collodion silk"	1.52	1.55
Gelatin, dry	1.54	.....
Horn	1.56	.....
Lacquer, dry ("Duco")	1.54	.....
Linseed oil, dry	1.48—1.50	.....
Rubber, pale crepe (vulcanized is higher)	1.51+	.....
Shellac	1.54	.....
Silk	1.54	1.59
Starch	1.53	.....
Varnish, dry	1.51—1.54	.....
"Viscose silk"	1.525	1.55
Wool	1.54+	1.55+

LIQUID STANDARDS FOR REFRACTIVE INDEX DETERMINATIONS BY IMMERSION METHODS

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Refr. Ind. (daylight, 20-22°C.)	Liquid
1.32	Methyl alcohol
1.333	Water
1.358	Acetone
1.36	Ethyl alcohol
1.38	Ethyl butyrate
1.39	Hexane
1.394	*iso*-Butyl alcohol
1.40	Heptane
1.40	Ethylene glycol monomethy ether
1.41	Amyl alcohol
1.41	Ethylene glycol monoethyl ether ("Cellosolve")
1.42	Ethylene glycol monobutyl ether
1.44	Chloroform
1.44	Ethylene chloride
1.45	Kerosene
1.46	Carbon tetrachloride
1.47	Cajeput oil
1.47	Glycerol
1.47	Olive oil
1.475	Paraffin oil ("Nujol")
1.475	Turpentine
1.48	Castor oil
1.49	Dibutyl phthalate
1.494	Xylene
1.495	Benzene
1.50	Lubricating oil (automobile)

Refr. Ind. (daylight, 20-22°C.)	Liquid
1.515	Anisole
1.515	Cedar wood oil
1.52	Chlorobenzene
1.53	Clove oil
1.54	Ethylene bromide
1.55	Nitrobenzene
1.56	Tricresyl phosphate
1.56	Bromobenzene
1.57	*o*-Toluidine
1.58	Bromophenol
1.586	Aniline
1.59	Bromoform
1.60	Cassia oil
1.61	Quinaldine
1.615	Cinnamic aldehyde
1.62	Iodobenzene
1.62	Quinoline
1.625	Carbon disulfide
1.63	α-Chloronaphthalene
1.66	α-Bromonaphthalene
1.74	Methylene iodide
1.78	Methylene iodide saturated with sulfur
1.87	Methylene iodide, S. CHI_3 SnI_4, AsI_3, SbI_3
1.64-2.10	Piperine, AsI_3, SbI_3
2.0-2.7	Sulfur-Selenium mixtures

MELTING POINTS OF COMPOUNDS USEFUL FOR DETERMINING APPROXIMATE MELTING POINTS WITH THE MICROSCOPE

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M.P. °C.	Compound
20	Acetophenone
22	Anethole
27	Diphenylmethane
30	*o*-Cresol
35	*p*-Cresol
41	Phenol
43	Salol
45	*o*-Nitrophenol
48	Chloral hydrate; Urethane
50	α-Naphthylamine
52	Thymol
53	*p*-Dichlorobenzene
58	Trichloroacetic acid
63	*m*-Phenylenediamine
67	Coumarin; Azobenzene
69	Diphenyl
70	Pyrazole
72	*o*-Nitroaniline
74	Hedonal
75	Borax
76	Trional
80	Naphthalene
81	Vanillin
86	Saligenin
87	*p*-Dibromobenzene
90	*m*-Dinitrobenzene
93	Triphenylmethane; Salipyrin
96	α-Naphthol; *m*-Nitrophenol
100	Phenanthrene; Exalgin
104	*o*-Phenylenediamine
105	Pyrocatechin
108	Pyramidon
110	Resorcinol; β-Naphthylamine
112	*m*-Nitroaniline
113	*p*-Nitrophenol
114	Acetanilide; Ammonium acetate
116	Atropine; Quinone
117	*o*-Dinitrobenzene
118	Chrysoidine
119	Iodoform
122	Benzoic acid; Picric acid; β-Naphthol
123	Dionine
128	Sulfonal
129	*o*-Tolidine
131	Maleic acid
133	Urea; Hydrastine
134	Pyrogallol

M.P. °C.	Compound
137	Picrolonic acid
140	*p*-Phenylenediamine
145	Anthranilic acid
148	*p*-Nitroaniline; 2, 4-Dinitroresorcinol
150	Ammonium thiocyanate
153	Citric acid; Methylglyoxime
156	Benzenesulphonimide
159	Salicylic acid
164	Cupferron
169	Hydroquinone
170	Santonin
171	Dimethylamine hydrochloride
172	*p*-Dinitrobenzene
173	Potassium thiocyanate
175	Quinine; Narcotine
178	Brucine
184	Quinine citrate
185	Succinic acid; Cinchonamine
186	Saccharose
189	Nitron
191	Veronal
193	Chrysophanic acid
198	Aniline hydrochloride
202	Salicin; Lactose
210	Cinchonidine
212	Silver nitrate
218	Anthracene
219	Phloroglucinol
228	Saccharin
235	Carbanilide
237	Caffeine
244	Carbazole
246	Dimethylglyoxime
248	Sodium chlorate
261	Phenolphthalein
268	Strychnine
280	Lead acetate (anhydrous)
285	Anthraquinone
288	Sulfanilic acid
290	Alizarin
297	Potassium nitrite
302	Mercurous chloride
324	Sodium acetate (anhydrous)
337	Theobromine
368	Potassium chlorate
398	Potassium dichromate

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Crystal Type	Crystal Units	Type of Binding	Characteristic Properties: Optical
Ionic	Simple and complex ions	Electrical attraction between ions of opposite signs	Transparent; color if present is due to ions
Silicate	O^{--} or F^{-} ions; Si^{4+} or Be^{2+} or Al^{3+} and other positive ions	Weak to moderate polarization	Refractivity due to positive ions
Homopolar	Atoms of the fourth group and of groups equidistant on either side of it	Homopolar bonds throughout or strongly polarized ionic bindings	Transparent with high refractivity or opaque metalloidal
Molecular	Inert gas atoms. Non-polar and polar molecules	Van der Waal's forces or residual electric fields	Transparent. Optical properites due to molecules
Layer	Strongly polarizing and easily polarized ions	In layers, homopolar or polarized ionic. Between layers, molecular	As homopolar
Metallic	Positive ions and electron gas	Electrical attraction between positive ions and electron gas	Opaque (due to free electrons)
Metalloidal	Metal atoms and atoms of the sulfur and arsenic groups	Mixture of homopolar, ionic, and metallic binding	Opaque, metallic or transparent with high refractivity and color

OF CRYSTALS

Freshmen," by C. W. Stillwell; *Jour. Chem. Education*, 10, 598 (1933).

Characteristic Properties			
Electrical	Thermal	Mechanical	Typical Crystals
Moderate insulators; in high fields conduct by transfer of ions	Fairly high melting point; ionization occurs in liquid, vapor	Strength increasing with higher ionization and decrease in distance beweeen ions. Fracture by cleavage	NaCl, CaF_2 $CaCO_3$, K_2SO_4, $(NH_4)_2PtCl_6$
When polarization is slight, dissolve in ionizing solvents (water); when stronger, are insoluble	Very high melting points, glasses formed on cooling of melt	Very hard with tendency to cleave or fracture conchoidally	Olivine, Mg_2SiO_2; Cyanite, Al_2SiO_5; Garnet, $R^{II}_3R^{III}_2$, Si_3O_{12}; Spinel, Al_2MgO_4, Al_2O_3, SiO_2
Diamond is a perfect insulator. The others conduct metalloidally. Very insoluble	Very high melting points with tendency to vaporize except in more metalloidal	Very hard. Hardness less for metalloidal types	Diamond, Zinc Blende, ZnS; Wurtzite, ZnS; Carborundum, CSi. Many intermediate compounds— γ brass
Insulators except when very polar; soluble in non-ionizing (molecular) solvents	Melting point very low with neutral atoms	Very soft, hardness increasing with polarity of molecules	Argon, A; CO_2; Ice, H_2O; Paraffins, C_nH_{2n+2}; Cellulose
Various, similar to both molecular and homopolar	Various, similar to both molecular and homopolar	Cleaving readily in layers which are soft and flexible	Graphite, C; CdI_2
Conductors, conductivity inversely proportional to number of free electrons	Moderate to very high melting points. Long liquid interval	Moderate hardness increased by alloying	Copper, iron, sodium, zinc
Medium to bad conductors. Soluble only with decomposition	Tendency to vaporize or decompose at high temperatures	Moderately hard to soft. Properties a mixture of those of other types	NiAs, FeS, FeS_2

X-RAY EMISSION SPECTRA OF THE K SERIES

Values selected from Siegbahn, *Spektroskopie der Rontgenstrahlen*, 2d. Ed., Julius Springer, Berlin, 1931.

Element	Atomic No.	Wave length in cm. $\times 10^{-11}$					
		α_1	α_2	α_3	β_1	β_2	β'
Sodium	11	11885		11805	11594	.....	11704
Magnesium	12	9869.0		9801.3	9539	.....	9648
Aluminum	13	8320.5		8266.9	7965	.....	8043
Silicon	14	7111.06		7064.9	6754.5	.....	6794.2
Phosphorus	15	6142.5		6103.0	5792.1	.....	5820.2
Sulfur	16	5361.3	5363.7	5329.4	5021.1	.....	5044.7
Chlorine	17	4718.2	4721.2	4688	4394.2	.....	4406
Potassium	19	3733.68	3737.07	3711.0	3446.8	.....	.....
Calcium	20	3351.69	3354.95	3332.3	3083.4	.....	3091.1
Scandium	21	3025.03	3028.40	$3006 = \alpha_{3,4}$	2773.9	.....	2799.2(?)
Titanium	22	2743.17	2746.81	$2726.9 = \alpha_{3,4}$	2509.0	.....	2517.0
Vanadium	23	2498.35	2502.13	$2484.6 = \alpha_{3,4}$	2279.7	.....	2287.8
Chromium	24	2285.03	2288.91	$2273.3 = \alpha_{3,4}$	2080.6	.....	2085.7
Manganese	25	2097.51	2101.49	$2087.9 = \alpha_{3,4}$	1906.20	.....	1910.50
Iron	26	1932.076	1936.012	$1923.30 = \alpha_{3,4}$	1753.013	.....	1756.46
Cobalt	27	1785.29	1789.19	$1777.4 = \alpha_{3,4}$	1617.44	.....	1620.11
Nickel	28	1654.50	1658.35	$1647.6 = \alpha_{3,4}$	1497.05	1485.61	1499.10
Copper	29	1537.395	1541.232	$1530.91 = \alpha_{3,4}$	1389.35	1378.24	.....
Zinc	30	1432.17	1436.03	$1428.8 = \alpha_{3,4}$	1292.55	1281.07	.....
Gallium	31	1337.15	1340.87	.....	1205.20	1193.8	.....
Germanium	32	1251.30	1255.21	.....	1126.71	1114.59	.....
Arsenic	33	1173.44	1177.43	.....	1055.10	1042.81	.....
Selenium	34	1102.48	1106.52	.....	990.13	977.91	.....
		α_1	α_2	α_3	β_1	β_2	β_3
Bromine	35	1037.59	1041.66	.....	930.87	918.53	.....
Krypton	36	978		.....	875	.....	.....
Rubidium	37	923.64	927.76	.....	826.96	814.76	827.49
Strontium	38	873.45	877.61	.....	781.30	769.21	781.83
Yttrium	39	827.12	831.32	.....	739.19	727.13	739.72
Zirconium	40	784.30	788.51	.....	700.28	688.50	700.83
Columbium (Niobium)	41	744.65	748.89	.....	664.38	652.80	664.96
Molybdenum	42	707.831	712.805	.....	630.978	619.698	631.543
Masurium	43	672	675	.....	601	.....	601
Ruthenium	44	641.74	646.06	.....	571.31	560.51	571.93
Rhodium	45	612.02	616.37	.....	544.49	533.96	545.09
Palladium	46	584.27	588.63	.....	519.47	509.18	520.09
Silver	47	558.28	562.67	.....	496.01	486.03	496.65
Cadmium	48	533.90	538.32	.....	474.08	464.20	474.71
Indium	49	511.06	515.48	.....	453.58	444.08	454.23
Tin	50	489.57	494.02	.....	434.30	424.99	434.95
Antimony	51	469.31	473.87	.....	416.23	407.10	416.23
Tellurium	52	450.37	454.91	.....	399.26	390.37	399.26
Iodine	53	432.49	437.03	.....	383.15	374.71	383.92
Xenon	54	417		.....	360	.....	.....
Cesium	55	399.59	404.11	.....	353.62	345.16	354.36
Barium	56	384.43	388.99	.....	340.22	332.22	340.89
Lanthanum	57	370.04	374.66	.....	327.26	319.66	328.09
Cerium	58	356.47	361.10	.....	315.01	307.70	315.72
Praseodymium	59	343.40	348.05	.....	303.60	296.25	304.39
Neodymium	60	331.25	335.95	.....	292.75	285.73	293.51
Illinium	61	320	324	.....	281	.....	.....
Samarium	62	308.33	313.02	.....	272.50	265.75	273.25
Europium	63	297.90	302.65	.....	263.07	256.45	263.86

X-RAY EMISSION SPECTRA OF THE K SERIES

Element	Atomic No.	Wave length in cm. $\times 10^{-11}$					
		α_1	α_2	α_3	β_1	β_2	β_3
Gadolinium	64	287.82	292.61	.....	253.94	247.62	254.71
Terbium	65	278.20	282.86	.....	245.51	239.12	246.29
Dysprosium	66	269.03	273.75	.....	237.10	231.28	237.87
Holmium	67	260.30	264.99	.....	.....	.....	.....
Erbium	68	251.97	256.64	.....	222.15	216.71	223.00
Thulium	69	243.87	248.61	.....	214.87	.....	215.58
Ytterbium	70	236.28	240.98	.....	208.34	203.22	209.16
Lutecium	71	228.82	233.58	.....	201.71	196.49	202.52
Hafnium	72	221.73	226.53	.....	195.15	190.42	195.83
		α_1		α_2	$\alpha_{1,3}$		β_2
Tantalum	73	214.88		219.73	189.91		184.52
Tungsten	74	208.62		213.45	184.22		178.98
Osmium	76	196.45		201.31	173.61		168.75
Iridium	77	190.65		195.50	168.50		163.76
Platinum	78	182.23		190.04	163.70		158.87
Gold	79	179.96		184.83	159.02		154.26
Thallium	81	169.80		174.66	150.11		145.39
Lead	82	165.16		170.04	146.06		141.25
Bismuth	83	160.41		165.25	142.05		136.21
Thorium	90	132.3		136.8	116.9		113.4
Uranium	92	126.40		130.95	111.87		108.42

X-RAY EMISSION SPECTRA OF THE M SERIES

Values selected from Siegbahn, *Spektroskopie der Rontgenstrahlen*, 2d. Ed., Julius Springer, Berlin, 1931.

Element	Atomic No.	Wave length in cm. $\times 10^{-11}$						
		γ	β	α_1	α_2	α_I	α_{II}	α_{III}
Cerium	58	11511	13755	.....	.....	14030	.....	.....
Praseodymium	59	10975	.....	.....	.....	.....	.....	.....
Neodymium	60	10483	12375	.....	.....	12650	.....	.....
Samarium	62	9580	11238	.....	.....	11406	11475	11532
Europium	63	9192	10723	.....	.....	10932	11003	.....
Gadolinium	64	8826	10233	.....	.....	10394	10428	10508
Terbium	65	8468	9772	.....	.....	9917	9946	9989
Dysprosium	66	8127	9345	.....	.....	9524	9555	9574
Holmium	67	7849	8947	.....	.....	9143	9165	9195
Erbium	68	7530	8576	.....	.....	8783	8794	8810
Ytterbium	70	7009	7893	.....	.....	8122	8138	.....
Lutecium	71	6748	7585	.....	.....	7824	.....	.....
Hafnium	72	6530	7289	7524	.....	.....	.....	.....
Tantalum	73	6299	7008	7237	.....	.....	.....	.....
Tungsten	74	6076	6743	6969	.....	.....	.....	.....
Rhenium	75	5875	6491	6715	.....	.....	.....	.....
Osmium	76	5670	6254	6477	.....	.....	.....	.....
Iridium	77	5490	6025	6249	6262	.....	.....	.....
Platinum	78	5309	5816	6034	6045	.....	.....	.....
Gold	79	5135	5612	5828	5842	.....	.....	.....
Thallium	81	4815	5239	5450	5461	.....	.....	.....
Lead	82	4665	5065	5274	5288	.....	.....	.....
Bismuth	83	4522	4899	5108	5119	.....	.....	.....
Thorium	90	3672	3934	4130	4143	.....	.....	.....
Uranium	92	3473	3708	3902	3916	.....	.....	.....

X-RAY EMISSION SPEC-

Values selected from Siegbahn, *Spektroskopie der*

Element	Atomic No.	Wave length in cm. $\times 10^{-11}$					
		ι	η	α_1	α_2	β_1	β_2
Iron	26	20120	19650		17580	17220	.....
Cobalt	27	18200	17770		15940	15620	.....
Nickel	28	16550	16170		14530	14240	.....
Copper	29	15190	14830		13306	13030	.....
Zinc	30	13950	13610		12230	11960	.....
Gallium	31	12890	12560		11270	11010	.....
Germanium	32	11922	11587		10415	10153	.....
Arsenic	33	11048	10711		9652	9395	.....
Selenium	34	10272	9939		8972	8718	.....
Bromine	35	9564	9235		8358	8109	.....
Rubidium	37	.....	.....	.....	.....	.....	.....
Strontium	38	7822	7506		6848.6	6610.0	.....
Yttrium	39	.....	7031.0		6435.7	6203.9	.....
Zirconium	40	6899	6593.9		6056.7	5823.6	5574.2
Columbium (Niobium)	41	6510	6196	5712.0	5718	5480.3	5226.0
Molybdenum	42	.....	5836	5395.0	5401	5166.5	4910.0
Ruthenium	44	5486.4	.....	4835.7	4843.7	4611.0	4361.9
Rhodium	45	5207.0	4911.2	4587.8	4595.6	4364.0	4122.1
Palladium	46	4939.6	4650.2	4358.5	4366.6	4137.3	3900.7
Silver	47	4697.6	4410.1	4145.6	4153.8	3926.6	3693.8
Cadmium	48	4471.3	4187 5	3947.8	3956.4	3730.1	3506.4
Indium	49	4259.3	3976.1	3763.7	3772.4	3547.8	3331.2
Tin	50	4063.3	3781.8	3592.2	3601 1	3377.9	3167.9
Antimony	51	3880.3	3599.6	3431.8	3440.8	3218.4	3016.6
Tellurium	52	3710.1	.....	3282.0	3291.0	3070.0	2876.1
Iodine	53	3549.7	.....	3141.7	3150.9	2930.9	2746.1
Cesium	55	3259.6	2983.3	2886.1	2895.6	2677.8	2506.4
Barium	56	3128.7	2857.1	2769.6	2779.0	2562.2	2399.3
Lanthanum	57	3000	2734	2659.7	2668.9	2453.3	2298.0
Cerium	58	2885.7	2614.7	2556.0	2565.1	2351.0	2204.1
Praseodymium	59	2778.1	2507	2457.7	2467.6	2253.9	2114.8
Neodymium	60	2670.3	2404.2	2365.3	2375.6	2162.2	2031.4
Samarium	62	2477	2214	2195.0	2205.7	1993.6	1878.1
Europium	63	2390.3	.....	2116.3	2127.3	1916.3	1808.2
Gadolinium	64	2307.1	.....	2041.9	2052.6	1842.5	1741.9
Terbium	65	2229.0	.....	1971.5	1982.3	1772.7	1679.0
Dysprosium	66	2154.0	1892.2	1904.6	1915.6	1706.6	1619.8
Holmium	67	2082.1	1822.0	1841.0	1852.1	1643.5	1563.7
Erbium	68	2015.1	1754.8	1780.4	1791.4	1583.4	1510.6
Thulium	69	1951.1	1692.3	1722.8	1733.9	1526.8	1460.2
Ytterbium	70	1890	1631	1667.8	1678.9	1472.5	1412.8
Lutecium	71	1831.8	1573.8	1615.51	1626.36	1420.7	1367.2
Hafnium	72	1777.4	1519.7	1566.07	1577.04	1371.1	1323.5
Tantalum	73	1724.9	1467.9	1518.85	1529.78	1324.23	1281.90
Tungsten	74	1675.0	1418.1	1473.36	1484.38	1279.17	1242.03
Rhenium	75	1627.3	1370.6	1429.97	1441.0	1236.03	1204.1

* For γ_4, γ'_4.

TRA OF THE L SERIES

Rontgenstrahlen, 2d. Ed. Julius Springer, Berlin.

Wave length in cm. $\times 10^{-11}$								No.
β_3	β_4	β_6	γ_1	γ_2	γ_3	γ_4	γ_5	
	15610	.....	.....	.....	.....	.....	.....	26
.....	.....	.....	.....	.....	.....	.....	.....	27
	13140	.....	.....	.....	.....	.....	.....	28
	12100	.....	.....	.....	.....	.....	.....	29
	11160	.....	.....	.....	.....	.....	.....	30
.....	.....	.....	.....	.....	.....	.....	.....	31
.....	.....	.....	.....	.....	.....	.....	.....	32
	8912	.....	.....	.....	.....	.....	.....	33
.....	.....	.....	.....	.....	.....	.....	.....	34
.....	.....	.....	.....	.....	.....	.....	.....	35
6769.4	6800.9	6968.1	.....		6036.0	.....	.....	37
6358.2	6391.8	6508.1	.....		5637.4	.....	6279.6	38
5974.1	6007.7	6085.7	.....		5270.3	.....	.....	39
5618.6	5651.7	5692.7	5373.8		4940.8	.....	5481.8	40
5297.1	5330.6	5347.1	5024.8		4646.7	.....	.....	41
5004.7	5041.0	.....	.....		4369.5	.....	4831.2	42
4476.4	4512.6	4476.4	4172.8		3887.9	.....	4276.6	44
4244.7	4280.2	4232.8	3935.7		3681.5	.....	4035.2	45
4025.7	4062.3	4007.0	3716.4		3480.9	.....	3811.6	46
3824.5	3861.1	3798.6	3514.9		3299.8	.....	3607.3	47
3636.4	3674.3	3607.3	3328.0		3131.6	.....	3418.1	48
3461.9	3499.0	3428.0	3155.3		2973.6	2919.1	3241.8	49
3298.9	3336.3	3262.2	2994.9		2830.1	2771.3	3077.4	50
3145.1	3184.3	3107.8	2845.1		2695.3	2633.6	2925.6	51
3001.3	3040.0	2964.4	2706.5		2564.9	2505.7	2783.1	52
2868.2	2905.9	2830.5	2577.5		2442.1	2386.2	.....	53

Wave length in cm $\times 10^{-11}$									
β_3	β_4	β_6	β_7	γ_1	γ_2	γ_3	γ_4	γ_5	γ_8
2622.9	2660.5	2587.5	2480	2342.5	2232.2	2227.0	2169.1	2411.1	.....
2511.0	2549.8	2477.2	2375.6	2236.6	2134.0	2129.5	2071.5	2302.3	2218
2405.3	2443.8	2373.9	2270	2137.2	2041.6	2036.6	1978.7	2200.8	.....
2305.9	2344.2	2276.9	2176.3	2044.3	1955.9	1950.9	1895.2	2105.6	2019
2212.4	2250.1	2185.9	2087.4	1956.8	1875.0	1869.9	1815.3	2016.1	1932.2
2122.2	2162.2	2099.3	2004.3	1873.8	1797.4	1792.5	1740.8	1931.3	.....
1958.0	1996.4	1942.2	1852.3	1723.1	1655.9	1651.7	1603.3	1775.1	.....
1882.7	1922.1	1870.5	1784	1654.3	1593.9	1587.7	1540.7	1705	1629
1810.9	1849.3	1803.1	1719.6	1588.6	1531.0	1525.9	1481.8	1637.6	.....
1742.5	1781.4	1737.5	1655.8	1526.6	1473.8	1468.3	1423 9*	1574.2	.....
1677.7	1716.7	1677.7	1595.7	1469.7	1420.3	1413.9	1371.4*	1515.2	.....
1616.0	1655.3	1618.8	.....	1414.2	1367.7	1361.3	1319.7*	1459	.....
1557.9	1596.4	1563.6	1489.2	1362.3	1318.4	1311.8	1273.2*	1403	.....
1502.3	1541.2	1511.5	.....	1312.7	1271.2	1265.3	1226.4*	1352.3	.....
1449.4	1488.2	1462.7	.....	1264.8	1225.6	1219.8	1182.0*	1303.0	1248.3
1398.2	1437.2	1414.3	1345.9	1220.3	1183.2	1177.5	1141.1*	1256	1202
1349.7	1389.3	1371.1	1303.5	1176.5	1141.3	1135.6	1100.1*	1212.1	.....
1304.09	1343.07	1328.4	1261.3	1135.58	1103.0	1097.08	1062.7*	1170.8	.....
1259.92	1298.79	1287.0	1221.7	1096.30	1065.88	1059.87	1025.8*	1129.8	1079.1
1217.6	1256.3	1248.1	1183.3	1058.7	1029.9	1023.6	991.0*	1091.2	.....

(*Completed on the following page.*)

X-RAY EMISSION SPEC-

Element	Atonic No.	Wave length in cm. $\times 10^{-11}$					
		ι	η	α_1	α_2	β_1	β_2
Osmium	76	.....	.....	1388.59	1398.66	1194.90	1168.84
Iridium	77	Cu $K\alpha_{3,4}$	1281.7	1348.47	1359.8	1155.40	1132.97
Platinum	78	1496.4	1240.3	1310.33	1321.55	1117.58	1099.74
Gold	79	1456.9	1200.3	1273.77	1285.02	1081.28	1068.01
Mercury	80	1418.41	1161.6	1238.63	1249.51	1046.52	1037.70
Thallium	81	1381.9	1125.4	1204.93	1216.26	1012.99	1008.22
Lead	82	1347.4	1090.0	1172.58	1184.08	980.83	980.83
Bismuth	83	1313.7	1056.5	1141.50	1153.01	950.02	953.24
Thorium	90	1112.8	852.8	954.05	965.85	763.56	791.92
Protoactinium	91	1088.5	827.8	930.9	942.7	740.7	772.1
Uranium	92	1064.9	803.5	908.74	920.62	718.51	753.07

*For γ_4, γ'_4.

MATERIALS COMMONLY USED FOR X-RAY FILTERS

Target Element	Atomic No.	Emission spectra, K series. λ in cm. $\times 10^{-11}$			Minimum voltage Kilovolts	Filter*	
		$\lambda\alpha_1$	$\lambda\alpha_2$	$\lambda\beta_1$		Element	K band
Cr	24	2285.03	2288.91	2080.6	5.98	V	2265.3
Fe	26	1932.08	1936.01	1753.01	7.10	Mn	1889.2
Ni	28	1654.50	1658.35	1497.05	8.29	Co	1601.8
Cu	29	1537.40	1541.23	1389.35	8.86	Ni	1489.0
Zn	39	1432.17	1436.03	1292.55	9.65	Cu	1378.5
Mo	42	707.83	712.81	630.98	20.0	Zr	687.2
Ru	44	641.74	646.06	571.31	22.1	Mo	618.4
Rh	45	612.02	616.37	544.49	23.2	Ru	558.4
Pd	46	584.27	588.63	519.47	24.4	Rh	533.0
Ag	47	558.28	562.67	496.01	25.5	Pd	507.5
							or
						Rh	533.0
Sn	50	489.57	494.02	434.30	29.1	Ag	485.0
							or
						Cd	463.2
W	74	208.62	213.45	184.22	69.3	.....	.....
Pt	78	182.23	190.04	163.70	78.1	W	178.2

* Desirable thickness for X-ray filters are: Mn = 0.005 mm.; Ni = 0.007mm; Zr = 0.03mm.; Pd = 0.03mm.

TRA OF THE L SERIES (Continued)

Wavelength in cm. $\times 10^{-11}$									
β_3	β_4	β_6	β_7	γ_1	γ_2	γ_3	γ_4	γ_5	γ_8
.....	.....	.....	.....	1022.96	.....	.....	.....	.....	.....
1138.47	1177.15	1175.45	1112.6	988.76	963.32	957.13	925.7*	1019.5	971.9
1101.65	1139.86	1141.00	1079.4	955.99	932.33	925.99	895.2*	985.7	938.6
1065.50	1104.22	1108.63	1049.8	924.61	902.48	895.81	865.5*	953.6	907.9
1030.46	1069.2	1076.8	1015.5	894.6	872.4	866.2	836.1*	922.9	.....
998.50	1036.99	1047.48	988.0	865.71	845.71	839.34	810.1*	892.9	849.0
967.21	1005.63	1019.06	960.3	838.01	819.17	812.93	784.3*	864.7	822.0
936.66	975.01	991.31	933.0	811.43	794.00	789.46	759.3	837.7	.....
753.24	791.92	826.46	772.8	651.76	640.79	634.13	609.5	673.4	637.4
730.7	768.3	806.2	753.0	632.5	622.6	615.6	592.5*	653.6	.....
708.79	746.4	786.79	734.6	613.59	603.86	597.11	573.6	634.2	600.0

LATTICE CONSTANTS OF STANDARD CRYSTALS

Values selected from Siegbahn, *Spektroskopie der Rontgenstrahlen*, 2d. Ed., Julius Springer, Berlin, 1931.

Crystal	Lattice Constant in cm. $\times 10^{-11}$ at 18°C.		
	First order	Second order	Third order
Calcite	3029.04	3029.34	3029.40
Gypsum	7579.07	7583.29	7584.15
Mica	9927.58	9938.93	9941.04
Quartz	4244.92	4245.74	4245.90
Rock salt	2814.00	.....	.....

TOTAL MASS ABSORPTION VALUES FROM FORMULA

The values given in the following table make it possible to calculate the mass absorption for any wave length in the given range by substituting in the formula in column 3. The values are those of Richtmyer.

Absorption material	Wave length, λ, in Å	Total mass absorption μ/ρ
Al	0.1 to 0.4	$14.45\lambda^3+0.15$
Al	0.4 to 0.7	$14.30\lambda^3+0.16$
Fe	0.1 to 0.3	$110\lambda^3+0.18$
Co	0.1 to 0.3	$124\lambda^3+0.18$
Ni	0.1 to 0.3	$145\lambda^3+0.20$
Cu	0.1 to 0.3	$153\lambda^3+0.20$
Cu	0.1 to 0.6	$147\lambda^3+0.5$
Mo	0.1 to 0.35	$450\lambda^3+0.4$
Mo	$>\lambda_K$	$51.5\lambda^3+1$
Ag	0.1 to 0.4	$603\lambda^3+0.7$
Ag	$>\lambda_K$	$86\lambda^3+0.6$
Pb	$>\lambda_K$	$510\lambda^3+0.75$

TOTAL MASS ABSORPTION COEFFICIENTS

In the following table, the wave length, λ, is in Angstrom units, ρ is the density as given for each element in the line above the table, while μ/ρ is the total mass absorption coefficient.

CARBON. Atomic No. = 6. Density of diamond = 3.51; of graphite = 2.3

λ in Å.	μ/ρ	λ in Å.	μ/ρ	λ in Å.	μ/ρ
0.081	0.143	0.50	0.326	1.00	1.5
0.10	0.150	0.631	0.55	1.17	2.4
0.20	0.165	0.709	0.63	1.39	3.8
0.30	0.190	0.80	0.90	1.53	4.9
0.40	0.245	0.90	1.2	1.933	9.2

ALUMINUM. Atomic No. = 13. Density = 2.7

λ in Å.	μ/ρ	λ in Å.	μ/ρ	λ in Å.	μ/ρ
0.081	0.145	0.90	10.4	2.00	110
0.09	0.160	0.925	11.8	2.50	182
0.10	0.16	1.00	14.2	2.744	248
0.15	0.20	1.09	18.5	3.026	320
0.20	0.27	1.175	22.5	3.353	433
0.30	0.56	1.293	29.8	4.146	771
0.40	1.08	1.39	36.0	4.36	894
0.50	1.96	1.433	40.3	5.394	1480
0.60	3.25	1.54	48.5	6.973	2800
0.631	3.71	1.655	61.5	(the K band)	
0.70	5.07	1.752	73.2	8.32	344
0.709	5.26	1.933	94	9.868	553
0.80	7.48			11.88	767

IRON. Atomic No. = 26. Density = 7.7 to 7.9

λ in Å.	μ/ρ	λ in Å.	μ/ρ	λ in Å.	μ/ρ
0.081	0.235	0.50	13.8	1.17	160
0.09	0.25	0.60	22.6	1.293	213
0.10	0.27	0.70	35.3	1.433	290
0.15	0.55	0.80	50.7	1.539	330
0.20	1.06	0.90	68.3	1.655	430
0.30	3.15	1.00	102	(the K band)	
0.40	7.25	1.09	128	1.75	56
				1.933	71

COPPER. Atomic No. = 29. Density = 8.9

λ in Å.	μ/ρ	λ in Å.	μ/ρ	λ in Å.	μ/ρ
0.081	0.27	0.90	98	1.934	99
0.09	0.295	1.00	133	2.00	116
0.10	0.35	1.09	165	2.50	202
0.15	0.72	1.10	176	2.744	262
0.20	1.41	1.17	206	3.026	321
0.30	4.31	1.293	266	3.353	404
0.40	9.92	1.348	287	4.146	621
0.50	18.9	(the K band)		4.359	730
0.60	32.3	1.39	38.0	5.394	1300
0.631	37.8	1.433	42.0	6.973	2120
0.70	49	1.54	50	8.319	3450
0.709	52	1.656	64	9.868	5030
0.80	72	1.752	76	11.884	7550
		1.787	85.6		

TOTAL MASS ABSORPTION COEFFICIENTS

MOLYBDENUM. Atomic No. = 42. Density = 10.2

λ in Å.	μ/ρ	λ in Å.	μ/ρ	λ in Å.	μ/ρ
0.10	1.38	0.40	25.0	0.70	18.1
0.15	2.26	0.50	48.0	0.80	26.7
0.20	4.00	0.60	82.0	0.90	37.5
0.30	11.1	(the K band)		1.0	51.0
		0.631	13.4		

SILVER. Atomic No. = 47. Density = 10.5

λ in Å.	μ/ρ	λ in Å.	μ/ρ	λ in Å.	μ/ρ
0.081	0.74	1.00	73	3.026	1330
0.09	0.90	1.104	97	(the LI band)	
0.10	1.55	1.17	111	3.353	1310
0.15	2.84	1.293	146	3.432	1460
0.20	5.36	1.389	173	(the LII band)	
0.30	15.8	1.433	192	3.592	1360
0.40	35.9	1.539	225	(the LIII band)	
(the K band)		1.656	280	4.146	461
0.50	9.75	1.752	325	4.359	539
0.60	16.1	1.934	410	5.394	852
0.70	25.0	2.50	696	6.973	1260
0.80	41	2.744	925	9.868	2720
0.90	55				

TIN. Atomic No. = 50. Density = 7.3

λ in Å.	μ/ρ	λ in Å.	μ/ρ	λ in Å.	μ/ρ
0.081	0.80	0.60	20.4	1.293	176
0.09	0.95	0.70	31.8	1.389	205
0.10	1.58	0.80	47	1.433	235
0.20	5.8	0.90	64	1.539	325(?)
0.30	18.0	1.00	87	1.656	375(?)
0.40	40.0	1.09	110	1.752	385
(the K band)		1.17	132	1.934	490
0.50	12.2				

TUNGSTEN. Atomic No. = 74. Density = 19.1

λ in Å.	μ/ρ	λ in Å.	μ/ρ	λ in Å.	μ/ρ
0.081	2.40	0.15	7.10	0.50	38.0
0.09	2.80	0.30	9.72	0.631	75
0.10	2.67	0.40	19.8	1.293	105
(the K band)				1.433	130

PLATINUM. Atomic No. = 78. Density = 21.4

λ in Å.	μ/ρ	λ in Å.	μ/ρ	λ in Å.	μ/ρ
0.081	2.50	0.40	24.5	0.90	169
0.09	2.95	0.50	45.5	(the LII band)	
0.10	3.7	0.60	75.2	1.0	165
0.15	7.8	0.70	107	(the LIII band)	
(the K band)		0.80	150	1.104	81.4
0.20	4.2	(the LI band)		1.17	100
0.30	11.5				

TOTAL MASS ABSORPTION COEFFICIENTS

PLATINUM (Cont.)

λ in Å.	μ/ρ	λ in Å.	μ/ρ	λ in Å.	μ/ρ
1.293	131	2.00	408	4.146	1290
1.389	155	2.50	596	(the MIII band)	
1.433	171	2.744	756	5.394	1640
1.539	199	3.026	939	(the MIV MV band)	
1.656	243	3.353	1120	6.973	1190
1.752	280	3.592	1370	8.319	1530
1.787	291	(the MI band)		9.868	2440
1.934	365				

GOLD. Atomic No. 79. Density = 19.3

λ in Å.	μ/ρ	λ in Å.	μ/ρ	λ in Å.	μ/ρ
0.081	2.44	0.80	150	1.17	104
0.09	2.85	0.847	184	1.293	137
0.10	3.07	(the LI band)		1.389	168
0.15	8.37	0.871	166	1.433	179
(the K band)		(the LII band)		1.539	210
0.20	4.01	0.912	165	1.656	265
0.30	11.5	1.0	179	1.752	303
0.50	49.7	(the LIII band)		1.934	386
0.70	110	1.09	88	2.0	427
0.709	122				

LEAD. Atomic No. = 82. Density = 11.3

λ in Å.	μ/ρ	λ in Å.	μ/ρ	λ in Å.	μ/ρ
0.081	2.53	0.50	58	1.17	120
0.09	3.0	0.60	77	1.293	154
0.10	3.27	0.63	102	1.39	180
(the K band)		0.709	140	1.43	202
0.15	2.31	0.8	147	1.54	230
0.20	4.51	(the L band)		1.65	290
0.30	13.6	1.0	77	1.93	420
0.40	31.8	1.09	98		

URANIUM. Atomic No. = 92. Density = 18.7

λ in Å.	μ/ρ	λ in Å.	μ/ρ	λ in Å.	μ/ρ
0.095	3.53	0.126	1.90	0.151	3.78
(the K band)		0.14	2.56	0.164	3.24
0.113	1.78				

FLUORESCENCE AND PHOSPHORESCENCE

Ultraviolet radiation causes many substances to emit light; if the emission occurs only when the ultraviolet radiation is present the phenomenon is known as *fluorescence*. If the emission occurs after removal of the ultraviolet radiation the afterglow is termed *phosphorescence*. Fundamentally both fluorescence and phosphorescence are identical.

Exciting agents need not be ultraviolet light. Fluorescence can be due to: heat (*thermoluminescence*); visible light (*photoluminescence*); X-rays; electrical waves; γ rays; radio waves; cathode rays (*cathodoluminescence*); β rays; α rays; molecular beams; neutron and deuteron beams; positrons; streams of various ions (*ionoluminescence*); friction (*triboluminescence*); crystallization (*crystalloluminescence*); cold; pressure; mechanical excitation; sound waves (*sonoluminescence*); oxidation and special chemical reactions (*bio-* and *chemi-luminescence*); flames; electrolysis; and several others. For additional data the references which follow should be consulted.

Fluorescence is characteristic of numerous substances, but in many it is highly variable, depending on the nature, purity, history, and condition of the material. Fluorescence generally occurs best in solution. Actually, only a few very pure and dry substances fluoresce since most substances have impurities which activate luminescence. Water and crystalline condition also predominate as activators. A *phosphor* is a luminescent system consisting of a base and a trace of impurity called an activator: $AB+M$ where A may be Ba, Ca, Na, K, Mg, Li, etc., associated with anion B which may be sulfide, oxide, tungstate, silicate, carbonate, etc. M is the trace of metal which may be U, Mn, Cu, rare earths, etc. A flux may be incorporated with this, and very complex phosphors are built upon this basis. The notation *ZnCuS* represents a typical phosphor-Cu activated ZnS.

The exciting agent used in most studies is usually one of two types of ultraviolet radiation suitably filtered to eliminate visible light. One wavelength is most suited to the study of organic substances and is called *long wavelength radiation*, the tentative standard being Hg = 3650Å. *Short wavelength radiation* is usually best suited for excitation of inorganic substances and its tentative standard wavelength is Hg = 2537Å (*resonance radiation*).

References which have been consulted for data in the following tables include:

Dake and De Ment: *Fluorescent Light and Its Applications*, Chemical Publishing Company, New York (1941); Dake and De Ment: *Ultraviolet Light and Its Applications*, Chemical Publishing Company, New York (1942); De Ment and Dake: *Uranium and Atomic Power*, Chemical Publishing Company, New York (1941); De Ment: *Fluorescent Chemicals and Their Applications*, Chemical Publishing Company, New York (1942); Radley and Grant; *Fluorescence Analysis in Ultraviolet Light*, D. Van Nostrand Company, 3d edition, New York (1939).

The arrangement in the following tables is alphabetical with abbreviations for filtered ultraviolet light being L = long λ = 3650Å, and S = short λ = 2537Å. The symbol LS is used to indicate both long and short wavelengths. The variability of fluorescent response should always be considered when using these tables. Aqueous solutions are indicated by the abbreviation *soln.*

FLUORESCENT CHEMICALS

In the following table, fluorescence most representative of the substance is listed together with the wavelength which evokes it. As with other substances fluorescence of chemicals may be widely variant, differing with the purity, history, structure, and state of the compound. Solution and alteration in pH markedly affect the fluorescence of many chemicals. However, numerous closely related compounds can easily be discriminated by their fluorescence. Impurities in inorganic substances usually enhance fluorescence but in many organic substances fluorescence is a property of the molecule. Fluorescence is a valuable adjunct in the study of materials and further information can be obtained from the references quoted. Several chemicals which emit ultraviolet light when excited by X-rays are also included in the table.

Name	λ	Fluorescence	Name	λ	Fluorescence
Acetamide	L	Medium bluish	*p*-Aminophenol sulfate	L	Violet
Acetanilide	L	Lavender	Aminophyllin	L	Strong blue-green
Acetic acid	L	Milky green	Aminopyrine	L	Vivid bluish
Acetoacetanilide	L	Bright medium blue	Ammonium salts	L	Usually bluish-white
Acetone	L	Slight pale bluish			
Acetophenone	L	Weak brown	Amyl alcohol (*iso*)	L	Slight gray-green
Acetphenetidin	L	Lavender	Amyl naphthalene.	L	Deep blue
Acetylaminoxyphenyl-arsonic acid	L	Medium purple	Amyl salicylate	L	Purple
			Anisaldehyde	L	Brown
Acetyl-β-methyl-choline bromide	L	Strong lavender	Anthraquinone	L	Orange
			Antipyrine	L	Purple
Acetylsalicylic acid	L	Brilliant sea blue	Apomorphine	L	Deep blue
Aconitine	L	Pale blue	Atropine sulfate	L	Pale blue
Acridine, soln.	L	Bright green	Ascorbic acid	L	Lavender
Acridine picrate, soln.	L	Brilliant greenish	Auramine, soln.	L	Brilliant yellow
Acriflavine, soln.	L	Very bright green	Barium acetate	L	Green
Albumin	L	Strong bluish	Barium carbonate	L	Brick red
Aldehyde bisulfite	L	Rose	Barium chloride	L	Bluish
Alloxan monohydrate	L	Medium violet	Barium dichromate	L	Reddish
Allylamine picrate	L	Crimson	Barium formate	L	Violet
Allyl thiourea	L	Strong whitish	Barium hydroxide	S	Bluish
Aluminum acetate	L	Strong blue	Barium nitrate	S	Bluish-lavender
Aluminum bromide	L	Reddish	Barium pyrovanadate	S	Light yellow
Aluminum carbide	L	Strong dark green	Barium succinate	L	Bright violet
Aluminum chloride	S	Bluish-green	Barium stearate	L	Bright blue-white
Aluminum formate	S	Blue-white	Barium sulfate	S	Bluish
Aluminum fluoride	S	Blue	Barium sulfide	S	Weak reddish
Aluminum iodide	S	Red-lavender	Benzamidine hydro-chloride	†	
Aluminum oxide	L	Bright crimson			
Aluminum palmitate	L	Bluish-white	Benzaldehyde	L	Brownish-green
Aluminum metaphosphate	S	Violet-white	Benzidrine sulfate	L	Vivid bluish
			Bensene-*m*-sodium disulfonate	†	
Aluminum monostearate	L	Bright bluish-white	Benzoflavine, soln.	L	Very bright yellow
			Benzoic acid	L	Violet
Aluminum potassium tartrate	L	Bluish-white	Benzyl alcohol	L	Pale gray
			Benzyl benzoate	L	Grayish
Amber	L	Bright green-yellow to blue	Benzyl salicylate	L	Violet
			Berberine	L	Very bright yellow
Ambergris	L	Sometimes bright blue-brown	Berberine hydro-chloride	L	Bright yellow-green
o-Aminobenzoic acid	†		Beryllium diphosphate	S	Bluish
p-Aminobenzoic acid	L	Medium purple	Beryllium nitrate	S	Bluish
2-Amino-1-butanol	L	Slight greenish	Beryllium oxide	S	Lavender
2-Amino-2-methyl-1, 3-propanediol	L	Bright blue			

† Emits ul[illegible]et rays under influence of X-rays.

FLUORESCENT CHEMICALS

Name	λ	Fluorescence	Name	λ	Fluorescence
Beryllium salicylate	L	Intense blue	*o*-Chlorobenzoic acid	L	†
Beryllium stannite	L	Blue to green	Choline	L	Dull blue
Bismuth ethyl camphorate	L	Strong yellow-green	Chromium stearate	L	Dark lavender-blue
			Chlorophyll	L	Strong deep red
Bismuth sodium tartrate	L	Medium blue	Chrysarobin	L	Bright orange
			Cinchonidine	L	Gray-purple
Bismuth subcarbonate	S	Bluish	Cinchonidine sulfate	L	Vivid blue
Bismuth subnitrate	S	Bluish	Cinchonine	L	Pale blue
5-Bromosalicylic acid	L	Whitish	Cinchonine sulfate	L	Whitish
Boric acid	S	Blue-white	Cinchophen hydroiodide	L	Bright orange-red
Butyryl pyrogallol	L	Strong deep purple			
Butanol	L	Slight pale blue	Cinchophen monoiodide	L	Cream
Butyl acetylricinoleate	L	Strong deep blue-green	Cinchopyrine	L	Dull tan
			Cinnamic acid	L	Red-violet
Butyl citrate, tri-	L	Blue-green	Cinnamic aldehyde	L	Brown
Butyl oleate	L	Greenish-yellow	Citronellol	L	Strong brownish-green
Butyl ricinoleate	L	Bright yellow-green			
Butyl sebacate, di-	L	Bright bluish-white	Cobaltous stearate	L	Purple-gray
Butyl stearate, mono-	L	Pale bluish	Codeine	L	Yellowish
Cadmium 8-hydroxyquinolinate	L	Bright yellow-green	Colchicine	L	Yellow-green
Cadmium sulfide	S	Yellowish	Columbium pentoxide	S	Bright whitish
Cadmium tungstate	S	Bright yellowish (impure)	Coramine	L	Bluish
			Coumaric acid	L	Green
Calcium acetate	S	Bluish	Coumarin	L	Violet
Calcium benzoate	L	Bright bluish	*o*-Cresol	L	Deep rose
Calcium carbide	S	Brownish	*m*-Cresol	L	Strong medium blue
Calcium *p*-caseinate	L	Vivid yellow-blue			
			p-Cresol	L	Cream-lavender
Calcium 8-hydroxyquinolinate	L	Dark greenish	Crotonic acid	L	Strong bluish
			Cupferron	L	Very dull crimson
Calcium *o*-iodoxybenzoate	L	Bright white	Curcubocitrin	L	Brilliant blue
Calcium lactate	L	Lavender	Decyl naphthalene	L	Bright blue
Calcium mandelate	L	Blue	Dehydrocholic acid	L	Violet-blue
Calcium molybdate	L	Bright gray-bluish	Desaminocasein	L	Variable; blue-green-yellowish
Calcium nitrate	S	Bluish			
Calcium oxalate	S	Bluish	Diacetone	L	Slight purplish
Calcium pantothenate	L	Dull purple	Diacetylamino-azotoluene	L	Dark red
Calcium phosphate	S	Blue to violet	Diallylbarbituric acid	L	Violet-white
Calcium pyrovanadate	S	Reddish	Diamyl naphthalene	L	Blue
Calcium tungstate	S	Bright medium blue	Dibutoxymethane	L	Pale bluish
Caffeine	L	Strong blue-green	Dibutylamine	L	Slight bluish
Caffeine citrate	L	Lavender	Dibutyl oxalate	L	Slight bluish
Camphor	L	Blue-violet	Dibutyl phthalate	L	Slight bluish
Carbon dioxide, solid	L	Strong blue-white	Didodecyl benzene	L	Bluish-yellow
Carbromal	L	Lavender	Diethylene glycol monolaurate	L	Bright bluish
Cerous citrate	L	Medium blue			
Cerous molybdate	S	Reddish	Diethylene glycol monooleate	L	Vivid blue
Cerous nitrate	S	Violet-blue			
Cerous nitrite	S	Bluish	Diethylene glycol monoethylether citrate	L	Bright blue
Cerous silicate, ortho-	S	Bright blue			
Cerous stannite	L	Bluish			
Cerous tellurite	L	Medium lavender			
Cerous tungstate	S	Blue	Diethylene glycol monoethylether phthalate	L	Strong green
Chloral ethanolate	L	Vivid yellow-green			
Chloral hydrate	L	Blue-yellowish			

† Emits ultraviolet rays under influence of X-rays.

FLUORESCENT CHEMICALS

Name	λ	Fluorescence	Name	λ	Fluorescence
Diethylene glycol monoethylether laurate	L	Blue-white	Gallium molybdate	L	Deep blue-green
			Gallium salicylate	L	Grayish-blue
			Gallium tetraborate	S	Grayish-white
Diethylene glycol monoethylether stearate	L	Bluish	Gallium tungstate	S	Bluish
			Gelatin	L	Light blue
			Germanium citrate	L	Pale bluish
Diethyl oxalate	L	Pale bluish	Germanium dioxide	S	Violet-blue
Dihydroxybenzoic acid	L	Purple	Germanium molybdate	S	Bluish
Diiodosalicylic acid	L	Green	Germanium salicylate	L	Bright sea blue
Dimethylglyoxime	L	Violet	Germanium stannite	L	Pale violet
Dimethyl phthalate	L	Greenish	Germanium tungstate	L	Reddish
Dimethyl sebacate	L	Slight bluish	Glutathione	L	Medium lavender
Diphenyl	†		Glycerin	L	Slight bluish
Diphenylamine	†		Glyceryl α,γ-di-chlorohydrin	L	Pale green
Diphenylamine	L	Very dull violet			
Diphenyl carbonate	L	Lavender-blue	Glyceryl α,γ-di-*iso*-amyl ether	L	Bluish
Dithiosalicylic acid	L	Blue			
1,2-Di(2-Xenoxy)-ethane	L	White	Glyceryl α,γ-dimethyl ether	L	Blue
Dodecyl benzene	L	Bluish-yellow	Glyceryl α,γ-diphenyl ether	L	Lavender-blue
Elastin	L	Strong light blue			
Emetine	L	Yellow-red	Glyceryl formal	L	Pale blue
Eosin, soln.	L	Brilliant red	Glyceryl furfural	L	Light yellow-green
Erbium aluminate	L	Pale violet	Glyceryl α-mono-*iso*-amyl ether	L	Pale blue
Erbium salicylate	L	Vivid sky blue			
Erbium tellurite	L	Whitish	Glyceryl α-mono-*n*-butyl ether	L	Blue-green
Erbium tungstate	S	Grayish			
Erythrosin, soln.	L	Bright green	Glyceryl α-mono-chlorohydrin	L	Blue-green
Erythritol tetranitrate	L	Deep violet			
Esculin, soln.	L	Vivid green-brown	Glyceryl α-mono-methyl ether	L	Slight bluish
Eserin salicylate	L	Lavender			
Ethanol	L	Very slight bluish	Glyceryl α-mono-phenyl-ether	L	Lavender-blue
Ethanolamine hydrochloride	L	Violet	Glyceryl monostearate	L	Bright yellow-blue
4-Ethoxyacridone	L	Bright green to blue	Glyceryl monoleate	L	Strong yellow-blue
Ethyl acetate	L	Slight blue	Glyceryl tristearate	L	Bright violet-blue
Ethyl borate	L	Pale blue	Glycollic acid	L	Strong violet
Ethyl formate	L	Pale blue-green	Glycol monoleate *	L	Bright blue-brown
Ethyl lactate	L	Pale blue-green	Glycol dilaurate *	L	Yellow-brown
Ethyl salicylate	L	Green	Glycol phthalate *	L	Bright light blue
Ethylene glycol laurate	L	Very bright blue	Glycol monolaurate *	L	Bright medium blue
Ethylene glycol oleate	L	Blue	Glycol monostearate *	L	Brownish-yellow
Ethylene glycol ricinoleate	L	Greenish-blue	Heliotropin	L	Bright yellow-brown
Eugenol	L	Dark brown	Hemin	L	Very dull reddish
Fluorescein, soln.	L	Very bright yellow-green	Hexamethylene-tetramine	L	Violet
Fluorescin, soln.	L	Yellow	Hexamethylenetetra-mine triguaiacol	†	
Furfural	L	Cherry-yellowish-green	Homatropine methyl-bromide	L	Lavender
Furfurine nitrate	L	Yellowish	Homoveratrol (*iso*)	L	Yellowish
Furfuryl alcohol	L	Dark yellow	Hydrastine	L	Green
Gallium chromate	L	Greenish-yellow	Hydrastine salicylate	L	Greenish-white
Gallium 8-hydroxy-quinolinate	L	Bright yellow	Hydrazine hydro-chloride	L	Violet
Gallium ferrocyanide	L	Deep blue			

† Emits ultraviolet rays under influence of X-rays. * Polymerized.

FLUORESCENT CHEMICALS

Name	λ	Fluorescence	Name	λ	Fluorescence
Hydrazine sulfate	LS	Whitish, violet	Manganese formate	L	Bright light blue
Hydrobenzoin	†		Manganese 8-hydroxy-quinolinate	L	Bright green
Hydrocinnamic aldehyde	L	Weak green	Manganese iodide	S	Yellowish
Hydrofuramide	L	Bright pink	Manganese stearate	L	Bright deep rose
Hydroxylammonium sulfate	S	Light blue	Manganese oxalate	L	Pale whitish
8-Hydroxyquinoline	L	Strong dark purple	Mannitol glyceryl monolaurate	L	Deep green-brown
Hydroquinone	L	Violet	Mannitol glyceryl monoleate	L	Brownish-blue
Indium cyanide	L	Weak blue-green	Mannitol glyceryl monostearate	L	Blue-gray
Indium *o*-iodoxy-benzoate	L	Light lavender	Mannitol triricinoleate	L	Deep green
Indium molybdate	L	Pale red-brown	Mercurous chloride	L	Bright pinkish
Indium salicylate	L	Bright blue-green	Mercury salicylate	L	Strong lavender
Indium tungstate	L	Grayish	Mercury salicylamide	L	Bluish
Indole	L	Violet-blue	Methanol	L	Very slight bluish
Inositol	L	Lavender	Methyl acetophenone	L	Gray-brown
Iron(ic) 8-hydroxy-quinolinate	L	Deep blue-black	Methylamine	L	Slight bluish
Iron(ous) 8-hydroxy-quinolinate	L	Blue-brown	Methyl anthranilate	L	Blue-green
Isoquinine	L	Violet	Methyl cinnamate	L	Bright violet
Lactose	L	Lavender	*β*-Methyl esculin	L	Brilliant blue
Lanthanum 8-hydroxy-quinolinate	L	Pale yellow-green	Methyl formate	L	Greenish
Lanthanum molybdate	L	Whitish	Methyl lactate	L	Greenish
Lanthanum salicylate	L	Bright light blue	2-Methyl-1,4-naphthoquinone	L	Lavender-white
Lanthanum silicate	S	Whitish	Methylglycolphene-tidin	L	Violet
Lanthanum tungstate	S	Whitish	2-Methyl-2,4-pentanediol	L	Light blue
Lead acetate	S	Medium blue	Methyl salicylate	L	Green
Lead bromide	S	Yellowish	*β*-Methylumbelli-ferone, soln.	L	Brilliant medium blue
Lead carbonate	S	Yellowish	Morphine	L	Pale green to lavender
Lead chloride	S	Whitish-yellow	Musk ambrette	L	Yellowish-brown
Lead iodide	S	Scarlet	Musk ketone	L	Yellowish-brown
Lead sebacate	L	Lavender-white	Musk xylol	L	Yellowish-brown
Lead monostearate	L	Vivid blue	Narceine	L	Violet-blue
Lead sulfate	S	Yellowish	Narcotine	L	Violet
Lead naphthenate	L	Brilliant blue-green	Nembutal	L	Bluish-violet
Legumin	L	Bright light blue	Neodymium chromate	L	Light yellow
Leptandrin	L	Red-violet	Neodymium cyanide	L	Blue
Linalyl acetate	L	Yellow-green	Neodymium ferrocyanide	L	Deep coral
Lithium benzoate	L	Whitish-violet	Neodymium molybdate	S	Coral
Lithium oxalate	L	Lavender	Neodymium nitrate	L	Pinkish-white
Lithium salicylate	L	Bright blue-green	Neodymium tellurite	L	Rose-blue
Lycopodium	L	Strong pinkish	Neodymium thiosulfate	L	Rose
Magnesium ammonium arsenate	L	Whitish	Neodymium salicylate	L	Vivid blue-green
Magnesium oxide	L	Scarlet to reddish	Nerolin	L	Violet
Magnesium 8-hydroxyquinolinate	L	Brilliant golden	Nickelous 8-hydroxy-quinolinate	L	Strong brownish
Magnesium phosphate	L	Blue			
Magnesium salicylate	L	Purple-green			
Magnesium stearate	L	Blue-white			
Magnesium sulfate	L	Usually blue-white			
Manganese acetate	S	Reddish			
Manganese bromide	S	Whitish			

† Emits ultraviolet rays under influence of X-rays.

FLUORESCENT CHEMICALS

Name	λ	Fluorescence	Name	λ	Fluorescence
Nickel stearate	L	Gray-purple	Phthalic anhydride	L	Bright violet
Nicotinamide	L	Bright blue	Pyramidon	L	Bright blue
Nicotinic acid	L	Purple-white	Pyridoxine hydrochloride	L	Strong medium blue
2-Nitro-1-butanol	L	Greenish-orange	Quinine	L	Light blue
Nitroethane	L	Very slight blue	Quinine bisulfate	L	Bright blue-greenish
2-Nitro-2-ethyl-1,3-propanediol	L	Light lavender	Quinine hydrochloride	L	Light blue
Nitrogen iodide	L	Violet-pink	Quinine hydrobromide	L	Lavender
2-Nitro-2-methyl-1,3-propanediol	L	Violet	Quinine sulfate	L	Strong blue
2-Nitro-2-methyl-1-propanol	L	Lavender	Quinine salicylate	L	Bright blue-green
1-Nitropropane	L	Very slight blue	Quinoline	L	Bright blue
α-Nitroso β-naphthol	L	Crimson	Quinone	L	Red-brown
Nuclein	L	Strong bluish	Rhodinol	L	Violet-yellow
Nupercaine	L	Violet	Rhodium diphosphate	L	Blue
Oleic acid	L	Bright blue-green	Rhodium nitrate	L	Pink
Opianic acid	L	Pale blue	Riboflavin	L	Bright orange
Oxyquinoline sulfate	L	Bright crimson	Rotenone	L	Dull violet
Parabanic acid	L	Violet	Salicylic acid	L	Blue
Papaverine	L	Pale yellowish	Samarium chloride	L	Red-orange
Paraldehyde	L	Strong bluish	Samarium diphosphate	L	Blue
Paregoric	L	Bright yellow-green	Samarium ferrocyanide	L	Blue
Pentaerythritol	L	Rose to bluish	Samarium molybdate	L	Pink
Pentamethylenetetrazol	L	Blue-violet	Samarium salicylate	L	Brilliant blue
p-Phenetole sulfonic acid	†		Samarium tellurite	L	Bright blue-green
o-Phenoxyphenyl benzoate	L	Lavender-blue	Samarium tungstate	L	Blue-green
Phenobarbital	L	Whitish	Santonin	L	Pink
Phenobarbital sodium	L	Violet	Silver 8-hydroxyquinolinate	L	Yellowish
Phenolphthalein	L	Purplish	Sodium salts	LS	Usually violet
Phenolphthalin	L	Violet	Sodium acetate	L	Rose
Phenylacetic acid	L	Purple	Sodium acetylsalicylate	L	Pale lavender
Phenylethanol	L	Pale violet	Sodium benzoate	L	Whitish-blue
o-Phenylenediamine	L	Bright violet	Sodium cyanate	L	Violet
p-Phenylenediamine	L	Bright blue	Sodium m-hydroxybenzoate	L	Deep violet
Phenyl mercuric chloride	L	Violet	Sodium p-hydroxybenzoate	L	Lavender
Phenyl semicarbazide	L	Violet	Sodium hexametaphosphate	L	Violet
Phloroglucinol	L	Bright medium blue	Sodium nitroprusside	L	Dull red
Pilocarpine	L	Whitish	Sodium phenolsulfonphthalein	L	Dull cherry
Pineol resorcinate	L	Brilliant blue-green	Sodium salicylate	L	Brilliant sea blue-green
Piperine	L	Yellowish	Solanine	L	Weak blue
Potassium salts	LS	Usually pink	Sorbitol triricinoleate	L	Green
Potassium benzoate	L	Bluish	Sorbitol lactate	L	Deep blue-green
Potassium opianate	L	Blue	Sorbitol tartrate	L	Bright yellow-blue
Potassium salicylate	L	Bright blue-green	Strontium benzoate	L	Whitish-blue
Praseodymium salicylate	L	Lavender	Strontium 8-hydroxyquinolinate	L	Light green
Praseodymium silicate	L	Strong blue-green	Strontium stearate	L	Blue-white
Propadrine hydrochloride	L	Strong lavender-blue			

† Emits ultraviolet rays under influence of X-rays.

FLUORESCENT CHEMICALS

Name	λ	Fluorescence	Name	λ	Fluorescence
Stannous stearate	L	Cream	Vanadous 8-hydroxy-quinolinate	L	Deep green
Sulfanilamide	L	Violet	Vanadous salicylate	L	Lavender
Sulforicinic acid	L	Vivid yellow-blue-green	Vanillin	L	Strong pink
Sulfosalicylic acid	L	Bright blue	Veratric acid	L	Pale blue
Sulfur	L	Crimson-tan	Varatrine sulfate	L	Pale blue
Terpin hydrate	L	Dull violet	Yohimbine hydrochloride	L	Light blue
Tetrahydrofurfuryl alcohol	L	Blue	Yttrium 8-hydroxy-quinolinate	L	Strong orange-red
Thebaine	L	Red-yellow	Yttrium molybdate	S	Yellowish-blue
Thiamin chloride, soln.	L	Bright yellowish-green	Yttrium nitrate	S	Pinkish-blue
Theobromine	†		Yttrium phosphate	S	Blue
Theobromine	L	Brilliant blue-green	Yttrium salicylate	L	Bright medium blue
Theobromine calcium salicylate	L	Bright blue	Yttrium silicate	S	Deep blue
Thiochrome	L	Bright bluish	Yttrium tungstate	S	Bluish
Theophyllin ethylene-diamine	L	Bright blue-green	Zinc carbonate	S	Light lavender
Thorium 8-hydroxy-quinolinate	L	Deep green	Zinc hydroxide	S	Blue-violet
Titanium dioxide	L	Strong violet-white	Zinc 8-hydroxy-quinolinate	L	Brilliant green
Titanium stearate	L	Gray-blue-tan	Zinc oxalate	S	Green (if impure)
Tocopherol	L	Bright blue-green	Zinc oxide	S	Yellow-green
Tributyl citrate	L	Weak blue-green	Zinc palmitate	L	Blue-white
Tributyl phosphate	L	Weak blue	Zinc potassium cyanide	S	Lavender
Triethyl phosphate	L	Slight bluish	Zinc sebacate	L	Whitish
Trimethylamine	L	Slight bluish	Zinc stearate	L	Blue
Tris(hydroxymethyl)-aminomethane	L	Deep pink	Zinc sulfanilate	L	Purple-blue
Tris(hydroxymethyl)-nitromethane	L	Greenish-blue	Zirconium nitrate	S	Pale bluish
Uranin, soln.	L	Brilliant yellow	Zirconium nucleate	L	Blue
Uranyl compounds	LS	Generally vivid yellow-green	Zirconium oxide	S	Whitish
			Zirconium tungstate	S	Gray-blue
			Zirconium uranyl nitrate	S	Yellowish

† Emits ultraviolet rays under influence of X-rays.

FLUORESCENT MINERALS AND GEMS

Many mineral species luminesce, but the response often varies according to the locality, history, and exciting agent. A wide variety of fluorescent colors may be noted in the same species, although in a few the response is consistent for all specimens. This also holds for phosphorescence, denoted in the following table by *P*. Therefore, close rules cannot be drawn about luminescence in most minerals.

Name	λ	Fluorescence	Name	λ	Fluorescence
Agate	LS	Variable; green when U containing	Hackmanite	....	Variable; strong orange(S), sometimes pinkish(L), P
Albite	S	Sometimes P			
Alexandrite	S	Feeble reddish	Halite	S	Vivid red, P
Alumnite	L	White	Hanksite	S	P
Alunite	S	Usually whitish	Hexagonite	LS	Reddish

FLUORESCENT MINERALS AND GEMS

Name	λ	Fluorescence	Name	λ	Fluorescence
Amythest	S	Infrequently feeble brownish	Hiddenite	S	Lilac
			Hydromagnesite	L	Medium green
Anglesite	S	Yellowish	Hydrozincite	S	Vivid blue, sometimes green or yellowish
Anorthoclase	S	Blue			
Apatite	S	Variable; blue to whitish	Ianthinite	....	Rarely fluorescent
Apophyllite	S	Yellowish	Johannite	LS	Strong yellow-green
Aragonite	....	Variable; green(S), red(S), P	Kunzite	S	Red or yellow, red-yellow, P
Autunite	LS	Bright yellow-green	Leucite	L	Orange
Axinite	S	Medium red	Metatorbernite	LS	Brilliant yellow-blue
Barite	L	Sometimes whitish P	Meyerhofferite	S	P
Barylite	S	Blue	Nasonite	S	Blue
Benitoite	LS	Strong medium blue	Opal	LS	Variable; sometimes greenish or yellow, perhaps P
Beryl	S	Usually only very feeble			
Borax	L	Greenish			
Calcite	....	Highly variable; bright red(S), sometimes bright green(S), P	Ozocerite	L	Bluish
			Pearl	LS	Variable; white, blue, or yellowish
Calcium-larsenite	S	Vivid yellow	Pectolite	S	Yellow, P
Celestite	S	Whitish P	Petroleum	LS	Bright blue
Cerusite	....	Variable; blue(S), yellow (L)	Powellite	S	Strong yellowish-white
			Priceite	S	Sometimes yellow
Chalcedony	....	Variable; greenish(S)	Pyromorphite	L	Usually white
Chalcocite	S	Bright yellow-green	Quartz	....	Highly variable; brownish(S), green(S), yellow(LS), sometimes P
Chrysoberyl	S	Usually only feeble			
Clinohedrite	S	Brilliant orange			
Colemanite	L	Variable; greenish	Ruby	LS	Variable; usually vivid red
Cuproscheelite	S	Bright yellow-white			
Curtisite	LS	Yellow-green	Sapphire	S	Variable; orange-red to red-blue
Dakeite	S	Bright yellowish-green			
Diamond	LS	Highly variable; blue, green, red, orange, yellow, P	Scheelite	S	Characteristic bright blue
			Selenite	S	Pale yellow, P
Dolomite	LS	Whitish to blue, P	Smithsonite	L	Usually greenish
Elaterite	L	Brownish	Sodalite	L	Orange-red
Epsomite	L	Pale bluish	Sphalerite	LS	Strong orange
Fluorapatite	S	Orangish	Spinel	S	Strong red
Fluorite	LS	Variable; blue, green, P	Strontianite	S	White
Glauberite	....	Sometimes P	Sulfur	L	Yellowish
Gummite	LS	Variable; dull purple	Torbernite	LS	Bright yellow-green
Gypsum	L	Usually greenish	Trona	L	Blue
Gyrolite	LS	Whitish	Uranocircite	S	Bright yellow-green
Uraniferous hyalite	LS	Yellow-green	β-Uranotil	LS	Medium yellow-green
			Vesuvianite	L	Yellow
Uranophane	S	Yellow-green	Wavellite	L	Green
Uranopilite	S	Strong yellow-green	Wernerite	LS	Vivid yellow
β-Uranopilite	LS	Brilliant yellow-green	Willemite	S	Brilliant green
Uranospathite	S	Bright yellow-green	Witherite	L	Yellowish
Uranospinite	S	Bright yellow-green	Wollastonite	S	Yellow-orange, P
Uranothallite	LS	Bright green	Zippeite	LS	Strong yellow-green
Uranotil	S	Medium yellow	Zircon	LS	Variable; pale orange

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

In the following table a selected list of the useful elements is given together with their interferences. In using this table, if no line is to be found at the wavelengths given as ***sensitive lines of an element,*** that element can be reported as 0.0%, 0.00%, 0.000%, or 0.0000%, the sensitivity varying with the line chosen, the element, and the mode of excitation. Where a line is to be found at the wavelength given for a ***sensitive line of an element,*** that element can be reported as present if it can be shown that no minor line from other elements in the sample is so close to the sensitive line that it cannot be differentiated from it with the instruments available.

All values in the table are taken from Harrison's *M. I. T. Wavelength Tables,* permission to do so having been granted by Professor George R. Harrison and by the Technology Press. The 1939 Edition, published by John Wiley and Sons, Inc., New York, was used.

The ***abbreviations*** used in the following table are those employed in the *M. I. T. Tables,* and are as follows:

bh, band head
d, double line
h, hazy, diffuse
l, shaded, or displaced to longer wavelengths
r, narrow self-reversal
R, wide self-reversal
s, shaded, or displaced to shorter wavelengths
w, wide or complex
W, very wide or complex
I, line classified as being emitted by the un-ionized atom
II, line classified as being emitted by the singly ionized atom
ʔ, line listed in M. I. T. Tables, but not found on a plate made from pure sample of the element in question*

The arrangement of the tables is as follows: The elements to be included are in bold face type and are in alphabetical order of their names. Under each element are listed the sensitive lines for which the interferences are given. These and other wavelengths are in Angstrom units. These sensitive lines, together with their interferences are then listed in order of decreasing wavelength. Each line is followed by its chemical symbol and arc intensity. In this intensity scale the most intense lines are given ratings of 9000, while the faintest lines recorded are assigned the value of 1. Lines of intermediate strength are given twenty-five different values in an effort to approximate their true relationship. To facilitate identification, the sensitive line is given in bold face type.

The interfering range is as follows:

Range in Å	Å above and below	Ditto for int. of 100 or more
10,000 to 4,000	1.5	2.5
4,000 to 3,000	1.0	2.0
3,000 to 2,000	0.5	1.0

Because of the fact that their lines do not appear in the arc spectra, all interfering lines due to the eighth group of inert gases, the seventh group of halogens, and to nitrogen, oxygen, and hydrogen have been omitted from the table. Most of the rare earths and other rare elements have also been omitted. The following elements were completely omitted: A, Ac, Br, Cl, Dy, Er, Eu, F, Gd, H, He, Hf, Ho, I, Il, Kr, La, Lu, Ma, N, Nd, Ne, O, Os, Pa, Pd, Po, Pr, Ra, Re, Rn, Ru, Sm, Tb, Tm, Xe, Yb.

All the interfering lines listed in the *M. I. T. Tables'* arc column and due to the following elements are given: Ag, Al, As, Au, B, Ba, Be, Bi, Ca, Cd, Cu, K, Li, Mg, Na, Pb, Sb, Si, Sn, Sr, and Zn. All interfering lines having an intensity of 10 or more in the arc are listed for all the elements. However, if lines under 10 are to be found in the *M. I. T. Tables* within the interfering range, the element symbol is given in parentheses at the end of the tabulation of interferences. For example, since ***Ni I*** is listed after the interferences for ***LEAD, 4057.82,*** this line is not to be used for the detection of lead in nickel. If, however, only small amounts of nickel are present, then line 4057.82 can be used.

See also the following table: ***Sensitive Lines of the Elements.***

* Experimental work of F. H. Emery, Harshaw Chemical Co., Cleveland, Ohio.

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLES

ALUMINUM

3961.527
3944.032
3092.713
3082.155

3962.28	Ca		3w
.12	Ni	I	10h
.09	Ce		15
3961.59	Zr		500
3961.53	**Al**	**I**	**3000**
.3	Ag		15
.15	Fe	I	25
.00	Co	I	60
3960.91	Ce	II	40
.76	Cr		40

(Also Cb, Fe, Mo, Sb, Th, U, W)

3945.33	Co	I	200
.13	Fe		30
3944.90	Fe	I	15
.38	Ir	I	20
3944.03	**Al**	**I**	**2000**
3943.89	Ce	II	40
.82	U		35
.69	Th		10
.67	Cb		20
.66	V	I	50
.61	Cr	I	18
.35	Fe	I	40
.14	Ce	II	12
.09	Mo		10
.04	Mo		10
3942.44	Fe	I	100

(Also Ni I, Rh, W, Y)

3094.18	Cb	II	100
3093.99	Cu	I	150
.68	Mo		10
.61	Ce		18
.58	Bi	I	10w
.51	W		12
.46	Ca		2
.36	Fe		70
.34	Ce	II	12
.11	V	II	100R
.01	U		20
3092.99	Ta		18
.99	Mg	I	125
.84	Al		50R
.78	Fe		50
.73	Na	II	50
.72	V		100r
3092.71	**Al**	**I**	**1000**
.70	Mo		20
.44	Ta		50
.39	Cd	II	10
.07	Mo		30
.06	Ta		15
3091.92	Ce		20
.84	Mo		10
.58	Fe	I	300

(Also Cr, Ir, Rh I, Sc II, Th, Y, Zr I)

3083.74	Fe	I	500
.05	Th		12
3082.84	Co	I	35
.70	Mn		12
.68	Cd	I	30
.62	Co		150R
.45	Ta		15h
.30	Ce		20
.27	Rb	I	10
.18	Th		10
3082.16	**Al**	**I**	**800**
.11	V	I	80r
.05	Mn		50
.03	Th		12
.01	V	I	15
3081.95	Mo		25
.86	W		10
.85	Ta		50
.66	Th		10
.55	Ca	I	2
.33	Mn		75
.16	Mo		25
3080.83	Cd	I	150
.76	Ni	I	200

(Also Cb, Sc II, Ti I, U, Y II)

ANTIMONY

2877.915
2598.062

2878.45	Cr		20
.38	Mo		20
2877.98	Cr	II	30
2877.92	**Sb**	**I**	**250W**
.91	Ca		1h
.69	Cu	II	5
.69	V		15
.69	Ta		15
.68	Ir	I	20
.52	Pt	II	40
.44	Ti	II	30
.30	Fe	I	200
2876.95	Cb		40W

(Also Ce, U, W, Zr II)

2598.42	W		10
.37	Fe	II	700
.17	Mn		12
2598.06	**Sb**	**I**	**200**
2597.73	W		10
.69	U		25

(Also Ce, Fe, Ir, Ir I, Rh, Rh I, Ta)

ARSENIC

2860.452
2780.197
2349.84

2860.96	Cr	II	60
.85	Zr	I	15
.80	U		15
.76	Rh	I	30
.68	Pt	II	30
.68	Rh	I	30
.67	Ir	I	12
.47	U		35
2860.45	**As**	**I**	**50r**
2859.97	V	I	50

(Also Ce, Fe, Ti I, W)

2780.70	Cr	I	600R
.70	Fe		30
.54	Fe		10
.52	Bi	I	200W
.28	W	II	10
.25	Cb		30
2780.20	**As**	**I**	**75R**
.04	Mo		60
.01	Ce		15
.00	Mn		25
2779.83	Mg		40
.82	Sn		80
.70	Ta		30r
.54	Rh	I	100

(Also Ir I, U, W)

2350.84	Be	I	12
.69	Be	I	25
.54	W		12
.47	Ni		10
.28	Co	I	12
.05	Ir		15
2349.86	Cd		2
.85	Sb		8
2349.84	**As**	**I**	**250R**
.78	Mo		10w
.59	Zr		10
2348.61	Be	I	2000R

(Also Cb, Cu, Fe I, Rh, Ti, Ti II, U, V, Y)

BARIUM

5535.551
4554.042
3071.591

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

BARIUM (Continued)

5535.55	**Ba**	**I**	**1000R**
.41	Fe		50
.24	Ce		15
.04	Rh		80
5534.81	Sr		20
.66	Fe	I	20
5533.05	Mo		200

(Also Rh I, Ta, U, V I, Zr)

4556.35	Ta		200
.13	Fe	I	150
4555.52	Zr	I	30
.49	Ti	I	125
.36	Cs	I	2000R
.30	Cr		15
.13	Zr	I	15
.10	U		20
.09	Cr		15
.08	Ti	I	12
4554.83	Cr		25
.59	Pt		10
.51	Ru	I	1000R
4554.04	**Ba**	**II**	**1000R**
.04	Ce		35s
4553.95	Cr		20
.80	Mo		20
.7	bhPb		6
.69	Ta		200*l*
.33	Co	I	25
.32	Mo		12
.31	Mn		12h
.22	Mo		12
.18	Ni	I	15r
.05	V	I	20
.01	Zr	I	10
4552.55	Fe		10
.53	W		12
4551.95	Ta		400

(Also Cb, Ir, Th, Y I, Zr II)

3072.39	Ce	II	20
.34	Co	I	200R
.12	Th		10
.11	Ti	II	25
.06	Zn	I	200
3071.96	Co		80
.94	Pt	I	60
.62	Ce		18s
3071.59	**Ba**	**I**	**100R**
.59	Ca	I	5
.56	Cb		10
.44	Mo		25
.30	Cr	I	15
.24	Ti	II	12
.11	Ce	II	20s
.03	Rh	I	20
3070.90	Mo		40
.89	V	I	10
.82	Th		12
.27	Mn		100

(Also Fe, Fe II, Ir, Ta, U, W II, Y)

BERYLLIUM

3131.072–3130.416
2348.610

3132.59	Mo		1000R
.07	Zr	I	10
.06	Cr	II	25
.04	Ce		15
3131.83	Hg	I	200
.55	Hg	I	400
.21	Cr		20
3131.07	**Be**	**II**	**200**
.07	Th		12
3130.87	Ce		30
.80	Ti	II	25
.79	Rh	I	60
.79	Cb		100
.73	U		10
.58	Ta		100W
.57	Ba	I	2
.46	W		10
3130.42	**Be**	**II**	**200**
.33	Ce		30
.29	Ta		15*l*
.27	V	II	50
.20	Ce		15
.01	Ag		25h
3129.95	Ta		50
.91	Th		10
.76	Zr	II	10
.55	Ta		50
.48	Co	I	40
.37	Na	II	35
.33	Fe	I	100
.31	Ni	I	125

(Also Fe, Fe II, Ir, Ti I, U, Y II)

2349.84	As	I	250R
.10	Bi	I	10
2348.82	Cu	II	15d
.74	Ni	I	10
2348.61	**Be**	**I**	**2000R**
.59	Zr		15
.30	Ir		20
2347.97	W		10
.58	Ba		30

(Also Cb, Fe II, Mn, Mo, Pt II, U)

BISMUTH

3067.716
2897.975

3069.24	Ta		150
3068.68	Ce		20
.64	Mo		15
.18	Fe	I	150
.00	Mo		30
3067.94	Fe		15
.76	Sn		10?
3067.73	Th		12
3067.72	**Bi**	**I**	**3000hR**
.64	Mo		10
.31	Rh		80
.24	Fe	I	300
.16	Cr	II	25
.12	V	I	15
.01	Ge		60
.01	Ca	I	6
3066.76	Ta		10
.38	V	I	400r

(Also Ir, U, W, W II, Zr I, Zr II)

2899.04	Ta		200
2898.54	Cr		12
.43	Ta		30
.36	Fe		100
.35	Ir	I	10
.27	Be	I	20
.19	Be	I	15
2897.99	Mn		15
2897.98	**Bi**	**I**	**500WR**
.87	Pt	I	400
.81	Cb		15
.80	Mn		15
.63	Mo		20

(Also Ce, Ir, Rh, Th, U, V, W, Y II, Zr)

BORON

2497.733–2496.778

2498.50	Pt	I	400
.33	Ta		30
.28	Mo		10
.23	V	I	10
2497.86	Mo		20
.82	Fe	II	15
2497.73	**B**	**I**	**500**
.72	Sn		8
.58	Mo		30h
.48	W	II	10
2496.99	Fe		20
2496.78	**B**	**I**	**300**
.77	Sn		10
.64	Ta		20
.64	W	II	10
.53	Fe		40

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

BORON (Continued)

.31	Cr	I	125r
.27	Ir	I	10
2495.86	Fe	I	25
.82	Pt	I	40
.72	Sn		100

(Also Cb, Co, Ge I, Th, V, W, Zr II)

CADMIUM

6438.4696
3610.510
3261.057
2288.018

6440.97	Mn		60
6439.17	Co		80
.07	Ca	I	150
6438.47	**Cd**	**I**	**2000**
6435.16	Y	I	150

(Also Ce, Ta, W, Zr I)

3612.47	Rh	I	200
3611.52	Cs	I	200
.39	U		12
.34	Ce	II	10
.13	Ta		25
.05	Y	II	40
.00	Ba		10
3610.91	Ce		10
.81	Cu	I	25
.70	Fe	I	10
3610.51	**Cd**	**I**	**1000**
.46	Ni	I	1000r
.30	Mn		60
.16	Fe	I	100
.16	Ti	I	100
.05	Cr		20
3609.77	Ir		30
.69	Ce		40
.68	U		15
.59	Ti	I	12
.31	Ni	I	200
3608.86	Fe	I	500

(Also Cb, Co, Mo, Pt, Th, Zr)

3262.33	Sn	I	400h
.01	Fe		30
.01	Ir	I	20
3261.96	Ba	I	40
.88	Cb		10
.72	U		15
.61	Tl	II	70
.33	Fe		25
.17	W		10
.08	V		15
3261.06	**Cd**	**I**	**300**
3260.98	Ce	II	25
.93	Ca		1h
.82	Co	I	70
.74	B	II	4
.56	Cb		15
.48	Mo		10
.26	Fe		20
.26	T	I, II	12
.23	Mn		75
.18	Ta		125
.11	Zr	I	10
3259.99	Fe	I	150

(Also Ce, Pt, Pt I, Th, Zr)

2288.39	Ni	I	12
.19	Pt	II	15
.12	As	I	250R
2288.02	**Cd**	**I**	**1500R**
2287.88	Ir		20
.81	Co		12d
.67	W		10
.08	Ni	II	100

(Also Fe I, Mn, Ta, V)

CALCIUM

4226.728
3968.468
3933.666
3179.332

4227.76	Zr	I	150
.75	Ce		40
.74	V	I	10
.65	Ti	I	18
.43	Fe	I	300
.41	Ce		10
4226.92	W		15
.76	Cr		125
.74	Ir		30
.74	Ce		50
4226.73	**Ca**	**I**	**500R**
.73	Mo		15
.57	Ge	I	200
.55	Mo		10
.43	Fe	I	80
.34	W		10
.29	Mo		20
4225.96	Fe	I	80
.50	Ir		15
.47	Fe	I	80

(Also B, Cb, Th, U, V II, Y)

3970.10	Ta		100
3969.75	Cr	I	200
.26	Sr	I	30
.26	Fe	I	600
.20	W		12
.17	Ir		30
.12	Co	I	100w
.06	Cr	I	80
.00	Th		10
3968.48	Ir		25
.47	Ce		35
3968.47	**Ca**	**II**	**500R**
.43	Y		10
.26	Zr	I	100
.22	Ag		100
.09	V	II	25
3967.97	Fe	I	60
.48	U		10
.42	Fe		125

(Also Cb, Ir I, Mo, Rh I, Y II, Zr)

3934.84	Ir	I	200
.24	Ti	I	30
.23	Rh	I	100
.12	Zr	II	20
.01	V	I	100
3933.91	Co	I	60
.90	Ir		20
.73	Ce		60
3933.67	**Ca**	**II**	**600R**
.66	Ir		20
.65	Co		80
.62	Ag		80
.60	Fe	I	200
.38	Sc	I	60
3932.92	Cu	I	10
.92	Th		10

(Also Cb, Fe, Mo, U, W, Zr I)

3180.95	Ta		100
.76	Fe	I	100
.28	Co	I	10
.23	Fe	I	300
.20	Th		15
.16	Fe	II	10
3179.83	U		12
.73	Rh	I	50
.54	Ta		15h
.42	Y	II	20
.35	B	II	5
3179.33	**Ca**	**II**	**100**
.29	Ti	I	10
.28	Cr		100
.24	Ag		2
.14	Ag		2
.06	W		10
.06	Na	II	6
.05	Th		10
.04	U		10
3178.97	Fe		30
.75	Ce		15
.69	Ir		10
.55	Fe		10
.50	Mn		150
.49	Ce	II	12

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

CALCIUM (Continued)

.02 Fe I 300
(Also Cb, Ir I, Mo, Pt, V, W II, Zr I)

CARBON

2478.573

2479.13 Cr 20
.05 V 15
2478.66 Hg I 15h
2478.57 C I 400
.31 Sb 75
.22 Ta 60
(Also Cb, Co, Fe II, Ir I, Zr)

CERIUM

4186.599

4188.32 Mo 100
.07 U 10
4187.80 Fe I 200
.32 Ce II 35
.25 Co I 50
.04 Fe I 250
4186.98 U 10
4186.60 Ce II 80
.36 Cr 50
.28 Mo 15
.12 Ti I 100
.02 W 12
4185.83 Mo 40
.66 Ir 25
.35 Cr 30
.33 Ce II 30
4184.90 Fe I 100
(Also Cb, Ce, Fe, Zr, Zr I, Zr II)

CHROMIUM

4289.721
4254.346
2843.252

4292.13 Mo 100
4291.47 Fe I 125
.20 Mo 15
.19 Cb 10
.17 Ba 10
.14 Ti 10
4290.94 Ti I 70
.89 U 15
.87 Fe I 20
.6 Na I 3
.38 Fe 35
.23 Ti II 35
.21 Zr I 40
.19 Mo 30h
4289.94 Ce 50
.92 Ti I 15
.88 U 12
4289.72 Cr I 3000R
.45 Ce II 25
.44 Cb 10
.42 Mo 20
.36 Ca I 35
.07 Ti I 125
4288.84 U 20
.71 Rh I 400
.67 Ce II 30
.64 Mo 80
.38 Cr 15
.01 Ni I 150
4287.41 Ti I 100
(Also Mn, Pt, Th, V II, W, Y I)

4255.78 Ce 40
.50 Cr 30
.44 Cb 30
.36 Ce II 10
4254.96 Mo 25
.70 Ce 20
.69 Cb 10
.43 Mo 10
.39 Cb 10
4254.35 Cr I 5000R
.15 Bi I 10
4253.85 U 12
.70 Cb 25
.57 Zr I 20
.5 Sr 2
.36 Ce 40s
.34 Cu I 7wh
4252.97 Cb 30
.97 Sr I 2
.31 Co I 150
(Also Co, Fe, Th, W, V II)

2844.25 Ta 400r
2843.98 Fe I 300
.95 Ag 5
.78 W 9
.63 Fe I 125
2843.25 Cr II 125
2842.83 Ce 25d
.82 Ta 200
.82 Th 12
(Also Cb, Fe, Mo, Tl I, U, Zr II)

COBALT

3453.505
3405.120

3455.23 Co I 2000R
.22 Rh I 300
3454.48 Ce 10
.17 Ti I 15
3453.74 Cr I 30
3453.51 Co I 3000R
.33 Cr I 35
.02 Fe 30
3452.89 Ni I 600R
.68 Th 10
.65 Cb 15
.62 W 7
.60 Mo 10
.28 Fe I 150
3451.92 Fe I 100
(Also Ce II, Pt, Pt I, Ta, U, Y I)

3406.81 Fe I 100
.13 Cb 30
3405.98 Ce 25
.94 Mo 25
.82 Co 30R
.81 Ce 10
.75 U 12
.66 Bi I 60
.41 Cb 80
.33 Bi 40
.22 Cr 12
.16 V I 30
3405.12 Co I 2000R
.09 Ti I 20
.03 Ag 3
3404.91 Ce 18
.83 Zr II 40
.58 Pd I 2000R
.43 Ce 12
.36 Fe I 100
.34 Mo 20
.30 Fe I 25
.13 Ce 18
3403.65 Cd I 800
(Also Fe, Ta, Th, W)

COLUMBIUM

4079.729
4058.938
3130.786
3094.183

4081.22 Ce 40
.22 Zr I 150
4080.93 Ba I 2
.61 U 12
.55 Cu I 30w
.22 Fe I 60
.22 Cr 15
.1 bhSr 2
4079.90 Ir 25
.85 Fe I 80
4079.73 Cb I 500w
.72 Ti I 40

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

COLUMBIUM (Continued)

.67 Ce 15
.42 Mn 50
.24 Mn 50
.21 Bi II 2h
.19 Ta 10
.02 Ce 15
4078.47 Tl I 125
.36 Fe I 80
.32 Ce 15
.31 Zr I 10
4077.81 Hg I 150
.71 Sr II 400r
.41 Co I 100wh
(Also Cb, Ce II, Fe, Mo, Rh I, Th, W, V I, Y I)

4060.27 Ti I 60
.08 Zr I 10
4059.88 Ca 2h
.72 Fe 15
.61 Mo 10
.39 Mn 20
.23 Ir 30
4058.96 Mg 2
4058.94 Cb I 1000w
.93 Mn 80
.93 Ca I 3d
.77 Cr 80
.76 Fe I 40
.60 Co I 100
.46 Ta 10
.24 Ce II 18
.23 Fe 80
.19 Co I 100
.16 U 10
.14 Ti I 50
.0 bhSr 3
4057.95 Mn 80
.87 In 80
.83 V I 10
.82 Pb I 2000R
.71 Zn II 80
.63 Mg I 10w
.62 Ti I 40
.58 Mo 10
.20 Co I 100
(Also Ce, Th, W)

3132.64 Ta 250w
.59 Mo 1000R
.07 Zr I 10
.06 Cr II 25
.04 Ce 15
3131.83 Hg I 200
.55 Hg I 400
.21 Cr 20
.07 Be II 200
.07 Th 12
3130.87 Ce 30
.80 Ti II 25
.79 Rh I 60
3130.79 Cb 100
.73 U 10
.58 Ta 100W
.57 Ba I 2
.46 W 10
.42 Be II 200
.33 Ce 30
.29 Ta 15 l
.27 V II 50
.20 Ce 15
.01 Ag 25h
3129.95 Ta 50
.91 Th 10
.33 Fe I 100
.31 Ni I 125
(Also Co I, Fe, Fe II, Ir, Ti I, Y II)

3095.86 Cr 125
.10 Ce II 15
.04 U 12
3094.90 Fe I 30
.83 U 10
.74 Th 10
.69 V I 40
.66 Mo 150
.20 V 20
3094.18 Cb II 100
.01 Ir I 20
3093.99 Cu I 150
.88 Fe 40
.87 Ta 50
.81 Fe I 50
.79 V I 30
.74 Cd II 3
.68 Mo 10
.61 Ce 18
.58 Bi I 10w
.51 W 12
.46 Ca 2
.36 Fe 70
.34 Ce II 12
.11 V II 100R
3092.99 Mg I 125
.72 V 100r
.71 Al I 1000
(Also Cb, Ir, Rh I, Sc, Ti I, Y II, Zr I, Zr II)

CESIUM

4593.177
4555.355

4594.63 Co I 400
.40 Cr 10
.11 Mn 12
.11 V I 30wh
4593.93 Ce 30
.83 Cr 12
4593.18 Cs I 1000R
4592.66 Fe I 200
.58 W 15
.54 Cr 25
.53 Ni I 200
.42 W 20
.21 Mo 20
4591.83 Ba 15
.39 Cr II 200
(Also Mo, Sc I, Th, U, Y)

4556.87 W 15
.35 Ta 200
.17 Cr 40
.13 Fe I 150
4555.92 Cu II 2
.90 Fe II 12
.52 Zr I 30
.49 Ti I 125
4555.36 Cs I 2000R
.30 Cr 15
.13 Zr I 15
.10 U 20
.09 Cr 15
.08 Ti I 12
4554.83 Cr 25
.59 Pt 10
.51 Ru I 1000R
.04 Ba II 1000R
.04 Ce 35s
4553.95 Cr 20
.69 Ta 200*l*
(Also Cb, Ir, Mo, Th, V, Y, Y I, Zr II)

COPPER

3273.962
3247.540

3274.95 Ta 200
.86 Ce 35
.66 Ca I 20
.46 Ta 35
.45 Fe 80
.22 Na II 15
.06 Ce 10
3273.96 Cu I 3000R
.96 Mo 20
.96 Ca 2
.93 Co 10
.89 Cb 20r
.88 Th 10

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

COPPER (Continued)

.62	Sc	I	35
.13	Ta		70
.05	Zr	II	50
.03	V	I	30
.02	Mn		20

(Also Ir I, Rh, Ti I, U)

3248.52	Ta		100
.52	Mn		100
.46	Ni	I	150
.43	Ce		12
.28	Ca		1h
.21	Fe	I	200
3247.62	Mo		30
.55	Ce		15
.55	Ag		15
.55	Sb		2h
.54	Mn		125
3247.54	**Cu**	**I**	**5000R**
.47	Cb		50w
.28	Fe	I	20
.27	Cr	I	20
.21	Fe		10
.18	Co	I	80
3247.00	Co	I	35
3246.96	Fe	I	100
.90	Ta		35h
.67	Ce	I,II	35
3245.98	Fe	I	200

(Also Ir I, Pt I, Th, U)

FLUORINE

5291.0

5292.9	bh F		150
.52	Cu	I	50
.14	Rh	I	80
.08	Mo		20
5291.0	**bh F**		**200**
5290.95	Ba		10
.94	Ce		12
.85	Fe	I	15
.72	V		10

(Also Cr, Mn, Th, U, V I, Y II, Zr)

GALLIUM

4032.982
2943.637

4034.49	Mn	I	250r
.26	Th		10
.05	Cr	I	20
4033.91	Ti	I	40
.76	Ir		100
.73	U		12
.54	Sb		70
.43	U		12
.26	Cr	I	30
.19	Sr	I	6
.07	Mn	I	400r
.07	Cr		15
.07	Ta		100
4032.98	**Ga**	**I**	**1000R**
.63	Ti	I	35
.63	Fe	I	80
.54	Th		10
.52	Cb		30
.38	Sr	I	20
.21	Ir		10
4031.97	Fe		80
.83	V	I	10
.75	Ti	I	35
.67	Ce		10d
4030.76	Mn	I	500r
.49	Fe	I	120

(Also In, Ir I, Mn, Mo, Sc I, W, Zr, Zr II)

2944.18	Ga		10
2943.91	Ni	I	50r
.90	U		10
.77	Ta		10
2943.64	**Ga**	**I**	**10**
.57	Fe		12
.48	Co	I	30
.20	V	I	30
.15	Ir	I	30

(Also Ce, Ir, Mn, Mo, V, W)

GERMANIUM

3039.064
2651.575

3040.85	Cr	I	500R
.81	Co	I	10
.60	Mn		50
.47	Ir	I	35
.43	Fe	I	400
.05	Th		12
3039.82	Mo		20
.78	Cr	I	80
.57	Cd		4
.57	Co	I	70
.50	U		10
.36	In	I	1000R
.32	Fe		20
.31	W		10
.26	U		15
.26	Ir	I	25
.21	Ca	I	1h
3039.06	**Ge**	**I**	**1000**
3038.71	V		20
.60	Th		12
.31	Co	I	25
3037.94	Ni	I	800R
.39	Fe	I	700R

(Also Cb, Ce, Ir, Mn II, Sc II, Ti II, W II, Y I)

2652.49	Al	I	150R
.04	Hg	I	100
.01	Ce		10
2651.90	V	I	50
.71	Fe	I	60
2651.58	**Ge**	**I**	**30**
.48	Ta		50
.18	Ge	I	40
2650.86	Pt	I	700

(Also Cb, U, W)

GOLD

2675.95
2427.95

2677.15	Pt	I	800w
2676.83	Ir	I	35
.33	Mn		15
.11	Fe		15w
.11	Rh	I	10
2675.98	Co	I	10w
2675.95	**Au**	**I**	**250R**
.94	Cb		10
.90	Ta		150
.88	U		15
.87	W		12
.76	V	I	12
.40	W		10
.3	bh B		60
.28	Fe		30
.13	W		10
.12	U		15
2674.57	Pt		200

(Also Ce, Cr, Hg I, Th, Ti I, Ti II)

2428.42	Mn		12
.29	Co	II	10
.28	V	I	30r
.23	Ti	I	15
.20	Pt	I	100
.20	Ag	II	1
.10	Sr	I	10h
.04	Pt	I	100
2427.95	**Au**	**I**	**400R**
.64	Ta		150
.62	U		12
.61	Ir	I	25
.49	W	II	10d
.45	U		12
.29	W		10
.00	Co		12
2426.35	Sb		75

(Also Cb, Fe, Fe II, Ir, Th)

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

INDIUM

4511.323
3256.090
3039.356

4512.74	Ti	I	100
.28	Ca	I	10
.15	Mo		25
4511.90	Cr		80
.64	Ce		10
.50	Ta		300
.34	Cd		5
4511.32	**In**	**I**	**5000R**
.30	Sn		200
.17	Ti		40
4510.98	Ta		200W
.54	Th		30
.32	U		20
.01	Cr		15
4509.39	Cu	I	150

(Also Cb, Ir, Mn, Pt I, V, V I. Zr I)

3257.59	Fe	I	100
.0	bh B		100
3256.77	Ta		100
.70	Fe		20
.68	Ce		20
.27	Th		10
.25	Ce		12
.21	Mo		40
.14	Mn		75
3256.09	**In**	**I**	**1500R**
3255.89	Fe	II	20
.81	Ca		1h
.69	Ta		18h
.68	Sc	I	15
.65	V	I	25
.51	Th		10
3254.36	Fe		200
.21	Co	I	300R

(Also Cb, Ir I, Pt, Pt I, U, V, W)

3040.85	Cr	I	500R
.43	Fe	I	400
.05	Th		12
3039.82	Mo		20
.78	Cr	I	80
.57	Cd		4
.57	Co	I	70
.50	U		10
3039.36	**In**	**I**	**1000R**
.32	Fe		20
.31	W		10
.26	U		15
.26	Ir	I	25
.21	Ca	I	1h
.06	Ge	I	1000
3038.71	V		20
.60	Th		12
3037.94	Ni	I	800R
.39	Fe	I	700R

(Also Cb, Ce, Ir, Mn, Mn II, Sc II, Ti II, W II, Y I)

IRIDIUM

3513.645
3220.780
2849.725

3515.05	Ni	I	1000R
3514.62	U		18
3513.93	Ni	I	200
.82	Fe	I	400
.68	U		10
3513.65	**Ir**	**I**	**100h**
.61	Ta		35
.48	Co	I	300R
.10	Rh	I	50
.07	Fe	I	10
3512.83	Ta		15
.64	Co	I	400R

(Also Cb, Ce, Cr, Fe, Ni, Th, V, W, Y I, Zr I, Zr II)

3222.07	Fe	I	200
3221.74	Mo		20
.65	Ni	I	300
.63	Ba	I	2
.38	Ti	I	25
.32	Ta		70
.29	Th		15
.28	Ir		10
.27	Ni	I	35
.21	W		12d
.17	Ce	II	50
3220.93	Cb		10
.87	Ce		30
3220.78	**Ir**	**I**	**100**
.54	Pb		50h
.40	Ce		12s
.30	Th		12
3219.81	Fe	I	100
.58	Fe	I	200

(Also Pt, Rh, U)

2850.49	Ta		200
.04	Co	I	75
2849.84	Cr	II	80
.82	Ta		15Ws
2849.73	**Ir**	**I**	**40h**
.48	U		18
.38	Mo		50
.29	Cr		35

(Also Cb, Fe, Rh, W)

IRON

3719.935
2395.625

3720.77	Cu	I	10
.38	Ti	I	40
.31	Th		15
.25	Mo		10
3719.94	**Fe**	**I**	**1000R**
.93	Ba	I	2
.80	Ce	II	15s
.44	Th		30
.41	W		12
.29	U		12
3718.93	Mn		75

(Also Cb, Ce, Ir, I, Pt, Ta)

2396.09	Ir	I	20
2395.89	Ir	I	15
.79	Cr	I	25
.63	Ag		4
2395.63	**Fe**	**II**	**50**
.61	Ni		10
.32	Cb		15
.25	Mo		12
.20	Sb		50

(Also Co, V I, W, W II)

LEAD

4057.820
3639.580
2833.069
2614.178

4059.23	Ir		30
4058.96	Mg		2
.94	Cb	I	1000w
.93	Mn		80
.93	Ca	I	3d
.77	Cr		80
.76	Fe	I	40
.60	Co	I	100
.46	Ta		10
.24	Ce	II	18
.23	Fe		80
.19	Co	I	100
.16	U		10
.14	Ti	I	50
.0	bhSr		3
4057.95	Mn		80
.87	In		80
.83	V	I	10
4057.82	**Pb**	**I**	**2000R**
.71	Zn	II	80
.63	Mg	I	10w
.62	Ti	I	40
.58	Mo		10
.35	Fe	I	20
.34	Th		10

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

LEAD (Continued)

4057.20	Co	I	100
.10	Ca		2
.07	V	I	20
4056.98	Co	I	20h
.90	Ce		15
.79	Cr		15
.7	Cu	I	8wh
.67	Sr	II	4
.47	Ir		12
.32	Mo		15

(Also Ni I, Rh I, Sc I, W, Zr I)

3641.10	V	I	100h
3640.39	Ba		8
.39	Fe	I	300
.39	Cr	I	30
3639.80	Cr	I	60
3639.58	**Pb**	**I**	**300**
.53	Zn		20
.51	Rh	I	125
.50	U		25
.45	Th		10
.44	Co	I	200
.33	Cb		15
.02	V	I	70
3638.79	Pt	I	250
.79	Cb		10
.30	Fe	I	100

(Also Ce, Ce II, Ir, Mn, Mo, Ti I, W, Y I, Zr, Zr I)

2833.64	Ta		300w
.63	W		15
.40	Fe		10
.31	Ce		50d
2833.07	**Pb**	**I**	**500R**
2832.95	W		10
.44	Fe	I	300

(Also Cb, Ir, Rh I, Th, U, Zr)

2614.67	Mg	I	5
.67	Sb		4
.61	Pt	I	10
.49	Fe	I	40
.20	Ir	I	10
2614.18	**Pb**		**200r**
2614.18	Sn		5
.17	Ta		200wh
.13	Co	I	30
2613.95	U		10
.90	Ce		15
.82	Fe	II	400
.82	W		15
.72	Mo		15
.72	Bi		8
.65	Pb		50R
.59	Mn		12

(Also Cb, Co II, V)

LITHIUM

6707.844
6103.642
3232.61

6709.88	Cb		15
.39	Ta		10
6708.18	W		20
6707.86	Co		200Wh
.85	Mo		300W
6707.84	**Li**	**I**	**3000R**
6705.9	bhSc		6

(Also Ce, V I, Zr I)

6105.47	Co	I	10h
.30	Cb		10
6104.57	Th		12
6103.64	**Li**	**I**	**2000R**
6102.74	Co		10
.72	Ca	I	80
.72	Rh		100
.71	Cr		10
.54	Zn	II	6
.18	Fe	I	15
6101.9	bhSc		30
.87	Mo		40
.65	Au		5
.58	Ta		150

(Also Ce, Fe I, U)

3234.61	Fe	I	200
.52	Ti	II	100
3233.97	Fe	I	300
.54	V	I	10
.54	Be	II	5
.44	Ce	II	30
.42	Pt	I	40
3233.25	Ag		5
.23	Cr	I	30
.19	V	I	40
.14	Mo		50
.05	Fe		100
3232.96	Ni	I	300R
.87	Co	I	60
3232.61	**Li**	**I**	**1000R**
.50	Sb	I	150
.35	Pb		30
.29	Ce		15
.28	Ti	II	30
.28	Ta		25
.16	U		12
.06	Os	I	500R
.00	Ir		20
3231.69	Zr	II	10
.67	Ta		18h
3230.97	Fe	I	300
.86	Ta		200

(Also Rh, Rh I, Th, Ti I, V, W, W II, Y II, Zr II)

MAGNESIUM

2852.129
2802.695
2795.53

2852.83	Na	I	100R
.75	U		15
.53	Ag		1
.13	Mo		10h
.13	Ir		20
.13	Fe		150
2852.13	**Mg**	**I**	**300R**
.12	Ce		50d
2851.97	Zr	II	12
.80	Fe	I	200
.75	V	I	30
.65	Mg	I	25
2850.99	Ta		400

(Also Cb, Th, V)

2803.24	Pt	I	400
.17	Fe	I	15
.12	Fe		35
2802.95	W		12d
.80	Mn		12
.80	V		15
2802.71	Co		100
.70	Ta		10
.70	Ce		18
2802.70	**Mg**	**II**	**150**
.68	Cu	I	10
.58	U		15
.49	Ta		15
.41	Mn		12
.35	Mo		15
.27	Ni		50
.07	Ta		300
.00	Pb		250Rh

(Also Cb, Hg, Ni I)

2796.34	Ta		400
2795.85	Fe		15W
.82	Co	I	15
.82	Cr		35
.70	Rh	I	15
.54	Fe	I	90
.53	Ag		10
2795.53	**Mg**	**II**	**150**
.53	Ce		30s
.23	U		18
.01	Fe	I	50
2794.82	Mn		1000R
.82	Co		100R

(Also Cb, W, Zr I)

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

MANGANESE

(4034.490
4033.073
4030.755)
2794.82
2576.104

4035.89	Ta		10
.89	Zr	I	40
.83	Ti	I	50
.73	Mn		50
.63	V	II	40
.55	Co	I	150
.36	W		10
4034.91	Ti	I	25
.52	Cb		10
4034.49	**Mn**		**250r**
.26	Th		10
.05	Cr	I	20
4033.91	Ti	I	40
.76	Ir		100
.73	U		12
.54	Sb		70
.43	U		12
.26	Cr	I	30
.19	Sr	I	6
4033.07	**Mn**	**I**	**400r**
.07	Cr		15
.07	Ta		100
4032.98	Ga	I	1000R
.63	Ti	I	35
.63	Fe	I	80
.54	Th		10
.52	Cb		30
.38	Sr	I	20
.21	Ir		10
4031.97	Fe		80
.83	V	I	10
.75	Ti	I	35
.67	Ce		10d
.40	Sc	I	10
.34	Ce	II	40
.22	V	I	10
.13	Cr		30
4030.86	Th		10
.76	Zr	I	20
4030.76	**Mn**	**I**	**500r**
.68	Cr		40
.67	Ta		10
.66	Sc	I	10
.51	Ti	I	80
.49	Fe	I	120
.38	Sr	I	40
.34	Ce	II	18
.3	Ca		10
.19	Fe	I	20
.04	Zr	I	35
4029.94	Ta		50
.68	Zr	II	40
.64	Fe	I	80
4028.95	Zr	I	40
.79	W		12
.41	Ce	II	35
.35	Ti	II	30

(Also Co, In, Ir I, Mo, Y, Y I, Zr)

2795.53	Mg	II	150
.23	U		18
.01	Fe	I	50
2794.82	**Mn**		**1000R**
.82	Co		100R
.70	Fe	I	50

(Also Cb, Ir I, Mo, Zr I)

2577.26	Pb		100wh
2576.69	Fe	I	40
.69	Th		15
.30	Hg	I	20
2576.10	**Mn**	**II**	**300R**
.10	Co		30
2575.74	Ag		10h
.74	Fe		80
.74	Ir	I	10
.51	Mn		150
.47	Ta		80
2575.47	W		10
.41	Al		30
.10	Al		200R

(Also Cb, Ce, Mo, Rh, Rh I, V, W II, Zr I)

MERCURY

4358.35
2536.519

4359.85	Cb		50
.81	Mn		25
.65	Sc		12
.63	Cr	I	200
.63	Mn		15
.62	Mo		15
.59	Ni	I	100
.58	Ir		12
.55	Ba		15
.43	Co	I	15
.08	Sc		12
.07	Ce		15
4358.74	Zr	I	10
.73	Y	II	60
.65	Ta		10
.65	Sc	I	10
.55	Mo		20w
.51	Fe	I	70
4358.35	**Hg**	**I**	**3000w**
4357.91	Ce		12
.73	Y	I	10
.53	Cr		12
.17	Co	I	10

(Also Fe, Pt I, Th, U, V I, Zr II)

2536.93	V		10
.85	Mo		25
.82	Fe	II	10
.71	Rh		15
.56	Bi		5h
2536.52	**Hg**	**I**	**2000R**
.49	Pt	I	100
.23	Ta		100W
2535.65	P	I	100
.60	Fe	I	1000

(Also Co I, Fe, Ir, Th, U, W)

MOLYBDENUM

3864.110
3798.252
3170.35
2816.154

3865.53	Fe	I	600
.04	Cb		10d
3864.86	V	I	100r
.50	Ti		15
.34	W		12
.34	Zr	I	50
.30	V	I	30
3864.11	**Mo**	**I**	**1000R**
3863.87	Zr	I	20
.87	V	I, II	25
.74	Fe	I	60
.61	Co	I	30
.39	Th		20
.38	Cb		15

(Also Ce, Ce II, Fe, Fe II, U)

3800.12	Ir		150
3799.55	Fe	I	400
.31	Rh	I	25
.27	V	I	10
.26	Mn		50
.22	Th		10
.00	Zn	I	5
3798.84	U		15
.51	Fe	I	400
.31	Ti	I	10
3798.25	**Mo**	**I**	**1000R**
.12	Cb		50
2797.77	U		10
.72	Cr	I	100
.52	Fe		300

(Also Ce, Ce II, Ir I, Ta, W)

3171.35	Fe	I	100
3170.86	U		10

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

MOLYBDENUM (Continued)

.58	Ag		5
.43	Th		10
3170.35	**Mo**		**1000R**
.35	Fe	II	10
.29	Ta		250w
.20	W		15
.07	Ce		12
3169.93	W		10
.85	Ca	I	10
.77	Co		100
.68	Cu	I	50
.58	Cr	I	25

(Also Cb, Fe, Ni I, Ti I)

2817.10	Ta		80d
2816.15	**Mo**	**II**	**200**
.08	Th		10
2815.97	V		12
.91	Mo		20
.60	Mn		12h
.12	Ta		100

(Also Ce, Fe, U)

NICKEL

3524.541
3515.054
3492.956
3414.765

3525.4	bhSr		8
.23	Cb		15w
.16	Ti	I	10
3524.99	Ba	I	20
.72	V	II	10
3524.54	**Ni**	**I**	**1000R**
.54	Mn		15
.54	Zr	I	9
.24	Zr		12
.24	Fe	I	60
.24	Cu	I	40
.07	Fe		50
3523.70	Co	I	15
.59	Cr		10
.44	Ni	I	100
.43	Co	I	300r

(Also Ce, Ir, Mo, Th, Ti, U, W)

3515.95	Ir	I	35
.55	Be	I	30
.42	Cb		20
.11	Zn	I	2h
3515.05	**Ni**	**I**	**1000R**
3514.8	bhCa		4
.62	U		18
3513.93	Ni	I	200
.82	Fe	I	400
.65	Ir	I	100h
.48	Co	I	300R

(Also Ce, Ce II, Fe, Mo, Pt, Ta, Th, V, W, Zr, Zr I, Zr II)

3494.00	U		12
3493.72	Ce	II	18
.53	Th		30
.47	Fe	II	40
.47	Ta		15W
.28	Ti	I	15
.17	V	II	15
.11	Ce		12
3492.96	Mn		10
3492.96	**Ni**	**I**	**1000R**
.25	Ce		12
.0	bhZr		30
3491.99	Co	I	10
.32	Co	I	200R

(Also Cb, Fe, Fe I, Ir I, Mo, W, W II, Zr I)

3415.78	Co	II	100R
.78	Cu		10Wh
.63	Mo		10
.61	Ce		10
.53	Fe	I	60
.53	Co	I	20
.38	Ca		2
.24	Ir		10
3414.77	**Ni**	**I**	**1000R**
.74	Co	I	200W
.66	Zr	II	20
.55	Ag	I	4
.20	V	I	20
.14	Ta		18W
.07	Cb		10
3413.94	Ni	I	300
.48	Ni	I	500
.14	Fe	I	400
3412.63	Co	I	1000R

(Also Ce II, Cr, Ir I, Th, U, W, Y, Zr I)

PHOSPHORUS

2553.28
2535.65–2534.01

2553.82	W		12
.70	Mo		15
.67	V		10
.60	W		10
.56	Cd	I	25
.41	Ag	II	2
.38	Ni	I	20
.37	Co	I	10r
2553.28	**P**	**I**	**80**
.19	Fe		10
.18	Ta		10h
.16	W		12
.06	Cr	I	20
.00	Co	I	40r
2552.98	Tl	I	10R
.96	V		10
.87	Mo		20
.77	Fe		20

(Also Cb, Ce, Fe I, U, Zr II)

2536.52	Hg	I	2000R
.49	Pt	I	100
.23	Ta		100W
2535.97	Ni		25
.97	Pt		25
.96	Co	I	10r
.87	Ti	II	20
2535.65	**P**	**I**	**100**
.60	Fe	I	1000
.60	Ta		50h
.31	Ag	II	10
.10	W		12
2534.97	Ta		30
.95	U		12
.83	V		20
.78	Hg	I	30
.68	W		12
.62	Ti	II	25
.52	V	II	10
.47	Ta		25
.46	Ir	I	100
2534.01	**P**	**I**	**50**
2533.98	W		10
.91	Cd	I	2
.81	V		10
.80	Fe		12
.63	W		10
.13	Ir	I	100

(Also Cb, Ce, Co, Cr II, Fe II, Ir, Rh, Th, V I, W II, Zr II)

PLATINUM

3064.712
2929.794
2659.454

3066.38	V	I	400r
3065.26	Cb		10
.11	Sc	II	12d
.07	Cr		20
.04	Mo		30
3064.94	W		10s
3064.71	**Pt**	**I**	**2000R**
.62	Ni	I	200r
.56	Mo		15
.51	Ir	I	20
.37	Na	II	2
.37	Co	I	100
.30	Al		20

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

PLATINUM (Continued)

.28	Mo		80
.02	Ce		15
3063.93	Fe		40
.88	Ta		18
.73	V	I	35
.73	Cd		2
.42	Cu	I	300

(Also Ir, Sc, U, V, W II, Zr II)

2930.25	Mn		25
.18	Ir	I	12
.15	W		10
2929.79	**Pt**	**I**	**800R**
.62	Fe	I	50
.51	Co	I	75
.35	Ag	II	20
.11	Rh		100
.01	Fe	I	150

(Also Mo, U, V, Y II)

2660.39	Al	I	150R
2659.66	Ta		15
.6	bhC		20
2659.45	**Pt**	**I**	**2000R**
.41	Ta		20
2658.98	V		10
.93	Fe		10

(Also Cb, Ce, Ga, Ir, Ir I, Rh I, Th, U)

POTASSIUM

4047.201
4044.140

4048.67	Zr	II	30
.4	Bi	II	3h
4047.79	Sc	I	25
.63	Y	I	50
.61	U		18
.35	Ca		2
.28	Ce		18
4047.20	**K**	**I**	**400**
4046.76	Cr	I	30
.70	W		10
.56	Hg	I	200
.49	Sc	I	10
.34	Ce	I, II	30
4045.82	Ag		10
.82	Fe	I	400
.39	Co	I	400

(Also Cb, Ir, Mo, Ni I, Rh, Th, V, Zr I)

4045.82	Fe	I	400
.61	Zr	II	10
.60	W		12
.39	Co	I	400
.21	Mn		15
.13	Mn		15
4044.82	U		10
.61	Fe	I	70
.56	Zr	I	25
.42	Ca		5d
.42	U		18
.29	W		15
4044.14	**K**	**I**	**800**
4043.91	Fe	I	25
4043.80	Sc	I	12
.78	Ti	I	20
.70	Cr		30
.58	Zr	I	25
.15	Th		10
4042.87	Mo		15
.75	U		40
.64	V	I	15

(Also Cb, Ce, Hg II, Ir)

RHODIUM

3434.893
3396.85

3435.82	Cr		30
.68	Cr	I	20
.56	Sc	I	12
.53	U		15d
.43	Ti		10
.21	Ce		20
.20	U		10
3434.89	**Rh**		**1000r**
.79	Mo		50
.76	Ir	I	10
.65	Ag	I	2h
.61	U		12
.50	Ta		35
.28	Sr	I	2
.11	Cr	I	30
.00	Th		12
3433.97	Cu	I	5h
.56	Ni	I	800R
.04	Co	I	1000R

(Also Fe I, V, W, Zr II)

3397.84	V	I	30
.69	Mo		20
.64	Fe	I	10
.21	Bi	I	100wh
.20	U		12
.08	Ce		12
3396.98	Fe	I	125
3396.85	**Rh**	**I**	**1000w**
.72	Ce		15
.52	V	I	15
.33	Zr	II	12
.32	Cu	I	30
3395.93	Cb		10
.82	W		8
.38	Co	I	400R

(Also Fe, Ni, Ni I, Ta, Th, Y I, Zr)

RUBIDIUM

7800.227
4201.851

7801.30	Si		3h
7800.44	Sc	I	40
7800.23	**Rb**	**I**	**9000R**
.0	Si		4Wh
7799.37	Zn	I	10
7798.26	Ba	I	4h
7797.62	Ni	I	80

(Also Ce, Ta, U, Y I, Zr I)

4203.99	Fe	I	200
.59	Cr	I	100
.22	Ca	I	2
4202.94	Ce	II	40
.76	Fe		10
.52	Sr	I	6
.03	Fe	I	400
4201.85	**Rb**	**I**	**2000R**
.76	Mn		40
.72	Ni	I	30
.52	Cb		10
.46	Zr	I	50
4200.93	Fe	I	80
.75	Ti	I	35
.57	Mo		15
.46	Ni	I	40
4199.10	Fe	I	300

(Also Ce, Ir, Pt I, Ta, Th, U, V II)

SCANDIUM

4023.688
3630.740

4026.17	Cr		100
4025.15	Ce		12
.14	Ti	II	15
.01	Cr		100
4024.92	Zr	I	25
.74	Fe	I	120
.68	Ca		3wh
.57	Ti	I	80
.57	Cr	I	20
.49	Ce		15
.09	Mo		30
4023.98	Zr	I	30
.74	Cr		40
4023.69	**Sc**	**I**	**100**
.43	Cr	I	15
.40	Co	I	200
.38	V	II	10

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

SCANDIUM (Continued)

.22	Sc	I	60
.14	Rh	I	10
4022.66	Cu	I	400
.27	Ce		15
.26	Cr		80
4021.87	Fe	I	200
.83	Ti	I	100

(Also Cb, Ni I, Th, U, W, V I, Zr, Zr II)

3631.71	Ir	I	10
.69	Cr	II	10
.46	Fe	I	500
.39	Co	I	50W
.27	Na	II	12
.19	Ce	I, II	50
.10	Fe	I	25
3630.95	Ca	I	10
.75	Ca	I	150
3630.74	**Sc**	**II**	**50**
.64	Ba		15
.35	Fe	I	40
.32	W		10
.02	Zr	II	15
3629.92	Sb	II	2
.79	Cu	I	15
.76	Ir	I	15
.74	Mn		100

(Also Cb, Ce, Ni I, Ti, U)

SELENIUM

4730.78
2039.851

4732.47	Ni	I	100
.30	Sc	I	10
.06	Co	I	40
4731.81	Ni	I	100
.60	U		40
.44	Mo		100
.17	Ti	I	50
4730.78	**Se**	**I**	**1000Spk**
.71	Cr		100
.36	Mn		15
.16	Mg	I	2
.12	Ta		100
4729.72	Cr		30
.70	Fe	I	25
.65	W		30
.53	V	I	15
.47	Sr	I	4h
.29	Ni	I	10
.23	Sc	I	100
4728.86	Ir		150

(Also Cb, Fe II, Ir, Rh, Th, Zr I)

2040.33	Pt		15
2039.85	**Se**	**I**	**1000Spk**
.79	Te		300
.70	Pt		12
.60	Sb		15
.43	Ir		25
.31	Cr		25h

(Also Rh, W, Zr)

SILICON

2881.578
2528.516
2516.123
2506.899

2882.37	Rh		80
.01	Th		10
2881.58	**Si**	**I**	**500**
.58	Ce		40
.25	Rh	I	20
.23	Ta		30
.23	Cd	I	50R
.16	Ir		15
.15	Th		10
.14	Cr		25
.14	Na	II	8
.13	Ce		12
2880.77	Cd	I	200R

(Also Co, Cr, Ir I, Ti I, U, W)

2529.13	Fe	I	80R
.13	Mn		80
2528.97	Ni		20
.97	Co	I	50R
.84	V		25
.70	Mn		12
.54	Sb	I	300R
2528.52	**Si**	**I**	**400**
.47	V		50
.29	Ce		15
.24	Cr	I	30
.10	U		10
.05	Ni	I	20
.01	Cr	I	35
2527.99	Ti	I	15

(Also Co II, Fe, Mo, Ta, W)

2516.58	W		12
.57	Fe	I	10
2516.12	**Si**	**I**	**500**
.12	V		25
.11	Mo		25
2515.81	Zn	I	150w
.75	Rh	I	60
.69	Bi	I	100
.66	Mo		10
.58	Pt	I	500

(Also Ta, U, W II)

2507.45	Ta		150
.33	Cr		15
2506.91	V	I	50r
2506.90	**Si**	**I**	**300**
.88	Ag	II	2
.88	Co	I	10w
.60	Ir		10
.60	Ag	II	15
.57	Fe		10
.46	Co	II	50w
2505.93	Pt		150

(Also Cb Fe II, U)

SILVER

3382.891
3280.683

3383.98	Fe	I	200
.80	Cb		15
.76	Ti	II	70
.70	Fe	I	100
.69	Ce		20
.39	Ce		12
.14	Sb		40
3382.89	**Ag**		**1000R**
.68	Cr	II	35
.61	W		10
.48	Mo		15
.41	Fe	I	50
.31	Ti	I	30
.29	Mo		10
.28	Bi		2
.08	Cr		30
.00	Au	II	6
3381.50	Co	I	100W

(Also Cb, Pt, Th, U, Y, Zr)

3281.50	Ba	I	25
.48	Ca		1h
.30	Fe	II	15
.10	Ce		18
.07	Mo		25
3280.76	Mn		60
.69	Cu		10
3280.68	**Ag**	**I**	**2000R**
.68	Eu		1000R
.55	Rh	I	30R
.49	Ce	II	15
.37	Th		10
.26	Fe		150
.00	Ti	II	10
3279.85	V		20
.84	Ce	I, II	30
.82	Cu	I	25

(Also Cb, Co, Ta, U, Y II, Zr II)

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

SODIUM

5895.923
5889.953
3302.323

5895.92	**Na**	**I**	**5000R**
.70	Pb		20*hl*
5894.35	Zn	II	3
.07	Ir	I	20
5893.9	bhY		10
(Also Fe, Mo, Sc I, Ta)			
5891.61	W		12
.56	Mo		25h
5889.99	Cr		12
.98	Mo		50h
5889.95	**Na**	**I**	**9000R**
5888.68	Ti		15
.33	Mo		150
.01	Cr		20
(Also Co I, Ta, Th)			
3303.28	Mn		40
.23	Ce	II	10
3302.99	Na	I	300R
.94	Zn		700R
.94	Ca		4
.91	Ce		10W
.88	Cr		30
.77	Ta		50
.67	Zr	II	10
.59	Zn	I	800
.55	Bi		150
3302.32	**Na**	**I**	**600R**
.19	Cr		50h
.13	Pa	I	1000wh
3301.91	Ce		10
.90	Ta		25
.86	Pt	I	300
.75	U		10
.73	Sr	I	100
.52	Ca		4
(Also Cb, Fe II, Ir I, Mo, Pt, Th, Ti II, W II, Y)			

STRONTIUM

4607.331
4077.714

4608.71	Mo		10
.12	Rh	I	15
4607.65	Fe	I	50
.63	Mn		50
.34	Au	I	30
4607.33	**Sr**	**I**	**1000R**
4606.8	bhSc		10
.77	Cb		50
4606.40	Ce		12
.38	Cr		15
.23	Ni	I	100
.2	bhSr		2
.15	V	I	30
4605.36	Mn		150
4604.99	Ni	I	300
(Also Co, Th, Ti, U, V, W, Y II)			
4079.72	Cb	I	500w
.24	Mn		50
.21	Bi	II	2h
.19	Ta		10
.02	Ce		15
4078.58	Sc	I	10
.47	Ti	I	125
.36	Fe	I	80
.32	Ce		15
.31	Zr	I	10
4077.81	Hg	I	150
.79	U		15
.72	Sn		2
.72	Cu		5
4077.71	**Sr**	**II**	**400r**
.68	Cr		30
.47	Ce	II	18
.41	Co	I	100wh
.37	Y	I	50
.15	Ti	I	18
.09	Cr		35
4076.64	Fe	I	80
.55	Ir		25
.53	Zr	I	10
.38	Ti	I	15
.35	Y		30
.33	Au	II	4
.24	Ce		12
.19	Mo		25
.13	Co	I	70
(Also Cb, Fe, Rh I, V I, W, Zr II)			

SULFUR

4695.45
4694.13

4695.45	**S**	**I**	**30Spk**
.15	Cr		50
4694.66	W		12
4694.13	**S**	**I**	**50Spk**
.09	Th		15
4693.95	Cr		50
.93	Mo		20
.73	W		50
.68	Ti	I	25
.35	Ta		150
.21	Co	I	500
4692.7	bhSr		5
4691.9	Ta		400
.62	Ba		100
(Also Cb, Ce, U, Zr I)			

TANTALUM

3318.840
3311.162

3320.26	Ni	I	400w
3319.83	Co	I	35
.68	Cu	I	60
.59	Mo		10
.48	Co		80
.25	Fe		70
.21	U		10
.16	Co	I	60
.03	Zr	II	25
.02	V	I	15
3318.98	Cb		10
.96	Ce	II	15
3318.84	**Ta**		**125**
.65	Au		3
.53	Ta		70
.53	Y	II	12
.40	Co	I	35
.36	Ti	I	12
.08	Cr		80wh
.03	Na	II	6
.03	Ti	II	60
3317.93	Ta		200
.80	Ce		15
.31	Mn		100
.12	Fe	I	100
(Also Ir, Ir I, Th, W)			
3312.15	Co	I	60
.13	Ir	I	25
.08	Cr	I	10
3311.91	Mn		75
.85	Sr		1
.72	U		10d
.50	Ce		15
.38	W		15*l*
.30	Cr	I	8
3311.16	**Ta**		**300w**
.00	Cu	I	3
3310.88	Ce		10
.77	Mo		20
.62	U		10
.53	Ir	I	30
.51	Ag	I	2
.50	Fe		50
.34	Fe		100
.20	Ni	I	50
(Also Cb, Cr, Cr II, Fe I Sc II, Th, Zr, Zr II)			

TELLURIUM

2385.76–2383.25

2386.19	Cr	I	20
.15	Ir		15
.14	Rh		80

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

TELLURIUM (Continued)

2385.86	Ir		20
2385.76	**Te**	**I**	**600**
.74	Cr	I	25
.23	Y		12
.01	Ni		10
2384.86	Co	I	10R
.82	W		12
.65	Rh		25
.39	Fe		20
.38	Ni	I	15
.28	V	I	15
.17	Zr		25
.05	Mn		40
2383.79	Ir		15
.64	Pt	I	30
.63	Sb		75
.52	Mo		12
.46	Co	II	15
.40	Rh		50
.33	Cr	I	20
2383.25	**Te**	**I**	**500**
.17	Ir		10
2382.99	W		15
.89	Rh		50

(Also Cb, Co, Fe I, Fe II, Ta, U, V, W II)

THALLIUM

5350.46
3519.24
3229.75

5353.49	Co	I	500w
5352.68	Cu	I	6
.35	Mo		10
.1	bhF		10
.05	Co	I	500w
5351.90	W		20
.08	Ti	I	50
5350.74	Cb		150
5350.46	**Tl**	**I**	**5000R**
.45	W		18
5349.88	Mn		20
.62	Ba		7
.57	Ta		30
.47	Ca	I	12
.31	Rh		20
.29	Sc	I	30
.09	Ta		80
.09	Co	I	80
5348.95	W		30
.32	Cr	I	150R

(Also Fe I, Th, U, Zr, Zr I, Zr II)

3521.26	Fe	I	300
3520.08	Co	I	100W
.07	Sb		4
.06	Cb		20
.03	Cu	I	30
3519.77	Ni	I	500h
.74	Ce		18
.61	Zr	I	100
.54	Rh	I	40
3519.24	**Tl**	**I**	**2000R**
.18	Bi		10
.17	V	I	10
.08	Ce		25
3518.88	Fe	I	10
.63	Ni	I	90
.48	W		10
.37	Ce		12
.35	Co	I	200w

(Also Co, Cr, Fe, Ir I, Mo, Th, Ti I, V II)

3230.97	Fe	I	300
.86	Ta		200
.72	Mn		75
.65	V	I	20
.64	Au I, II		15
.29	Pt	I	100
.21	Fe	I	100
.08	Ce		10
3229.99	Fe		20
.99	Ag		1
.88	Ta		35h
.87	Fe		10
.79	Mo		25
3229.75	**Tl**	**I**	**2000**
.69	Be	I	15
.61	V	I	15
.60	Ce		10
.59	Fe		10
.50	U		18
.42	Ti	II	15
.37	Mg	I	25
.36	Ce	II	25
.28	Ir	I	35
.23	Ta		300w
.20	Cr		35
.19	Ti	II	30
.12	Fe	I	80
.12	Ce		25
3228.97	Th		12
.91	Fe		80
.81	Zr	II	10
.25	Fe	I	100
.09	Mn		100
3227.75	Fe	II	200

(Also Cb, W, W II)

THORIUM

4019.137
3290.59 Spk

4020.91	Co	I	500w
.46	Mo		10
.40	Sc	I	50
.1	bhSr		2
.09	Mn		10
.03	Ir		80
4019.79	Mo		10
.64	Pb		6
.30	Co	I	80
.23	W		18
4019.14	**Th**		**8**
.04	Ce		15
4018.99	U		25
.28	Fe	I	50
.20	Cr	I	35
.12	Zr		25
.10	Mn		80
4017.77	Ti	I	70h
.72	U		25

(Also Cb, Ce II, Fe, Ni I, Zr II)

3292.59	Fe	I	300
.02	Fe		150
3291.34	U		12
.06	Cb		10
3290.99	Cr		30wh
.99	Fe	I	125
.99	Mn		10
.82	Mo		40
.72	Fe		15
3290.59	**Th**		**40h Spk**
.54	Cu	I	25
.42	Ca		1h
3290.34	Ce	II	20
.22	Pt	I	150
.01	Cb		10
3289.85	Y		15
.84	Mo		10
.84	Ta		25
.64	Rh		50r
.14	Rh	I	150

(Also Ce, Ir, Ir I, Ti I, V, W)

TIN

3262.328
3175.019
2863.327
2839.989

3263.24	V	I	40
.21	Co	I	30
.14	Rh	I	200
.11	U		25
.07	Ce	II	10
.00	Ta		20
3262.67	Th		12
.63	Mo		15
.35	Pb		20h

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

TIN (Continued)

3262.33	**Sn**	**I**	**400h**
.29	Os	I	500R
.28	Fe		50
.28	Ba	I	3
.06	V	I	10
.01	Fe		30
.01	Ir	I	20
3261.96	Ba	I	40
.88	Cb		10
.72	U		15
.61	Ti	II	70
.33	Fe		25
.06	Cd	I	300
(Also Ce, Co, Pt, W)			
3175.99	Fe		12
.84	Mg	II	5
.73	Th		12
.45	Fe	I	200
.11	Te	I	30
.06	Ce		10
3175.02	**Sn**	**I**	**500h**
3174.91	Co	I	80
.65	Mn		15h
.17	Th		10
.14	Co	I	20
.08	Ce		15
(Also Cb, Mo, Pt I, Ta, U, V, W II)			
2863.88	W		10
.86	Fe	I	125
.84	Ir	I	15
.81	Mo		30
.75	Bi	I	80w
.44	Fe		100
.34	Ce		12
2863.33	**Sn**	**I**	**300R**
.05	V	I	20
2862.94	Rh	I	150
.84	Mo		10
.79	Ce	II	15
.50	Fe	I	100
(Also Co, Fe, Mn, Sc II, U, V)			
2840.42	Fe	I	125
.22	Ir	I	15
.02	Cr		25
.00	Mn		20
2839.99	**Sn**	**I**	**300R**
.89	U		18
.59	Mo		25
.56	Na	II	2
.44	V	I	12
(Also Cb, Ce, Fe II, Ta, Th, V, W, W II)			

TITANIUM

3372.800
3349.035
3199.92

3374.22	Ni	I	400
3373.75	W		10
.73	Ce	II	25
.73	U		10
.46	Ce		25
.42	Zr	II	12
.23	Co	I	60
.00	Pd	I	800r
.00	Pt		10
3372.80	**Ti**	**II**	**80**
.77	Y		15
.68	Ca		1
.56	Cb		10h
.53	Rh	I	10
.51	Ag	II	1
.25	Rh	I	300
.21	Ti	II	10
.08	Fe	I	40
.00	Ca		2
3371.99	Ni	I	400
.45	Ti	I	100
3370.79	Fe		300
(Also Mo, Th, Sc II)			
3350.89	Rb	I	150
3349.97	Ce	II	30
.52	Cb		30
.41	Ti	II	100
.40	Au		15
.32	Cr		35
.29	Cu	I	70
.07	Cr		125
.06	Cb		80
3349.04	**Ti**	**II**	**125**
3348.84	Ti	II	12
.72	Rb	I	100
.72	Cs	I	15
.11	Co	I	80
3347.93	Fe	I	150
(Also Ce, Co, Fe, Mo, Sc I, Th, Ti I, U, W)			
3200.89	Ag		1h
.89	Ir	I	10
.84	Ca		1
.78	Fe	I	25
.71	Pt	I	100
.52	Ce		10
.48	Fe	I	150
.42	Ni		30
.27	Y	II	30
.22	Sr	I	2h
.14	U		15
3199.92	**Ti**	**I**	**200**
.82	V	I	25
.53	Fe	I	300
.32	Co	I	35
.28	Ce		25
3198.99	Sr	I	10
.97	Th		10
.92	Ir	I	30
.67	Ta		125
.01	V	I	100r
(Also Cb, Mo, Pt, Sc II, W, Zr II)			

TUNGSTEN

4302.108
4008.753
2944.395

4303.53	V		15
.24	Co	I	15
.17	Fe	II	12
4302.98	Ti	I	10
.98	Ta		125W
.89	Zr	I	100
.77	Cr		40
.7	bhSr		4
.65	Ce		10
.53	Ca	I	50
.29	Y	I	30
.19	Fe	I	50
.14	Bi	II	2h
4302.11	**W**	**I**	**60**
4301.93	Ti	II	25
.93	Mo		10
.60	Ir		200
.53	Ce		10
.47	U		15
.26	Mo		20
.18	Cr		100
.09	Ti	I	150
4300.99	Cb		30
.86	Ce		15
.64	Ir		10
.57	Ti	I	125
.51	Cr		100
4299.72	Cr	I	100
(Also Th, V I)			
4010.26	Ca		2
.14	Ce		15
4009.72	Fe	I	120
.66	Ti	I	60
.37	Mo		20
.07	Th		10
.06	Ce		12*l*
4008.93	Ti	I	80
4008.75	**W**	**I**	**45**
.22	Th		10
.06	Ti	I	50

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

TUNGSTEN (Continued)

.05 Ir I 12
.02 Mn 15
4007.60 Zr I 25
.59 Ce 15
.27 Fe I 80
(Also Cb, Co I, Fe, Ni I, U, V II, Zr)

2945.06 Fe 100
2944.75 Pt I 15
.57 V II 50
.40 Fe II 70
2944.40 W 30
.35 Ce 18
.29 Bi 5
.21 Mo 25
.18 Ga 10
2943.91 Ni I 50r
.90 U 10
(Also Cb, Mn, V I, Zr II)

URANIUM

4241.669
3552.172

4242.85 Cr I 15
.80 Mo 15
.72 Ce II 15
.63 Cb 10
4242.62 Ba 10
.47 Mg II 4
.26 Co I 20
.01 Ce 10
4241.77 Au I 40
.69 Zr I 100
4241.67 U 40
.6 Na I 3
.45 W 30
.32 V I 15
.20 Zr I 100
.19 Cr 10
.11 U 10
4240.83 Mo 30
.8 bhCa 3
.71 Cr 200
.59 U 10
.54 Sr II 1
.49 Ir 15
.46 Ca I 10
.37 Fe 30
.36 V I 15
.34 Zr I 100
.28 Mo 25
4239.72 Mn 100
.31 Zr I 100
(Also Co I, Cr II, Fe I, Th)

3553.74 Fe 100
3552.99 Co I 20
.83 Fe I 80
.73 Ce II 18s
.72 Mn 12
.72 Co I 20
.45 Ba II 1
3552.17 U 8
.12 Fe 10
.10 Ir I 20
3551.95 Zr II 30
.78 Ce 10
.66 Ce II 10
.54 V I 25
.53 Ni I 50
.43 Ce 10
3550.60 Co I 200
(Also Cb, Cr, Mo, Th, W, Y I, Zr I)

VANADIUM

4379.238
3185.396–3183.982

4381.64 Mo 150
4380.59 Mo 15
.55 V I 15
.29 Mo 30
.27 U 12
.06 Ce 30
4379.92 Rh I 60
.78 Cr I 15
.78 Zr II 10
.4 Bi II 25
.25 Ag 5
4379.24 V I 200R
4378.82 Ta 40
.49 W 25
.20 Cu I 200w
4377.96 Cb 10
.01 Ir 100
(Also Co I, Cr, Th, Y I)

3186.45 Ti I 150
.35 Co I 70
.32 U 10
.13 Ce 40
3185.95 Co I 40
.71 U 12
.59 Rh I 100
3185.40 V I 500R
.10 Mo 20
3184.90 Th 10
.90 Fe I 200
.72 Ce 10
.62 Fe I 60
.62 Ce 12
.55 Ta 70
.42 W 10
.41 Ba 3
.37 Ni I 150
.21 Ce II 20
.04 W 10
3183.98 V I 500R
.97 Th 12
.97 Ti 12
.95 Ba I 2
.52 Ce 40
.41 V I 200R
.25 Ni I 25
.16 Ba I 5
.03 Mo 10
3182.98 Fe 125
(Also Cb, Cr, Fe II, Ir, Ir I, Ti II, W II, Y I, Zr I)

YTTRIUM

3710.290
3242.280

3711.23 Fe I 80
.07 Na II 8
3710.52 Sb II 2
.45 Cb 15
3710.29 Y II 80
.14 Mo 20
3709.96 Ti I 80
.93 Ce 25
.29 Ce 25
.25 Fe I 600
.25 Ag I 10
(Also Cr, Fe, Ir I, Ta, Th, U, W)

3244.19 Fe I 300
3243.84 Co I 100
.78 Mn 100
.27 V I 20
.16 Cu I 15
.11 Fe 50
.06 Ni I 400R
3242.83 Ta 125
.70 Pd I 2000wh
3242.28 Y II 60
.14 Ce II 12
.05 Ta 125
.03 W 10
3241.99 U 10
.99 Ti II 60
.84 Be II 5
.76 Ca 1
.65 Be II 5
.52 Ir I 100
(Also Cb, Ce, Th, Zr I, Zr II)

QUALITATIVE SPECTROGRAPHIC ANALYSIS TABLE

ZINC

4722.159
3345.020
3302.588—see under *SODIUM*

2138.56

4724.42	Cr		125
4723.17	Ti	I	40
.10	Cr		125
.06	Mo		10
4722.88	Ta		200
.87	V	I	20
.83	Bi	I	10
.73	U		40
.62	Ti	I	80
.55	Bi	I	1000
.28	Sr	I	30
.19	Bi	I	10
4722.16	**Zn**	**I**	**400w**
4721.51	V	I	15
(Also Cb, Co, Ir, Rh I, Sc I, Th, W)			
3346.94	Co	I	100
.74	Cr		150R
.02	Cr		35
3345.93	Zn	I	150
.89	U		12
.86	W	II	10
.57	Zn	I	500
.54	U		12
.45	Be	I	2
.44	Ce		20
.37	Cr		18
.35	Mn		15
.15	Cr		15
3345.02	**Zn**	**I**	**800**
3344.79	Zr	II	15
.76	Ce	II	50
.75	Mo		50
.51	Ca	I	100
.51	Cr		20
.22	Ir	I	10
.20	Rh	I	100
3343.90	Pt	I	100
(Also Fe, Ta, Th, Ti I, W, Y)			
2138.97	Co	I	15
.58	Ni	II	10
.57	Ir		15
2138.56	**Zn**	**I**	**800R**
.53	As		2
.51	Cu	I	25wh
.15	W	II	10
(Also Cb, Fe I, V II)			

ZIRCONIUM

3496.210
3438.230
3391.975

3497.84	Fe	I	200
.11	Fe	I	200
.03	Sc		12w
3496.94	V	I	12
.81	Mn	II	10
.79	Co	I	30
.68	Co	I	150R
.35	Ni	I	15
.33	Ce		12
3496.21	**Zr**	**II**	**100**
.08	Y	II	20
.07	Co		10
.03	Cb		10
3495.96	Ti	I	10
.94	Ce	II	15
.84	Mn	II	25
.75	Ti	I	25
.73	Ce		10
.70	Th		10
.69	Co	I	1000R
.48	Ce		10
.38	Cr	II	12
.29	Fe	I	100
.25	W		12
(Also Fe, Ir I, Mo, U, Zr I)			
3439.31	Ti	I	18
3438.97	Mn	II	20
.95	Th		10
.91	Co	I	30
.87	Mo		20
.71	Co	I	80W
.31	Fe		10
3438.23	**Zr**	**II**	**250**
.07	Ce		15
3437.95	Fe		15
.81	Ce		10
.69	Co	I	150Wh
.50	Ir	I	30
.49	Sb		2h
.32	Ce		12
.28	Ni	I	600R
.22	Mo		25
(Also Cb, Ta, U, V I, W, W II, Y)			
3392.99	Ni	I	600R
.99	Cu	I	5
.99	Cr	II	10
.81	Ca		1
.78	Ce	II	10
.71	Ti	I	20
.66	Fe	I	300
.34	Cb		20r
.31	Fe	I	125
.17	Mo		15
.04	Th		10
.02	Cu	I	7
.01	Fe		20
3391.98	**Zr**	**II**	**300**
.59	Ce		10
.53	W		10
.37	Cr		12
.10	W		10
.05	Ni	I	400
(Also Ir, Ir I, Rh I, Th, Ti, U, V I)			

SENSITIVE LINES OF THE ELEMENTS

In the following table the sensitive lines of the elements are arranged in order of decreasing wavelengths. The **abbreviations** are the same as those used in the preceding table, ***Qualitative Spectrographic Analysis Tables,*** which see. In addition, in the column headed ***Sensitivity*** the most sensitive line of the neutral or un-ionized atom is indicated by U1, and other lines by U2, U3, etc. in order of decreasing sensitivity. For the singly ionized atom, the corresponding designations are V1, V2, V3, etc. In cases where U1 is not given, the most sensitive lines lie outside the range of 10,000 to 2,000 Å.

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Wavelength	Element	Intensity		Sensitivity	Wavelength	Element	Intensity		Sensitivity
		Arc	Spk [Dis]				Arc	Spk [Dis]	
9237.49	S I	....	[200]	U6	5777.665	Ba I	500R	100R	U2
9228.11	S I	....	[200]	U5	5688.224	Na I	300	....	..
9212.91	S I	....	[200]	U4	5682.657	Na I	80	....	..
8943.50	Cs I	2000R	....	U2	5679.56	N II	....	[500]	V2
8521.10	Cs I	5000R	....	U1	5676.02	N II	....	[100]	V4
8115.311	A I	....	[5000]	U2	5666.64	N II	....	[300]	V3
7947.60	Rb I	5000R	....	U2	5608.8	Pb II	....	[40]	V2
7800.227	Rb I	9000R	....	U1	5570.2895	Kr I	....	[2000]	U3
7775.433	O I	....	[100]	U4	5535.551	Ba I	1000R	200R	U1
7774.138	O I	....	[300]	U3	5519.115	Ba I	200R	60R	U3
7771.928	O I	....	[1000]	U2	5465.487	Ag I	1000R	500R	U4
7698.979	K I	5000R	....	U2	5464.61	I II	....	[900]	..
7664.907	K I	9000R	....	U1	5460.740	Hg I	....	[2000]	..
7503.867	A I	....	[700]	U4	5455.146	La I	200	1	U3
7450.00	Rn I	....	[600]	U2	5424.616	Ba I	100R	30R	U4
7067.217	A I	....	[400]	U3	5400.562	Ne I	....	2000	..
7055.42	Rn I	....	[400]	U3	5350.46	Tl I	5000R	2000R	U1
6965.430	A I	....	[400]	U3	5291.0	bhCaF	200	....	..
6902.46	F I	....	[500]	U3	5218.202	Cu I	700	....	U3
6856.02	F I	....	[1000]	U2	5209.067	Ag I	1500R	1000R	U3
6707.844	Li I	3000R	200	U1	5208.436	Cr I	500R	100	U4
6562.79	H I	....	[3000]	U2	5206.039	Cr I	500R	200	U5
6438.4696	Cd I	2000	1000	..	5204.518	Cr I	400R	100	U6
6402.246	Ne I	....	[2000]	..	5183.618	Mg I	500wh	300	..
6362.347	Zn I	1000Wh	500	..	5172.699	Mg I	200wh	100wh	..
6249.929	La I	300	....	U1	5167.343	Mg I	100wh	50	..
6243.36	Al II	....	100	V3	5161.188	I II	....	[300]	..
6231.76	Al II	....	30	..	5153.235	Cu I	600	....	U4
6103.642	Li I	2000R	300	U3	5105.541	Cu I	500	....	U5
5930.648	La I	250	....	U2	5007.213	Ti I	200	40	..
5895.923	Na I	5000R	500R	U2	4999.510	Ti I	200	80	..
5889.953	Na I	9000R	1000R	U1	4991.066	Ti I	200	100	..
5875.618	He I	....	[1000]	U3	4981.733	Ti I	300	125	U1
5870.9158	Kr I	....	[3000]	U2	4962.263	Sr I	40	....	U4
5852.488	Ne I	....	[2000]	..	4934.086	Ba II	400h	400h	V2

SENSITIVE LINES OF THE ELEMENTS

Wavelength	Element	Intensity		Sensitivity	Wavelength	Element	Intensity		Sensitivity
		Arc	Spk [Dis]				Arc	Spk [Dis]	
4889.17	Re I	2000w	....	U2	4420.468	Os I	400R	100	..
4872.493	Sr I	25	....	U3	4390.865	Sm II	150	150	..
4861.327	H I	....	[500]	U3	4389.974	V I	80R	60R	..
4832.075	Sr I	200	8	U2	4384.722	V I	125R	125R	..
4825.91	Ra I	....	[800]	U1	4379.238	V I	200R	200R	U1
4819.46	Cl II	....	[200]	V4	4358.35	Hg I	3000w	500	..
4816.71	Br II	....	[300]	V3	4305.447	Sr II	40	....	..
4810.534	Zn I	400w	300h	..	4303.573	Nd	100	40	..
4810.06	Cl II	....	[200]	V3	4302.108	W I	60	60	U1
4794.54	Cl II	....	[250]	V2	4294.614	W I	50	50	U2
4785.50	Br II	....	[400]	V2	4289.721	Cr I	3000R	8000r	U3
4772.312	Zr I	100	....	..	4274.803	Cr I	4000R	800r	U2
4742.25	Se I	....	[500]	U6	4267.27	C II	....	500	V2
4739.478	Zr I	100	....	..	4267.02	C II	....	350	V3
4739.03	Se I	....	[800]	U5	4254.346	Cr I	5000R	1000	U1
4730.78	Se I	....	[1000]	U4	4241.669	U	40	50	..
4722.552	Bi I	1000	100	..	4226.728	Ca I	500R	50W	U1
4722.159	Zn I	400w	300h	..	4226.570	Ge I	200	50	..
4710.075	Zr I	60	....	..	4225.327	Pr	50	40	..
4704.86	Br II	....	[250]	V1	4215.556	Rb I	1000R	300	U4
4696.25	S I	....	[15]	U9	4215.524	Sr II	300r	400W	V2
4695.45	S I	....	[30]	U8	4211.719	Dy	200	15	..
4694.13	S I	....	[500]	U7	4205.046	Eu II	200R	50	..
4687.803	Zr I	125	....	U4	4201.851	Rb I	2000R	500	U3
4685.75	He II	....	[300]	..	4189.518	Pr	100	50	..
4682.28	Ra II	....	[800]	V2	4186.599	Ce II	80	25	..
4680.138	Zn I	300w	200h	..	4179 422	Pr	200	40	..
4674.848	Y I	80	100	U1	4177.321	Nd	15	25	..
4671.226	Xe I	....	[2000]	U2	4172.056	Ga I	2000R	1000R	U1
4643.695	Y I	50	100	U2	4167.966	Dy	50	12	..
4624.276	Xe I	....	[1000]	U3	4165.606	Ce II	40	6	..
4607.331	Sr I	1000R	50R	U1	4137.095	Cb I	100	60	U5
4603.00	Li I	800	....	U4	4130.664	Ba II	50r	60Wh	V3
4593.177	Cs I	1000R	50	U4	4129.737	Eu II	150R	50R	..
4555.355	Cs I	2000R	100	U3	4123.810	Cb I	200	125	U4
4554.042	Ba II	1000R	200	V1	4123.228	La II	500	500	V4
4524.741	Sn	500wh	50	..	4109.98	N I	....	[1000]	U2
4518.57	Lu	300	40	..	4103.37	N III	....	[80]	..
4511.323	In I	5000R	4000R	U1	4101.773	In I	2000R	1000R	U2
4500.977	Xe I	....	[500]	U4	4100.923	Cb I	300w	200w	U3
4454.781	Ca I	200	....	U2	4099.94	N I	....	[150]	U3
4434.960	Ca I	150	....	U3	4097.31	N III	....	[100]	..
4434.321	Sm II	200	200	V2	4093.161	Hf II	25	20	..
4425.441	Ca I	100	....	U4	4079.729	Cb I	500w	200w	U2
4424.342	Sm II	300	300	V1	4077.974	Dy	150r	100	..

SENSITIVE LINES OF THE ELEMENTS

Wave-length	Element	Intensity		Sensi-tivity	Wave-length	Element	Intensity		Sensi-tivity
		Arc	Spk [Dis]				Arc	Spk [Dis]	
4077.714	Sr II	400r	500W	V1	3774.332	Y II	12	100	..
4077.340	La II	600	400	V3	3768.405	Gd	20	20	..
4062.817	Pr	150	50	..	3761.917	Tm	200	120	..
4058.938	Cb I	1000w	400w	U1	3761.333	Tm	250	150	..
4057.820	Pb I	2000R	300R	U1	3748.264	Fe I	500	200	U4
4047.201	K I	400	200	U4	3748.17	Ho	60	40	..
4046.561	Hg I	200	300	..	3745.903	Fe I	150	100	U5
4045.983	Dy	150	12	..	3745.564	Fe I	500	500	U3
4044.140	K I	800	400	U3	3737.133	Fe I	1000r	600	U2
4040.762	Ce II	70	5	..	3719.935	Fe I	1000R	700	U1
4034.490	Mn I	250r	20	U3	3710.290	Y II	80	150	V1
4033.073	Mn I	400r	20	U2	3694.203	Yb	500R	1000R	..
4032.982	Ga I	1000R	500R	U2	3692.652	Er	20	12	..
4030.755	Mn I	500r	20	U1	3692.357	Rh I	500hd	150wd	..
4023.688	Sc I	100	25	U3	3683.471	Pb I	300	50	U2
4020.399	Sc I	50	20	U4	3672.579	U	8	15	..
4019.137	Th	8	8	..	3663.276	Hg I	500	400	U5
4012.388	Ce I, II	60	20	..	3657.987	Rh I	500W	200W	..
4008.753	W I	45	45	U3	3654.833	Hg I	....	[200]	U4
4000.454	Dy	400	300	..	3653.496	Ti I	500	200	U2
3987.994	Yb	1000R	500R	..	3650.146	Hg I	200	500	U3
3968 468	Ca II	500R	500R	V2	3646.196	Gd	200w	150	..
3961.527	Al I	3000	2000	U1	3642.785	Sc II	60	50	V3
3951.154	Nd	40	30	..	3642.675	Ti I	300	125	..
3949.106	La II	1000	800	V2	3639.580	Pb I	300	50h	..
3944.032	Al I	2000	1000	U2	3635.463	Ti I	200	100	..
3933.666	Ca II	600R	600R	V1	3634.695	Pd	2000R	1000R	U3
3911.810	Sc I	150	30	U1	3633.123	Y II	50	100	..
3907.476	Sc I	125	25	U2	3630.740	Sc II	50	70	V2
3906.316	Er	25	12	..	3613.836	Sc II	40	70	V1
3905.528	Si I	20	15W	..	3613.790	W II	10	30	..
3902.963	Mo I	1000R	500R	U3	3610.510	Cd I	1000	500	..
3891.785	Ba II	18	25	V4	3609.548	Pd I	1000R	700R	..
3891.02	Ho	200	40	..	3601.193	Zr I	400	15	U1
3888.646	He I	....	[1000]	U2	3601.040	Th	8	10	..
3874.18	Tb	200	200	..	3600.734	Y II	100	300	..
3864.110	Mo I	1000R	500R	U2	3596.179	Ru I	30	100	U3
3848.75	Tb	100	200	..	3572.473	Zr II	60	80	V4
3838.258	Mg I	300	200	U2	3561.74	Tb	200	200	..
3832.306	Mg I	250	200	U3	3554.43	Lu	50	150	..
3829.350	Mg I	100w	150	U4	3552.172	U	8	12	..
3814.42	Ra II	....	[2000]	V1	3547.682	Zr I	200	12	U2
3798.252	Mo I	1000R	1000R	U1	3538.75	Th	....	50	..
3788.697	Y II	30	30	..	3529.813	Co I	1000R	30	U3
3775.72	Tl I	3000R	1000R	U2	3524.541	Ni I	1000R	100wh	..

SENSITIVE LINES OF THE ELEMENTS

Wavelength	Element	Intensity		Sensitivity	Wavelength	Element	Intensity		Sensitivity
		Arc	Spk [Dis]				Arc	Spk [Dis]	
3519.605	Zr I	100	10	U3	3302.988	Na I	300R	150R	U4
3519.24	Tl I	2000R	1000R	U3	3302.588	Zn I	800	300	U3
3516.943	Pd I	1000R	500R	..	3302.323	Na I	600R	300R	U3
3515.054	Ni I	1000R	50h	..	3290.59	Th	....	40h	..
3513.645	Ir I	100h	100	U2	3289.37	Yb	500R	1000R	..
3509.17	Tb	200	200	..	3282.333	Zn I	500R	300	U4
3499.104	Er	18	15	..	3280.683	Ag I	2000R	1000R	U1
3498.942	Ru I	500R	200	U1	3273.962	Cu I	3000R	1500R	U2
3496.210	Zr II	100	100	V3	3269.494	Ge I	300	300	U3
3492.956	Ni I	1000R	100h	U2	3267.945	Os I	400R	30	..
3474.887	Sr II	80	50	..	3267.502	Sb I	150	150Wh	..
3472.48	Lu	50	150	..	3262.328	Sn I	400h	300h	U3
3466.201	Cd I	1000	500	..	3262.290	Os I	500R	50	..
3465.800	Co I	2000R	25	U2	3261.057	Cd I	300	300	..
3464.57	Sr II	200	200	..	3258.564	In I	500R	300R	U5
3462.21	Tm	200	100	..	3256.090	In I	1500R	600R	U3
3460.47	Re I	1000W	....	U1	3247.540	Cu I	5000R	2000R	U1
3453.505	Co I	3000R	200	U1	3242.280	Y II	60	100	..
3451.41	B II	5	30	V2	3232.61	Li I	1000R	500	U2
3438.230	Zr II	250	200	V2	3232.499	Sb I	150	250wh	..
3437.015	Ir I	20	15	..	3229.75	Tl I	2000	800	..
3436.737	Ru I	300R	150	U2	3225.479	Cb II	150w	800wr	..
3434.893	Rh	1000R	200r	U1	3220.780	Ir I	100	30	U1
3421.24	Pd I	2000R	1000R	U2	3215.560	W I	10	9	..
3414.765	Ni I	1000R	50wh	U1	3194.977	Cb II	30	300	..
3406.664	Ta	70w	18s	..	3185.396	V I	500R	400R	U2
3405.120	Co I	2000R	150	..	3183.982	V I	500R	400R	..
3404.580	Pd I	2000R	1000R	U1	3183.406	V I	200R	100R	..
3403.653	Cd I	800	500h	..	3179.332	Ca II	100	400w	V3
3397.07	Lu	50	20r	..	3175.019	Sn I	500h	400hr	..
3396.85	Rh I	1000w	500	..	3163.402	Cb II	15	8	..
3391.975	Zr II	300	400	V1	3158.869	Ca II	100	300w	V4
3383.761	Ti II	70	300R	..	3134.718	Hf II	80	125	..
3382.891	Ag I	1000R	700R	U2	3131.072	Be II	200	150	V2
3380.711	Sr II	150	200	..	3130.786	Cb II	100	100	..
3372.800	Ti II	80	400R	V3	3130.416	Be II	200	200	V1
3361.213	Ti II	100	600R	V2	3125.284	V II	80	200R	..
3349.035	Ti II	125	800R	V1	3118.383	V II	70	200R	V4
3345.020	Zn I	800	300	U2	3110.706	V II	70	300R	V3
3323.092	Rh I	1000	200	..	3102.299	V II	70	300R	V2
3321.343	Be I	1000r	30	U2	3094.183	Cb II	100	1000	V1
3321.086	Be I	100	....	U3	3093.108	V II	100R	400R	V1
3321.013	Be I	50	....	U4	3092.713	Al I	1000	1000	U3
3318.840	Ta	125	35	..	3082.155	Al I	800	800	U4
3311.162	Ta	300w	70w	U1	3072.877	Hf I	80	18	..

SENSITIVE LINES OF THE ELEMENTS

Wavelength	Element		Intensity		Sensitivity
			Arc	Spk [Dis]	
3071.591	Ba	I	100R	50R	U5
3067.716	Bi	I	3000hR	2000wh	U1
3064.712	Pt	I	2000R	300R	U1
3058.66	Os	I	500R	500	..
3039.356	In	I	1000R	500R	U4
3039.064	Ge	I	1000	1000	U2
3034.121	Sn	I	200wh	150wh	..
3009.147	Sn	I	300h	200h	..
2997.967	Pt	I	1000R	200r	..
2989.029	Bi	I	250wh	100wh	..
2976.586	Ru		60	200	..
2965.546	Ru		60	200	..
2945.668	Ru		60	300	..
2943.637	Ga	I	10	20r	U3
2940.772	Hf	I	60	12	..
2938.298	Bi	I	300w	300w	..
2936.77	Ho		....	1000R	..
2929.794	Pt	I	800R	200w	..
2924.792	Ir	I	25wh	15	..
2918.32	Tl	I	400R	200R	..
2916.481	Hf	I	50	15	..
2911.39	Lu		100	300	..
2909.116	Mo	II	25	40h	V5
2909.061	Os	I	500R	400	U1
2904.408	Hf	I	30	6	..
2898.71	As	I	25r	40	..
2898.259	Hf	I	50	12	..
2897.975	Bi	I	500WR	500WR	U2
2894.84	Lu		60	200	..
2890.994	Mo	II	30	50h	V4
2881.578	Si	I	500	400	U1
2877.915	Sb	I	250W	150	..
2874.244	Ga	I	10	15r	U4
2871.508	Mo	II	100	100h	V3
2863.327	Sn	I	300R	300R	U2
2860.934	Cr	II	60	100	V5
2860.452	As	I	50r	50	..
2855.676	Cr	II	60	200Wh	V4
2854.581	Pd	II	4	500h	..
2852.129	Mg	I	300R	100R	U1
2849.838	Cr	II	80	150r	V3
2849.725	Ir	I	40h	20h	..
2848.232	Mo	II	125	200h	V2
2843.252	Cr	II	125	400r	V2
2839.989	Sn	I	300R	300R	U1
2837.602	C	II	....	40	V5
2836.710	C	II	....	200	V4
2835.633	Cr	II	100	400r	V1
2833.069	Pb	I	500R	80R	..
2830.295	Pt	I	1000R	600r	..
2820.224	Hf	II	40	100	..
2816.179	Al	II	10	100	V2
2816.154	Mo	II	200	300h	V1
2809.625	Bi	I	200w	100	..
2802.695	Mg	II	150	300	V2
2802.19	Au		....	200	..
2795.53	Mg	II	150	300	V1
2780.521	Bi	I	200w	100	..
2780.197	As	I	75R	75	U5
2773.357	Hf	II	25	60	..
2769.67	Te	I	....	[30]	..
2767.87	Tl	I	400R	300R	..
2748.58	Cd	II	5	200	..
2712.410	Ru		80	300	..
2709.626	Ge	I	30	20	..
2692.065	Ru		8	200	..
2678.758	Ru		100	300	..
2675.95	Au	I	250R	100	U2
2669.166	Al	II	3	100	V1
2659.454	Pt	I	2000R	500R	U2
2658.722	Pd	II	20	300	..
2651.575	Ge	I	30	20	..
2651.178	Ge	I	40	20	..
2650.781	Be	I	25	....	U5
2641.406	Hf	II	40	125	..
2631.553	Al	II	....	40	..
2614.178	Pb		200r	80	..
2605.688	Mn	II	100R	500R	V3
2598.062	Sb	I	200	100	..
2593.729	Mn	II	200R	1000R	V2
2589.167	W	II	15d	25	..
2576.104	Mn	II	300R	2000R	V1
2573.09	Cd	II	3	150	..
2557.958	Zn	II	10	300	V3
2554.93	P	I	60	[20]	..
2553.28	P	I	80	[20]	U3
2536.519	Hg	I	2000R	1000R	U2
2535.65	P	I	100	[30]	U2
2534.01	P	I	50	[20]	..
2530.70	Te	I	....	[30]	..

SENSITIVE LINES OF THE ELEMENTS

Wavelength	Element	Intensity		Sensitivity	Wavelength	Element	Intensity		Sensitivity
		Arc	Spk [Dis]				Arc	Spk [Dis]	
2528.535	Sb I	300R	200	..	2307.857	Co II	25	50w	..
2528.516	Si I	400	500	U2	2304.235	Ba II	60R	80R	..
2519.822	Co II	40	200	..	2296.89	C III	....	200	..
2516.881	Hf II	35	100	..	2288.12	As I	250R	5	U3
2516.123	Si I	500	500	U3	2288.018	Cd I	1500R	300R	U1
2513.028	Hf II	25	70	..	2287.084	Ni II	100	500	V1
2506.899	Si I	300	200	U4	2286.156	Co II	40	300*l*	V1
2505.739	Pd II	3	30	..	2276.578	Bi I	100R	40	..
2502.001	Zn II	20	400w	V4	2270.213	Ni II	100	400	V2
2498.784	Pd II	4	150h	..	2265.017	Cd II	25d	300	V2
2497.733	B I	500	400	U1	2264.457	Ni II	150	400	V3
2496.778	B I	300	300	U2	2253.86	Ni II	100	300	V4
2488.921	Pd II	10	30	..	2246.995	Cu II	30	500	V3
2478.573	C I	400	[400]	U2	2246.412	Ag II	25	300hs	V3
2456.53	As I	100r	8	U4	2203.505	Pb II	50W	5000R	V1
2437.791	Ag II	60	500wh	V2	2192.260	Cu II	25	500h	V2
2427.95	Au I	400R	100	U1	2175.890	Sb I	300	40	U2
2413.309	Fe II	60	100h	V5	2169.994	Pb I	1000R	1000R	..
2410.517	Fe II	50	70h	V4	2144.382	Cd II	50	200R	V1
2404.882	Fe II	50	100wh	V3	2142.75	Te I	60R	....	..
2397.091	W II	18	30	..	2138.56	Zn I	800R	500	U1
2395.625	Fe II	50	100wh	V2	2135.976	Cu II	25	500w	V1
2388.918	Co II	10	35	..	2068.38	Sb I	300R	3	U1
2385.76	Te I	600	[300]	U2	2062.788	Se I	....	[800]	U3
2383.25	Te I	500	[300]	U3	2062.38	I	....	[900]	..
2382.039	Fe II	40r	100R	V1	2061.91	Zn II	100	100	V2
2378.622	Co II	25	50w	..	2061.70	Bi I	300R	100	..
2370.77	As I	50r	3	..	2039.851	Se I	....	[1000]	U2
2369.67	As I	40r	....	..	2025.51	Zn II	200	200	V1
2363.787	Co II	25	50	..					
2349.84	As I	250R	18	U3					
2348.610	Be I	2000R	50	U1					
2335.269	Ba II	60R	100R	..					
2312.84	Cd II	1	200	..					
2311.469	Sb I	150R	50	..					

SINGLE ELECTRODE POTENTIALS AT 25°C

According to the convention used in this table, a positive (or negative) E_o means that the solution is *positive* (or *negative*) with respect to the electrode, as compared with a "normal" hydrogen electrode.

E_o is the single potential of the electrode, when the concentration of ions involved is one molar ("unity activity"). To calculate the single electrode potential E, if the ion concentration is other than one molar, the following equation is used:

$E = E_o - \frac{0.05915}{n} \log_{10} \frac{(C_p)^a}{(C_r)^b}$; where n = number of electrons (e) involved in the electrode reaction, C_p = ionic concentration of the products, C_r = ionic concentration of the reactants, a and b are the coefficients of products and reactants, respectively, in the electrode reaction. Solid, liquid and gaseous states are abbreviated s, l, and g respectively.

Examples

(1) If $[Cl^-] = 0.1$ M, in the Ag, AgCl, Cl^- electrode then:-

$$E = -0.2221 - \frac{0.05915}{1} \log_{10} \frac{1}{0.1} = -0.2813$$

(2) If $[Cr^{++}] = 0.2$ M and $[Cr^{+++}] = 0.5$ M, then:-

$$E = 0.400 - \frac{0.05915}{1} \log_{10} \frac{0.5}{0.2} = +0.376$$

(3) If $[Fe^{++}] = 0.1$ M, then $E = 0.441 - \frac{0.05915}{2} \log_{10} 0.1 = +0.471$

Of two electrodes, the one higher in the table (E_1) forms the negative pole of the cell, while the other electrode (E_2) forms the positive pole. The EMF of such a cell equals $E_1 - E_2$.

Example

For the cell: $\overset{(-)}{\underset{E_1 = 0.7618}{Zn,\ Zn^{++}(1\ M)}} \Big\| \underset{E_2 = -0.3441}{Cu^{++}\ (1\ M),\ Cu^{(+)}}$,

the EMF of this cell is $E_1 - E_2 = +0.7618 - (-0.3441) = 1.1059$ volts.

Electrode	Electrode Reaction	E_o (volts)
Li, Li^+	$Li = Li^+ + e$	+2.9595
Rb, Rb^+	$Rb = Rb^+ + e$	+2.9259
K, K^+	$K = K^+ + e$	+2.9241
Ca, Ca^{++}	$Ca = Ca^{++} + 2e$	+2.763
Na, Na^+	$Na = Na^+ + e$	+2.7146
Mg, Mg^{++}(18°)	$Mg = Mg^{++} + 2e$	+1.866
Zn, ZnO, OH^-	$Zn + 2OH^- = ZnO\,(s) + H_2O + 2e$	+1.2483
(Pt)H_2, OH^-	$\frac{1}{2}H_2 + OH^- = H_2O + e$	+0.829
Zn, Zn^{++}	$Zn = Zn^{++} + 2e$	+0.7618
Cr, Cr^{++}	$Cr = Cr^{++} + 2e$	+0.557
Fe, Fe^{++}	$Fe = Fe^{++} + 2e$	+0.441
Cd, Cd^{++}	$Cd = Cd^{++} + 2e$	+0.4013
(Pt)Cr^{++}, Cr^{+++}	$Cr^{++} = Cr^{+++} + e$	+0.400
(Pt) Tl^{++}, Ti^{+++}	$Ti^{++} = Ti^{+++} + e$	+0.37
Tl, Tl^+	$Tl = Tl^+ + e$	+0.3360
Co, Co^{++}	$Co = Co^{++} + 2e$	+0.29
Ni Ni^{++}	$Ni = Ni^{++} + 2e$	+0.231
Ag, AgI, I^-	$Ag + I^- = AgI\,(s) + e$	+0.151
Sn, Sn^{++}	$Sn = Sn^{++} + 2e$	+0.136
Pb, Pb^{++}	$Pb = Pb^{++} + 2e$	+0.122

SINGLE ELECTRODE POTENTIALS AT 25° C.

Electrode	Electrode Reaction	Eo (volts)
Hg, Hg_2I_2, I^-	$2Hg(l) + 2I^- = Hg_2I_2(s) + 2e$	+0.0416
(Pt) H_2, H^+	$\frac{1}{2}H_2 = H^+ + e$	±0.0000
(Pt) Ti^{++}, Ti^{+++}	$Ti^{+++} + 2SO_4^{--} = Ti(SO_4)_2 + e$	−0.04
Ag, AgBr, Br^-	$Ag + Br^- = AgBr(s) + e$	−0.0734
Cu, CuCl, Cl^-	$Cu + Cl^- = CuCl(s) + e$	−0.1287
(Pt) Sn^{++}, Sn^{++++}	$Sn^{++} = Sn^{++++} + 2e$	−0.13
Hg, Hg_2Br_2, Br^-	$2Hg(l) + 2Br^- = Hg_2Br_2(s) + 2e$	−0.1385
Ag, AgCl, Cl^-	$Ag + Cl^- = AgCl(s) + e$	−0.2221
Bi, Bi^{+++} (18.5°)	$Bi = Bi^{+++} + 3e$	−0.226
(Pt) As, As_2O_3, H^+	$2As(s) + 3H_2O = As_2O_3(s) + 6H^+ + 6e$	−0.2340
Saturated calomel electrode	.....	−0.2464
Hg, Hg_2Cl_2, Cl^-	$Hg + Cl^- = \frac{1}{2}Hg_2Cl_2(s) + e$	−0.2676
Normal calomel electrode	.....	−0.2805
Deci-normal calomel electrode	.....	−0.3334
Cu, Cu^{++}	$Cu = Cu^{++} + 2e$	−0.3441
(Pt) UO_2^{++}, U^{++++}	$U^{++++} + 2H_2O = UO_2^{++} + 4H^+ + 2e$	−0.358
(Pt) O_2, OH^-	$OH^- = \frac{1}{2}H_2O + \frac{1}{4}O_2 + e$	−0.39
(Pt) Cu^+, Cu^{++}	$CuCl_2^- = Cu^{++} + 2Cl^- + e$	−0.455
(Pt) $Fe(CN)_6^{4-}$, $Fe(CN)_6^{3-}$	$K_4Fe(CN)_6 = K_3Fe(CN)_6 + K^+ + e$	−0.4866
(Pt) I_2, I^-	$I^- = \frac{1}{2}I_2 + e$	−0.5345
(Pt) AsO_2^{---}, AsO_4^{----}	$H_3AsO_3 + H_2O = H_3AsO_4 + 2H^+ + 2e$	−0.574
(Pt) MnO_4^{--}, MnO_4^-	$MnO_4^{--} = MnO_4^- + e$	−0.664
(Pt) Fe^{++}, Fe^{+++}	$Fe^{++} = Fe^{+++} + e$	−0.7477
Ag, Ag^+	$Ag = Ag^+ + e$	−0.7978
Hg, Hg_2^{++}	$2Hg = Hg_2^{++} + 2e$	−0.7986
(Pt) Hg_2^{++}, Hg^{++}	$\frac{1}{2}Hg_2^{++} = Hg^{++} + e$	−0.9011
(Pt)	$VOSO_4 + 2H_2O = HVO_3 + 3H^+ + SO_4^{--} + e$	−0.92
(Pt) Br_2, Br^-	$Br^- = \frac{1}{2}Br_2(l) + e$	−1.0648
(Pt) I_2, IO_3^-	$\frac{1}{2}I_2(s) + 3H_2O = IO_3^- + 6H^+ + 5e$	−1.197
(Pt) Tl^+, Tl^{+++}	$Tl^+ = Tl^{+++} + 2e$	−1.211
MnO_2, Mn^{++}	$Mn^{++} + 2H_2O = MnO_2(s) + 4H^+ + 2e$	−1.332
(Pt) Cl_2, Cl^-	$Cl^- = \frac{1}{2}Cl_2(g) + e$	−1.3583
Au, Au^{+++}	$Au(s) = Au^{+++} + 3e$	−1.36
(Pt) Br_2, BrO_3^-	$\frac{1}{2}Br_2(l) + 3H_2O = BrO_3^- + 6H^+ + 5e$	−1.491
(Pt) Ce^{+++}, Ce^{++++}	$Ce^{+++} = Ce^{++++} + e$	−1.55
MnO_2, MnO_4^-	$MnO_2(s) + 2H_2O = MnO_4^- + 4H^+ + 3e$	−1.586
PbO_2, $PbSO_4$, SO_4^{--}	$PbSO_4(s) + 2H_2O = PbO_2(s) + 4H^+ + SO_4^{--} + 2e$	−1.6797
(Pt) Co^{++}, Co^{+++}	$Co^{++} = Co^{+++} + e$	−1.817

ELECTROMOTIVE SERIES OF THE METALS

Lithium	Magnesium	Cobalt	Arsenic
Rubidium	Aluminum	Nickel	Copper
Potassium	Manganese	Tin	Mercury
Sodium	Zinc	Lead	Silver
Strontium	Chromium	HYDROGEN	Platinum
Barium	Iron	Antimony	Gold
Calcium	Cadmium	Bismuth	

COMPOSITION AND E. M. F. OF VOLTAIC CELLS

Compiled in collaboration with George W. Heise

Single Fluid Cells.

Name of Cell	E.M.F. volts	Negative pole	Electrolyte	Positive pole
Air cell	1.45	Amal. zinc	20% NaOH solution	Carbon, air-depolarized
Clark standard	1.434 at 15°C.	" "	Saturated solution of $ZnSO_4$	Mercury, paste of Hg_2SO_4 and $ZnSO_4$
Edison (storage type)	1.1 (mean)	Iron	20% KOH solution	A nickel oxide
Fery	1.4 ±	Amal. zinc	Saturated NH_4Cl solution	Carbon, air-depolarized
Gassner dry cell[1]	1.4	Zinc	1 part ZnO, 1 part NH_4Cl, 3 parts plaster of paris, 1 part $ZnCl_2$, 2 parts water	Carbon; MnO_2 depolarized
Law[2]	1.4	"	15% NH_4Cl solution	Carbon; air-depolarized
Lead accumulator (storage type)	2.2	Lead	H_2SO_4 solution density 1.25	PbO_2
Leclanche[3] (dry cell type)	1.6	Amal. zinc	NH_4Cl and $ZnCl_2$ solution	Carbon; depolarizer: MnO_2 mixed with powdered carbon
Lalande-Chaperon (Edison-Lalande)	1.1	" "	20% NaOH Solution	CuO
Main	2.50	" "	H_2SO_4 solution, density about 1.1	PbO_2
Poggendorf	2.0	" "	12 parts $K_2Cr_2O_7$ + 25 parts H_2SO_4 + 100 parts H_2O	Carbon
Regnault	0.34	" "	1 part H_2SO_4 + 1 part $CaSO_4$ + 12 parts H_2O	Cadmium
Reynier (1) (storage type)	1.3 (average)	Copper	$CuSO_4 + H_2SO_4$	PbO_2
" (2)	2.36	Amal. zinc	$ZnSO_4$ in H_2SO_4	PbO_2
Silver chloride	1.02	Zinc	23% NH_4Cl solution	Silver and AgCl
Volta couple	0.98	"	NaCl solution	Copper
Weston normal	1.0183 at 20°C.	Cadmium amalgam	Saturated solution of $CdSO_4$	Mercury, paste of Hg_2SO_4 and $CdSO_4$

1. Of historical interest as the forerunner of the modern dry cell.
2. Of historical interest as the forerunner, though with very inactive carbon, of the Fery cell.
3. Ordinary dry cell of commerce.

Double Fluid Cells.

Name of cell	E.M.F. volts	Negative pole	Anolyte	Positive pole	Catholyte
Bunsen	1.94	Amal. zinc	1 part H_2SO_4 to 12 parts H_2O	Carbon	Fuming HNO_3
"	1.86	" "	1 part H_2SO_4 to 12 parts H_2O	"	HNO_3, dens. 1.38
Daniell	1.09	" "	1 part H_2SO_4 to 12 parts H_2O	Copper	Saturated solution of $CuSO_4 \cdot 5H_2O$
"	1.08	" "	5% solution of $ZnSO_4 \cdot 6H_2O$	"	"

(Completed on the following page.)

COMPOSITION AND E. M. F. OF VOLTAIC CELLS

Double Fluid Cells.

Name of cell	E.M.F. volts	Negative pole	Anolyte	Positive pole	Catholyte
Daniell	1.05	Amal. zinc	1 part NaCl to 4 parts H_2O	Copper	Saturated solution of $CuSO_4 \cdot 5H_2O$
Fuller[1]	2.0	" "	1 part H_2SO_4 to 12 parts H_2O	Carbon	12 parts $K_2Cr_2O_7$ to 25 parts H_2SO_4 and 100 parts H_2O
Grove[2]	1.93	" "	1 part H_2SO_4 to 12 parts H_2O	Platinum	Fuming HNO_3
Marie Davy	1.50	" "	1 part H_2SO_4 to 12 parts H_2O	Carbon	Paste of Hg_2SO_4 and H_2O
Partz (modified Bunsen)	2.06	" "	Solution of $MgSO_4$	"	Solution of $K_2Cr_2O_7$ and H_2SO_4

1. Modification of the single fluid Poggendorf cell by introduction of a porous pot separating anolyte from catholyte. In one type the carbon was inside the porous pot, the zinc outside; in another, the electrode positions were reversed.
2. $ZnSO_4$ and NaCl have been used in the anolyte and various concentrations of HNO_3 in the catholyte.

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

For any single electrode, the equation

$$E = E_o - 2.303\frac{RT}{nF}log_{10}\frac{(C_p)^a}{(C_r)^b} \qquad (1)$$

is valid. See section on "Single Electrode Potentials at 25°C." **E** is the electrode potential in the case under consideration, E_o the single electrode potential when the concentration of *ions* involved is hypothetically one molar ("unit activity"). **R**, the "gas constant," has the value 1.9869 cal_{15} deg^{-1} $mole^{-1}$; **F**, the Faraday, is equivalent to 23074 cal_{15} $volt^{-1}$ $equiv^{-1}$; **T**, the absolute temperature; **n** is the number of electrons taking part in the electrode reaction; (C_p) the ionic concentration of the products and (C_r) of the reactants, respectively, in the electrode reaction, written so that the electrons appear on the *right* side of the equation. For the hydrogen electrode, the reaction is: $\frac{1}{2}H_2 = H^+ + e$, *a* is unity and there are no ionic reactants. $\frac{2.303\ R}{nF}$ has the value 0.000198322, and the single electrode equation may be simplified to

$$E_H = -0.000198322\ T\ log_{10}\ (H^+) \qquad (2)$$

The expression $-\log_{10}(H^+)$ is generally indicated by the symbol **pH**, the so-called "hydrogen-ion exponent," from the relation

$$pH = (H^+)^{-pH} = -log(H^+) = log\frac{1}{(H^+)}\ *$$

E_o, the single electrode potential of a hydrogen electrode in a solution normal with respect to hydrogen-ion concentration ("unit activity"), is taken as zero at all temperatures, and is the arbitrary standard to which all other single electrode potentials are referred. Then,

$$pH = \frac{E_H}{0.000198322\ T} \qquad (2a)$$

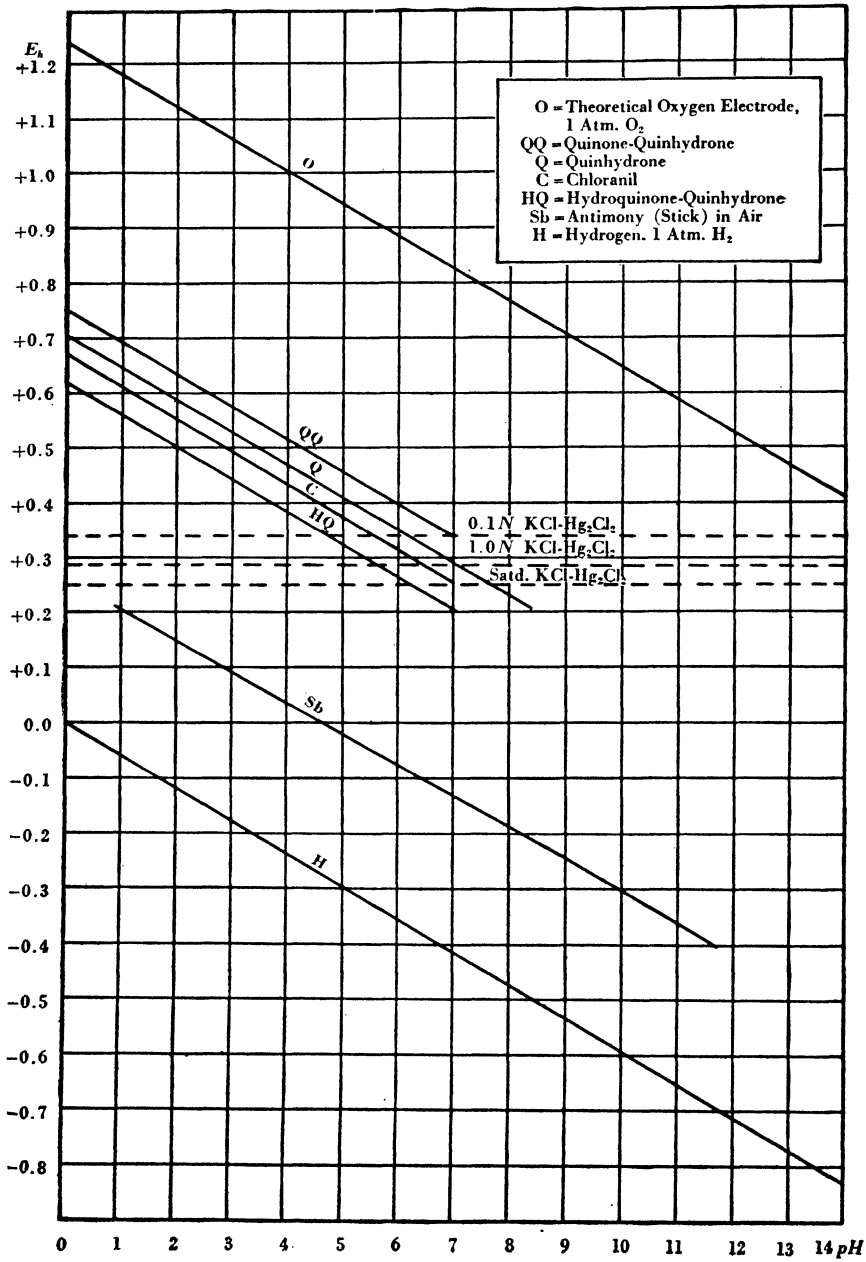
It is not possible to measure a single electrode potential except by comparison with another taken as a standard and opposed to the first in a cell or "gas chain," so that metallic contacts with the potentiometric circuit can be established. Within the cell, electrical contact must be made by reproducible means with minimum E. M. F. at the junction. The requirements are usually fulfilled in practice by one of the calomel electrodes, containing Hg, excess Hg_2Cl_2 and KCl solution at some definite concentration and saturated with Hg_2Cl_2. The potential difference between Hg and solution is then dependent upon Hg^+ concentration, in turn upon Cl^- concentration. Saturated KCl solution is used for the internal contact, since liquid junction potential will be minimized by the practically equal migration velocities of K^+ and Cl^-. Equations for calculating E_c, the single potential value of a calomel electrode at a given temperature, are shown in Table I.

*Note that a pH value is a negative logarithm, not merely a negative characteristic with mantissa positive, as taken from a table. See section on logarithms for method of changing sign of mantissa. The characteristic is negative because the log is of a number less than unity. Quite rarely is the pH scale applied to acid solutions with (H^+) greater than unity, but expressions like pH -0.2 referring to this case are sometimes used. It is customary to invert the signs. Hydrogen-ion concentration may be expressed as a common or decimal fraction of unit activity, or exponentially, as well as by pH. Thus,

$$(H^+) = 1/80000 = 0.0000125 = 1.25 \times 10^{-5} = \text{pH } 4.90$$

As only two decimal places are practically important, the last is evidently the handiest and most compact expression.

RELATION OF POTENTIAL, E_h, OF VARIOUS ELECTRODES TO *pH*



ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

Table I

Characteristics of Calomel Electrodes

Electrode	Common name	Equation for Ec at t°C. (volt)
Hg | Hg_2Cl_2 (s), 0.1 *N* KCl | satd. KCl | (a, b, c)	0.1 *N* calomel	+0.3380 −0.00006 (t −18)
Hg | Hg_2Cl_2 (s), 1.0 *N* KCl | satd. KCl |	Normal calomel	+0.2864 −0.00024 (t −18)
Hg | Hg_2Cl_2 (s), 3.5 *N* KCl | satd. KCl |	3.5 *N* calomel	+0.2549 −0.00039 (t −18)
Hg | Hg_2Cl_2 (s), satd. KCl | satd. KCl |	satd. calomel	+0.2648 −0.00076t

Values of Ec at Various Temperatures
Values in Volts

t° C.	0.1 *N*	*N*	3.5 *N*	Satd. calomel
15	+0.3382	+0.2871	+0.2561	+0.2534
16	.3381	.2869	.2557	.2526
17	.3381	.2866	.2553	.2519
18	.3380	.2864	.2549	.2511
19	.3379	.2862	.2545	.2504
20	.3379	.2859	.2541	.2496
21	.3378	.2857	.2537	.2488
22	.3378	.2854	.2533	.2481
23	.3377	.2852	.2529	.2473
24	.3376	.2850	.2526	.2466
25	.3376	.2847	.2522	.2458
26	.3375	.2845	.2518	.2450
27	.3375	.2844	.2514	.2443
28	.3374	.2840	.2510	.2435
29	.3373	.2838	.2506	.2428
30	.3372	.2835	.2502	.2420

Table II

Barometric Corrections, E_B for Hydrogen Electrode Potentials

Corrected barometer reading in mm. Hg	E_B in Volts at t°C.							
	5°	10°	15°	20°	25°	30°	35°	40°
780	−.0002	−.0002	−.0001	.0000	+.0001	+.0002	+.0004	+.0006
775	−.0001	−.0001	.0000	.0000	+.0002	+.0003	+.0005	+.0007
770	−.0001	.0000	+.0001	+.0001	+.0002	+.0004	+.0006	+.0008
765	.0000	+.0001	+.0001	+.0002	+.0003	+.0005	+.0007	+.0009
760	+.0001	+.0002	+.0002	+.0003	+.0004	+.0006	+.0008	+.0010
755	+.0002	+.0002	+.0003	+.0004	+.0005	+.0007	+.0009	+.0011
750	+.0003	+.0003	+.0004	+.0005	+.0006	+.0007	+.0010	+.0012
745	+.0003	+.0004	+.0005	+.0006	+.0007	+.0008	+.0010	+.0013
740	+.0004	+.0005	+.0006	+.0006	+.0008	+.0009	+.0011	+.0014
735	+.0005	+.0006	+.0006	+.0007	+.0009	+.0010	+.0012	+.0015

In a typical cell such as:

$$^{(-)}Pt,\ H_2\ (g,\ 760mm)\ |\ (H^+)\ |\ satd.\ KCl\ |\ 0.1\ N\ KCl,\ Hg_2Cl_2\ (s)\ |\ Hg^{(+)}$$
$$\qquad\qquad d \qquad\quad c \qquad\quad b \qquad\qquad a$$

the sum of the potentials at *a*, *b*, and *c* is given by E_c in Table I above, while the potential at *d* is the value E_H in equation (2a). With respect to zero potential represented by the hydrogen electrode in a solution of unit activity, potentials in solutions

less than normal will always be negative, and those of all calomel electrodes positive. But the potentiometer measures difference in potential in positive units, therefore $E = E_H + E_c$ and $E_H = E - E_c$. Hence,

$$pH = \frac{E - E_c}{0.000198322\ T} = -log_{10}(H^+) \qquad (2b)$$

Equation 2b may be used as long as the *partial pressure* of the hydrogen gas (barometer reading minus the vapor pressure of the solution at that temperature) is 760 mm. The effect of reduction in hydrogen pressure is to reduce the negative potential of the hydrogen electrode, thus shifting the indicated pH to the acid side. Therefore, a correction E_B, must be added algebraically to $E - E_c$, and the complete equation becomes

$$pH = \frac{E + E_B - E_c}{0.000198322\ T} \qquad (3)$$

The representative values for E_B in Table II were obtained as follows: Suppose the corrected barometer reading is 760 mm. and the temperature 25°C., at which the vapor pressure of water is 23.8 mm. The partial pressure of H_2 is then $760 - 23.8 = 736.2$ mm. Setting this equal to x in the formula

$$E_B = \frac{0.000198322\ T}{2} log_{10} \frac{760}{x}$$

the value 0.00041 volt is obtained on solving for E_B. Values from the table may be plotted and others read from the graph, but under most conditions the correction is negligible.

Table III

Values for 0.000198322 T at Various Temperatures

t°C.	Value	t°C.	Value	t°C.	Value	t°C.	Value
0	0.054162	17	0.057533	23	0.058723	29	0.059913
5	0.055153	18	0.057732	24	0.058921	30	0.060111
10	0.056145	19	0.057930	25	0.059120	35	0.061103
14	0.056938	20	0.058128	26	0.059318	38	0.061698
15	0.057137	21	0.058327	27	0.059516	50	0.064078
16	0.057335	22	0.058525	28	0.059715	70	0.068044

Example for the calculation of pH.—The potential of the cell

$(^-)Pt, H_2(g) \mid H^+ (pH = x) \mid$ satd. KCl $\mid$ 0.1 *N* KCl, $Hg_2Cl_2(s) \mid Hg(^+)$

is observed to be 0.6138 volt at 20°C and 765 mm. corrected barometer reading. From Table II, E_B is taken to be 0.0002 volt. From Table I, E_c is taken as 0.3379 volt. From Table III, 0.000198322T is taken as 0.05813. Substituting these values in (3), we have

$$pH = \frac{0.6138 + 0.0002 - 0.3379}{0.05813} = 4.75$$

Equations for Practical Work

The following equations, in which the barometric corrections are neglected, are satisfactory for most practical work.

(a) Hydrogen electrode with 0.1 *N* calomel electrode:

at 20°C, $pH = \frac{E - 0.3379}{0.0581}$; at 25°C, $pH = \frac{E - 0.3376}{0.0591}$

(b) Hydrogen electrode with saturated calomel electrode:

at 20°C, $pH = \frac{E - 0.2491}{0.0581}$; at 25°C, $pH = \frac{E - 0.2458}{0.0591}$

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

Notes on Hydrogen Electrode

Directions for preparing the hydrogen electrode may be found in Clark's "*The Determination of Hydrogen Ions*," 3d edition, 1928, Williams and Wilkins Co., publishers, Baltimore, Md.

The hydrogen electrode cannot be used in the presence of salts of heavy metals, nor easily reduced substances in general. Thus, unsaturated organic acids, some alkaloids, etc., are reduced by hydrogen in the presence of the finely divided noble metal electrode which acts as a catalyst for the reduction. The electrode is very sensitive to traces of oxygen, so that highly purified hydrogen must be used in generous amounts. The commercial compressed hydrogen, however, is generally sufficiently pure for practical work. The hydrogen electrode is always negative with respect to all calomel electrodes, and the cell must be connected to the potentiometer with the former attached to the (−) binding post and the latter to the (+).

* Table IV

Hydrogen Electrode and Saturated Calomel Electrode

$$pH = \frac{E + E_B - 0.2648 + 0.00076t}{0.0001983T}$$

pH	Volt 5° C	Volt 10° C	Volt 15° C	Volt 20° C	Volt 25° C	Volt 30° C	Volt 35° C	Volt 40° C
0	0.2610	0.2572	0.2534	0.2496	0.2458	0.2420	0.2382	0.2344
.1	.2665	.2628	.2591	.2554	.2517	.2480	.2443	.2406
.2	.2720	.2684	.2648	.2612	.2576	.2540	.2504	.2468
.3	.2775	.2740	.2705	.2670	.2635	.2600	.2565	.2530
.4	.2831	.2797	.2763	.2728	.2694	.2660	.2626	.2592
.5	.2886	.2853	.2820	.2787	.2754	.2721	.2687	.2654
.6	.2941	.2909	.2877	.2845	.2813	.2781	.2749	.2717
.7	.2996	.2965	.2934	.2903	.2872	.2841	.2810	.2779
.8	.3051	.3021	.2991	.2961	.2931	.2901	.2871	.2841
.9	.3106	.3077	.3048	.3019	.2990	.2961	.2932	.2903
1.0	.3161	.3133	.3105	.3077	.3049	.3021	.2993	.2965
1.1	.3217	.3190	.3162	.3135	.3108	.3081	.3054	.3027
1.2	.3272	.3246	.3220	.3193	.3167	.3141	.3115	.3089
1.3	.3327	.3302	.3277	.3252	.3226	.3201	.3176	.3151
1.4	.3382	.3358	.3334	.3310	.3286	.3261	.3237	.3213
1.5	.3437	.3414	.3391	.3368	.3345	.3322	.3298	.3275
1.6	.3492	.3470	.3448	.3426	.3404	.3382	.3360	.3337
1.7	.3548	.3526	.3505	.3484	.3463	.3442	.3421	.3399
1.8	.3603	.3582	.3562	.3542	.3522	.3502	.3482	.3462
1.9	.3658	.3639	.3619	.3600	.3581	.3562	.3543	.3524
2.0	.3713	.3695	.3677	.3658	.3640	.3622	.3604	.3586
2.1	.3768	.3751	.3734	.3717	.3699	.3682	.3665	.3648
2.2	.3823	.3807	.3791	.3775	.3758	.3742	.3726	.3710
2.3	.3878	.3863	.3848	.3833	.3818	.3802	.3787	.3772
2.4	.3934	.3919	.3905	.3891	.3877	.3863	.3848	.3834
2.5	.3989	.3975	.3962	.3949	.3936	.3923	.3909	.3896
2.6	.4044	.4032	.4019	.4007	.3995	.3983	.3971	.3958
2.7	.4099	.4088	.4077	.4065	.4054	.4043	.4032	.4020
2.8	.4154	.4144	.4134	.4123	.4113	.4103	.4093	.4082
2.9	.4209	.4200	.4191	.4182	.4172	.4163	.4154	.4145
3.0	.4264	.4256	.4248	.4240	.4231	.4223	.4215	.4207
3.1	.4320	.4312	.4305	.4298	.4291	.4283	.4276	.4269
3.2	.4375	.4368	.4362	.4356	.4350	.4343	.4337	.4331
3.3	.4430	.4425	.4419	.4414	.4409	.4403	.4398	.4393
3.4	.4485	.4481	.4476	.4472	.4468	.4464	.4459	.4455
3.5	.4540	.4537	.4534	.4530	.4527	.4524	.4520	.4517

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(*Continued on following page.*)

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

Table IV (Continued)

Hydrogen Electrode and Saturated Calomel Electrode

pH	Volt 5° C	Volt 10° C	Volt 15° C	Volt 20° C	Volt 25° C	Volt 30° C	Volt 35° C	Volt 40° C
3.6	.4595	.4593	.4591	.4588	.4586	.4584	.4581	.4579
3.7	.4650	.4649	.4648	.4647	.4645	.4644	.4643	.4641
3.8	.4706	.4705	.4705	.4705	.4704	.4704	.4704	.4703
3.9	.4761	.4761	.4762	.4763	.4763	.4764	.4765	.4765
4.0	.4816	.4818	.4819	.4821	.4823	.4824	.4826	.4828
4.1	.4871	.4874	.4876	.4879	.4882	.4884	.4887	.4890
4.2	.4926	.4930	.4933	.4937	.4941	.4944	.4948	.4952
4.3	.4981	.4986	.4991	.4995	.5000	.5005	.5009	.5014
4.4	.5036	.5042	.5048	.5053	.5059	.5065	.5070	.5076
4.5	.5092	.5098	.5105	.5111	.5118	.5125	.5131	.5138
4.6	.5147	.5154	.5162	.5170	.5177	.5185	.5192	.5200
4.7	.5202	.5211	.5219	.5228	.5236	.5245	.5254	.5262
4.8	.5257	.5267	.5276	.5286	.5296	.5305	.5315	.5324
4.9	.5312	.5323	.5333	.5344	.5355	.5365	.5376	.5386
5.0	.5367	.5379	.5391	.5402	.5414	.5425	.5437	.5448
5.1	.5423	.5435	.5448	.5460	.5473	.5485	.5498	.5510
5.2	.5478	.5491	.5505	.5518	.5532	.5545	.5559	.5573
5.3	.5533	.5547	.5562	.5576	.5591	.5606	.5620	.5635
5.4	.5588	.5603	.5619	.5635	.5650	.5666	.5681	.5697
5.5	.5643	.5660	.5676	.5693	.5709	.5726	.5742	.5759
5.6	.5698	.5716	.5733	.5751	.5768	.5786	.5803	.5821
5.7	.5753	.5772	.5790	.5809	.5827	.5846	.5864	.5883
5.8	.5809	.5828	.5848	.5867	.5887	.5906	.5926	.5945
5.9	.5864	.5884	.5905	.5925	.5946	.5966	.5987	.6007
6.0	.5919	.5940	.5962	.5983	.6005	.6026	.6048	.6069
6.1	.5974	.5996	.6019	.6041	.6064	.6086	.6109	.6131
6.2	.6029	.6053	.6076	.6100	.6123	.6146	.6170	.6193
6.3	.6084	.6109	.6133	.6158	.6182	.6207	.6231	.6256
6.4	.6139	.6165	.6190	.6216	.6241	.6267	.6292	.6318
6.5	.6195	.6221	.6247	.6274	.6300	.6327	.6353	.6380
6.6	.6250	.6277	.6305	.6332	.6359	.6387	.6414	.6442
6.7	.6305	.6333	.6362	.6390	.6419	.6447	.6475	.6504
6.8	.6360	.6389	.6419	.6448	.6478	.6507	.6537	.6566
6.9	.6415	.6446	.6476	.6506	.6537	.6567	.6598	.6628
7.0	.6470	.6502	.6533	.6565	.6596	.6627	.6659	.6690
7.1	.6525	.6558	.6590	.6623	.6655	.6687	.6720	.6752
7.2	.6581	.6614	.6647	.6681	.6714	.6748	.6781	.6814
7.3	.6636	.6670	.6705	.6739	.6773	.6808	.6842	.6876
7.4	.6691	.6726	.6762	.6797	.6832	.6868	.6903	.6938
7.5	.6746	.6782	.6819	.6855	.6891	.6928	.6964	.7001
7.6	.6801	.6839	.6876	.6913	.6951	.6988	.7025	.7063
7.7	.6856	.6895	.6933	.6971	.7010	.7048	.7086	.7125
7.8	.6911	.6951	.6990	.7029	.7069	.7108	.7148	.7187
7.9	.6967	.7007	.7047	.7088	.7128	.7168	.7209	.7249
8.0	.7022	.7063	.7104	.7146	.7187	.7228	.7270	.7311
8.1	.7077	.7119	.7162	.7204	.7246	.7288	.7331	.7373
8.2	.7132	.7175	.7219	.7262	.7305	.7349	.7392	.7435
8.3	.7187	.7232	.7276	.7320	.7364	.7409	.7453	.7497
8.4	.7242	.7288	.7333	.7378	.7424	.7469	.7514	.7559
8.5	.7298	.7344	.7390	.7436	.7483	.7529	.7575	.7621
8.6	.7353	.7400	.7447	.7494	.7542	.7589	.7636	.7684
8.7	.7408	.7456	.7504	.7553	.7601	.7649	.7697	.7746
8.8	.7463	.7512	.7561	.7611	.7660	.7709	.7758	.7808
8.9	.7518	.7568	.7619	.7669	.7719	.7769	.7820	.7870
9.0	.7573	.7624	.7676	.7727	.7778	.7829	.7881	.7932

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

Table IV (Continued)

Hydrogen Electrode and Saturated Calomel Electrode

pH	Volt 5° C	Volt 10° C	Volt 15° C	Volt 20° C	Volt 25° C	Volt 30° C	Volt 35° C	Volt 40° C
9.1	.7628	.7681	.7733	.7785	.7837	.7890	.7942	.7994
9.2	.7684	.7737	.7790	.7843	.7896	.7950	.8003	.8056
9.3	.7739	.7793	.7847	.7901	.7956	.8010	.8064	.8118
9.4	.7794	.7849	.7904	.7959	.8015	.8070	.8125	.8180
9.5	.7849	.7905	.7961	.8018	.8074	.8130	.8186	.8242
9.6	.7904	.7961	.8019	.8076	.8133	.8190	.8247	.8304
9.7	.7959	.8017	.8076	.8134	.8192	.8250	.8308	.8367
9.8	.8014	.8074	.8133	.8192	.8251	.8310	.8369	.8429
9.9	.8070	.8130	.8190	.8250	.8310	.8370	.8431	.8491
10.0	.8125	.8186	.8247	.8308	.8369	.8430	.8492	.8553
10.1	.8180	.8242	.8304	.8366	.8428	.8491	.8553	.8615
10.2	.8235	.8298	.8361	.8424	.8488	.8551	.8614	.8677
10.3	.8290	.8354	.8418	.8483	.8547	.8611	.8675	.8739
10.4	.8345	.8410	.8476	.8541	.8606	.8671	.8736	.8801
10.5	.8400	.8467	.8533	.8599	.8665	.8731	.8797	.8863
10.6	.8456	.8523	.8590	.8657	.8724	.8791	.8858	.8925
10.7	.8511	.8579	.8647	.8715	.8783	.8851	.8919	.8987
10.8	.8566	.8635	.8704	.8773	.8842	.8911	.8980	.9049
10.9	.8621	.8691	.8761	.8831	.8901	.8971	.9041	.9112
11.0	.8676	.8747	.8818	.8889	.8960	.9032	.9103	.9174
11.1	.8731	.8803	.8875	.8948	.9020	.9092	.9164	.9236
11.2	.8786	.8860	.8933	.9006	.9079	.9152	.9225	.9298
11.3	.8842	.8916	.8990	.9064	.9138	.9212	.9286	.9360
11.4	.8897	.8972	.9047	.9122	.9197	.9272	.9347	.9422
11.5	.8952	.9028	.9104	.9180	.9256	.9332	.9408	.9484
11.6	.9007	.9084	.9161	.9238	.9315	.9392	.9469	.9546
11.7	.9062	.9140	.9218	.9296	.9374	.9452	.9530	.9608
11.8	.9117	.9196	.9275	.9354	.9433	.9512	.9591	.9670
11.9	.9173	.9253	.9332	.9412	.9492	.9572	.9652	.9732
12.0	.9228	.9309	.9390	.9471	.9552	.9633	.9714	.9795
12.1	.9283	.9365	.9447	.9529	.9611	.9693	.9775	.9857
12.2	.9338	.9421	.9504	.9587	.9670	.9753	.9836	.9919
12.3	.9393	.9477	.9561	.9645	.9729	.9813	.9897	.9981
12.4	.9448	.9533	.9618	.9703	.9788	.9873	.9958	1.0043
12.5	.9503	.9589	.9675	.9761	.9847	.9933	1.0019	1.0105
12.6	.9559	.9645	.9732	.9819	.9906	.9993	1.0080	1.0167
12.7	.9614	.9702	.9790	.9877	.9965	1.0053	1.0141	1.0229
12.8	.9669	.9758	.9847	.9936	1.0024	1.0113	1.0202	1.0291
12.9	.9724	.9814	.9904	.9994	1.0084	1.0174	1.0263	1.0353
13.0	.9779	.9870	.9961	1.0052	1.0143	1.0234	1.0325	1.0415
13.1	.9834	.9926	1.0018	1.0110	1.0202	1.0294	1.0386	1.0477
13.2	.9889	.9982	1.0075	1.0168	1.0261	1.0354	1.0447	1.0540
13.3	.9945	1.0038	1.0132	1.0226	1.0320	1.0414	1.0508	1.0602
13.4	1.0000	1.0095	1.0189	1.0284	1.0379	1.0474	1.0569	1.0664
13.5	1.0055	1.0151	1.0247	1.0342	1.0438	1.0534	1.0630	1.0726
13.6	1.0110	1.0207	1.0304	1.0401	1.0497	1.0594	1.0691	1.0788
13.7	1.0165	1.0263	1.0361	1.0459	1.0557	1.0654	1.0752	1.0850
13.8	1.0220	1.0319	1.0418	1.0517	1.0616	1.0714	1.0813	1.0912
13.9	1.0275	1.0375	1.0475	1.0575	1.0675	1.0775	1.0874	1.0974
14.0	1.0331	1.0431	1.0532	1.0633	1.0734	1.0835	1.0935	1.1036

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

Measurement of pH with the Quinhydrone Electrode

A bright platinum or gold electrode is usually employed. No hydrogen is required. The solution is saturated with quinhydrone, which is an equimolecular mixture of quinone and hydroquinone. The single electrode reaction is:

$$C_6H_4(OH)_2 \rightarrow C_6H_4O_2 + 2H^+ + 2e$$

Accordingly, the electrode equation is

$$E_H = E_{oq} - \frac{RT}{2F} \ln \frac{(C_6H_4O_2)(H^+)^2}{(C_6H_4(OH)_2)} \quad \text{or}$$

$$E_H = E_{oq} - \frac{RT}{2F} \ln \frac{(C_6H_4O_2)}{(C_6H_4(OH)_2)} - 2.303\frac{RT}{F} log_{10}\ (H^+)$$

Since quinone and hydroquinone are present in equimolecular proportions, it is assumed that their "activities" are equal in the solution. The second term on the right hand side of the equation therefore becomes zero, and

$$E_H = E_{oq} - 0.000198322\,T \log_{10}(H^+) \qquad (4)$$

This is the same as equation (2), with the constant term E_{oq}, which has a value $0.7177 - 0.00074t°C$ from 0° to 38°C. The quinhydrone single electrode must be paired with another, usually the satd. calomel electrode, to make a cell. It is *positive* to the calomel electrode over the greater part of the pH range in which it is applicable, but with a satd. calomel electrode at 25°C E is zero at pH 7.67. For measurements at higher pH values, the quinhydrone electrode must be connected to the (−) binding post of the potentiometer, and E considered negative in calculating pH.

Table V

Standard Electrode Potential, E_{oq}, for the Quinhydrone Electrode

$E_{oq} = 0.7177 - 0.00074t°C$									
t°C.	E_{oq}	t°C.	E_{oq}	t°C.	E_{oq}	t°C.	E_{oq}	t°C.	E_{oq}
15	0.7066	19	0.7036	23	0.7007	27	0.6977	35	0.6918
16	.7059	20	.7029	24	.6999	28	0.6970	38	.6896
17	.7051	21	.7022	25	.6992	29	0.6952	40	.6881
18	.7044	22	.7014	26	.6985	30	0.6955		

The general formula for calculation of pH value from the potential of a quinhydrone electrode is

$$pH = \frac{E_{oq} - E_e - E}{0.000198322\,T} \qquad (5)$$

The value of E, the potential read from the potentiometer, is considered positive if the metal of the quinhydrone electrode is connected to the (+) binding post of the potentiometer, negative if connected to the (−) binding post.
For instance, in the cell

$^{(+)}Pt|H^+$(quinhydrone) | satd. KCl | satd. KCl, $Hg_2Cl_2(s)$ | $Hg^{(-)}$

the platinum electrode is connected to the positive binding post, and the observed potential is 0.0200 volt at 20°. The value of E_{oq} at 20°C is read from Table V, E_e from Table I and 0.000198322 T from Table III. E is positive in this case and substituting

$$pH = \frac{0.7029 - 0.2496 - 0.0200}{0.05813} = 7.45$$

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

To illustrate a second example, a case in which the quinhydrone electrode must be connected to the negative binding post of the potentiometer when the observed potential is 0.0100 volt at 20°C. E is considered negative and therefore must be added, when

$$pH = \frac{0.7029 - 0.2496 - (-0.0100)}{0.05813} = 7.97$$

Notes on the Quinhydrone Electrode

An electrode having an area of at least one square centimeter is desirable. If the platinum is sealed in glass with mercury for a connection, the seal is quite certain to crack sooner or later and the electrode then becomes unreliable. Platinum electrodes should be clean and free from stains, but need not be highly polished. Methods of cleaning platinum electrodes include (1) heating in fresh cleaning solution (sulfuric acid and potassium dichromate mixture), washing well with water and drying in air for twenty minutes; (2) boiling in nitric acid, then in 5 to 10% sodium acid sulfite, rinsing well with water and using at once. With a platinum electrode treated by method (2), very little quinhydrone is necessary, four drops of a saturated solution in acetone being sufficient for 50 milliliters of solution, for correct potentials in two minutes. Commercial quinhydrone is usually satisfactory. It should not be exposed to light or heated, as it decomposes with loss of quinone. The quinhydrone electrode cannot be used in the presence of active reducing or oxidizing agents, and it is also subject to protein and salt errors. Above pH 8.5 it becomes unreliable, both because hydroquinone has acid properties (K'_a is approximately 10^{-10}), and because it is appreciably oxidized by air in alkaline solutions.

Measurement of pH with the Glass Electrode

If a membrane permeable only to water, H, and OH ions, separates two solutions differing in pH, it can be shown from theory that there should be a difference in potential between the two solutions, in accordance with the equation

$$E = \frac{RT}{F} \ln \frac{(H)_1}{(H)_2}$$

A very thin film of certain kinds of glass, which may be considered a solid solution containing some water, appears to function as a membrane of limited permeability as indicated. The resistance of even the thinnest glass film is extremely high, therefore a quadrant electrometer or electron-tube amplifier must be used as the null instrument in the potentiometric circuit, to measure the potential of the chain:

$$\mathrm{Hg}\left|\mathrm{Hg_2Cl_2},\ \mathrm{KCl\ satd.}\right|\mathrm{KCl\ satd.}\left|\begin{matrix}\text{Sample}\\ \text{pH} = \text{x}\end{matrix}\right|\text{glass}\left|\begin{matrix}\text{Buffer}\\ \text{pH} = \text{c}\end{matrix}\right|\mathrm{KCl\ satd.}\left|\mathrm{KCl\ satd.,\ Hg_2Cl_2}\right|\mathrm{Hg}$$

The characteristics of glass films differ, so that each must be standardized by the use of buffers. Once the glass film has reached stability and the constants have been established, potential is found to vary with pH almost as predicted from theory. In practice, glass electrodes have been found satisfactory in sensitivity and speed in reaching equilibrium, and to remain stable for considerable lengths of time. It is possible to operate with very small volumes of sample solution, and the glass electrode appears to function solely as a pH indicator, without complication from oxidation-reduction potentials shown by metal electrodes. (Cf. Britton, "*Hydrogen Ions*," 2d edition, D. Van Nostrand Co., publishers, New York, 1932.)

Standard Solutions for Testing Electrodes

Potassium Acid Phthalate, 0.05 *M*.—The pH is accepted as 3.97 at all temperatures between 0° and 40°C. A 0.2 *M* solution is prepared from 10.209 grams of the pure salt dissolved and diluted to 250 ml. A portion may be diluted with three volumes of water for use. The 0.05 *M* solution deteriorates and is worthless in a few days, but the more concentrated solution is quite permanent.

"Standard Acetate." The pH value varies slightly with temperature having a value of 4.62 at 18°C, 4.63 at 25°C and 4.64 at 38°C. The solution contains

N acetic acid	50 ml.
N sodium hydroxide	25 ml.
Water to make	250 ml.

The sodium hydroxide must be pure and free from carbonate, and exactly twice the equivalent of acetic acid is added. Unless sealed and sterilized, molds will grow and consume the acid.

General Data

The following data apply to Tables VI, VII and VIII which pertain to systems involving a glass electrode. Since these three tables apply to various combinations of different glass electrodes and saturated calomel electrodes, the following data should be carefully read before using the tables to be sure that the correct table is used and also to apply the corrections (when needed and desired) for asymmetry or for errors caused by the presence of sodium, lithium or potassium salts in the solution being measured.

When using Tables VI, VII and VIII, the measured E.M.F. should be considered positive when the reference electrode (saturated calomel electrode) is connected to the positive terminal of the measuring instrument and should be considered negative when the reference electrode is connected to the negative terminal.

Table VI

Table VI should be used when making measurements with the L & N Cat. 7685 Glass Electrode and the L & N Cat. 7724 Saturated Calomel Electrode.

It is to be noted, however, that the first two pages of this Table are also for use when making measurements with a quinhydrone electrode and a saturated calomel electrode.

Table VII

Table VII should be used when making measurements with the following combinations of electrodes:

L & N Glass Electrode		L & N Reference Electrode (Saturated Calomel Electrode)
Std. 1199–10	and	Std. 119–11 or Cat. 7724
Std. 1199–12	and	Std. 1199–13

It is to be noted that zero volts in this Table occurs at 4 pH.

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

Table VIII

Table VIII should be used when making measurements with the following combinations of electrodes:

L & N Glass Electrodes		L & N Reference Electrodes (Saturated Calomel Electrode)
Std. 1199–8	and	Std. 1199–11 or Cat. 7724
Std. 1199–14	and	Std. 1199–13

It is to be noted that zero volts in this Table occurs at 7 pH.

Asymmetry Correction—To determine the asymmetry correction for a given electrode system (glass electrode with a saturated calomel electrode), proceed as follows:

(1) Place the electrode system in a buffer solution of known pH value and measure the pH of the buffer solution with the electrode system. If the measuring instrument being used reads E.M.F., convert this E.M.F. value to pH by referring to the voltage table which applies to the glass electrode being used.

(2) The difference between the measured pH value of the buffer solution and the known value of this solution represents the asymmetry correction to be applied.

Under ordinary conditions the asymmetry changes very little. However, if the glass electrode is heated to 70° C. or higher, quite an appreciable change may occur.

Sodium, Lithium and Potassium Errors—Sodium, lithium and potassium salts in solution will cause appreciable errors in the alkaline pH range. These errors are small below 9 pH and 25° C., but increase appreciably above 25° C. and cause the E.M.F. reading to be too low. Potassium errors are less than 0.005 volt up to 11 pH and 25° C. Lithium and sodium errors may be much greater. It is not recommended that a glass electrode be used for absolute pH measurements above 9 pH and 25° C. in solutions containing appreciable amounts of the above named salts. If measurements of such solutions must be made, it is necessary to calibrate the glass electrode with some suitable secondary electrode, in the solution in question, at the same temperature and pH as subsequent measurements are to be made. A hydrogen gas electrode may be used as a secondary electrode for many solutions, but must not be used in oxidizing or reducing solutions.

If a suitable secondary electrode can be found and the proper correction once established for a specific solution, temperature, and pH, subsequent glass electrode measurements may be corrected by adding the voltage correction to the E.M.F. values in Tables VI, VII, VIII.

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

*Table VI

Quinhydrone or Glass Electrode and Saturated Calomel Electrode

$$pH = \frac{E + 0.4529 + 0.00002t}{0.00019832T}$$

pH	Volt 5° C	Volt 10° C	Volt 15° C	Volt 20° C	Volt 25° C	Volt 30° C	Volt 35° C	Volt 40° C
0	−0.4530	−0.4531	−0.4532	−0.4533	−0.4534	−0.4535	−0.4536	−0.4537
.1	−.4475	−.4475	−.4475	−.4475	−.4475	−.4475	−.4475	−.4475
.2	−.4420	−.4419	−.4418	−.4417	−.4416	−.4415	−.4414	−.4413
.3	−.4365	−.4363	−.4361	−.4359	−.4357	−.4355	−.4353	−.4351
.4	−.4309	−.4306	−.4303	−.4300	−.4298	−.4295	−.4292	−.4289
.5	−.4254	−.4250	−.4246	−.4242	−.4238	−.4234	−.4230	−.4227
.6	−.4199	−.4194	−.4189	−.4184	−.4179	−.4174	−.4169	−.4164
.7	−.4144	−.4138	−.4132	−.4126	−.4120	−.4114	−.4108	−.4102
.8	−.4089	−.4082	−.4075	−.4068	−.4061	−.4054	−.4047	−.4040
.9	−.4034	−.4026	−.4018	−.4010	−.4002	−.3994	−.3986	−.3978
1.0	−.3978	−.3970	−.3961	−.3952	−.3943	−.3934	−.3925	−.3916
1.1	−.3923	−.3913	−.3904	−.3894	−.3884	−.3874	−.3864	−.3854
1.2	−.3868	−.3857	−.3846	−.3835	−.3825	−.3814	−.3803	−.3792
1.3	−.3813	−.3801	−.3789	−.3777	−.3765	−.3754	−.3742	−.3730
1.4	−.3758	−.3745	−.3732	−.3719	−.3706	−.3693	−.3681	−.3668
1.5	−.3703	−.3689	−.3675	−.3661	−.3647	−.3633	−.3619	−.3606
1.6	−.3648	−.3633	−.3618	−.3603	−.3588	−.3573	−.3558	−.3543
1.7	−.3592	−.3577	−.3561	−.3545	−.3529	−.3513	−.3497	−.3481
1.8	−.3537	−.3520	−.3504	−.3487	−.3470	−.3453	−.3436	−.3419
1.9	−.3482	−.3464	−.3446	−.3429	−.3411	−.3393	−.3375	−.3357
2.0	−.3427	−.3408	−.3389	−.3370	−.3352	−.3333	−.3314	−.3295
2.1	−.3372	−.3352	−.3332	−.3312	−.3292	−.3273	−.3253	−.3233
2.2	−.3317	−.3296	−.3275	−.3254	−.3233	−.3213	−.3192	−.3171
2.3	−.3261	−.3240	−.3218	−.3196	−.3174	−.3152	−.3131	−.3109
2.4	−.3206	−.3184	−.3161	−.3138	−.3115	−.3092	−.3070	−.3047
2.5	−.3151	−.3127	−.3104	−.3080	−.3056	−.3032	−.3008	−.2985
2.6	−.3096	−.3071	−.3046	−.3022	−.2997	−.2972	−.2947	−.2923
2.7	−.3041	−.3015	−.2989	−.2964	−.2938	−.2912	−.2886	−.2860
2.8	−.2986	−.2959	−.2932	−.2905	−.2879	−.2852	−.2825	−.2798
2.9	−.2931	−.2903	−.2875	−.2847	−.2820	−.2792	−.2764	−.2736
3.0	−.2875	−.2847	−.2818	−.2789	−.2760	−.2732	−.2703	−.2674
3.1	−.2820	−.2791	−.2761	−.2731	−.2701	−.2672	−.2642	−.2612
3.2	−.2765	−.2734	−.2704	−.2673	−.2642	−.2611	−.2581	−.2550
3.3	−.2710	−.2678	−.2647	−.2615	−.2583	−.2551	−.2520	−.2488
3.4	−.2655	−.2622	−.2589	−.2557	−.2524	−.2491	−.2459	−.2426
3.5	−.2600	−.2566	−.2532	−.2499	−.2465	−.2431	−.2397	−.2364
3.6	−.2544	−.2510	−.2475	−.2440	−.2406	−.2371	−.2336	−.2302
3.7	−.2489	−.2454	−.2418	−.2382	−.2347	−.2311	−.2275	−.2240
3.8	−.2434	−.2398	−.2361	−.2324	−.2287	−.2251	−.2214	−.2177
3.9	−.2379	−.2341	−.2304	−.2266	−.2228	−.2191	−.2153	−.2115
4.0	−.2324	−.2285	−.2247	−.2208	−.2169	−.2131	−.2092	−.2053
4.1	−.2269	−.2229	−.2189	−.2150	−.2110	−.2070	−.2031	−.1991
4.2	−.2214	−.2173	−.2132	−.2092	−.2051	−.2010	−.1970	−.1929
4.3	−.2158	−.2117	−.2075	−.2034	−.1992	−.1950	−.1909	−.1867
4.4	−.2103	−.2061	−.2018	−.1975	−.1933	−.1890	−.1847	−.1805
4.5	−.2048	−.2005	−.1961	−.1917	−.1874	−.1830	−.1786	−.1743

* Before using Tables VI, VII and VIII, it is important that the descriptive matter preceding Table VI be read carefully.

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ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

Table VI (Continued) *

Quinhydrone or Glass Electrode and Saturated Calomel Electrode

pH	Volt 5° C	Volt 10° C	Volt 15° C	Volt 20° C	Volt 25° C	Volt 30° C	Volt 35° C	Volt 40° C
4.6	−.1993	−.1948	−.1904	−.1859	−.1815	−.1770	−.1725	−.1681
4.7	−.1938	−.1892	−.1847	−.1801	−.1755	−.1710	−.1664	−.1619
4.8	−.1883	−.1836	−.1789	−.1743	−.1696	−.1650	−.1603	−.1556
4.9	−.1828	−.1780	−.1732	−.1685	−.1637	−.1590	−.1542	−.1494
5.0	−.1772	−.1724	−.1675	−.1627	−.1578	−.1529	−.1481	−.1432
5.1	−.1717	−.1668	−.1618	−.1568	−.1519	−.1469	−.1420	−.1370
5.2	−.1662	−.1611	−.1561	−.1510	−.1460	−.1409	−.1359	−.1308
5.3	−.1607	−.1555	−.1504	−.1452	−.1401	−.1349	−.1298	−.1246
5.4	−.1552	−.1499	−.1447	−.1394	−.1342	−.1289	−.1236	−.1184
5.5	−.1497	−.1443	−.1390	−.1336	−.1282	−.1229	−.1175	−.1122
5.6	−.1441	−.1387	−.1332	−.1278	−.1223	−.1169	−.1114	−.1060
5.7	−.1386	−.1331	−.1275	−.1220	−.1164	−.1109	−.1053	−.0998
5.8	−.1331	−.1275	−.1218	−.1162	−.1105	−.1049	−.0992	−.0936
5.9	−.1276	−.1218	−.1161	−.1103	−.1046	−.0988	−.0931	−.0873
6.0	−.1221	−.1162	−.1104	−.1045	−.0987	−.0928	−.0870	−.0811
6.1	−.1166	−.1106	−.1047	−.0987	−.0928	−.0868	−.0809	−.0749
6.2	−.1111	−.1050	−.0990	−.0929	−.0869	−.0808	−.0748	−.0687
6.3	−.1055	−.0994	−.0932	−.0871	−.0809	−.0748	−.0687	−.0625
6.4	−.1000	−.0938	−.0875	−.0813	−.0750	−.0688	−.0625	−.0563
6.5	−.0945	−.0882	−.0818	−.0755	−.0691	−.0628	−.0564	−.0501
6.6	−.0890	−.0825	−.0761	−.0697	−.0632	−.0568	−.0503	−.0439
6.7	−.0835	−.0769	−.0704	−.0638	−.0573	−.0508	−.0442	−.0377
6.8	−.0780	−.0713	−.0647	−.0580	−.0514	−.0447	−.0381	−.0315
6.9	−.0724	−.0657	−.0590	−.0522	−.0455	−.0387	−.0320	−.0253
7.0	−.0669	−.0601	−.0532	−.0464	−.0396	−.0327	−.0259	−.0190
7.1	−.0614	−.0545	−.0475	−.0406	−.0337	−.0267	−.0198	−.0128
7.2	−.0559	−.0489	−.0418	−.0348	−.0277	−.0207	−.0137	−.0066
7.3	−.0504	−.0432	−.0361	−.0290	−.0218	−.0147	−.0076	−.0004
7.4	−.0449	−.0376	−.0304	−.0232	−.0159	−.0087	−.0014	+.0058
7.5	−.0394	−.0320	−.0247	−.0173	−.0100	−.0027	+.0047	+.0120
7.6	−.0338	−.0264	−.0190	−.0115	−.0041	+.0033	+.0108	+.0182
7.7	−.0283	−.0208	−.0133	−.0057	+.0018	+.0094	+.0169	+.0244
7.8	−.0228	−.0152	−.0075	+.0001	+.0077	+.0154	+.0230	+.0306
7.9	−.0173	−.0096	−.0018	+.0059	+.0136	+.0214	+.0291	+.0368
8.0	−.0118	−.0039	+.0039	+.0117	+.0196	+.0274	+.0352	+.0431
8.1	−.0063	+.0017	+.0096	+.0175	+.0255	+.0334	+.0413	+.0493
8.2	−.0007	+.0073	+.0153	+.0233	+.0314	+.0394	+.0474	+.0555
8.3	+.0048	+.0129	+.0210	+.0292	+.0373	+.0454	+.0535	+.0617
8.4	+.0103	+.0185	+.0267	+.0350	+.0432	+.0514	+.0597	+.0679
8.5	+.0158	+.0241	+.0325	+.0408	+.0491	+.0574	+.0658	+.0741
8.6	+.0213	+.0297	+.0382	+.0466	+.0550	+.0635	+.0719	+.0803
8.7	+.0268	+.0354	+.0439	+.0524	+.0609	+.0695	+.0780	+.0865
8.8	+.0323	+.0410	+.0496	+.0582	+.0668	+.0755	+.0841	+.0927
8.9	+.0379	+.0466	+.0553	+.0640	+.0728	+.0815	+.0902	+.0989
9.0	+.0434	+.0522	+.0610	+.0698	+.0787	+.0875	+.0963	+.1051
9.1	+.0489	+.0578	+.0667	+.0757	+.0846	+.0935	+.1024	+.1114
9.2	+.0544	+.0634	+.0725	+.0815	+.0905	+.0995	+.1085	+.1176
9.3	+.0599	+.0690	+.0782	+.0873	+.0964	+.1055	+.1147	+.1238
9.4	+.0654	+.0747	+.0839	+.0931	+.1023	+.1115	+.1208	+.1300
9.5	+.0710	+.0803	+.0896	+.0989	+.1082	+.1176	+.1269	+.1362

* Before using this table, it is important that the descriptive matter preceding Table VI be read carefully.

(Completed on following page.)

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

Table VI (Continued) *

Quinhydrone or Glass Electrode and Saturated Calomel Electrode

pH	Volt 5° C	Volt 10° C	Volt 15° C	Volt 20° C	Volt 25° C	Volt 30° C	Volt 35° C	Volt 40° C
9.6	+.0765	+.0859	+.0953	+.1047	+.1141	+.1236	+.1330	+.1424
9.7	+.0820	+.0915	+.1010	+.1105	+.1201	+.1296	+.1391	+.1486
9.8	+.0875	+.0971	+.1067	+.1164	+.1260	+.1356	+.1452	+.1548
9.9	+.0930	+.1027	+.1124	+.1222	+.1319	+.1416	+.1513	+.1610
10.0	+.0985	+.1083	+.1182	+.1280	+.1378	+.1476	+.1574	+.1672
10.1	+.1040	+.1140	+.1239	+.1338	+.1437	+.1536	+.1635	+.1735
10.2	+.1096	+.1196	+.1296	+.1396	+.1496	+.1596	+.1696	+.1797
10.3	+.1151	+.1252	+.1353	+.1454	+.1555	+.1656	+.1758	+.1859
10.4	+.1206	+.1308	+.1410	+.1512	+.1614	+.1717	+.1819	+.1921
10.5	+.1261	+.1364	+.1467	+.1570	+.1674	+.1777	+.1880	+.1983
10.6	+.1316	+.1420	+.1524	+.1629	+.1733	+.1837	+.1941	+.2045
10.7	+.1371	+.1476	+.1582	+.1687	+.1792	+.1897	+.2002	+.2107
10.8	+.1427	+.1533	+.1639	+.1745	+.1851	+.1957	+.2063	+.2169
10.9	+.1482	+.1589	+.1696	+.1803	+.1910	+.2017	+.2124	+.2231
11.0	+.1537	+.1645	+.1753	+.1861	+.1969	+.2077	+.2185	+.2293
11.1	+.1592	+.1701	+.1810	+.1919	+.2028	+.2137	+.2246	+.2356
11.2	+.1647	+.1757	+.1867	+.1977	+.2087	+.2197	+.2308	+.2418
11.3	+.1702	+.1813	+.1924	+.2035	+.2146	+.2258	+.2369	+.2480
11.4	+.1757	+.1870	+.1982	+.2094	+.2206	+.2318	+.2430	+.2542
11.5	+.1813	+.1926	+.2039	+.2152	+.2265	+.2378	+.2491	+.2604
11.6	+.1868	+.1982	+.2096	+.2210	+.2324	+.2438	+.2552	+.2666
11.7	+.1923	+.2038	+.2153	+.2268	+.2383	+.2498	+.2613	+.2728
11.8	+.1978	+.2094	+.2210	+.2326	+.2442	+.2558	+.2674	+.2790
11.9	+.2033	+.2150	+.2267	+.2384	+.2501	+.2618	+.2735	+.2852
12.0	+.2088	+.2206	+.2324	+.2442	+.2560	+.2678	+.2796	+.2914
12.1	+.2144	+.2262	+.2382	+.2500	+.2619	+.2738	+.2857	+.2976
12.2	+.2199	+.2319	+.2439	+.2559	+.2679	+.2799	+.2919	+.3038
12.3	+.2254	+.2375	+.2496	+.2617	+.2738	+.2859	+.2980	+.3101
12.4	+.2309	+.2431	+.2553	+.2675	+.2797	+.2919	+.3041	+.3163
12.5	+.2364	+.2487	+.2610	+.2733	+.2856	+.2979	+.3102	+.3225
12.6	+.2419	+.2543	+.2667	+.2791	+.2915	+.3039	+.3163	+.3287
12.7	+.2474	+.2599	+.2724	+.2849	+.2974	+.3099	+.3224	+.3349
12.8	+.2530	+.2656	+.2781	+.2907	+.3083	+.3159	+.3285	+.3411
12.9	+.2585	+.2712	+.2839	+.2966	+.3092	+.3219	+.3346	+.3473
13.0	+.2640	+.2769	+.2896	+.3024	+.3152	+.3279	+.3407	+.3535
13.1	+.2695	+.2824	+.2953	+.3082	+.3211	+.3340	+.3468	+.3597
13.2	+.2750	+.2880	+.3010	+.3140	+.3270	+.3400	+.3530	+.3659
13.3	+.2805	+.2936	+.3067	+.3198	+.3329	+.3460	+.3591	+.3722
13.4	+.2860	+.2992	+.3124	+.3256	+.3388	+.3520	+.3652	+.3784
13.5	+.2916	+.3049	+.3181	+.3314	+.3447	+.3580	+.3713	+.3846
13.6	+.2971	+.3105	+.3239	+.3372	+.3506	+.3640	+.3774	+.3908
13.7	+.3026	+.3161	+.3296	+.3431	+.3565	+.3700	+.3835	+.3970
13.8	+.3081	+.3217	+.3353	+.3489	+.3624	+.3760	+.3896	+.4032
13.9	+.3136	+.3273	+.3410	+.3547	+.3684	+.3820	+.3957	+.4094
14.0	+.3191	+.3329	+.3467	+.3605	+.3743	+.3881	+.4018	+.4156

* Before using this table, it is important that the descriptive matter preceding Table VI be read carefully.

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

*Table VII

Glass Electrode and Saturated Calomel Electrode

$e = .000198322\ T$ (pH-4)

where e = Electrode potential in volts
T = Absolute temperature

pH	Volt 5° C	Volt 10° C	Volt 15° C	Volt 20° C	Volt 25° C	Volt 30° C	Volt 35° C	Volt 40° C
0	−.2206	−.2246	−.2285	−.2325	−.2365	−.2404	−.2444	−.2484
.1	−.2151	−.2190	−.2228	−.2267	−.2306	−.2344	−.2383	−.2422
.2	−.2096	−.2134	−.2171	−.2209	−.2247	−.2284	−.2322	−.2360
.3	−.2041	−.2077	−.2114	−.2151	−.2187	−.2224	−.2261	−.2298
.4	−.1986	−.2021	−.2057	−.2093	−.2128	−.2164	−.2200	−.2235
.5	−.1930	−.1965	−.2000	−.2034	−.2069	−.2104	−.2139	−.2173
.6	−.1875	−.1909	−.1943	−.1976	−.2010	−.2044	−.2078	−.2111
.7	−.1820	−.1853	−.1886	−.1918	−.1951	−.1984	−.2016	−.2049
.8	−.1765	−.1797	−.1828	−.1860	−.1892	−.1924	−.1955	−.1987
.9	−.1710	−.1740	−.1771	−.1802	−.1833	−.1863	−.1894	−.1925
1.0	−.1655	−.1684	−.1714	−.1744	−.1774	−.1803	−.1833	−.1863
1.1	−.1599	−.1628	−.1657	−.1686	−.1714	−.1743	−.1772	−.1801
1.2	−.1544	−.1572	−.1600	−.1628	−.1655	−.1683	−.1711	−.1739
1.3	−.1489	−.1516	−.1543	−.1569	−.1596	−.1623	−.1650	−.1677
1.4	−.1434	−.1460	−.1486	−.1511	−.1537	−.1563	−.1589	−.1614
1.5	−.1379	−.1404	−.1428	−.1453	−.1478	−.1503	−.1528	−.1552
1.6	−.1324	−.1347	−.1371	−.1395	−.1419	−.1443	−.1466	−.1490
1.7	−.1268	−.1291	−.1314	−.1337	−.1360	−.1383	−.1405	−.1428
1.8	−.1213	−.1235	−.1257	−.1279	−.1301	−.1322	−.1344	−.1366
1.9	−.1158	−.1179	−.1200	−.1221	−.1242	−.1262	−.1283	−.1304
2.0	−.1103	−.1123	−.1143	−.1163	−.1182	−.1202	−.1222	−.1242
2.1	−.1048	−.1067	−.1086	−.1104	−.1123	−.1142	−.1161	−.1180
2.2	−.0993	−.1011	−.1028	−.1046	−.1064	−.1082	−.1100	−.1118
2.3	−.0938	−.0954	−.0971	−.0988	−.1005	−.1022	−.1039	−.1056
2.4	−.0882	−.0898	−.0914	−.0930	−.0946	−.0962	−.0978	−.0994
2.5	−.0827	−.0842	−.0857	−.0872	−.0887	−.0902	−.0916	−.0931
2.6	−.0772	−.0786	−.0800	−.0814	−.0828	−.0842	−.0855	−.0869
2.7	−.0717	−.0730	−.0743	−.0756	−.0769	−.0781	−.0794	−.0807
2.8	−.0662	−.0674	−.0686	−.0698	−.0709	−.0721	−.0733	−.0745
2.9	−.0607	−.0618	−.0628	−.0639	−.0650	−.0661	−.0672	−.0683
3.0	−.0552	−.0561	−.0571	−.0581	−.0591	−.0601	−.0611	−.0621
3.1	−.0496	−.0505	−.0514	−.0523	−.0532	−.0541	−.0550	−.0559
3.2	−.0441	−.0449	−.0457	−.0465	−.0473	−.0481	−.0489	−.0497
3.3	−.0386	−.0393	−.0400	−.0407	−.0414	−.0421	−.0428	−.0435
3.4	−.0331	−.0337	−.0343	−.0349	−.0355	−.0361	−.0367	−.0373
3.5	−.0276	−.0281	−.0286	−.0291	−.0296	−.0301	−.0306	−.0310
3.6	−.0221	−.0225	−.0228	−.0232	−.0236	−.0240	−.0244	−.0248
3.7	−.0165	−.0168	−.0171	−.0174	−.0177	−.0180	−.0183	−.0186
3.8	−.0110	−.0112	−.0114	−.0116	−.0118	−.0120	−.0122	−.0124
3.9	−.0055	−.0056	−.0057	−.0058	−.0059	−.0060	−.0061	−.0062
4.0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
4.1	+.0055	+.0056	+.0057	+.0058	+.0059	+.0060	+.0061	+.0062
4.2	+.0110	+.0112	+.0114	+.0116	+.0118	+.0120	+.0122	+.0124
4.3	+.0165	+.0168	+.0171	+.0174	+.0177	+.0180	+.0183	+.0186
4.4	+.0221	+.0225	+.0228	+.0232	+.0236	+.0240	+.0244	+.0248
4.5	+.0276	+.0281	+.0286	+.0291	+.0296	+.0301	+.0306	+.0310

* Before using Tables VI, VII and VIII, it is important that the descriptive matter preceding Table VI be read carefully.

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(*Continued on following page.*)

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

Table VII (Continued) *

Glass Electrode and Saturated Calomel Electrode

pH	Volt 5° C	Volt 10° C	Volt 15° C	Volt 20° C	Volt 25° C	Volt 30° C	Volt 35° C	Volt 40° C
4.6	+.0331	+.0337	+.0343	+.0349	+.0355	+.0361	+.0367	+.0373
4.7	+.0386	+.0393	+.0400	+.0407	+.0414	+.0421	+.0428	+.0435
4.8	+.0441	+.0449	+.0457	+.0465	+.0473	+.0481	+.0489	+.0497
4.9	+.0496	+.0505	+.0514	+.0523	+.0532	+.0541	+.0550	+.0559
5.0	+.0552	+.0561	+.0571	+.0581	+.0591	+.0601	+.0611	+.0621
5.1	+.0607	+.0618	+.0628	+.0639	+.0650	+.0661	+.0672	+.0683
5.2	+.0662	+.0674	+.0686	+.0698	+.0709	+.0721	+.0733	+.0745
5.3	+.0717	+.0730	+.0743	+.0756	+.0769	+.0781	+.0794	+.0807
5.4	+.0772	+.0786	+.0800	+.0814	+.0828	+.0842	+.0855	+.0869
5.5	+.0827	+.0842	+.0857	+.0872	+.0887	+.0902	+.0916	+.0931
5.6	+.0882	+.0898	+.0914	+.0930	+.0946	+.0962	+.0978	+.0994
5.7	+.0938	+.0954	+.0971	+.0988	+.1005	+.1022	+.1039	+.1056
5.8	+.0993	+.1011	+.1028	+.1046	+.1064	+.1082	+.1100	+.1118
5.9	+.1048	+.1067	+.1086	+.1104	+.1123	+.1142	+.1161	+.1180
6.0	+.1103	+.1123	+.1143	+.1163	+.1182	+.1202	+.1222	+.1242
6.1	+.1158	+.1179	+.1200	+.1221	+.1242	+.1262	+.1283	+.1304
6.2	+.1213	+.1235	+.1257	+.1279	+.1301	+.1322	+.1344	+.1366
6.3	+.1268	+.1291	+.1314	+.1337	+.1360	+.1383	+.1405	+.1428
6.4	+.1324	+.1347	+.1371	+.1395	+.1419	+.1443	+.1466	+.1490
6.5	+.1379	+.1404	+.1428	+.1453	+.1478	+.1503	+.1528	+.1552
6.6	+.1434	+.1460	+.1486	+.1511	+.1537	+.1563	+.1589	+.1614
6.7	+.1489	+.1516	+.1543	+.1569	+.1596	+.1623	+.1650	+.1677
6.8	+.1544	+.1572	+.1600	+.1628	+.1655	+.1683	+.1711	+.1739
6.9	+.1599	+.1628	+.1657	+.1686	+.1714	+.1743	+.1772	+.1801
7.0	+.1655	+.1684	+.1714	+.1744	+.1774	+.1803	+.1833	+.1863
7.1	+.1710	+.1740	+.1771	+.1802	+.1833	+.1863	+.1894	+.1925
7.2	+.1765	+.1797	+.1828	+.1860	+.1892	+.1924	+.1955	+.1987
7.3	+.1820	+.1853	+.1886	+.1918	+.1951	+.1984	+.2016	+.2049
7.4	+.1875	+.1909	+.1943	+.1976	+.2010	+.2044	+.2078	+.2111
7.5	+.1930	+.1965	+.2000	+.2034	+.2069	+.2104	+.2139	+.2173
7.6	+.1986	+.2021	+.2057	+.2093	+.2128	+.2164	+.2200	+.2235
7.7	+.2041	+.2077	+.2114	+.2151	+.2187	+.2224	+.2261	+.2298
7.8	+.2096	+.2134	+.2171	+.2209	+.2247	+.2284	+.2322	+.2360
7.9	+.2151	+.2190	+.2228	+.2267	+.2306	+.2344	+.2383	+.2422
8.0	+.2206	+.2246	+.2285	+.2325	+.2365	+.2404	+.2444	+.2484
8.1	+.2261	+.2302	+.2343	+.2383	+.2424	+.2465	+.2505	+.2546
8.2	+.2316	+.2358	+.2400	+.2441	+.2483	+.2525	+.2566	+.2608
8.3	+.2372	+.2414	+.2457	+.2500	+.2542	+.2585	+.2627	+.2670
8.4	+.2427	+.2470	+.2514	+.2558	+.2601	+.2645	+.2689	+.2732
8.5	+.2482	+.2526	+.2571	+.2616	+.2660	+.2705	+.2750	+.2794
8.6	+.2537	+.2583	+.2628	+.2674	+.2720	+.2765	+.2811	+.2856
8.7	+.2592	+.2639	+.2685	+.2732	+.2779	+.2825	+.2872	+.2918
8.8	+.2647	+.2695	+.2743	+.2790	+.2838	+.2885	+.2933	+.2980
8.9	+.2702	+.2751	+.2800	+.2848	+.2897	+.2945	+.2994	+.3043
9.0	+.2758	+.2807	+.2857	+.2906	+.2956	+.3006	+.3055	+.3105
9.1	+.2813	+.2863	+.2914	+.2964	+.3015	+.3066	+.3116	+.3167
9.2	+.2868	+.2920	+.2971	+.3023	+.3074	+.3126	+.3177	+.3229
9.3	+.2923	+.2976	+.3028	+.3081	+.3133	+.3186	+.3238	+.3291
9.4	+.2978	+.3032	+.3085	+.3139	+.3192	+.3246	+.3300	+.3353
9.5	+.3033	+.3088	+.3142	+.3197	+.3252	+.3306	+.3361	+.3415

* Before using this table, it is important that the descriptive matter preceding Table VI be read carefully.

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

Table VII (Continued) *

Glass Electrode and Saturated Calomel Electrode

pH	Volt 5° C	Volt 10° C	Volt 15° C	Volt 20° C	Volt 25° C	Volt 30° C	Volt 35° C	Volt 40° C
9.6	+.3089	+.3144	+.3200	+.3255	+.3311	+.3366	+.3422	+.3477
9.7	+.3144	+.3200	+.3257	+.3313	+.3370	+.3426	+.3483	+.3539
9.8	+.3199	+.3256	+.3314	+.3371	+.3429	+.3486	+.3544	+.3601
9.9	+.3254	+.3313	+.3371	+.3430	+.3488	+.3547	+.3605	+.3664
10.0	+.3309	+.3369	+.3428	+.3488	+.3547	+.3607	+.3666	+.3726
10.1	+.3364	+.3425	+.3485	+.3546	+.3606	+.3667	+.3727	+.3788
10.2	+.3420	+.3481	+.3542	+.3604	+.3665	+.3727	+.3788	+.3850
10.3	+.3475	+.3537	+.3600	+.3662	+.3724	+.3787	+.3849	+.3912
10.4	+.3530	+.3593	+.3657	+.3720	+.3784	+.3847	+.3911	+.3974
10.5	+.3585	+.3649	+.3714	+.3778	+.3843	+.3907	+.3972	+.4036
10.6	+.3640	+.3706	+.3771	+.3836	+.3902	+.3967	+.4033	+.4098
10.7	+.3695	+.3762	+.3828	+.3895	+.3961	+.4027	+.4094	+.4160
10.8	+.3750	+.3818	+.3885	+.3953	+.4020	+.4088	+.4155	+.4222
10.9	+.3806	+.3874	+.3942	+.4011	+.4079	+.4148	+.4216	+.4284
11.0	+.3861	+.3930	+.4000	+.4069	+.4138	+.4208	+.4277	+.4347
11.1	+.3916	+.3986	+.4057	+.4127	+.4198	+.4268	+.4338	+.4409
11.2	+.3971	+.4042	+.4114	+.4185	+.4257	+.4328	+.4399	+.4471
11.3	+.4026	+.4099	+.4171	+.4243	+.4316	+.4388	+.4460	+.4533
11.4	+.4081	+.4155	+.4228	+.4301	+.4375	+.4448	+.4522	+.4595
11.5	+.4136	+.4211	+.4285	+.4360	+.4434	+.4508	+.4583	+.4657
11.6	+.4192	+.4267	+.4342	+.4418	+.4493	+.4568	+.4644	+.4719
11.7	+.4247	+.4323	+.4400	+.4476	+.4552	+.4629	+.4705	+.4781
11.8	+.4302	+.4379	+.4457	+.4534	+.4611	+.4689	+.4766	+.4843
11.9	+.4357	+.4435	+.4514	+.4592	+.4670	+.4749	+.4827	+.4905
12.0	+.4412	+.4492	+.4571	+.4650	+.4730	+.4809	+.4888	+.4968
12.1	+.4467	+.4548	+.4628	+.4708	+.4789	+.4869	+.4949	+.5030
12.2	+.4523	+.4604	+.4685	+.4766	+.4849	+.4929	+.5010	+.5092
12.3	+.4578	+.4660	+.4742	+.4825	+.4907	+.4989	+.5072	+.5154
12.4	+.4633	+.4716	+.4799	+.4883	+.4966	+.5049	+.5133	+.5216
12.5	+.4688	+.4772	+.4857	+.4941	+.5025	+.5109	+.5194	+.5278
12.6	+.4743	+.4828	+.4914	+.4999	+.5084	+.5170	+.5255	+.5340
12.7	+.4798	+.4885	+.4971	+.5057	+.5143	+.5230	+.5316	+.5402
12.8	+.4853	+.4941	+.5028	+.5115	+.5202	+.5290	+.5377	+.5464
12.9	+.4909	+.4997	+.5085	+.5173	+.5262	+.5350	+.5438	+.5526
13.0	+.4964	+.5053	+.5142	+.5232	+.5321	+.5410	+.5499	+.5588
13.1	+.5019	+.5109	+.5199	+.5290	+.5380	+.5470	+.5560	+.5651
13.2	+.5074	+.5165	+.5256	+.5348	+.5439	+.5530	+.5621	+.5713
13.3	+.5129	+.5221	+.5314	+.5406	+.5498	+.5590	+.5683	+.5775
13.4	+.5184	+.5278	+.5371	+.5464	+.5557	+.5650	+.5744	+.5837
13.5	+.5240	+.5334	+.5428	+.5522	+.5615	+.5711	+.5805	+.5899
13.6	+.5295	+.5390	+.5485	+.5580	+.5675	+.5771	+.5866	+.5961
13.7	+.5350	+.5446	+.5542	+.5638	+.5735	+.5831	+.5927	+.6023
13.8	+.5405	+.5502	+.5599	+.5697	+.5794	+.5891	+.5988	+.6085
13.9	+.5460	+.5558	+.5656	+.5755	+.5853	+.5951	+.6049	+.6147
14.0	+.5515	+.5614	+.5714	+.5813	+.5912	+.6011	+.6110	+.6209

* Before using this table, it is important that the descriptive matter preceding Table VI be read carefully.

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

*Table VIII

Glass Electrode and Saturated Calomel Electrode

e = .000198322 T (pH-7)

where e = Electrode potential in volts
T = Absolute temperature

pH	Volt 5° C	Volt 10° C	Volt 15° C	Volt 20° C	Volt 25° C	Volt 30° C	Volt 35° C	Volt 40° C
0	−.3861	−.3930	−.4000	−.4069	−.4138	−.4208	−.4277	−.4347
.1	−.3806	−.3874	−.3942	−.4011	−.4079	−.4148	−.4216	−.4284
.2	−.3750	−.3818	−.3885	−.3953	−.4020	−.4088	−.4155	−.4222
.3	−.3695	−.3762	−.3828	−.3895	−.3961	−.4027	−.4094	−.4160
.4	−.3640	−.3706	−.3771	−.3836	−.3902	−.3967	−.4033	−.4098
.5	−.3585	−.3649	−.3714	−.3778	−.3843	−.3907	−.3972	−.4036
.6	−.3530	−.3593	−.3657	−.3720	−.3784	−.3847	−.3911	−.3974
.7	−.3475	−.3537	−.3600	−.3662	−.3724	−.3787	−.3849	−.3912
.8	−.3420	−.3481	−.3542	−.3604	−.3665	−.3727	−.3788	−.3850
.9	−.3364	−.3425	−.3485	−.3546	−.3606	−.3667	−.3727	−.3788
1.0	−.3309	−.3369	−.3428	−.3488	−.3547	−.3607	−.3666	−.3726
1.1	−.3254	−.3313	−.3371	−.3430	−.3488	−.3547	−.3605	−.3664
1.2	−.3199	−.3256	−.3314	−.3371	−.3429	−.3486	−.3544	−.3601
1.3	−.3144	−.3200	−.3257	−.3313	−.3370	−.3426	−.3483	−.3539
1.4	−.3089	−.3144	−.3200	−.3255	−.3311	−.3366	−.3422	−.3477
1.5	−.3033	−.3088	−.3142	−.3197	−.3252	−.3306	−.3361	−.3415
1.6	−.2978	−.3032	−.3085	−.3139	−.3192	−.3246	−.3300	−.3353
1.7	−.2923	−.2976	−.3028	−.3081	−.3133	−.3186	−.3238	−.3291
1.8	−.2868	−.2920	−.2971	−.3023	−.3074	−.3126	−.3177	−.3229
1.9	−.2813	−.2863	−.2914	−.2964	−.3015	−.3066	−.3116	−.3167
2.0	−.2758	−.2807	−.2857	−.2906	−.2956	−.3006	−.3055	−.3105
2.1	−.2702	−.2751	−.2800	−.2848	−.2897	−.2945	−.2994	−.3043
2.2	−.2647	−.2695	−.2743	−.2790	−.2838	−.2885	−.2933	−.2980
2.3	−.2592	−.2639	−.2685	−.2732	−.2779	−.2825	−.2872	−.2918
2.4	−.2537	−.2583	−.2628	−.2674	−.2720	−.2765	−.2811	−.2856
2.5	−.2482	−.2526	−.2571	−.2616	−.2660	−.2705	−.2750	−.2794
2.6	−.2427	−.2470	−.2514	−.2558	−.2601	−.2645	−.2689	−.2732
2.7	−.2372	−.2414	−.2457	−.2500	−.2542	−.2585	−.2627	−.2670
2.8	−.2316	−.2358	−.2400	−.2441	−.2483	−.2525	−.2566	−.2608
2.9	−.2261	−.2302	−.2343	−.2383	−.2424	−.2465	−.2505	−.2546
3.0	−.2206	−.2246	−.2285	−.2325	−.2365	−.2404	−.2444	−.2484
3.1	−.2151	−.2190	−.2228	−.2267	−.2306	−.2344	−.2383	−.2422
3.2	−.2096	−.2134	−.2171	−.2209	−.2247	−.2284	−.2322	−.2360
3.3	−.2041	−.2077	−.2114	−.2151	−.2187	−.2224	−.2261	−.2298
3.4	−.1986	−.2021	−.2057	−.2093	−.2128	−.2164	−.2200	−.2235
3.5	−.1930	−.1965	−.2000	−.2034	−.2069	−.2104	−.2139	−.2173
3.6	−.1875	−.1909	−.1943	−.1976	−.2010	−.2044	−.2078	−.2111
3.7	−.1820	−.1853	−.1886	−.1918	−.1951	−.1984	−.2016	−.2049
3.8	−.1765	−.1797	−.1828	−.1860	−.1892	−.1924	−.1955	−.1987
3.9	−.1710	−.1740	−.1771	−.1802	−.1833	−.1863	−.1894	−.1925
4.0	−.1655	−.1684	−.1714	−.1744	−.1774	−.1803	−.1833	−.1863
4.1	−.1599	−.1628	−.1657	−.1686	−.1714	−.1743	−.1772	−.1801
4.2	−.1544	−.1572	−.1600	−.1628	−.1655	−.1683	−.1711	−.1739
4.3	−.1489	−.1516	−.1543	−.1569	−.1596	−.1623	−.1650	−.1677
4.4	−.1434	−.1460	−.1486	−.1511	−.1537	−.1563	−.1589	−.1614
4.5	−.1379	−.1404	−.1428	−.1453	−.1478	−.1503	−.1528	−.1552

* Before using Tables VI, VII and VIII, it is important that the descriptive matter preceding Table VI be read carefully.

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ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

Table VIII (Continued)*

Glass Electrode and Saturated Calomel Electrode

pH	Volt 5° C	Volt 10° C	Volt 15° C	Volt 20° C	Volt 25° C	Volt 30° C	Volt 35° C	Volt 40° C
4.6	−.1324	−.1347	−.1371	−.1395	−.1419	−.1443	−.1466	−.1490
4.7	−.1268	−.1291	−.1314	−.1337	−.1360	−.1383	−.1405	−.1428
4.8	−.1213	−.1235	−.1257	−.1279	−.1301	−.1322	−.1344	−.1366
4.9	−.1158	−.1179	−.1200	−.1221	−.1242	−.1262	−.1283	−.1304
5.0	−.1103	−.1123	−.1143	−.1163	−.1182	−.1202	−.1222	−.1242
5.1	−.1048	−.1067	−.1086	−.1104	−.1123	−.1142	−.1161	−.1180
5.2	−.0993	−.1011	−.1028	−.1046	−.1064	−.1082	−.1100	−.1118
5.3	−.0938	−.0954	−.0971	−.0988	−.1005	−.1022	−.1039	−.1056
5.4	−.0882	−.0898	−.0914	−.0930	−.0946	−.0962	−.0978	−.0994
5.5	−.0827	−.0842	−.0857	−.0872	−.0887	−.0902	−.0916	−.0931
5.6	−.0772	−.0786	−.0800	−.0814	−.0828	−.0842	−.0855	−.0869
5.7	−.0717	−.0730	−.0743	−.0756	−.0769	−.0781	−.0794	−.0807
5.8	−.0662	−.0674	−.0686	−.0698	−.0709	−.0721	−.0733	−.0745
5.9	−.0607	−.0618	−.0628	−.0639	−.0650	−.0661	−.0672	−.0683
6.0	−.0552	−.0561	−.0571	−.0581	−.0591	−.0601	−.0611	−.0621
6.1	−.0496	−.0505	−.0514	−.0523	−.0532	−.0541	−.0550	−.0559
6.2	−.0441	−.0449	−.0457	−.0465	−.0473	−.0481	−.0489	−.0497
6.3	−.0386	−.0393	−.0400	−.0407	−.0414	−.0421	−.0428	−.0435
6.4	−.0331	−.0337	−.0343	−.0349	−.0355	−.0361	−.0367	−.0373
6.5	−.0276	−.0281	−.0286	−.0291	−.0296	−.0301	−.0306	−.0310
6.6	−.0221	−.0225	−.0228	−.0232	−.0236	−.0240	−.0244	−.0248
6.7	−.0165	−.0168	−.0171	−.0174	−.0177	−.0180	−.0183	−.0186
6.8	−.0110	−.0112	−.0114	−.0116	−.0118	−.0120	−.0122	−.0124
6.9	−.0055	−.0056	−.0057	−.0058	−.0059	−.0060	−.0061	−.0062
7.0	.0000	.0000	.0000	.0000	.0000	.0000	.0000	.0000
7.1	+.0055	+.0056	+.0057	+.0058	+.0059	+.0060	+.0061	+.0062
7.2	+.0110	+.0112	+.0114	+.0116	+.0118	+.0120	+.0122	+.0124
7.3	+.0165	+.0168	+.0171	+.0174	+.0177	+.0180	+.0183	+.0186
7.4	+.0221	+.0225	+.0228	+.0232	+.0236	+.0240	+.0244	+.0248
7.5	+.0276	+.0281	+.0286	+.0291	+.0296	+.0301	+.0306	+.0310
7.6	+.0331	+.0337	+.0343	+.0349	+.0355	+.0361	+.0367	+.0373
7.7	+.0386	+.0393	+.0400	+.0407	+.0414	+.0421	+.0428	+.0435
7.8	+.0441	+.0449	+.0457	+.0465	+.0473	+.0481	+.0489	+.0497
7.9	+.0496	+.0505	+.0514	+.0523	+.0532	+.0541	+.0550	+.0559
8.0	+.0552	+.0561	+.0571	+.0581	+.0591	+.0601	+.0611	+.0621
8.1	+.0607	+.0618	+.0628	+.0639	+.0650	+.0661	+.0672	+.0683
8.2	+.0662	+.0674	+.0686	+.0698	+.0709	+.0721	+.0733	+.0745
8.3	+.0717	+.0730	+.0743	+.0756	+.0769	+.0781	+.0794	+.0807
8.4	+.0772	+.0786	+.0800	+.0814	+.0828	+.0842	+.0855	+.0869
8.5	+.0827	+.0842	+.0857	+.0872	+.0887	+.0902	+.0916	+.0931
8.6	+.0882	+.0898	+.0914	+.0930	+.0946	+.0962	+.0978	+.0994
8.7	+.0938	+.0954	+.0971	+.0988	+.1005	+.1022	+.1039	+.1056
8.8	+.0993	+.1011	+.1028	+.1046	+.1064	+.1082	+.1100	+.1118
8.9	+.1048	+.1067	+.1086	+.1104	+.1123	+.1142	+.1161	+.1180
9.0	+.1103	+.1123	+.1143	+.1163	+.1182	+.1202	+.1222	+.1242
9.1	+.1158	+.1179	+.1200	+.1221	+.1242	+.1262	+.1283	+.1304
9.2	+.1213	+.1235	+.1257	+.1279	+.1301	+.1322	+.1344	+.1666
9.3	+.1268	+.1291	+.1314	+.1337	+.1360	+.1383	+.1405	+.1428
9.4	+.1324	+.1347	+.1371	+.1395	+.1419	+.1443	+.1466	+.1490
9.5	+.1379	+.1404	+.1428	+.1453	+.1478	+.1503	+.1528	+.1552

* Before using this table, it is important that the descriptive matter preceding Table VI be read carefully.

(Completed on following page.)

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

Table VIII (Continued) *

Glass Electrode and Saturated Calomel Electrode

pH	Volt 5° C	Volt 10° C	Volt 15° C	Volt 20° C	Volt 25° C	Volt 30° C	Volt 35° C	Volt 40° C
9.6	+.1434	+.1460	+.1486	+.1511	+.1537	+.1563	+.1589	+.1614
9.7	+.1489	+.1516	+.1543	+.1569	+.1596	+.1623	+.1650	+.1677
9.8	+.1544	+.1572	+.1600	+.1628	+.1655	+.1683	+.1711	+.1739
9.9	+.1599	+.1628	+.1657	+.1686	+.1714	+.1743	+.1772	+.1801
10.0	+.1655	+.1684	+.1714	+.1744	+.1774	+.1803	+.1833	+.1863
10.1	+.1710	+.1740	+.1771	+.1802	+.1833	+.1863	+.1894	+.1925
10.2	+.1765	+.1797	+.1828	+.1860	+.1892	+.1924	+.1955	+.1987
10.3	+.1820	+.1853	+.1886	+.1918	+.1951	+.1984	+.2016	+.2049
10.4	+.1875	+.1909	+.1943	+.1976	+.2010	+.2044	+.2078	+.2111
10.5	+.1930	+.1965	+.2000	+.2034	+.2069	+.2104	+.2139	+.2173
10.6	+.1986	+.2021	+.2057	+.2093	+.2128	+.2164	+.2200	+.2235
10.7	+.2041	+.2077	+.2114	+.2151	+.2187	+.2224	+.2261	+.2298
10.8	+.2096	+.2134●	+.2171	+.2209	+.2247	+.2284	+.2322	+.2360
10.9	+.2151	+.2190	+.2228	+.2267	+.2306	+.2344	+.2383	+.2422
11.0	+.2206	+.2246	+.2285	+.2325	+.2365	+.2404	+.2444	+.2484
11.1	+.2261	+.2302	+.2343	+.2383	+.2424	+.2465	+.2505	+.2546
11.2	+.2316	+.2358	+.2400	+.2441	+.2483	+.2525	+.2566	+.2608
11.3	+.2372	+.2414	+.2457	+.2500	+.2542	+.2585	+.2627	+.2670
11.4	+.2427	+.2470	+.2514	+.2558	+.2601	+.2645	+.2689	+.2732
11.5	+.2482	+.2526	+.2571	+.2616	+.2660	+.2705	+.2750	+.2794
11.6	+.2537	+.2583	+.2628	+.2674	+.2720	+.2765	+.2811	+.2856
11.7	+.2592	+.2639	+.2685	+.2732	+.2779	+.2825	+.2872	+.2918
11.8	+.2647	+.2695	+.2743	+.2790	+.2838	+.2885	+.2933	+.2980
11.9	+.2702	+.2751	+.2800	+.2848	+.2897	+.2945	+.2994	+.3043
12.0	+.2758	+.2807	+.2857	+.2906	+.2956	+.3006	+.3055	+.3105
12.1	+.2813	+.2863	+.2914	+.2964	+.3015	+.3066	+.3116	+.3167
12.2	+.2868	+.2920	+.2971	+.3023	+.3074	+.3126	+.3177	+.3229
12.3	+.2923	+.2976	+.3028	+.3081	+.3133	+.3186	+.3238	+.3291
12.4	+.2978	+.3032	+.3085	+.3139	+.3192	+.3246	+.3300	+.3353
12.5	+.3033	+.3088	+.3142	+.3197	+.3252	+.3306	+.3361	+.3415
12.6	+.3089	+.3144	+.3200	+.3255	+.3311	+.3366	+.3422	+.3477
12.7	+.3144	+.3200	+.3257	+.3313	+.3370	+.3426	+.3483	+.3539
12.8	+.3199	+.3256	+.3314	+.3371	+.3429	+.3486	+.3544	+.3601
12.9	+.3254	+.3313	+.3371	+.3430	+.3488	+.3547	+.3605	+.3664
13.0	+.3309	+.3369	+.3428	+.3488	+.3547	+.3607	+.3666	+.3726
13.1	+.3364	+.3425	+.3485	+.3546	+.3606	+.3667	+.3727	+.3788
13.2	+.3420	+.3481	+.3542	+.3604	+.3665	+.3727	+.3788	+.3850
13.3	+.3475	+.3537	+.3600	+.3662	+.3724	+.3787	+.3849	+.3912
13.4	+.3530	+.3593	+.3657	+.3720	+.3784	+.3847	+.3911	+.3974
13.5	+.3585	+.3649	+.3714	+.3778	+.3843	+.3907	+.3972	+.4036
13.6	+.3640	+.3706	+.3771	+.3836	+.3902	+.3967	+.4033	+.4098
13.7	+.3695	+.3762	+.3828	+.3895	+.3961	+.4027	+.4094	+.4160
13.8	+.3750	+.3818	+.3885	+.3953	+.4020	+.4088	+.4155	+.4222
13.9	+.3806	+.3874	+.3942	+.4011	+.4079	+.4148	+.4216	+.4284
14.0	+.3861	+.3930	+.4000	+.4069	+.4138	+.4208	+.4277	+.4347

*Before using this table, it is important that the descriptive matter preceding Table VI be read carefully.

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

MEASUREMENT OF pH WITH THE ANTIMONY ELECTRODE

The relationships involved in the metal oxide system may be expressed by the following equations:

$$Sb+3H_2O=Sb(OH)_3+3H^++3e^-$$

$$E=E_o-\frac{RT}{3F}\ln\frac{(Sb(OH)_3)(H^+)^3}{(H_2O)^3}$$

The E.M.F. relationships can be expressed in another equation:

$$E=E_o-\frac{RT}{F}\log K_w+\frac{RT}{nF}\log K_s+\frac{RT}{F}\log (H^+)$$

where K_w is the ionization constant of water and K_s is the solubility product of the sparingly soluble metal compound. For the equation to reduce to the form

$$E=constant+\frac{RT}{F}\log (H^+)$$

it is necessary that the activity of the water remain constant and the solution remain saturated with the oxide. For an industrial electrode of moderate accuracy when used in aqueous solutions in contact with air, there is evidence that enough oxide is formed according to the equation $4Sb+3O_2+xH_2O=2Sb_2O_3\cdot xH_2O$, so that further addition of the metal oxide to the aqueous solution is unnecessary.

For an antimony-saturated calomel electrode system used in air-saturated, agitated buffer solutions at 25°C., the following equations apply:

From 3 to 7 pH:	$E=-0.008+0.059pH$
From 7 to 11pH:	$E=\ 0.050+0.051pH$

When involved in low salt concentrations, as in water treatment applications at 25°C., the following equations apply:

From 3 to 6 pH:	$E=-0.024+0.056pH$
From 6 to 8 pH:	*A non-linear relationship*
From 8 to 11pH:	$E=-0.071+0.060pH$

The temperature coefficient of the antimony-saturated calomel electrode system varies with the pH value of the buffer and is of the order of 0.00115 volt per 1°C. at 3 pH, 0.00210 volt per 1°C. at 7 pH, and 0.00344 volt per 1°C. at 12 pH.

Reproducible pH measurements may be made in ordinary solutions to ± 0.15 pH over the pH range of 3 to 11. The electrode is rugged and, since the electrode system is of low resistance, the problem of electrical leakage and pick-up is minimized.

NOTES ON THE ANTIMONY ELECTRODE

Impurities in the metal electrode tend to decrease the stability of the electrode system especially in the acid range. The presence of small amounts of copper is particularly harmful. Antimony of sufficient purity can be obtained by electrolyzing a solution composed of antimony oxide dissolved in hydrofluoric acid.

The E.M.F. -pH relationships of the antimony electrode are influenced by (*1*) the nature of the electrode surface; (*2*) concentration of dissolved air or oxygen; (*3*) agitation at the electrode surface; (*4*) nature and concentration of dissolved salts; and, (*5*) temperature of the system.

The E.M.F. of the electrode system gradually drifts until the surface of the electrode has become etched. Continuous exposure to aqueous solutions containing air results in a deeply etched surface with the possibility of occluding impurities.

ELECTROMETRIC DETERMINATION OF HYDROGEN ION CONCENTRATION

The tendency towards instability in the acid range when the concentration of dissolved oxygen is low, and the failure of the electrode to follow the Nernst equation in the alkaline range when dissolved oxygen is present, is characteristic of the antimony electrode. The extent of the influence of agitation depends upon the pH, the temperature, the nature of the solution, and the concentration of the dissolved oxygen and is more critical in a solution of low salt content.

Dilute solutions of hydrogen peroxide, potassium permanganate, and sodium chromate result in low pH values. Good results have been reported with dilute solutions of sodium sulfide and sulfite. Traces of copper in acid solution cause large deviations and for reliable results the copper content should be below 0.1 part per million. The presence of metals less electropositive than antimony cause a similar behavior. As yet, no systematic study of the possible salt errors of the antimony electrode has been published but there are indications that these errors may be serious with concentrations above one molar.

Cf. Perley, *Ind. Eng. Chem., Anal. Ed. 11, 316-23 (1939).*

COMPOSITION AND *pH* OF MacILVAINE'S BUFFER MIXTURES

Cf. T. C. MacIlvaine, *J. Biol. Chem., 49, 183 (1921)*; C. J. Schollenberger, *The Chemist-Analyst, 19 No. 3, 8 (1930).*

Stock solution A, 0.2*M* disodium phosphate: Dissolve 145 g. C. P. clear crystals in 2 liters CO_2-free water. Titrate 10 ml. with 0.1 *N* HCl and a drop of methyl orange indicator to match the tint shown by 30 ml. of a solution containing 2.28 g. C. P. KH_2PO_4 and 1.00 g. C. P. NaCl in 250 ml. H_2O. Adjust solution A to require 20.00 ml. 0.1 *N* HCl in a repeating titration.

Stock solution B, 0.1*M* citric acid: Dissolve 45 g. C. P. clear crystals and dilute to 2 liters. Titrate 10 ml. with 0.1 *N* NaOH (carbonate-free) and phenolphthalein indicator, and adjust solution **B** to require 30.00 ml. in a repeating titration. To preserve solutions **A** and **B**, about 0.1% of toluene may be added.

To prepare the buffer mixtures, measure into a test tube the required volume of solution **A** for the desired *pH*, as shown in the table below, and add sufficient solution **B** to make the total volume exactly 10.00 ml.

pH	ml. A	*pH*	ml. A	*pH*	ml. A	*pH*	ml. A	*pH*	ml. A
2.2	0.20	3.4	2.85	4.6	4.67	5.8	6.05	7.0	8.24
2.4	0.62	3.6	3.22	4.8	4.93	6.0	6.32	7.2	8.70
2.6	1.09	3.8	3.55	5.0	5.15	6.2	6.61	7.4	9.09
2.8	1.58	4.0	3.85	5.2	5.36	6.4	6.92	7.6	9.37
3.0	2.05	4.2	4.14	5.4	5.57	6.6	7.27	7.8	9.58
3.2	2.47	4.4	4.41	5.6	5.80	6.8	7.72	8.0	9.73

ACID—BASE INDICATORS

An acid-base indicator is a weak acid or a weak base, the undissociated form of which has another color and constitution than the iogenic form. An indicator does not change its color from the purely acid to the purely alkaline side at a definite hydrogen concentration, but the color change takes place over a certain range of hydrogen ion concentrations. This range is called the color change interval and is expressed in the term of *pH* (the negative logarithm of the hydrogen ion concentration). A great number of substances show indicator properties although relatively few of them are practically applied for neutralization reactions and *pH* determinations.

COLOR CHANGE AND pH INTERVAL OF THE MOST IMPORTANT INDICATORS

(See also Indicator Chart which follows)

Scientific Name	Trade Name	Solvent	Color		*pH* Interval
			Acid	Basic	
Sodium salt of diphenylaminoazo-*p*-benzenesulfonic acid	Tropeolin 00	Water	Red	Yellow	1.3—3.0
Thymolsulfonphthalein	Thymol blue	Water (+NaOH)	Red	Yellow	1.2—2.8
p-Dimethylaminoazobenzene	Methyl yellow	90% alcohol	Red	Yellow	2.9—4.0
Sodium salt of *p*-dimethylaminoazobenzene-sulfonic acid	Methyl orange	Water	Red	Orange-yellow	3.1—4.4
Tetrabromophenoltetrabromosulfonphthalein	Tetrabromophenol blue	Water (+NaOH)	Yellow	Blue	3.0—4.6
Tetrabromophenolsulfonphthalein	Bromophenol blue	Water (+NaOH)	Yellow	Blue-violet	3.0—4.6
Tetrabromo-*m*-cresolsulfonphthalein	Bromocresol-green	Water (+NaOH)	Yellow	Blue	3.8—5.4
Dimethylaminoazobenzene-*o*-carboxylic acid	Methyl red	Water (+NaOH)	Red	Yellow	4.4—6.2
Dichlorophenolsulfonphthalein	Chlorophenol red	Water (+NaOH)	Yellow	Red	4.8—6.4
Dibromophenolsulfonphthalein	Bromophenol red	Water (+NaOH)	Yellow	Red	5.4—7.0
Dibromothymolsulfonphthalein	Bromothymol blue	Water (+NaOH)	Yellow	Blue	6.0—7.6
Phenolsulfonphthalein	Phenol red	Water (+NaOH)	Yellow	Red	6.4—8.0
Dimethyldiaminophenazinechloride	Neutral red	90% alcohol	Red	Yellow-orange	6.8—8.0
m-Cresolsulfonphthalein	*m*-Cresol purple	Water (+NaOH)	Yellow	Purple	7.4—9.0
Thymolsulfonphthalein	Thymol blue	Water (+NaOH)	Yellow	Blue	8.0—9.6
Phenolphthalein	.....	90% alcohol	Colorless	Red	8.0—9.8
Thymolphthalein	.....	90% alcohol	Yellow	Blue	9.3—10.5
Sodium salt of *p*-nitranilineazosalicylic acid	Alizarine yellow	Water	Yellow	Red	10.1—12.0

It should be emphasized that the intervals as given above hold for aqueous solutions. The characteristics of indicators vary with different solvents; e. g., in mixtures of water and alcohol. Therefore, in the measurement of *pH* in tinctures, a correction should be applied for the effect of the medium.

ACID—BASE INDICATORS

Preparation and Properties of Indicator Solutions.—A useful concentration of the indicator in the solution is of the order of 0.05 to 0.1%. Ordinarily the addition of 0.1 to 0.2 cc. of such an indicator solution to 10 cc. of the liquid to be investigated will give satisfactory results. Five of the indicators listed above (tropeolin 00, methyl yellow, methyl orange, methyl red, and neutral red) behave like weak bases, whereas the others behave like weak acids. The sulfonphthaleins originally introduced by Clark and Lubs (1917) and later extended by others (especially Barnett Cohen), are all indicators with very sharp color changes from yellow to intense red, blue or purple. Bromophenol blue in its tranition interval shows a so-called "*dichroism*," the color of the indicator depending upon its concentration and the depth of the layer observed. It appears blue in a thin layer of the solution, and purple when viewed through a greater depth. In the colorimetric determination of *pH* this dichroism is very objectionable. Often the solution under examination contains substances which affect the light absorption of the indicator (alcohol, alkaloids; in alcoholic medium the color change is from yellow to blue); moreover, the indicator cannot be used in turbid solutions. When a layer of the liquid is viewed only a small amount of light from the bottom of the cell reaches the eye. Most of the light enters the cell through the side, is reflected by the particles and thus produces the effect of a thin layer of liquid with the accompanying blue color. A comparison of the color with that of the indicator in a clear buffer solution is scarcely possible, for a thin layer of fluid would have to be taken. Fortunately, Harden and Drake (*Jour. Am. Chem. Soc.*, 51, 562 (1929)) found that tetrabromophenol - tetrabromosulfonphthalein is a good substitute for bromophenol blue since it shows the same color change without the objectional dichroism.

As a rule, water can be used as a solvent for indicators, but methyl yellow and the phthaleins must be dissolved in 90% alcohol. The various sulfonphthaleins and methyl red must be neutralized with sodium hydroxide before they are soluble in water. The former behave as dibasic acids, the indicator properties being determined by the magnitude of the second ionization constant. For most purposes it is sufficient to neutralize the strong sulfonic group, except that in cases where the *pH* of practically unbuffered solutions have to be measured, then more attention must be paid to the proper preparation of the indicator solution. To prepare an indicator solution, 100 mg. of the indicator are rubbed in an agate mortar with the amount of 1/20*N* sodium hydroxide specified in the table below. After solution of the indicator has taken place, sufficient water is added to make the volume 100 cc. (0.1%) or 200 cc. (0.05%).

Indicator	Molecular Weight	cc. 1/20 *N* NaOH per 100 mg. of Indicator
Thymol blue	466	4.3
Tetrabromophenol blue	986	2.0
Bromophenol blue	669	3.0
Bromocresol green	698	2.9
Methyl red	269	7.4
Chlorophenol red	423	4.7
Bromothymol blue	624	3.2
Phenol red	354	5.7
m-Cresol purple	382	5.2

Colorimetric Determination of *pH* with Selected Buffer Mixtures.—The colorimetric determination of *pH* is based upon the principle that if an indicator be added to different solutions and it assumes the same transition shade, then such solutions are supposed to have the same *pH*. To the solutions, the *pH* of which is to be determined, a measured volume of a suitable indicator

is added and the color compared with that of the same indicator in solutions of known *pH*. The method, therefore, is a comparison procedure the accuracy of which depends primarily upon the correctness of the standard reference solutions. The *pH* of the latter is determined by means of the hydrogen electrode. The standardization according to the potentiometric method is, therefore, the primary procedure upon which the colometric procedure rests. Such standard reference solutions are called "*buffer-mixtures*." Buffer solutions of various compositions have been described in the literature (compare Clark, *The Determination of Hydrogen Ions*, Baltimore, Md., 1928; Kolthoff, *Indicators*, translated by Furman); the most popular set of buffers is that of Clark and Lubs which is given below.

Preparation of Buffer Solutions.—Purity of Materials.

Hydrochloric acid, 0.2 *N* and 0.1 *N*, ordinary C. P. grade prepared and standardized according to the usual volumetric procedure. (Cf. Section on Standard Solutions.)

Sodium hydroxide, 0.1 *N*, prepared carbonate free and standardized according to the usual volumetric procedure.

Potassium acid phthalate, $KHC_8H_4O_4$, $M=204.2$. The C. P. product commercially available is of sufficient purity. It can be recrystallized from water and dried at 110-120°C. The purity of the material must be checked by a titration with standardized sodium hydroxide using phenolphthalein or thymol blue as an indicator. A 0.1 molar solution of the salt is prepared as a stock solution.

Monopotassium phosphate, KH_2PO_4, $M=136.2$. The C. P. salt commercially available is recrystallized twice from water and dried at 110-120°C. A 0.1 molar solution of the salt is prepared as a stock solution.

Potassium chloride, KCl, $M=74.6$, The C. P. product is recrystallized twice from water and is dried at 120°.

Boric acid, H_3BO_3, $M=62.0$. The C. P. product is recrystallized from water and dried in the air. A 0.1 molar solution of boric acid in 0.1 molar potassium chloride is prepared as a stock solution.

COMPOSITION AND pH OF CLARK AND LUBS BUFFER MIXTURES AT 20°C.

Composition	*pH*
48.5 cc 0.2 *N* HCl + 25 cc 0.2 *N* KCl diluted to 100 cc	1.0
32.25 cc " " " " " "	1.2
20.75 cc " " " " " "	1.4
13.15 cc " " " " " "	1.6
8.3 cc " " " " " "	1.8
5.3 cc " " " " " "	2.0
3.35 cc " " " " " "	2.2
46.70 cc 0.1 *N* HCl + 50 cc 0.1 *M* $KHC_8H_4O_4$ diluted to 100 cc	2.2
39.60 cc " " " " " "	2.4
32.95 cc " " " " " "	2.6
26.42 cc " " " " " "	2.8
20.32 cc " " " " " "	3.0
14.70 cc " " " " " "	3.2
9.90 cc " " " " " "	3.4
5.97 cc " " " " " "	3.6
2.63 cc " " " " " "	3.8
0.40 cc 0.1 *N* NaOH + 50 cc 0.1 *M* $KHC_8H_4O_4$ diluted to 100 cc	4.0
3.70 cc " " " " " "	4.2
7.50 cc " " " " " "	4.4
12.15 cc " " " " " "	4.6
17.70 cc " " " " " "	4.8
23.85 cc " " " " " "	5.0
29.95 cc " " " " " "	5.2

ACID—BASE INDICATORS

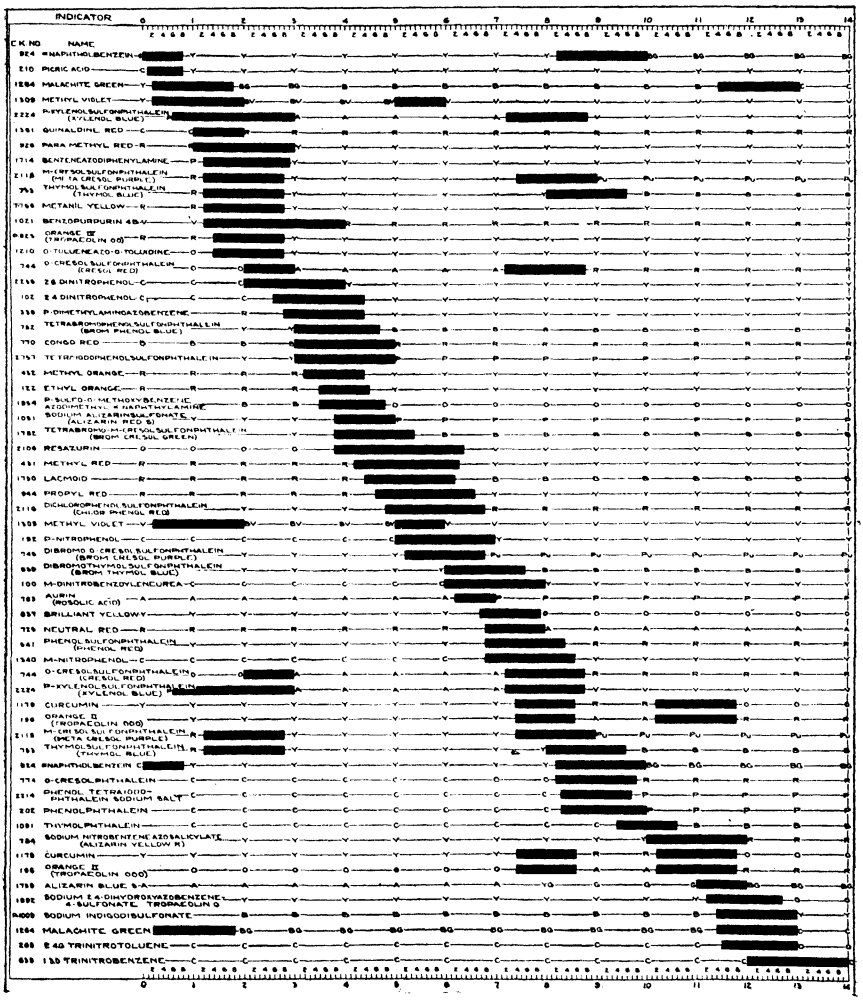
Composition	*pH*
35.45 cc 0.1 *N* NaOH + 50 cc 0.1 *M* $KHC_8H_4O_4$ diluted to 100 cc	5.4
39.85 cc " " " " " "	5.6
43.00 cc " " " " " "	5.8
45.45 cc " " " " " "	6.0
5.70 cc 0.1 *N* NaOH + 50 cc 0.1 *M* KH_2PO_4 diluted to 100 cc	6.0
8.60 cc " " " " " "	6.2
12.60 cc " " " " " "	6.4
17.80 cc " " " " " "	6.6
23.65 cc " " " " " "	6.8
29.63 cc " " " " " "	7.0
35.00 cc " " " " " "	7.2
39.50 cc " " " " " "	7.4
42.80 cc " " " " " "	7.6
45.20 cc " " " " " "	7.8
46.80 cc " " " " " "	8.0
2.61 cc 0.1 *N* NaOH + 50 cc 0.1 *M* H_3BO_3 diluted to 100 cc	7.8
3.97 cc " " " " " "	8.0
5.90 cc " " " " " "	8.2
8.50 cc " " " " " "	8.4
12.00 cc " " " " " "	8.6
16.30 cc " " " " " "	8.8
21.30 cc " " " " " "	9.0
26.70 cc " " " " " "	9.2
32.00 cc " " " " " "	9.4
36.85 cc " " " " " "	9.6
40.80 cc " " " " " "	9.8
43.90 cc " " " " " "	10.0

Measurement of pH.—If the approximate value of the *pH* of a solution is unknown, the order of its magnitude must first be approximated in order to select the correct indicator for a more accurate evaluation. As a rule, a few simple tests will supply this information. For example, if a solution remains colorless after the addition of a drop of phenolphthalein, it indicates that the *pH* of the solution is less than 8.0 (cf. table of indicators); if now a second test is made with methyl orange or bromophenol blue and the solution assumes the alkaline color of the indicator, it means that the *pH* is greater than 4.5. Therefore, such a solution has a *pH* value between 4.5 and 8.0. A few more tests with methyl red (*pH* interval 4.4 to 6.0); bromothymol blue (*pH* interval 6.0 to 7.2) and phenol red (*pH* interval 6.8 to 7.0) would serve to show the approximate *pH* value and suggest which indicators should be used for the exact determination. Instead of testing small amounts of the liquid with indicator solutions, indicator papers (litmus, congo, phenolphthalein, thymol blue, etc., papers) as a rule may be used by application of the spot method.

When the approximate value of *pH* is known, 3, 5, or 10 cc (depending upon the amount of liquid available) are measured out by means of a graduated cylinder and transferred into a test tube of pyrex glass or any other resistant glass. Soft glass should not be used because of the possibility of an alkaline reaction of the glass; the tubes should all be of the same inner size with a diameter of 1.5 cm and a length of 15 cm. A measured amount of the indicator solution is added carefully from a pipette of 1 cc volume which is graduated in 0.01 cc. As a rule, 0.1 to 0.2 cc of 0.05% indicator solution to 10 cc liquid will be the proper amount. Then some buffer solutions (4 to 6 cc) the *pH* of which overlaps that of the unknown are taken and treated in exactly the same way. Especially if one-color indicators are used, it is extremely important to add to the unknown and to the buffer solutions exactly the same amount of indicator. The best way of judging the color is to observe, against

ACID—BASE INDICATORS

a white back-ground, the light transmitted through the whole length of the tube. A suitable colorimeter may be used as well, although it is not necessary in routine work. Enough reference solutions must be taken so that the color of the unknown falls between two of the series and not beyond them. If buffer solutions are used with *pH* differences of 0.2 respectively, the *pH* of the unknown can be approximated very easily to within 0.1, and with some practice to 0.05. With buffer solutions that differ by 0.1 *pH* unit or less, the *experimental* error can be reduced to 0.01 to 0.02 in *pH*.



INDICATOR CHART

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The pH ranges shown are approximations and are intended to aid in selecting the proper indicator. The first column on the left gives the catalog number for ordering the indicator from the Eastman Kodak Co. The following abbreviations are used: A, amber; B, blue; C, colorless; BG, blue green; BV, blue violet; G, green; O, orange; P, pink; Pu, purple; R, red; V, violet; Y, yellow.

AN OUTLINE FOR QUALITATIVE ANALYSIS

By R. C. Hummell, Ph. D.

Preparation of Solution for Metal Analysis

A. If the sample to be analyzed is already in solution, acidify with nitric acid unless it is already acid.

B. If the sample is solid and metallic in appearance indicating a metal or alloy, dissolve in dilute nitric acid. (A few metals and alloys dissolve better in hydrochloric acid.) If a white residue remains from the treatment with nitric acid filter it off and dissolve it in boiling concentrated hydrochloric acid and test this solution for tin and antimony only.

C. If solid and non-metallic try to dissolve the sample first with water (cold and boiling), then if a residue is left, filter it and next try dilute nitric and hydrochloric acids successively, then concentrated hydrochloric acid, then aqua regia and if a residue still remains it must be filtered off and treated as an insoluble material.

D. Insoluble Material. (Cf. note following D2.) If a platinum crucible is available, mix the powdered "Insoluble" with about ten times its bulk of a mixture of equal parts of sodium carbonate and potassium carbonate and then fuse in the platinum crucible using a blast burner or Meeker burner. If a platinum crucible is not available an iron crucible may be substituted in which case a piece of sodium hydroxide about twice the size of a pea is substituted for the potassium carbonate. Heat the crucible and its contents for five minutes after a clear fusion is obtained. Then pour the melt on to a small piece of sheet-iron to solidify. Digest this with water until entirely disintegrated. Filter and treat the residue as directed in D1 and the filtrate as in D2.

D1. Dissolve the residue in dilute nitric acid and test for metals as outlined.

D2. Add the filtrate from digestion of the fusion above to the solution prepared especially for acid analysis as given in the tests for acid radicals.

Note. If the "insoluble" is white, before fusion its solubility in ammonium hydroxide or ammonium acetate should be tested as it might be silver chloride or lead sulfate and the ammonium hydroxide and ammonium acetate are solvents respectively for these.

All of the solutions prepared according to the directions given above, except D2 are to be analyzed for metals as directed in the following outline.

GROUP I

Add cold dilute hydrochloric acid drop by drop until precipitation is complete. Precipitate: $PbCl_2$, HgCl, AgCl. Filter. Wash with cold water. Save the filtrate to test for the subsequent groups.

Precipitate. Boil with 10 cc of water. Filter while hot.

Filtrate—$PbCl_2$. Add $K_2Cr_2O_7$ or K_2CrO_4 solution. Yellow ppt.—$PbCrO_4$ indicates Pb.	Precipitate—HgCl and AgCl Pour 5 cc NH_4OH over the precipitate.	
	Residue—If black indicates Hg.	Filtrate—Just acidify with HNO_3. White ppt. of AgCl indicates Ag.

GROUP II

To the filtrate from Group I add 1 cc of concentrated HNO_3 and evaporate just to dryness being careful near the end of the evaporation not to overheat any of the dry residue. Dissolve this residue with 2½ cc of concentrated HCl and 5 cc of water. Heat to boiling and pass H_2S into the solution for 5 minutes Dilute to 40 cc and again pass in H_2S for 5 minutes. Filter 2 cc of this solution and dilute it to 5 cc and test with H_2S. If no precipitate forms then filter the main solution. If a precipitate does form, dilute the main solution to 100 cc and again pass in H_2S until precipitation is complete. Filter. Wash with hot water. Save the filtrate for subsequent groups.

AN OUTLINE FOR QUALITATIVE ANALYSIS

Precipitate: Sulfides of Hg, Pb, Bi, Cu, Cd, As, Sb, and Sn. To the precipitate add 15 cc of 2*N* NaOH, warm and stir. Filter. Wash with hot water.

Residue—Sulfides of Hg, Pb, Bi, Cu and Cd. Boil with 15 cc dilute HNO_3. Filter. Wash.

Residue—HgS. Dissolve in aqua regia. Boil out excess Cl_2. Add $SnCl_2$. A white or gray ppt. indicates Hg.

Filtrate—Make just alkaline with NaOH, then add 7 cc of 6*N* NaOH in excess. Warm and stir. Filter.

Filtrate—Na_2PbO_2. Acidify with acetic acid. Add K_2CrO_4. Yellow ppt. $PbCrO_4$. Indicates Pb.

Precipitate—Hydroxides of Bi, Cu, Cd. Dissolve in dilute HNO_3. Make strongly alkaline with NH_4OH. Filter.

Precipitate—$Bi(OH)_3$. Treat on filter with freshly prepared sodium stannite solution.* Immediate black coloration indicates Bi.

Filtrate—Ammoniated salts of Cu and Cd. If solution is deep blue Cu is present. If doubtful take a small portion and make acid with acetic acid, then add potassium ferrocyanide solution. Filter. A red ppt. on the white filter indicates Cu and is $Cu_2Fe(CN)_6$. If Cu is present add KCN to the main bulk of the filtrate until the solution is decolorized. Pass in H_2S. A yellow ppt. indicates Cd. If Cu is not present omit the addition of KCN.

Filtrate—Sodium thio-salts of As, Sb, Sn. Make just acid with acetic acid. Filter. Discard filtrate. Precipitate—Sulfides of As, Sb, Sn. Treat the well drained ppt. with 10 cc of hot conc. HCl. Stir thoroughly but do not boil. Dilute with 5 cc of water and filter.

Residue—Sulfides of As. Dissolve in NH_4OH adding a few drops of H_2O_2. Add magnesia mixture. A fine feathery ppt., slow in forming, indicates As and is $MgNH_4AsO_4$

Filtrate—Chlorides of Sb and Sn. Evaporate to a few cc. Place a few drops of this solution on a silver coin or platinum foil. Place a piece of tin so it touches the solution on the coin and the coin itself. A black coating on the coin indicates Sb. The main bulk of the solution is heated and some metallic iron added. After this reacts for a minute or so, decant off the clear solution and add to it $HgCl_2$. A white ppt. of $HgCl$ or a gray ppt. of Hg indicates Sn.

*Sodium stannite solution is prepared by adding sodium hydroxide solution to a few cc of stannous chloride solution until the white precipitate which is formed at first just dissolves.

GROUP III

Evaporate the filtrate from Group II to 10 cc. Test 1 cc for phosphates by adding to it 2 cc of conc. HNO_3 and 2 cc of ammonium molybdate reagent. Warm and allow to stand for at least 5 minutes. A fine yellow precipitate indicates phosphates. If phosphates are present remove them from the main solution as follows. First make the solution neutral with NH_4OH then add 3 cc of acetic acid and 5 cc of 50% ammonium acetate solution. Add to this sufficient $FeCl_3$ solution until no more precipitate forms and the solution becomes reddish in color. Dilute to 70 cc and boil until a condition is obtained where the precipitate on settling leaves the solution free from the reddish brown color. If necessary add more ammonium acetate to get this result. Filter.

Precipitate—Phosphates of Fe and possibly Al and Cr. Test for Al and Cr. Add 10 cc of dilute NaOH and 1 g Na_2O_2 to the ppt. Boil and then filter. Discard the ppt. Divide the filtrate into two parts.

First portion—Make acid with HCl, then alkaline with NH_4OH. White flocculent ppt. indicates Al.

Second portion—Make acid with acetic acid, then add lead acetate. Yellow ppt. indicates Cr.

Filtrate—Group III except possibly Fe, Al and Cr. Analyze according to procedure given for Group III with phosphates absent.

GROUP III

Phosphates Absent.

If phosphates are absent, or after removing them if present, add 1 g of NH_4Cl to the solution, then make it alkaline with NH_4OH and pass in H_2S to complete precipitation. Filter. Wash. Save filtrate for subsequent groups.

AN OUTLINE FOR QUALITATIVE ANALYSIS

Precipitate—Sulfides of Co, Ni, Mn, Zn, Fe and the hydroxides of Al and Cr. Digest cold with 25 cc of 1 **N** HCl. Filter. Wash.

Residue—CoS and NiS. Make a borax bead test on this residue. Blue bead indicates Co. Brown bead indicates Ni. Then dissolve residue in aqua regia and divide into two parts.

First portion—Add $NaHCO_3$ (solid) until effervescence ceases. Then add H_2O_2; development of deep green color indicates Co.

Second portion — Make alkaline with NH_4OH and add dimethylglyoxime. A red or scarlet ppt. indicates Ni.

Filtrate—Chlorides of Fe, Mn, Al, Cr and Zn. Evaporate to about 5 cc. add 5 cc of 30% NaOH solution and 3 cc of H_2O_2 and boil. Filter. Wash.

Precipitate — Hydroxides of Fe and Mn. Make a Na_2CO_3 bead test on this ppt. for Mn using a little $KClO_3$ in the bead in the last part of the fusion. Bluish-green bead indicates Mn. Dissolve the remainder of the ppt. in HCl and add NH_4CNS solution. Blood red color indicates Fe. If iron was added to remove phosphates a little of the original sample can be tested for Fe by boiling with HCl and testing with NH_4CNS.

Filtrate—$NaAlO_2$, $NaCrO_4$, Na_2ZnO_2. Make acid with HCl, then just alkaline with NH_4OH. Filter.

Precipitate — $Al(OH)_3$. This ppt. should be white and flocculent. If in doubt remove the paper from the funnel, roll it up, drop 2 drops of dil. HCl down the top, then 2 drops of dil. $Co(NO_3)_2$ soln. Coil a wire around the rolled paper and burn to an ash. Blue ash indicates Al.

Filtrate—Make acid with acetic acid. Add 2 cc ammonium acetate solution, then 2 cc of $BaCl_2$ solution. Filter.

Precipitate — Yellow ppt. indicates Cr. If a white ppt. formed it is to be disregarded.

Filtrate—Pass in H_2S. A white or gray ppt. composed of fine curdy particles indicates Zn. A milky suspension but not curdy is due to sulfur.

GROUP IV

Make the filtrate from Group III acid with acetic acid and evaporate to 10 cc. Filter if necessary and discard the precipitate. To the filtrate or clear solution add NH_4OH until alkaline, then add 15 cc of 95% ethyl alcohol and 15 cc of ammonium carbonate solution. Filter. Wash. Save the filtrate for subsequent group.

Precipitate—Carbonates of Ba, Ca, Sr and Mg. Dissolve in acetic acid. Add 5 cc of ammonium acetate solution and about 10 cc of potassium dichromate solution. Filter.

Precipitate—$BaCrO_4$. Moisten this ppt. with HCl and make a flame test with a platinum wire. Green flame indicates Ba.

Filtrate—Acetates of Sr, Ca, Mg and excess $K_2Cr_2O_7$. Make alkaline with NH_4OH and add 5 cc of alcohol. Filter.

Precipitate—$SrCrO_4$ and possibly some $CaCrO_4$. Boil with $(NH_4)_2CO_3$ and $(NH_4)_2C_2O_4$. Filter. Discard filtrate. Treat residue with acetic acid. Filter.

Residue—CaC_2O_4

Filtrate — Add Na_2SO_4 solution. White ppt. indicates Sr.

Filtrate—Ca and Mg salts. Add $(NH_4)_2C_2O_4$ solution. Filter.

Precipitate — CaC_2O_4 and possibly some MgC_2O_4. Treat with dil. H_2SO_4. Filter. To the solution add 5 cc of alcohol. Ppt. indicates Ca.

Filtrate — Add Na_2HPO_4 solution. White ppt. indicates Mg.

GROUP V

Evaporate the filtrate from Group IV to dryness. Heat the dry residue just short of a red heat until all of the ammonium salts have been expelled. Cool. Moisten with HCl and make a flame test with a platinum wire. An in-

tense yellow flame indicates Na. A pale violet flame indicates K. If flame is intense yellow view it through a small bottle containing a 10% solution of $KCr(SO_4)_2$ or several thicknesses of cobalt glass. A red flame as thus viewed indicates K. To test for NH_4^+—Take about 1 g of the original sample in a small beaker, add sodium hydroxide solution in excess, cover the beaker with a watch glass containing on the under side a moist piece of red litmus paper. Warm and observe the litmus paper. If it changes slowly and evenly from red to blue, NH_4^+ is present.

ACIDIC CONSTITUENTS

Detection of Groups of Acidic Constituents.

The following acid ions are provided for in this procedure: Chlorides, bromides, iodides, ferrocyanides, ferricyanides, thiocyanates, sulfates, sulfites, thiosulfates, chromates, fluorides, silicates, oxalates, tartrates, sulfides, carbonates, phosphates, borates, nitrates, nitrites, acetates, and permanganates.

Preliminary Examination. Detection of some acid radicals.—

1. Moisten with concentrated H_2SO_4 and observe results both cold and when heated.
   (a) Tartrates heated with H_2SO_4 turn brownish black and give odor of burnt sugar.
   (b) Carbonates give off colorless, odorless gas which will cloud a drop of lime water held over the reacting materials.
   (c) Some sulfides readily give off H_2S with H_2SO_4 and this can be detected by the odor or the darkening of a piece of paper moistened with $Pb(C_2H_3O_2)_2$.
   (d) Nitrites will give off brown fumes immediately.
   (e) Bromides will oxidize slowly with the formation of free bromine which can be recognized by the reddish brown color of the gas.
   (f) Iodides will liberate free iodine which is recognized by the purple color.
   (g) Sulfites will liberate SO_2 which is colorless but has the characteristic, sharp pungent odor of burning sulfur.
   (h) Oxalates, when heated with H_2SO_4, give off CO and CO_2. The CO can be ignited.
   (i) Thiosulfates liberate SO_2 and form a residue of sulfur.
   (j) Acetates heated with H_2SO_4 liberate acetic acid which is recognized by the odor of vinegar.

2. Moisten a gram of the solid in an evaporating dish (if Cu and Ba are absent) with conc. H_2SO_4, add a few drops of alcohol and ignite the alcohol. A green flame indicates borates. If Cu or Ba are present use a test tube fitted with a stopper and short constricted outlet tube instead of the evaporating dish. In either case heat to help expel the volatile ethyl borate which will burn in the alcohol vapor with a green flame.

3. Add cold dilute HCl solution. An immediate evolution of brown fumes indicates nitrites.

4. If the sample is yellow or deep purple in color heat with dilute alcohol.
   (a) If the yellow color is changed to green and the metal analysis shows Cr present then chromates are present.
   (b) If the purple color is discharged and manganese was found in the metal analysis this test indicates the presence of permanganates.

5. The test for phosphates was made at the beginning of the analysis for Group III and need not be repeated at this point.

Preparation of Special Solution for Detection of Acidic Groups.—Take about 2 g of the powdered sample and boil with 25 cc of a saturated solution of sodium carbonate for 15 minutes. If a fusion was made in the analysis for metals, add the water extract from D2, dilute to 40 cc and filter. Use this solution for the following acid tests. Take 20 cc of this "prepared solution," make acid with dilute acetic acid and then add 1 cc of the acid in excess, boil gently to expel CO_2 and any H_2S which might be present. Test the vapor for H_2S by holding a piece of paper moistened with lead acetate in the vapors evolved during the boiling. A dark coloration

AN OUTLINE FOR QUALITATIVE ANALYSIS

indicates sulfides. If a white gelatinous precipitate forms at this point test it for silicic acid by the microcosmic bead test as follows: Filter, ignite the residue in a crucible, make a bead of microcosmic salt, dip it in the residue and fuse. If undissolved particles float in the bead while melted, Si is indicated. Make the filtrate from the procedure above neutral or slightly alkaline. Add a mixture of $Ca(NO_3)_2 + Ba(NO_3)_2$ solution and filter. Precipitate see Group I. Filtrate see Group II.

Precipitate—Group I acids. Add 5 cc acetic acid, warm and stir. Filter. The filtrate contains $CaHPO_4$, $CaC_4H_4O_6$. This filtrate is discarded as these groups were tested for previously.
Residue—CaF_2, CaC_2O_4, $BaSO_4$, $BaCrO_4$. Treat with 5 cc dilute HCl. Filter.

Precipitate—CaF_2, $BaSO_4$. Divide into two parts.

First portion — Add conc. HCl and boil for a few minutes. Dilute White ppt. indicates SO_4''.

Second portion — Dry over a low flame. Mix with a little sand. Place in a test tube and moisten with conc. H_2SO_4. Hold a film of water in a glass loop just above the mixture and warm. A ppt. in the water film indicates fluorides.

Filtrate—If yellow, chromates are present. As confirming this recall whether the filtrate from Group I metals was yellow and then turned green when H_2S was passed in and a formation of colloidal sulfur formed. To test for oxalates take 2 cc of the prepared solution, boil with a small excess of acetic acid, filter, make alkaline with NH_4OH, add $Ca(NO_3)_2$, filter, treat with 5 cc acetic acid, filter, wash. Then treat with dilute H_2SO_4, warm and add dilute $KMnO_4$ solution. Color destroyed indicates C_2O_4''.

Filtrate—Sodium salts of Group II. Make exactly neutral with HNO_3. Add $Zn(NO_3)_2$ solution. Filter.

Precipitate—$Zn_3(FeC_6N_6)_2$ brownish yellow and $Zn_2Fe(CN)_6$ white. Divide into 2 parts.

First portion—Dissolve in NH_4OH. Brown coloration indicates $FeC_6N_6)''$.

Second portion—Dissolve in HCl and add $FeCl_3$ solution. Deep blue indicates $(FeC_6N_6)''$.

Filtrate—Take out a few drops to test for CNS.

To the few drops add $FeCl_3$ soln. Blood red color that remains on heating indicates CNS.

To the remainder of the solution add HNO_3 until acid and then add $AgNO_3$ solution. Filter. Discard filtrate. Add "chloride reagent" (described below). **Filter.

Filtrate—Acidify with HNO_3. White ppt. indicates chlorides.

Precipitate—Place a small amount in a test tube. Add 2 cc CS_2 or CCl_4, then some chlorine water (see below)*. Shake vigorously. Purple color in CS_2 indicates iodine. Brown color in CS_2 indicates bromine. If purple at first, continue to add Cl water until the purple color is discharged. If the brown color presists both iodine and bromine are present.

*Chlorine water for this test should be freshly prepared by adding one or two small crystals of $KClO_3$ to a few cc of dilute hydrochloric acid and then warming the solution.

**Chloride Reagent: Dissolve 1.7 grams of $AgNO_3$ and 25 grams of KNO_3 in an amount of water less than a liter, add 17cc of conc. NH_4OH, and dilute to a liter.

OTHER TESTS FOR ACIDIC CONSTITUENTS

Nitrates—If iodides, bromides, ferrocyanides, ferricyanides, chromates and nitrites are absent, take 2 cc of the "Prepared solution," make just acid with acetic acid, boil, filter if any precipitate forms, add 3 cc of ferrous sulfate solution, then tip the test tube to an angle of 45° and slowly pour a few cc of concentrated H_2SO_4 down the side of the tube. Bring the tube back to an upright position without stirring the contents. A brown ring forming at the

junction of the two layers indicates NO_3'. If any of the acids which interfere with test and which are mentioned above are present they can be removed as follows: make 5 cc of the "prepared solution" as nearly neutral as possible (do not permit the solution to become acid) with acetic acid, boil with 5 cc $(NH_4)_2SO_4$ solution. This removes nitrites. Acidify the boiled solution with H_2SO_4 and add $AgSO_4$ solution which removes Br', I', $Fe(CN)_6'''$ and $Fe(CN)_6''''$. Filter. To the filtrate add Na_2SO_3 and allow to stand for a few minutes. This reduces the chromates. Boil to expell SO_2, then make alkaline with NH_4OH to precipitate Cr. Filter and test the filtrate as directed above for nitrates $(NO_3)'$.

Sulfides—Some sulfides are left in the residue from boiling the "prepared solution" with acetic acid and do not evolve H_2S in this step. If this residue is placed in a test tube with some sulfur-free zinc and heated with HCl the H_2S will be liberated and can be detected with lead acetate paper.

Phosphates — Arsenates, arsenites, chromates and permanganates are usually detected in the course of the metal analysis.

A few unusual interfering combinations may be met with which because of the nature of this treatise are not discussed.

FLAME TESTS

The substance is heated on a piece of charcoal with a blow-pipe, or held in the outer flame of a Bunsen burner on a loop of platinum wire.

Blue:— *Azure*, Pb, Se, $CuCl_2$ or other copper compounds that have been moistened with hydrochloric acid.
Light blue, As and some of its compounds.
Greenish blue, $CuBr_2$, Sb.

Green:— *Emerald green*, copper compounds other than the halides.
Blue-green, phosphates when moistened with H_2SO_4, B_2O_3.
Faint green, Sb and NH_4 compounds.

White:— *White-green*, Zn.

Red:— *Carmine*, Li compounds. Masked by Ba or Na.
Scarlet or *Crimson*, Sr compounds. Masked by Ba.
Yellow-red, Ca compounds. Masked by Ba.

Violet:— K compounds other than borates, phosphates and silicates. Masked by Na or Li.
Purple-red given by K in the presence of Na when viewed through a blue glass, the blue glass cutting out the yellow caused by Na. Rb and Cs are the same as K compounds.

Yellow:—Na compounds even in small traces. *Caution*—Most compounds contain traces of Na which will color the flame. The appearance of a yellow flame is not a test for Na unless it persists and is not perceptibly increased in intensity on the addition of about 1% of NaCl to the dry compound.

BEAD TESTS

A clear bead is made by fusing a little borax or microcosmic salt on a loop of platinum wire. This bead is touched to the dry unknown material and again held in the flame of a Bunsen burner. The outer part of the flame is the oxidizing flame, while the inner cone is the reducing flame. The abbreviations used below are h., hot; c., cold; *h. c.*, hot or cold; *s.*, saturated; *n. s.*, not saturated; and *sprs.*, supersaturated.

Color of the Bead	Borax Bead, $Na_2B_4O_7 \cdot 10H_2O$		Microcosmic Salt Bead, $NaNH_4HPO_4$	
	Oxidizing Flame	Reducing Flame	Oxidizing Flame	Reducing Flame
Colorless	*h.c.*: Al, Si, Sn, Bi, Cd, Mo, Pb, Sb, Ti, V, W. *n.s.*: Ag, Al, Ba, Ca, Mg, Sr.	Al, Si, Sn, alk. earths and earths. *h.*: Cu. *h.c.*: Ce, Mn.	Si (undissolved) Al, Ba, Ca, Mg, Sn, Sr. *n.s.*: Bi, Cd, Mo, Pb, Sb, Ti, Zn.	Si (undissolved) Ce, Mn, Sn. Al, Ba, Ca, Mg, Sr (*sprs.*, not clear)
Gray and Opaque	*sprs.*: Al, Si, Sn.	Ag, Bi, Cd, Ni, Pb, Sb, Zn. *s.*: Al, Si, Sn. *sprs.*: Cu.	*s.*: Al, Ba, Ca, Mg, Sn, Sr.	Ag, Bi, Cd, Ni, Pb, Sb, Zn.
Blue	*c.*: Cu. *h. c.*: Co.	*h. c.*: Co.	*c.*: Cu. *h.c.*: Co.	*c.*: W. *h. c.*: Co.
Green	*c.*: Cr, Cu. *h.*: Cu, Fe+ Co.	Cr. *h.c.*: U. *sprs.*: Fe. *c.*: Mo, V.	U. *c.*: Cr. *h.*:Cu, Mo, Fe+ (Co or Cu)	*c.*: Cr. *h.*: Mo, U.
Red	*c.*: Ni. *h.*: Ce, Fe.	*c.*: Cu.	*h., s.*: Ce, Cr, Fe, Ni.	*c.*: Cu. *h.*: Ni, Ti+Fe.
Yellow or Brownish	*h., n.s.*: Fe, U, V. *h., sprs.*: Bi, Pb, Sb.	W. *h.*: Mo, Ti, V.	*c.*: Ni. *h., s.*: Co, Fe, U.	*c.*: Ni. *h.*: Fe, Ti.
Violet	h.: Ni+Co. *h. c.*: Mn.	*c.*: Ti.	*h. c.*: Mn.	*c.*: Ti.

ORGANIC REAGENTS FOR INORGANIC ANALYSIS

Compiled by

WAYNE E. WHITE, ALUMINUM COMPANY OF AMERICA

with the assistance of

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Abbreviations used in the table: AcOH-acetic acid; addn.-addition; alc.-alcohol; alk.-alkaline; amm.-ammonia, ammonium, ammoniacal; aq.-aqueous; colmtc.-colorimetric; conc.-concentrated; concn.-concentration; contg.-containing; detc.-detection; detg.-determining; detn.-determination; dil.-dilute; estn.-estimation; g.-gram; gravmtc.-gravimetric; intfr.-interfere; mcg.-microgram; mg.-milligram; ml.-milliliter; ppm-parts per million; ppt.-precipitate; pptn.-precipitation; qual.-qualitative; quant.-quantitative; reagt.-reagent; recomm.-recommended; satd.-saturated; sepg.-separating; sepn.-separation; sl.-slight; soln.-solution; volmtc.-volumetric; xs.-excess.

References.—The references in some cases do not include a citation of the original publication because the aim has been to be utilitarian rather than historically complete in choice. The following standard works are frequently referred to under abbreviations as follows:

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Yoe I and *Yoe II*—Photometric Chemical Analysis, by J. H. Yoe, Vol. I (1928), Vol. II (1929), published by Wiley (New York).

ACETATE

o-NITROBENZALDEHYDE is used in freshly prepd. satd. soln. in 2 *N* NaOH. Unknown is heated with $Ca(OH)_2$ or $CaCO_3$ to form acetone if acetate is present; the acetone is detected by a blue coloration (due to formation of indigo) on filter paper moistened with reagt. Specific. Recomm. (*I. C.*) *Feigl, p. 331.*

ALUMINUM

AURIN TRICARBOXYLIC ACID, AMM. SALT (ALUMINON), 0.1% aq. soln., forms a red lake with $Al(OH)_3$. Extensively used for detc. and colmtc. detn. (0.01–1.0 mg.). Optimum lake formation at pH 4.5 to 6.0; dil. HCl soln. buffered with amm. acetate, elevated temp. After cooling, satd. $(NH_4)_2CO_3$ added to raise pH to 7.1–7.3 which decolorizes xs. reagt. Detc. Al in baking powders, cf. *A. O. A. C., p. 190.* Colmtc. detn. Al in alloys, in tissue, and in water, cf. *Snell pp. 260–6.* Fe

(III) and Cr (III) give violet and red colors, resp., but these intfr. may be avoided by extraction of Al as aluminate. Much PO_4 intfr. For Al in foods cf. Cox et al., *Ind. Eng. Chem.* **24**, *403* (*1932*). For test paper, absorb soln. of 0.1% reagt. and 1.0% amm. acetate in filter paper, dry, add drop of acid test soln. After about one minute, expose to ammonia vapors to get rose pink of Al lake. W. E. Thrun, *J. Chem. Education* **14**, *281* (*1937*). Reagt. recomm. (*I. C.*)

SODIUM ALIZARIN SULFONATE (ALIZARIN S), 0.1 to 1.0% aq. soln., is used for detc. by spot and test tube methods, and also for colmtc. detn. In the latter case starch glycerite is useful to prevent pptn.; cf. Thrun, *Ind. Eng. Chem.*, (*Anal. Ed.*) **2**, *8–9* (*1930*). The reagt. is added to a sl. acid soln. which should contain between 0.005 and 0.05 mg. Al; after standing, the soln. is made more acid with AcOH to obtain a red coloration. Fe, Cu, Co, and Mn must be absent. For the spot test cf. *Feigl, pp. 115.* For the colmtc. detn. cf. *Snell, pp. 259–60; Yoe I, pp. 119–20.* An alc. soln. of **ALIZARIN** may be used in much the same way as the alizarin S; the former may be used for impregnating paper for Al tests; cf. *Feigl, p. 116.* Recomm. (*I. C.*).

ERIOCHROMCYANINE R, 0.1% aq. soln., when used in a soln. contg. AcOH at pH 4.6 to 5.6 gives a bluish-red color with Al; in the absence of Al, the color is orange. Fe, Mn, Mg, much PO_4 intfr. It may also be used for a spot test, cf. Eegriwe, *Z. anal. Chem.* **76**, *438–43* (*1929*), or for colmtc. estn., cf. *Snell, pp. 271–3.* Recomm. (*I. C.*).

8-HYDROXYQUINOLINE (OXINE), in dil. AcOH soln., may be used to separate Al quantitatively from Mg and Be by pptn. in acetic acid-acetate soln.; the ppt. may be dried at 110° C. and weighed for detn. of Al, or may be ignited and weighed as the oxide; when the ppt. is small the detn. is better made by titration with $KBrO_3$; cf. Berg. *Z. anal. Chem.* **70**, *341; ibid.* **71**, 171 (*1927*), *et al.* There are many references to the use of this reagt. in the detn. of Al and other metals; cf. *Hiliebrand and Lundell, p. 114 ff.* and *C. A.* indexes. For the colmtc. detn. the Al hydroxyquinolate is pptd. and coupled with diazotized sulfanilic acid; cf. *Snell, p. 267.*

MORIN, satd. methyl alcohol soln. In a neutral or sl. acid soln., minute amounts of Al give a green fluorescence in ultraviolet light; cf. *Feigl, p. 113.* For adaptation to quant. method and discussion of intfrnces., cf. White and Lowe, *Ind. Eng. Chem.*, (*Anal. Ed.*) **12**, *229–31* (*1940*). Recomm. **QUERCETIN** used in manner similar to Morin said to be satisfactory, cf. *C. A.* **36**, *363* (*1942*).

UREA may be used in hot acid soln. which causes its slow hydrolysis and consequent pptn. of basic Al salts in presence of sulfate or succinic acid. Ppt. may then be ignited to oxide. Ppts. thus formed are easily filtered and free from contamination. Willard and Tang; *Ind. Eng. Chem.*, (*Anal. Ed.*) **9**, *357–63* (*1937*).

AMMONIUM

SILVER NITRATE, MANGANESE NITRATE and **BENZIDINE.** A soln. of $AgNO_3$ and $Mn(NO_3)_2$ made 0.1*M* in respect to each salt is neutralized to sl. ppt. with dil. NaOH. The soln. is then filtered and kept in dark bottle. Additional hydroxyl as from NH_3 collected on filter paper moistened with this soln. gives black or gray spot which may be intensified by formn. of blue coloration on addn. of benzidine soln. in AcOH. This test may be highly sensitive. *Feigl, p. 154.* Recomm. (*I. C.*).

SILVER NITRATE AND FORMALIN reagt. is prepared by mixing 10 ml. of 20% silver nitrate soln. with 5 drops of 40% formalin and a few drops of dil. NaOH soln., filtering off any ppt. which may form. The filtrate is immediately absorbed upon strips of filter paper. Ammonia vapor causes the treated filter paper to turn gray or black; the test paper is compared with a blank left exposed to air. **TANNIC ACID** may be substituted for the formalin. A test is obtainable with as little as 0.0001 mg. NH_3; cf. *Feigl, p. 154.* The color may be produced in soln. and used for estn. of NH_3; cf. *Snell, p. 659*; cf. also K. G. Makris, *Z. anal. Chem.* **81**, *212–4* (*1930*); *ibid.* **84**, *241–2* (*1931*). The $AgNO_3$—HClIO reagt. recomm. (*I. C.*).

ORGANIC REAGENTS FOR INORGANIC ANALYSIS

p-**NITROBENZENEDIAZONIUM CHLORIDE (RIEGLER'S REAGENT)** is prepared by diazotization of *p*-**NITRANILINE.** The test may be made on a spot plate by using a drop of neutral or sl. acid unknown soln., adding a drop of reagt. and a little piece of solid CaO. In the presence of as much as 0.0007 mg. NH_3 a red zone is produced around the CaO; cf. *Feigl, p. 152.* Recomm. (*I. C.*).

HEMATOXYLIN, in alc. soln. for impregnating paper. NH_3 gives a red to bluish-red color; cf. G. Gutzeit, *Helv. Chim. Acta* **12,** *730 (1929).*

PHENOL AND SODIUM HYPOCHLORITE, 4% aq. soln. of the former and 5% aq. soln. of the latter. A blue color results when the two reagts. are mixed and warmed in the presence of as little as 0.0001 mg. of ammonia as the salt. The color may be used for estimating the amount of ammonium. The accuracy of the detn. is less than with the Nessler reagt. but the method requires only 4 minutes; Ca does not intfr.; xs. free acid must be neutralized; cf. *Snell, p. 658.* **CHLORAMINE T** may be used instead of NaOCl as a source of Cl; to 2 ml. of sample add 1 ml. of phenol soln. (25 g. phenol in 50 ml. 40% NaOH and dild. to 100 ml.) and 3 ml. 5% Chloramine T. Ammonia free water must be used. After heating mixture for 10 min. the blue color is compared to standards, cf. Crismer, *Bull. soc. chim. biol.* **19,** *1000–9 (1937); C. A.* **31,** *7796 (1937).*

THYMOL, 25% soln. in alcohol. To 5 ml. of the test soln. are added 1 ml. of the reagt. with mixing, then 12 ml. of bromine water and 6 ml. of 2*N* NaOH. After 2 or 3 minutes, xylene is added, the mixture shaken and color observed in the xylene layer; cf. Lapin and Hein, *Z. anal. Chem.* **98,** *236–40 (1934).* For colmtc. detn. of NH_3, cf. Hansen and Nielsen, *J. Biol. Chem.* **131,** *309 (1939).*

ANTIMONY

RHODAMINE B, 0.01% aq. soln., is suitable as a spot or test tube test to detect Sb in the presence of Sn. The Sb is oxidized to pentavalent form by the addn. of KNO_2 to the acidified soln. and, on the addn. of a few drops of reagt., the soln. color changes from bright red to violet. Bi, Hg, and tungstate give similar coloration; cf. Eegriwe, *Z. anal. Chem.* **70,** *400–3 (1927); Feigl, p. 56.* For colmtc. detn. of 0.1 to 300 mcg. Sb, cf. W. G. Frederick, *Ind. Eng. Chem., (Anal. Ed.)* **13,** *922–4 (1941).* Recomm. (*I. C.*).

POTASSIUM IODIDE and **PYRIDINE,** in acid solns., give a yellow color or ppt. in the presence of Sb. As and Sn do not intfr.; cf. Clarke, *Analyst* **53,** *373 (1928).* The color may be used for detg. from 0.05 to 3.0 mg. Sb in Sn.; cf. *Snell, p. 253.* Recomm. (*I. C.*).

PYROGALLOL, in aq. soln. gives a white ppt. with Sb in dil. HCl contg. tartrate to give antimonyl tartrate ion. Procedure may be used for detn. of Sb and sepg. it from As; cf. Feigl, *Z. anal. Chem.* **64,** *41–47 (1924); C. A.* **18,** *3016; Prodinger, p. 115.*

9-METHYL-2,3,7-TRIHYDROXYFLUORONE, 0.5% soln. in ethyl alc. gives red ppt. with Sb (III); may be used as test tube or spot test. Test is sensitive and is apparently specific at pH 4.0 and in pres. of F ion. Wenger, Duckert, and Blancpain, *Helv. Chim. Acta* **20,** *1427–45 (1937); C. A.* **32,** *1205 (1938).* Prepn. of reagt.: triacetyl derivative made from *p*-quinone with acetic anhydride and H_2SO_4, and then it is mixed with acetaldehyde in ratio of 1 mol. of former to 1.2 of latter. The mixture is heated on water bath at 50°–60° for 1 hr. with 5 parts by wt. of ethyl alc. and one part of 5–10% H_2SO_4. Reagt. is pptd. by adding water. R. Duckert, *Helv. Chim. Acta* **20,** *362–7 (1937).*

ARSENIC

COCAINE-MOLYBDATE is prepared by mixing 1 part by vol. of 1% potassium molybdate soln., 2 parts of 0.1 *N* HCl, and 1 part of 2% cocaine soln. Pentavalent As in a soln. slightly acid with HCl gives a turbidity suitable for nephelometric detn. of amts. of As between 0.0005 and 0.06 mg. Phosphates must be absent and errors are small (2–3%). The method is said to be convenient and more exact than those

involving evolution of arsine; cf. *Yoe II, pp. 107–16.* **STRYCHNINE** may be used instead of cocaine; cf. *Snell, p. 241;* also **QUININE-ARSENOMOLYBDATE** may be used in a similar manner; cf. *Snell, p. 242; Yoe I, pp. 128–30.*

***N*-ETHYL-8-HYDROXYTETRAHYDROQUINOLINE HYDROCHLORIDE (KAIRIN),** 0.5% aq. soln. A drop of the test soln. is put on filter paper, allowed to dry, then moistened with HCl and a drop of the reagt. soln., a drop of $FeCl_3$ soln. is added and the spot is warmed. In the presence of as much as 6×10^{-7} mg. As (III) a reddish-brown coloration appears. Hg, Pb, and Cu must be absent; cf. W. Reppmann, *Z. anal. Chem.* **99,** *180–2 (1934).*

BARIUM

SODIUM RHODIZONATE, freshly prepd. 5% aq. soln. For spot test, place drop of neutral or sl. acid test soln. on filter paper and add drop of reagt. soln. A red to brown stain, becoming more red with dil. HCl, indicates Ba. Metals of H_2S and $(NH_4)_2S$ groups intfr. and should be removed before making test. Recomm. (*I. C.*). *Feigl, p. 137.* **TETRAHYDROXYQUINONE** gives a similar reaction and is considerably more stable than the rhodizonate; cf. under the heading *sulfate.*

BERYLLIUM

MORIN, 20 mg. in 100 ml. of acetone, is a valuable reagt. for detc. and detn. of minute amts. of Be. In 0.01 to 0.1 *N* NaOH soln. Be gives a yellow-green fluorescence visible in daylight or better in ultraviolet light. Estn. of minute amts. may be made by comparison with standards. Only Li, Ca, Zn, and Sc give fluorescence to intfr.; these may be masked or removed. Oxidizing agts. destroy reagt. and must be avoided. Recomm. (*I. C.*) E. B. Sandell, *Ind. Eng. Chem.*, (*Anal. Ed.*) **12,** *674, 762–4 (1940).*

1-AMINO-4-HYDROXYANTHRAQUINONE, 0.1% in alc., gives a red fluorescence with Be in alk. soln. This reagt. is said to be less sensitive but more nearly specific than morin. White and Lowe, *Ind. Eng. Chem.*, (*Anal. Ed.*) **13,** *809 (1941).*

QUINALIZARIN (1,2,5,8-TETRAHYDROXYANTHRAQUINONE), satd. alc. soln. or freshly prepared 0.05% soln. in 0.1 *N* NaOH. In alkaline soln. Be changes the color of the reagt. from reddish-violet to a distinct blue; it may be used as a test on spot plate as well as in other detc. methods; cf. *Feigl, p. 120.* A blank should be run along with the test. In solns. alkaline with NaOH, a moderate xs. of Al does not intfr.; Fe intfr. may be prevented by tartrate but the sensitivity is diminished by the latter. PO_4 should be absent. Mg gives the same color as Be; the latter, however, loses its color on addn. of bromine water while the Mg lake remains unaffected. The reagt. may be used for estn. of Be by adding xs. to unknown and titrating back to clear, pure, blue end point with standard Be soln.; cf. H. Fischer, *Z. anal. Chem.* **73,** *54–64 (1928).* As little as 0.1 mg. Be may be detd. After sepn. of Al, Be may be detd. colmtcly.; cf. *Snell, p. 399;* cf. also *C. A.* **30,** *2132 (1936),* and **31,** *3815 (1937).* Recomm. (*I. C.*) **ALKANNIN** or **NAPHTHAZARIN** may be used instead of quinalizarin although they are not as sensitive; cf. *C. A.* **30,** *5143 (1936).*

CURCUMIN, 0.1% alc. soln., forms an orange-red lake in faintly alkaline soln. contg. Be; the blank is yellow to brown in color. Pptn. occurs in concns. over 50 mg. Be per liter. For solns. contg. 0.05 to 1 mg. per liter, the reagt. may be used for colmtc. estn.; Fe and Al are removed before detn. by adding xs. NaF to sl. acid soln.; cf. Kolthoff, *J. Am. Chem. Soc.* **50,** *393–5 (1928); Snell, p. 398.* The addn. of starch glycerite increases sensitivity of colmtc. detn. W. E. Thrun, *Ind. Eng. Chem.*, (*Anal. Ed.*) **2,** *8 (1930).*

***p*-NITROBENZENEAZO-ORCINOL,** 0.025% soln. in dil. NaOH, is used for a spot test on filter paper giving an orange-red color. In testing, a drop of the reagt. is placed on the paper, then a little of the test soln. is applied to the middle of the spot, followed by another drop of reagt. In the presence of as much as 0.0002 mg. Be an

orange-red spot is obtained. Zn gives a similar color but the color disappears on the addn. of KCN soln.; Mg and Al are both inactive; cf. Komarowskii and Poluektov, *Mikrochemie* **14**, *315–7 (1934); Feigl, p. 121.* Recomm. (*I. C.*)

8-HYDROXYQUINOLINE (OXINE), in acetic acid soln., may be used to precipitate quantitatively Al, Fe, and Zn in acetic acid-amm. acetate soln. leaving Be unaffected which may be detd. by suitable means in the filtrate; cf. Lundell and Knowles, *Bur. Stand. J. Research* **3**, *91 (1929)*.

AURIN TRICARBOXYLIC ACID (ALUMINON), 0.1% aq. soln., gives a reaction similar to that with Al (q.v.); cf. Middleton, *J. Am. Chem. Soc.* **48**, *2125 (1926)*; Kolthoff, *J. Am. Chem. Soc.* **50**, *353–5 (1928)*.

BISMUTH

CINCHONINE POTASSIUM IODIDE reagt. is prepared by mixing 5 g. cinchonine with enough conc. HNO_3 to make a paste, dissolving the paste in water, diluting to about 50 ml., adding to 250 ml. KI soln. contg. 10 g. KI, diluting to 500 ml., allowing to stand 48 hrs., and then filtering. The reagt. is stable for long periods and any suspended matter which appears on standing should be filtered off before use. In a slightly acid soln. of Bi the reagt. gives an orange-red color or ppt. As a spot test, Bi may be recognized even in the presence of Cu, Pb, and Hg by different colors and a zoning effect when all are present. Cd does not intfr.; cf. *Feigl, p. 33.* The reagt. may be used for colmtc. detn. of 0.03 to 0.15 mg. Bi; cf. *Snell, p. 218.* **QUININE** with the iodide ion may be used instead of the cinchonine; cf. *Snell, p. 221, Yoe I, p. 133.* **GLYCEROL** has also been used with KI to keep the Bi colored compd. in suspension for colmtc. estn.; cf. P. Planes, *J. Soc. Chem. Ind.* **22**, *1259 (1903)*. **8-HYDROXYQUINOLINE (OXINE)** with KI is also suitable for detc. of as little as 0.5×10^{-6} mg. Bi and for colmtc. estn. of amounts up to 0.25 mg.; cf. *Snell, p. 221*, and *C. A.* **26**, *2391 (1932)*. Cinchonine recomm. (*I. C.*).

THIOUREA, solid or satd. aq. soln., gives a yellow color suitable for colmtc. detn. as well as for detc. Xs. reagt. is used to ppt. other metals from a test soln. strongly acid with HNO_3; cf. C. Mahr, *Z. anal. Chem.* **94**, *161–6 (1933); Snell, p. 220.* For use of thiourea in detn. of Bi in refined leads and tins, cf. *C. A.* **34**, *5778 (1940)*. Recomm. (*I. C.*).

PYROGALLOL, conc. aq. soln., will ppt. Bi quant. from a hot, slightly acid soln.; the yellow crystalline ppt., containing 62.84% Bi, may be washed, filtered off and dried for detn.; cf. Feigl, *Z. anal. Chem.* **65**, *448 (1925)*. The reagt. is also useful for sepg. Bi from Pb and Cu; cf. E. A. Ostroumov, *Zavodskaya Lab.* **4**, *1016–20 (1935); C. A.* **30**, *1684 (1936); Prodinger, p. 116.*

DIMERCAPTOTHIODIAZOLE and numerous similar compounds have been suggested for detc. and detn. of Bi; cf. J. V. Dubsky, A. Okac, B. Okac, and J. Trtilek, *Z. anal. Chem.* **98**, *184–93 (1934); ibid.*, **100**, *408–18 (1935)*, recomm. (*I. C.*); cf. also *Prodinger, p. 114* for use of **MERCAPTOBENZOTHIAZOLE.** 1% alc. soln. of **2-METHYL BENZOTHIAZOLE** with KI used for detc. of Bi in qual. scheme; B. Naiman, *J. Chem. Education* **14**, *484–6 (1937)*.

CUPFERRON (AMMONIUM NITROSOPHENYLHYDROXYLAMINE) has been used for the sepn. and detn. of Bi; cf. Pinkus and Dernier, *C. A.* **23**, *53 (1929); Prodinger, p. 79.*

DIPHENYLTHIOCARBAZONE (DITHIZONE), 25–50 mg. per liter of $CHCl_3$ or CCl_4 has been used for detc. and colmtc. detn. of minute amounts of Bi. The green color of the reagt. is changed to orange-red in the presence of Bi in a slightly alk. soln. Pb, Sn (II), Tl interference may be removed by making the soln. acid; cf. H. Fischer, *Z. angew. Chem.* **47**, *685–92 (1934)*; Willoughby, Wilkins and Kraemer, *Ind. Eng. Chem., (Anal. Ed.)* **7**, *285–6 (1935); A. O. A. C., p. 405.* For detn. of Bi in biological material, cf. D. M. Hubbard, *Ind. Eng. Chem., (Anal. Ed.)* **11**, *343 (1939)*.

CAFFEINE as sulfate or nitrate used to ppt. Bi which is subsequently detd. by a volmtc. method. Of the common ions only Ag, Cu, and Hg (I) intfr. Beale and Chandlee, *Ind. Eng. Chem., (Anal. Ed.)* **14**, *43 (1942)*.

ORGANIC REAGENTS FOR INORGANIC ANALYSIS

BORON, BORATE

TURMERIC paper and solution, **CURCUMIN** paper and solution. Turmeric soln. made by extraction of the powder with cold alc.; curcumin soln. 0.1% in alc. Papers made by immersion in solns. and drying. To test for a borate, the test paper is immersed in the sample acidified with HCl and then allowed to dry; a brownish-red color which is intensified on drying and which turns to a dark blue-green with NH_4OH indicates borate; cf. *U.S. Pharmacopoeia XI, p. 449; A. O. A. C., p. 459, 542.* Test papers are used for estn. of small amounts of B (under 0.1 mg. B_2O_3). B separated by volatilization as the methyl ester, absorbed in NaOH soln., evaporated, made acid, and tested with papers. Length of red stain permits estn. of boron; cf. *Snell, pp. 527–8; Yoe I, p. 134.* Solns. of turmeric or curcumin may be added to borate soln. or to residue after evaporation for colmtc. estn.; cf. *Snell, p. 526; Yoe I, p. 135.* Fe (III), Mo, Ti, Cb, Ta, Zr, give red colorations with these reagts. but differ in that NH_4OH does not cause the usual change in color. Oxidizing substances must be absent; phosphate and silicate ions diminish the sensitivity of the reaction; cf. *Feigl, p. 223.*

METHYL ALCOHOL.—In the absence of Cu, B may be easily detected and roughly estimated by adding the reagt. and H_2SO_4 (5 vol.: 1 vol.) and igniting the vapor contg. methyl borate to obtain a green bordered flame; cf. *U. S. Pharmacopoeia XI, p. 449;* W. Stahl, *Z. anal. Chem.* **101**, *342–56 (1935).*

MANNITOL or **GLYCEROL** can be used for the detn. of borate by titrating the test soln. to about pH 7, adding the reagent which makes the test soln. acid in proportion to the amount of borate present, and titrating back to neutrality with dil. standard NaOH; cf. *A. P. H. A., pp. 30–4; A. O. A. C., pp. 13, 460.*

***p*-NITROBENZENEAZOCHROMOTROPIC ACID (CHROMOTROPE 2B)**, 0.005% soln. in conc. H_2SO_4. As little as 8×10^{-5} mg. B may be detected by evaporating a drop of slightly alk. test soln. in a porcelain dish and adding 2 drops of the reagt. while the dish is still hot; on cooling, a violet to green color indicates B; cf. *Feigl, p. 225;* Komarowskii and Poluektov, *Mikrochemie* **14**, *317–20 (1934).* Recomm. (*I. C.*).

QUINALIZARIN (1,2,5,8-TETRAHYDROXYANTHRAQUINONE), 0.01% soln. in conc. H_2SO_4; other concentrations are better for colmtc. determinations; cf. literature reference. The violet color of the reagt. changes to blue in the presence of minute amounts of borate; cf. Feigl and Krumholz, *Mikrochemie, Pregl-Festschrift 77–86 (1929).* For detn. of B in soils and plants see Berger and Truog, *Ind. Eng. Chem., (Anal. Ed.)* **11**, *540–5 (1939).* For detn. of B in steel, cf. H. A. Kar, *Metals and Alloys* **9**, *175–7 (1938).*

TITAN YELLOW (CLAYTON YELLOW) in aq. soln. may be used to impregnate filter paper upon which sl. acid test soln. is dropped. In pres. of H_3BO_3 the spot is yellow and addn. of Na_2CO_3 or NH_4OH soln. turns it red. Mg, PO_4, and organic anions intfr. L. Robin, *Compt. rend.* **138**, *1046–8 (1904).* Recomm. (*I. C.*).

BROMINE, BROMIDE

FLUORESCEIN becomes eosin with change in color from greenish-yellow to pink by action of bromine liberated by suitable oxidizing agent. Test may be made on paper impregnated with reagt. and held over mouth of tube contg. unknown and oxidizing agent; *Feigl, p. 162.* Iodine giving similar reactions must be absent. For colmtc. detn. of bromide by fluorescein; cf. *Snell, p. 548.* **PHENOL RED**, 10 mg. per 100 ml. very dil. NaOH soln., reacts in a similar way but has several advantages. At pH 5.0 to 5.4 the color is changed from yellow to red or violet by 0.001 to 0.018 mg. Br. Iodide must be removed by boiling with $NaNO_2$ in acid soln.; cf. Stenger and Kolthoff, *J. Am. Chem. Soc.* **57**, *831–3 (1935).*

FUCHSIN-BISULFITE (SCHIFF'S REAGENT), 1% aq. soln. of fuchsin which has been decolorized with $NaHSO_3$ or SO_2. Bromine liberated by chromic acid soln. (25%) or chlorine produces a bluish color in the colorless reagt. Chlorides and iodides

do not interfere and the test may be used for detc. or colmtc. estn. of bromides in iodides and chlorides; cf. *Feigl, p. 163; Snell, pp. 544–5;* Recomm. (*I. C.*). Dilute H_2SO_4 may be used as a solvent for fuchsin and the colored substance formed from the bromine extracted with isoamyl alcohol for colmtc. estn.; cf. *Snell, p. 546.*

α-**NAPHTHOFLAVONE** (**7,8-BENZOFLAVONE; 2-PHENYL-1,4-α-NAPHTHOPYRONE**), 0.5% soln. in alc., is a reagt. which gives an intense rust-brown color with bromide ion in a neutral or acid soln. and may be used as an indicator in bromometric titrations; the color is reversibly discharged with As (III), Sb (III), Sn (II); cf. E. Schulek, *Z. anal. Chem.* **102,** *111–13 (1935);* cf. also *C. A.* **29,** *3934 (1935),* and *C. A.* **29,** *6523 (1935); Feigl, p. 164.* **DIPHENYLCARBAZIDE** may also be used as an indicator in titrating bromide solns. with 0.025 *N* mercuric nitrate soln.; H. R. McCleary, *Ind. Eng. Chem.,* (*Anal. Ed.*) **14,** *31 (1942).*

CADMIUM

β-**NAPHTHOQUINOLINE**, 3% soln. in 0.5 *N* H_2SO_4, is a reagt. which gives with KI a quant. ppt. of Cd as $(C_{13}H_9NH)_2CdI_4$ and may be used for detn. of Cd in Zn ores and in spelter; Group II metals do not hinder the detn.; cf. Berg and Wurm, *Ber.* **60,** *1664–71 (1927).* For less than 50 mg. of Zn a volmtc. method may be used; cf. Pass and Ward, *Analyst* **58,** *667–72 (1933).* Recomm. (*I. C.*).

DIPHENYLCARBAZIDE, satd. alc. soln., is used to impregnate paper used for a spot test. The test soln. is dropped on the paper which, after 1 or 2 minutes, is held over an open ammonia bottle to develop the blue-violet spot indicating Cd; by various means, interference by other Group II metals may be overcome; cf. *Feigl, p. 47.*

DINITRODIPHENYLCARBAZIDE, 0.1% alc. soln., gives with $Cd(OH)_2$ and other metallic hydroxides colored adsorption complexes; with KCN present, Cu does not intfr. with the Cd test which gives a greenish-blue color when test soln. is mixed on spot plate with NaOH, KCN and a little 40% formaldehyde; cf. *Feigl, p. 49.* Recomm. (*I. C.*).

DIPHENYLTHIOCARBAZONE (DITHIZONE), 30 mg. per liter of $CHCl_3$, may be used to detect minute amounts of Cd in a soln. made alk. with NaOH and contg. tartrate; the reagt. on shaking with the test soln. gives a red to violet color with Cd; Co and Ni give colorations under the same conditions; cf. H. Fischer, *Z. angew. Chem.* **47,** *685–92 (1934).* Recomm. (*I. C.*). For detn. of Cd in silicate rocks, cf. E. B. Sandell, *Ind. Eng. Chem.,* (*Anal. Ed.*) **11,** *364 (1939).*

NITROPHENOLARSINIC ACID, in 10% AcOH soln., is a specific qual. reagt. for Cd in AcOH soln.; 1 part of Cd in 200,000 parts of soln. will show a yellowish crystalline ppt. when warmed with the reagt.; cf. Pavelka and Kolmer, *Mikrochemie* **8,** *277–80 (1930).* Recomm. (*I. C.*).

HEXAMETHYLENETETRAMINE ALLYLIODIDE (ALLYL IODOUROTROPINE), 10% aq. soln., quantitatively ppts. a complex Cd compound, containing 11.45% Cd, which may be dried at 105° C. for gravmtc. detn.; cf. Evrard, *Ann. chim. anal. chim. appl.*, **11,** *322–6 (1929).* In the presence of Zn and some other metals the method is not satisfactory; cf. Hurd and Evans, *Ind. Eng. Chem.*, (*Anal. Ed.*) **5,** *16 (1933).*

1-(2-QUINOLYL)-4-ALLYL-THIOSEMICARBAZIDE, satd. soln. in 50% alc., with KI in a neutral or slightly acid soln. gives a yellow ppt. with Cd; Cu does not intfr.; cf. Scott and Adams, *J. Am. Chem. Soc.* **57,** *2541–2 (1935).*

8-HYDROXYQUINOLINE (OXINE) quant. ppts. Cd from an AcOH soln. buffered with AcONa; Cu is also pptd. The ppt. is $Cd(C_9H_6ON)_2 \cdot 1.5H_2O$; cf. Burg and Wurm, *Z anal. Chem.* **71,** *321 (1927);* or, $Cd(C_9H_6ON)_2 \cdot 2H_2O$; cf. Wenger, Cimerman and Wyszewianska, *Mikrochemie* **18,** *182 (1935).*

4-NITRONAPHTHALENE-DIAZOAMINOBENZENE-4-AZOBENZENE (CADION 2B), 0.02 g. in 100 ml. of ethyl alc. contg. 1 ml. of 2 *N* KOH, is said to be specific,—in absence of Hg,—as a spot test for Cd. A drop of reagt. is placed on filter

paper and a smaller drop of neutral or sl. acid (with AcOH) test soln. contg. tartrate is added. Finally a drop of 2 *N* KOH in 20% alc. is added. If as much as 0.002 mcg. Cd is present in the test drop, a pink spot surrounded by a blue circle will appear. F. P. Dwyer, *Australian Chem. Inst. J. & Proc.* **5**, *37–40 (1938); C. A.* **32**, *2871.*

CALCIUM

AMMONIUM OXALATE is the most commonly useful reagt. for detc. and detn. of Ca in soln. contg. in addn. to Ca only Mg and alkali metals and no strong acids. The detn. may be made by gravmtc. or volmtc. methods, the latter being done by titration of oxalic acid liberated from the ppt. by action of strong acid; cf. Hillebrand and Lundell, *Applied Inorganic Analysis (Wiley), pp. 493–503 (1929)* and other references. Recomm. (*I. C.*).

DIHYDROXYTARTARIC ACID OSAZONE (sodium salt) gives a yellow ppt. with Ca in even very low concn.; other alkaline earth metals behave similarly although Mg does not ppt. unless present in an amount greater than the Ca; alkali metals and ammonium do not intfr. Test is made by placing a small grain of the solid reagt. in depression of black spot plate and adding drop of neutral test soln.; the ppt. is formed slowly; cf. *Feigl, p. 140.* Recomm. (*I. C.*).

OLEIC, RICINOLEIC and **STEARIC ACIDS** are used in the estn. of Ca forming insoluble soaps which are determined by means of nephelometric or colorimetric measurements of the suspended soaps. In these methods it is usually necessary to make a preliminary sepn. of the Ca as CaC_2O_4 which is subsequently dissolved and detd. in the soln. freed from Mg and other interfering substances. The methods have been used in the detn. of Ca in urine, feces, blood, milk, and other organic materials. Samples used in the detn. should contain from 0.005 to 2.5 mg. Ca; cf. *Snell, pp. 449–53; Yoe I, pp. 143–7; Yoe II, pp. 119–25.* **SULFORICINOLEIC ACID** may be used in the same way and is said to have the advantage of not forming an insoluble Mg salt; for the method of use, cf. *Yoe II, 125–9; Snell, p. 453.*

ALIZARIN, 0.1% alc. soln., is used for the detn. of Ca which has been sepd. from Mg by pptn. as oxalate; the calcium oxalate is dissolved in dil. HCl, the reagt. and NH_4OH added, after several hours the blue-black crystalline ppt. of Ca alizarinate filtered off, washed, redissolved in oxalic acid, and the liberated alizarin estimated colmtcly.; 0.1 mg. Ca can be detd. to within 2 to 5%; cf. Laidlow and Payne, *Biochem. J.* **16**, *494–8 (1922); Yoe I, pp. 139–43; Snell, p. 465.*

PICROLONIC ACID, aq. soln., has been used for the microscopic detc. of Ca. which forms spiny, yellow balls or needles; Mg, K, Na, NH_4 ions do not intfr.; Cu and Pb intfr.; cf. J. Kisser, *Mikrochemie* **1**, *25 (1923).* The method has also been used for the colmtc. detn. of samples contg. between 0.02 and 0.15 mg. Ca; the Ca is pptd. as the picrolonate, filtered off, dissolved in hot water, xs. bromine water added, after warming a short time it is made alk. and the color compared with standards; cf. *Snell, p. 466.* In another method, Li picrolonate is used in xs. to ppt. the Ca salt and the xs. is detd. by titration with methylene blue; cf. A. Bollinger, *Australian J. Exptl. Med. Biol. Sci.* **13**, *75–8 (1935).* The Ca salt may also be used for direct gravmtc. detn. of Ca; cf. F. Alten and associates, *Biochem. Z.* **265**, *85 (1933);* Dvorzak and Reich-Rohrivig, *Z. anal. Chem.* **86**, *98 (1931).*

ANTIPYRINE may be used for an indirect colmtc. detn. of Ca which is quant. ppt. as $K_2CaNi(NO_2)_6$, the nitrite ion of which is estimated colmtcly. by use of antipyrine; Ba and Sr react similarly but Cu, Mn, Al, Fe, Zn, and Mg do not ppt.; the error should be less than 4%; cf. *Snell, pp. 462–3.*

HYDROQUINONE with sodium bisulfite, **1,2,4-AMINONAPHTHOLSULFONIC ACID,** and other organic reducing agents are used for an indirect colmtc. detn. of Ca. The calcium is obtained as the phosphate, amm. molybdate is added to form the phosphomolybdate which is then reduced to the "molybdenum blue" for colmtc. estn.; As must be absent; the method is suitable for detn. of 0.02 to 0.2 mg. Ca; cf. *Snell, pp. 454–6;* Roe and Kahn, *J. Biol. Chem.* **81**, *1–8 (1929).*

LORETIN (3-HYDROXY-7-IODOQUINOLINE-5-SULFONIC ACID) gives a bright orange-red ppt. with Ca salts in sl. acid solns. contg. between 5 ppm and 2% Ca. Mg, Na and K do not intfr. N. Schoorl, *Pharm. Weekblad* **76**, *620–5 (1939)*; *C. A.* **33**, *5767*.

CARBON DIOXIDE, CARBONATE, CARBON MONOXIDE

PHENOLPHTHALEIN-sodium carbonate, 2.5 ml. 0.5% phenolphthalein, 1 ml. 0.1 *N* Na_2CO_3, and 10 ml. water, is a reagt. which is colored red but becomes colorless by absorption of CO_2; a drop may be held on a coiled platinum wire to test a mixture of gases, or the gas evolved on acidulation of a solid or liquid unknown substance; the test is not specific as any acid-forming gas will decolorize the reagt.; cf. *Feigl, p. 221;* Feigl and Krumholz, *Mikrochemie* **8**, *131 (1930)*.

PHENOLSULFONEPHTHALEIN, BROMOTHYMOL BLUE and other indicators have been used for determining CO_2; cf. *Snell, pp. 117–24*.

HEMOGLOBIN with **PYROGALLIC** and **TANNIC ACIDS** has been used for the detn. of CO in blood and in gaseous mixtures; normal blood becomes gray when diluted with water and treated with tannic acid whereas in the presence of CO this color change does not occur and the color remains red; for details cf. Sayers, Yant and Jones, *Bur. Mines Repts. Investigations No. 2486 (1923)*; *Snell, pp. 112–5*.

CERIUM

GALLIC ACID, 0.02% aq. soln., gives a blue-violet color with ceric ion in a soln. contg. in addition amm. hydroxide and Na_2SO_4; for colmtc. detn. a sample contg. 0.03 to 0.07 mg. Ce should be used and the test soln. covered with a protective layer of mineral oil or ether; Th, La, Ti ions intfr.; Fe, Al, Cr, Mn, Co, Ni, and uranyl ions do not intfr.; **PYROGALLOL** may be used for detc. instead of gallic acid; cf. F. M. Shemyakin, *Zavodskaya Lab.* **3**, *1090–1 (1934)*; *C. A.* **29**, *2879*; *Snell, p. 366*. **TANNIN** may also be used; cf. *C. A.* **33**, *3289 (1939)*.

BENZIDINE, in AcOH soln., will detect 0.0002 mg. Ce when a drop of the test soln. is placed on filter paper, then one drop of dil. NaOH followed by a drop of the reagt.; Ce (III) or Ce (IV) give a blue coloration; the test is specific in the rare earth metals, but ions of Mn, Co, Cu, Ag, Tl, CrO_4 intfr. by reacting similarly; in the presence of these interfering metals the Ce may be pptd. with HF and then tested; cf. *Feigl, p. 132;* cf. also E. Herzfeld, *C. A.* **33**, *3289 (1939)*. The leuco base of **MALACHITE GREEN** is said to be slightly more sensitive to the Ce (IV) than is benzidine and the same ions intfr.; cf. L. M. Kul'berg, *J. Applied Chem. (U. S. S. R.)* **8**, *1452–6 (1935)*; *C. A.* **30**, *5143 (1936)*; **31**, *626 (1937)*.

CESIUM

DIPICRYLAMINE (HEXANITRODIPHENYLAMINE) in soln. in Na_2CO_3 gives ppt. with Cs but reaction is not distinctive; cf. van Nieuwenburg and van der Hoek, *Mikrochemie* **18**, *175–8 (1935)*; *C. A.* **30**, *43 (1936)*.

CHLORINE, CHLORIDE, CHLORATE, PERCHLORATE

***o*-TOLIDINE**, 1 g. per liter of 10% HCl (prepared by mixing the solid tolidine with HCl and then adding more water and HCl) is stable for 6 months; it gives a yellow coloration with water contg. 0.01 to 1.0 ppm chlorine and is used in detg. free or chloramine chlorine in water. Permanent standards may be made from $CuSO_4$ and $K_2Cr_2O_7$, or K_2CrO_4 and $K_2Cr_2O_7$; cf. Dragt and Mellon, *Ind. Eng. Chem.*, (*Anal. Ed.*) **10**, *256–8 (1938)*. The color is allowed to develop 5 to 15 minutes in the dark before comparison is made. More than 0.3 ppm Fe (III), 0.01 ppm Mn (III), 0.3 ppm nitrite and other oxidizing agents intfr. by producing the same coloration as chlorine; cf. *A. P. H. A., pp. 20–5; ibid., pp. 228–31*. The reagt. has also been used for estn. of free chlorine in sewage and in air; cf. *Snell, pp. 538–41; Yoe I, pp. 157–9*. Recomm. (*I. C.*).

BENZIDINE has also been recommended for colmtc. detn. of free chlorine giving a green color which is more intense and better suited for colmtc. comparison than is *o*-tolidine; the color fades in 2 or 3 minutes and sulfates intfr. if present in a concentration sufficient to ppt. benzidine sulfate; cf. Stratton, Ficklen and Hough, *Ind. Eng. Chem., (Anal. Ed.)* **4**, 2 *(1932)*; *Snell, p. 541.*

DIMETHYL-*p*-PHENYLENEDIAMINE gives a red coloration with free chlorine which is suitable for colmtc. estn.; cf. Kolthoff, *Chem. Weekblad* **23**, *203–4 (1926)*; *Snell, p. 542.*

CHLOROPHENOL RED or **BROMOCRESOL GREEN**, 0.1 g. in 100 ml. 20% alc. soln., are adsorption indicators for titration of *chloride* with standard $HgNO_3$; cf. Zombary and Pollak, *Z. anorg. allgem. Chem.* **215**, *255–6 (1933)*; cf. also *J. Am. Chem. Soc.* **56**, *1891 (1934)*. **DIPHENYLCARBAZIDE** is also recommended as an indicator for titration with $Hg(NO_3)_2$; cf. I. Roberts, *Ind. Eng. Chem., (Anal. Ed.)* **8**, *365–7 (1936)*. Diphenylcarbazide may also be used for detc. of chloride in a solid sample by volatilization therefrom of chromyl chloride the Cr of which affects the reagt. Recomm. *(I. C.)*. *Feigl, 160.* **DICHLOROFLUORESCEIN**, 0.1% soln. in 50% alc. contg. a small amount of NaOH, as an indicator in titration of chloride with Ag ion, has some advantages over unsubstituted fluorescein; cf. Fajans and Wolf, *Z. anorg. allgem. Chem.* **137**, *221 (1924)*; Kolthoff and associates, *J. Am. Chem. Soc.* **51**, *3273–7 (1929)*. **TARTRAZINE** has also been used; cf. Fearon and Gillespie, *Biochem. J.* **28**, *1629 (1934)*.

NITROBENZENE has been added to the soln. in the Volhard method to enable titration of xs. $AgNO_3$ without removal of AgCl; cf. Caldwell and Moyer, *Ind. Eng. Chem., (Anal. Ed.)* **7**, *38–9 (1935)*.

ANILINE HYDROCHLORIDE, in the absence of oxidizing agents, may be used for the detc. and colmtc. detn. of *chlorate*; reducing agents, other than the reagt., must be absent; cf. *Snell, p. 588; Yoe I, 163.* Chlorate may also be detc. by warming of unknown soln. with a mixture of 85% phosphoric acid and satd. manganous sulfate soln. On cooling, if chlorate is present, a violet color is obtained. Test can be made more sensitive by addn. of a drop of 1% alc. soln. of **DIPHENYLCARBAZIDE** which intensifies the color. Periodates and persulfates intrf. *Feigl, p. 190.* Recomm. *(I. C.)*.

NITROSODIMETHYLANILINE, 0.1% soln. in dil. alc., gives a violet color with *perchlorate* and is recommended for detc. and colmtc. estn. of this ion in Chile saltpeter; iodides must be removed with silver oxide; cf. *Yoe I, p. 163; Snell, p. 592.*

METHYLENE BLUE, 1.6% aq. soln., may be used for pptn. or colmtc. detn. of *perchlorate. Snell, p. 590.* Recomm. *(I. C.)*.

α-PHENYL-β-DIETHYLAMINOETHYL-*p*-NITROBENZOATE, 3 g. of the hydrochloride in 10 ml. water, may be used for detc. of *perchlorate* giving a turbidity or a white ppt. in neutral soln. with concns. of ClO_4 ion as low as 0.0025 *N*; nitrate ion also gives a ppt. in concns. of 0.01 *N*; iodide, oxalate, thiocyanate, and dichromate ions intfr.; cf. Marvel and du Vigneaud, *J. Am. Chem. Soc.* **46**, *2661–3 (1924)*.

CHROMIUM, CHROMATE

***s*-DIPHENYLCARBAZIDE**, satd. alc. soln., gives a violet coloration with chromate in a soln. acidified with AcOH; the color is suitable for estn. of Cr after oxidation to chromate by means of Na_2O_2 or other strong oxidizing agents; Fe does not intfr.; cf. A. Cazeneuve, *Analyst* **25**, *331 (1900)*. For the spot test, cf. *Feigl, pp. 98–102*; for colmtc. detn., cf. *Snell, p. 279* and *Yoe I, p. 166*; for application to qual. analysis scheme, cf. Stover, *J. Am. Chem. Soc.* **50**, *2363–6 (1928)*; for detn. of Cr in TiO_2, cf. Flatt and Vogt, *Bull. soc. chim.* (5) **2**, *1985–93 (1935)*. Recomm. *(I. C.)*.

DISODIUM-1,8-DIHYDROXYNAPHTHALENE-3,6-DISULFONATE (CHROMOTROPIC ACID), 1% aq. soln., gives a pink to light red color with chromate and may be used for colmtc. detn. of Cr in steel and in plant ash; the reaction is carried out in strongly acid soln. contg. H_3PO_4. Cr is oxidized and removed from most of the iron by treatment with NaOH and Na_2O_2; steel contg. less than

0.6% Cr may be analyzed advantageously with this reagt., and 0.02 mg. Cr may be detd. with an average error of 1%; vanadium does not intfr. if present in amounts less than Cr; cf. F. Garratt, *Ind. Eng. Chem.* 5, *298 (1913); Snell, p. 278; Yoe I, p. 165.* Recomm. (*I. C.*).

BENZIDINE, 0.1% in 10% AcOH may be used for detc. of Cr by oxidn. to chromate through use of Na_2O_2, placing drop on filter paper, then drop of reagt. to get a blue ring. Mn and V intfr. by giving similar color. Cf. *Feigl, p. 102.* Recomm. (*I. C.*).

SERICHROME BLUE R may be used for estn. of chromate by first dyeing wool yarn or flock with the reagt. which produces a crimson color. The dyed samples are changed to blues of varying intensities by immersion in chromic acid of varying concentrations; cf. G. C. Spencer, *Ind. Eng. Chem.*, (*Anal. Ed.*) 4, *245 (1932); Snell, p. 281.*

DIPHENYLAMINE or **DIPHENYLCARBAZIDE** may be used as an internal indicator in titrations with dichromate; cf. Kolthoff, *J. Am. Chem. Soc.* 53, *2902 (1931).*

ORCINOL (*s*-**DIHYDROXYTOLUENE**) in alc. soln. gives a brown coloration as a spot test on paper; cf. G. Gutzeit, *Helv. Chim. Acta* 12, *713 (1929).*

COBALT

α-NITROSO-β-NAPHTHOL, 7 g. in 100 ml. glacial AcOH, is used for detg. Co in tungsten steels by adding to a slightly acid soln. of the steel 6 ml. of reagt. for every 10 mg. of expected Co, filtering, washing and igniting to Co_3O_4; with comparatively large amounts of Co the oxide is reduced to the metal with hydrogen; the ppt. may be contaminated with Ni if this metal predominates in the original soln.; cf. *Standards and Specifications for Metals and Metal Products; Misc. Publication No. 120 of the Bu. of Standards, issued March 11th, 1933;* cf. also Hillebrand and Lundell, *Applied Inorganic Analysis, p. 326.* For colmtc. methods of detg. Co in paints and other commercial products cf. *Snell, pp. 322–4;* E. G. Jones, *Analyst* 43, *317 (1918);* in these methods the reagt. is dissolved in dil. NaOH; cf. also *Yoe 1, pp. 173–6.* As a spot test, giving a brown coloration, 0.05 mcg. Co may be detected; cf. *Feigl, pp. 83–6.* For detection and detn. of Co in soils cf. J. S. Hosking, *Australian Chem. Inst. J. and Proc.* 3, *172–83 (1936).* **β-NITROSO-α-NAPHTHOL** is said to be a more sensitive reagt. for Co; cf. I. Bellucci, *Gazz. Chim. Ital.* 49, *11, 294–8 (1919).* Yoe and Barton, *Ind. Eng. Chem.*, (*Anal. Ed.*) 12, *405–9 (1940)* discuss intfr. and colmtc. procedure using this reagt. Both reagts. recomm. (*I. C.*). **DINITROSORESORCINOL** has also been suggested for the gravmtc. detn. of Co, but results may be inaccurate; cf. Orndorf and Nichols, *J. Am. Chem. Soc.* 45, *1439 (1923);* Tomicek and Komarek, *Z. anal. Chem.* 91, 90 *(1932).* **NITROSO-R-SALT** (**α-NITROSO-β-NAPHTHOL-3,6-DISODIUM DISULFONATE**), in 0.5% aq. soln., is a useful reagt. for detc. of Co. in a soln. strongly acid with HNO_3; cf. van Klooster, *J. Am. Chem. Soc.* 43, *746 (1921).*

RUBEANIC ACID (**DITHIO-OXAMIDE**), 1% alc. soln., gives a brown ppt. with ammoniacal Co soln. and may also be used for a spot test; Cu gives a black ppt., and Ni gives blue under the same conditions; cf. *Feigl, p. 86.* **POTASSIUM DITHIO-OXALATE** has also been used; cf. Gutzeit, *Helv. Chim. Acta* 12, *(1929).*

FORMALDOXIME reagt. is made by boiling a mixture of 7 g. $NH_2OH \cdot HCl$, 15 ml. H_2O, and 3 g. trioxymethylene until clear, then cooling. For detc. of Co, add 1 drop reagt. and 2 drops of 10 *N* NaOH to 10 ml. of test soln. to get a pale yellow coloration or ppt. Mn (II), Ni, Fe (III) and Cu (II) intfr. Recomm. (*I. C.*). Cf. *C. A.* 27, *927 (1933).*

DIMETHYLGLOXIME, in the absence of Cu and Fe, may be used for detc. or colmtc. detn. of Co; Ni, if present, is filtered off for observation of the soln. which will be brown in the presence of as much as 0.5 mcg. per ml.; the error in the estn. may be as high as 10%; cf. *Snell, p. 327;* Braley and Hobart, *J. Am. Chem. Soc.* 43, *482 (1921).* The reaction is more sensitive if **BENZIDINE** or **TOLIDINE** is used along with the

dimethylglyoxime reagt.; cf. Spacu and Macarovici, *Bul. soc. Stiinte Cluj* **8**, *245–56 (1935); C. A.* **30**, *1684 (1936)*.

POTASSIUM XANTHATE gives a green ppt. with Co in a neutral or slightly acid soln.; Ni may ppt. but will dissolve in NH_4OH, making it possible to detect traces of Co in Ni; cf. Tougarinoff, *Ann. soc. sci. Bruxelles* **50B**, *168 and 235 (1930)*.

DIPHENYLTHIOCARBAZONE (DITHIZONE), in $CHCl_3$, has been used to detect traces of Co in Ni; cf. H. Fischer, *Wiss. Veroffentlich. Siemens-Konzern* **6**, *147–9 (1928); C. A.* **23**, *1364 (1929)*.

PHENYLTHIOHYDANTOIC ACID has been used for the sepn. and gravmtc. detn. of Co in the presence of Al, Cr, V, W, U, Mo, As, Ti, Zn, Mn, Ca and Mg. The Ni ppt. is washed out with NH_4OH and the violet colored ppt. is ignited and weighed as Co_3O_4; cf. Willard and Hall, *J. Am. Chem. Soc.* **44**, *2219; ibid.*, **44**, *2226; ibid.*, **44**, *2253 (1922)*.

THIOGLYCOLIC ACID ANILIDE, 2% alc. soln., is a reagt. for detc. of Co in a soln. from which Ag and the Cu-Sn groups have been removed. The test soln., made ammoniacal, is boiled, the reagt. added, boiled, and then made acid with HCl; a ppt. remaining on acidification indicates Co; cf. T. Berzin, *Z. anal. Chem.* **85**, *428–33 (1931)*.

ANTHRANILIC ACID (*o*-**AMINOBENZOIC ACID**) quant. ppts. Co from a soln. free from Zn, Cd, Ni, Mn, and Cu, and buffered to a pH of 4.4 or above; cf. Funk and Ditt, *Z. anal. Chem.* **93**, *241–7 (1933)*; H. Goto, *J. Chem. Soc. Japan*, **55**, *1156–63 (1934)*.

For a critical report on about 150 reagts. for detc. of Co see Wenger, Duckert, and Basset, *Helv. Chim. Acta* **24**, *657–70 (1941); C. A.* **35**, *6536 (1941)*.

COLUMBIUM

TANNIN with oxalic or tartaric acids has been used for the separation of Cb from Ta, and from Zr, Th, and Al; with Cb, tannin in the presence of oxalic acid gives a red ppt., whereas Ta gives a yellowish-brown; if Ta ppt. is contaminated with Cb, it is red. For details of quant. methods; cf. W. R. Schoeller, *The Analytical Chemistry of Tantalum and Niobium (1937)*, *Nordemann Publishing Co. (New York)*.

COPPER

α-BENZOINOXIME (CUPRON), 5% soln. in alc. gives a green ppt. with Cu from a hot ammoniacal soln. preferably free of NH_4 salts; tartrate prevents pptn. of Fe, Al, and other insol. hydroxides, thus permitting a sepn. of Cu from them; the ppt. may be dried at 100° C. for gravmtc. detn.; the reagt. may also be used for a spot test; cf. *Feigl. p. 38* and *Prodinger, pp. 63–66*. Recomm. (*I. C.*). For use in soil analysis, cf. J. S. Hosking, *Australian Chem. Inst. J. and Proc.* **3**, *172–83 (1936); C. A.* **30**, *6488 (1936)*; in steel analysis, Kar, *Ind. Eng. Chem.*, (*Anal. Ed.*) **17**, *193 (1935)*, and in amperometric titration of Cu, A. Langer, *Ind. Eng. Chem.*, (*Anal. Ed.*) **14**, *283 (1942)*.

SALICYLALDOXIME reagt. is prepared by dissolving 1 g. in 5 ml. alc., pouring into 95 ml. water at 80°, allowing to stand a few minutes and then filtering, or it may be made without isolation of the oxime by dissolving 2.22 g. of salicylaldehyde in 8 ml. ethyl alc., adding to a soln. of 1.27 g. of $NH_2OH \cdot HCl$ in 2 ml. H_2O, diluting with 15 ml. alc. then stirring slowly into 225 ml. H_2O at 80°. Asten and Riley, *J. Chem. Soc.* (**1933**) 314. It is more nearly specific than benzoinoxime and only Au and Pd, in addition to Cu, ppt. in a soln. acid with AcOH. The yellow-green ppt. of Cu $(C_7H_6O_2N)_2$ may be used as a spot test for detc. or gravmtc. detn., or for the sepn. of Cu from Cd, Ni, Pb, and other metals. Recomm. (*I. C.*) cf. F. Ephraim, *Ber.* **63**, *1928 (1930); ibid.*, **64**, *1210 (1931); Feigl. p. 40;* Ishibashi and Kishi, *J. Chem. Soc. Japan* **55**, *1060–9 (1934); C. A.* **29**, *702 (1936)*. For a nephelometric method using salicylaldoxime cf. Alten and associates, *Mikrochemie* **20**, *77 (1936)*. Cu may be sepd.

and quant. pptd. from Pb and Zn at pH 2.5 to 4.0; Biefeld and Ligett, *Ind. Eng. Chem., (Anal. Ed.)* **14**, *359–61 (1942)*. ***p*-HOMOSALICYLALDOXIME**, 1% aq. soln. with a little alc. is said to be easier to prepare than salicylaldoxime and is used in the same way; cf. Kao and Chen, *J. Chinese Chem. Soc.* **3**, *22–6 (1935)* *C. A.* **29**, *4691 (1935)*.

ANTHRANILIC ACID, 3% soln. of the sodium salt, gives a greenish crystalline ppt. $Cu(C_7H_6O_2N)_2$, which is formed in neutral or acidic (AcOH-AcONa) soln., and has been used for gravmtc. and volmtc. detn.; at pH 2.8 to 3.0 no other metals ppt.; cf. Funk and Ditt, *Z. anal. Chem.* **93**, *345–7 (1933)*; H. Goto, *J. Chem. Soc. Japan* **55**, *1156–63 (1934)*; *C. A.* **29**, *1029 (1935)*; *Prodinger, p. 37.*

α-QUINALDINIC ACID, about 5% soln. of the sodium salt, has been used for the gravmtc. detn. and for separation of Cu from Cd, P, As, Pb, Ni, Co, and Mn; a green ppt. is formed in sl. acid soln. (H_2SO_4) and is dried at 125° C. to Cu $(C_{10}H_6NO_2)_2 \cdot H_2O$; Zn and uranyl also ppt.; cf. Ray and Bose, *Z. anal. Chem.* **95**, *400–14 (1933)*; Lindsey and Shennan, *Analyst* **65**, *636 (1940)*; *C. A.* **35**, *1340*; *Prodinger, p. 55.*

POTASSIUM ETHYL XANTHATE, 0.1% aq. soln. prepared fresh every day, is used for the colmtc. detn. of Cu in amounts less than 1 mg. and gives a yellow color in neutral or acid soln.; there is an error of 10–15% in detns. of 0.005 to 0.018 mg. of Cu; Fe, Pb, Ni, Co, Zn, and Mn in small amounts are said to be without interference but in plant ash it is best to separate out Cu first as CuS; *A. O. A. C., p. 130; Snell, pp. 152–5; Yoe I, p. 184.*

SODIUM DIETHYLDITHIOCARBAMATE, 0.1% aq. soln. is stable for several weeks if kept in a brown bottle and may be used for detc. of Cu in dilutions as low as 0.01 ppm and for colmtc. estn. of low concentrations as found in water which has been treated with $CuSO_4$ as an algaecide. The sample for detn. should not contain over 0.1 mg.; concentrations between 0.1 and 1.0 ppm are best for estn.; in this concentration a brown coloration is obtained and at higher concentrations a brown ppt. is formed; the reaction should be carried out in a slightly ammoniacal soln.; other metals in comparable amounts are not likely to intfr. although cyanide must be absent; cf. *A. P. H. A., pp. 25–6*; Callan and Henderson, *Analyst* **54**, *650 (1929)*. For a more general discussion cf. *Snell, pp. 164–6*; for Cu in milk cf. Conn and others, *Ind. Eng. Chem., (Anal. Ed.)* **7**, *15–23 (1935)*; for Cu in blood and other biological materials cf. S. L. Tompsett, *Biochem. J.* **29**, *480–6 (1915)*.

THIOGLYCOLIC β-AMINONAPHTHALIDE (THIONALID), alc. or AcOH soln. freshly prepared, ppts. Cu as a yellow compound from acid soln.; most of the metals which are pptd. by H_2S are likewise pptd.; in the absence of intfr. metals, the reagt. may be used for gravmtc., volmtc., colmtc., or nephelometric detn.; cf. Berg and Roebling, *Z. angew. Chem.* **48**, *430–2* and *597–601 (1935)*. It is claimed that Cu can be quant. sepd. from Tl, Fe, Ca, Ba, Mg, Zn, Cd, Mn, Co, Ni, Cr, Pb and Al; cf. *Prodinger, p. 88.*

RUBEANIC ACID (DITHIO-OXAMIDE), 0.5% alc. soln., gives a dark green to black ppt. with Cu, and as a spot test may be used for detc. of Cu in the presence of a large excess of Co, Ni, Fe, and Cd; cf. Ray, *Z. anal. Chem.* **79**, *94 (1930)*; *Feigl, pp. 44–46.* Recomm. (*I. C.*).

MERCAPTOBENZOTHIAZOLE, alc. soln., gives a yellow ppt. with Cu and also forms ppts. with Au, Ag, Pb, and Hg but not with Ni, Co, Zn, Cd, Mg, Mn, Ca, Ba, and Sr; cf. Spacu and Kuras, *Z. anal. Chem.* **102**, *24* and *108 (1935)*. **DIMERCAPTOTHIODIAZOLE** is similar in its actions with metals; cf. Ray and Gupta, *J. Ind. Chem. Soc.* **12**, *308–17 (1935)*; *C. A.* **29**, *7214 (1935)*; *Prodinger, p. 112.*

DIPHENYLTHIOCARBAZONE (DITHIZONE), in $CHCl_3$ or CCl_4 soln., can be used for the colmtc. detc. and detn. of mcg. quantities of Cu; cf. Fischer and Leopoldi, *Z. angew. Chem.* **47**, *90–2 (1934)*; R. M. Mehurin, *J. Assoc. Official Agr. Chem.* **18**, *192–4 (1935)*; *Feigl, p. 46.* For review of uses of this reagt., cf. Wichmann, *Ind. Eng. Chem., (Anal. Ed.)* **11**, *66–72 (1939)*.

PYRIDINE and thiocyanate may be used for pptn. of Cu as $Cu(CSN)_2 \cdot 2C_5H_5N$ which is dissolved in $CHCl_3$ for colmtc. detn.; or xs. KCNS may be titrated for volmtc.

detn.; cf. *Snell, pp. 159–62;* Hawk and Bergheim, *Practical Physiological Chemistry, 10th Ed., p. 468;* Tettamanzi, *Industria Chimica* **9**, *609–10 (1934); C. A.* **28**, *6653.* **BENZIDINE** or **TOLIDINE** may be used instead of pyridine; cf. *Z. anal. Chem.* **67**, *31 (1925).* Benzidine may be used with sodium salicylate for a rough colmtc. estn. of Cu; cf. *Snell, p. 162;* for other reactions of benzidine used in the detc. and detn. of Cu cf. *C. A.* **30**, *43 (1936);* **29**, *4498 (1935);* **29**, *6167 (1935);* **28**, *1951 (1934).*

The **AMMONIUM** salt of **NITROSOPHENYLHYDROXYLAMINE (CUPFERRON)**, 6% aq. soln. is a reagt. which is stable for weeks and gives a ppt. of Cu, in a neutral or slightly acid (AcOH) soln., which may be ignited to CuO for gravmtc. detn.; many other metals, such as Pb, Bi, Ag, Hg, Sn, and Fe, intfr. by pptg. also; Baudisch and King, *Ind. Eng. Chem.* **3**, *629 (1911);* cf. also *C. A.* **29**, *3624 (1935); Prodinger, p. 72–75.*

5,7-DIBROMO-8-HYDROXYQUINOLINE, 0.5% soln. in 5 *N* HCl or satd. soln. (about 0.3%) in acetone, may be used for the gravmtc. detn. of Cu in micro quantities as in water; the ppt. is $C_{18}H_5O_2N_2Br_4Cu$; cf. Berg, *Z. anal. Chem.* **70**, *347 (1927);* L. W. Haase, *Z. anal. Chem.* **78**, *113–24 (1929);* cf. also *Mikrochemie* **17**, *127 (1935)* and *C. A.* **30**, *983 (1936).* Unsubstituted **8-HYDROXYQUINOLINE (OXINE)** may also be used; in AcOH soln., Cu may be detd. in presence of Be, Mg, Ca, Cd, Pb, As and Mn, cf. *Prodinger, p. 110.*

BENZOTRIAZOLE in 2% aq. soln. gives quant. pptn. of Cu as a blue-green compd., $(C_6H_4N_3)_2Cu$, at pH 7.0–8.5. Ni, Co, Ag, Cd, Zn intfr. J. A. Curtis, *Ind. Eng. Chem., (Anal. Ed.)* **13**, *349–51 (1941).*

CYANIDE

BENZIDINE, in AcOH soln., is oxidized to a blue compound by nascent oxygen from interaction of $Cu(OAc)_2$ and HCN; in the absence of other oxidizing and reducing agents, the reaction is specific for HCN. Paper may be impregnated with the reagt. and $Cu(OAc)_2$ solns. and, while moist. exposed to the gas suspected of contg. HCN; a distinct blue coloration indicates HCN; solids or solns. may be tested by acidification to liberate HCN. With controlled conditions, the test may be made roughly quant.; cf. *Feigl, p. 176.* Sieverts and Hermsdorf, *Z. angew. Chem.* **34**, *3 (1921);* cf. also *C. A.* **7**, *3292.* **PHENOLPHTHALIN** will detect 0.2 ppm HCN which in the presence of dil. copper soln. yields the red phenolphthalein; Childs and Ball, *Analyst* **60**, *294–9 (1935).*

PICRIC ACID, alkaline soln., is a reagt. for impregnating paper and gives a red to brown spot with cyanide of low concn.; sulfide gives a similar color; cf. G. Gutzeit, *Helv. Chim. Acta* **12**, *713 (1929);* R. G. Smith, *J. Am. Chem. Soc.* **51**, *1171 (1929).*

FLUORIDE

SODIUM ALIZARINSULFONATE (ALIZARIN S) as a 0.05% aq. soln. is much used as an indicator in titration of fluoride solns. with standard thorium nitrate (0.05 to 1.0 *N*). The fluoride soln. should be adjusted to pH 3.0–3.2. The end point is shown by formation of pink color of thorium alizarin lake. Phosphate and certain other ions intfr. and are frequently eliminated from sample by distn. of the fluorine from sulfuric and perchloric acids. For detn. of F in soils cf. *A. O. A. C. p. 13;* in insecticides, *ibid. p. 51,* and in water, *same reference, p. 529.* In analysis for F in waters, however, distillation is usually unnecessary and detn. is made by colmtc. methods involving the use of the **ZIRCONIUM-ALIZARIN** lake which is changed from red-violet to yellow by an xs. of fluoride; the extent of the decoloration is a measure of amount of F. For details of detg. 0.1 ppm of F in presence of 500 ppm SO_4 cf. Lamar and Seegmiller, *Ind. Eng. Chem., (Anal. Ed.)* **13**, *901 (1941).* See also report of American Water Works Association Committee on methods of detg. fluorides, *J. Am. Water Works Assoc.* **33**, *1965–2017 (1941).* The color change of the Zr lake may be used as a spot test for F, *Feigl, p. 170.* Recomm. *(I. C.).*

***p*-DIMETHYLAMINOAZOPHENYLARSONIC ACID** gives a brown insol. compound with zirconium salts which turns red with F ion due to liberation of the

free dye; as with the alizarin reagt., other ions which remove Zr or form complexes with F intfr.; in all cases of intfr. the F may be separated out as HF or SiF_4; cf. *Feigl, p. 172.* Recomm. (*I. C.*).

After conversion to H_2SiF_6 and the treatment with ammonium molybdate, fluorine may be detc. by the oxidation of **BENZIDINE** to a blue compd. and simultaneous reduction of Mo to molybdenum blue; phosphates, arsenates, and silicates react similarly; cf. *Feigl, p. 173.* Cf. also Pertusi, *C. A.* **25,** *2076 (1931).* Recomm. (*I. C.*).

TRIPHENYLTIN CHLORIDE has been suggested as a reagt. for the gravmtc. detn. of fluoride which ppts. as $(C_6H_5)_3$ SnF. Allen and Furman, *J. Am. Chem. Soc.* **54,** *4625–31 (1932).*

GALLIUM

QUINALIZARIN, 0.01% alc. soln., will detect and determine colorimetrically Ga in concns. from 0.02 mg. to 0.2 mg. per liter by formation of a pink to amethyst colored lake. The test soln. should be normal in NH_4OAc, 0.5 *N* in NH_4Cl, have a pH of about 5 and should contain 0.5 g. NaF per liter. Ga may be separated from most metals but the test sample should not contain more than 10 mg. Al or more than 1 mg. Fe; V and Mo must be absent; cf. Willard and Fogg, *J. Am. Chem. Soc.* **59,** *40–5 (1937).* Recomm. (*I. C.*).

MORIN, satd. soln. in methyl alc., gives a green fluorescence in a soln. slightly acid with AcOH; Al gives the same test but its fluorescence is prevented by NaF; the Ga is also affected by the NaF but not as much as the Al; cf. G. Beck, *Mikrochemie* **20,** *194–7 (1936).* Recomm. (*I. C.*).

8-HYDROXYQUINOLINE (OXINE), 0.1% in dil. AcOH, may be used to detect minute amts. of Ga. Test soln. at pH 2.6–3.0 is shaken with reagt. and $CHCl_3$. Chloroform layer shows yellowish fluorescence in ultraviolet light if Ga is present. Fe (III), Cu (II), vanadate, and molybdate must be removed; other elements do not intfr. E. B. Sandell, *Ind. Eng. Chem.*, (*Anal. Ed.*) **13,** *844 (1941).*

GERMANIUM

BENZIDINE, 0.1% soln. in AcOH, may be used for a spot test; to a drop of the test soln. on a filter paper, is added a drop of amm. molybdate soln., a drop of HNO_3, then a drop of reagt., and the color developed with NH_3 fumes; as little as 0.25 mcg. of Ge gives a blue spot; the same reaction is given by Si, As, P_2O_5 and these must be absent; cf. Komarovskii and Poluektov, *Mikrochemie* **18,** *66–73 (1935).* Recomm. (*I. C.*).

Germanic acid, H_2GeO_3, reacts towards reagts. listed under *boron* in a manner similar to that of boric acid; **QUINALIZARIN** is especially recommended; cf. N. S. Poluektov, *Mikrochemie* **18,** *48–9 (1935).*

GOLD

Reducing agents such as *m*-**PHENYLENEDIAMINE, FORMALDEHYDE, PHENYLHYDRAZINE, BENZIDINE,** or **ACETYLENE** may be used for reduction of gold ion to colloidal gold which can be detc. or determined colmtcly.; cf. *Snell, pp. 402–8.* **BENZIDINE** may be used in a spot test with Au (III) giving the familiar blue spot; many other ions react similarly; cf. Malatesta and Di Nola, *Bull. Chim. Farm.* **52,** *461 (1912); Feigl, p. 71.* For analysis of Au and sepn. from the platinum metals, cf. F. E. Beamish, et al., *Ind. Eng. Chem.*, (*Anal. Ed.*) **9,** *174–6 (1937).*

DIMETHYLAMINOBENZALRHODANINE, satd. alc. soln., is used to impregnate paper for a spot test; Au in neutral or slightly acid soln. gives a reddish-violet ppt. or spot; Ag, Hg, and Pd react in a similar manner; *Feigl, p. 71;* cf. also *C. A.* **25,** *2380 (1931).*

PYRIDINE, 1 vol. in 9 vol. 40% HBr, gives orange to maroon colored crystals with Au (III) in an acid soln. if the concn. of Au is above 0.01%; cf. M. N. Short, *Microscopic Determination of the Ore Minerals, Bull. 825 U. S. Geol. Survey, Pt. 4 Microchemical Methods (1931).*

HYDROGEN ION

See table on **ACID-BASE INDICATORS.**

INDIUM

MORIN as satd. soln. in alc. is said to give a distinctive green fluorescence with In in presence of dil. mineral acid. It may be recognized even in admixture with Al, Sc, and Ga; cf. G. Beck, *Mikrochim. Acta* **2,** *287–90 (1937); C. A.* **32,** *1606.*

A sensitive spot test for In may be made by the use of **ALIZARIN-** impregnated paper to which is added a drop of the prepared test soln. and which is then dipped in a satd. aq. soln. of H_3BO_3 to get a red spot if In is present; most elements of the $(NH_4)_2S$ group intfr., cf. Komarovskii and Poluektov, *Mikrochemie* **16,** *227–32 (1934).*

In may be detd. with **8-HYDROXYQUINOLINE** by pptn. from buffered AcOH soln. Cf. Geilmann and Wrigge, *Z. anorg. allgem. Chem.* **209,** *129 (1932).*

IODINE, IODIDE

The familiar **STARCH** test for free iodine has been used with some success for the colmtc. estn. of iodine; cf. *Snell, p. 569.*

***o*-TOLIDINE,** 0.6% soln. in alc., gives with iodine a blue-green color suitable for colmtc. detn. of amounts between 0.01 mg. and 0.10 mg.; iodides may be oxidized to free iodine with H_2O_2 an xs. of which does not intfr.; iodates may be reduced for detn.; the test is made in a neutral soln.; nitrites are oxidized with H_2O_2 and bicarbonate decomposed by boiling; under conditions of the test 1500 ppm of chloride or bromide have no effect; Fe, Cu, Hg, and other metals must be removed if present in a concn. high enough to cause pptn. with the reagt.; cf. Lange and Ward, *J. Am. Chem. Soc.* **47,** *1000–3 (1925).*

METHYLENE BLUE soln. is decolorized by sulfite in a soln. 2 *N* with HCl at an immeasurably slow rate in the absence of iodide; up to 4 mcg. iodide may be detd. with errors no greater than 5% by observing the rate of fading of the reagt. in the presence of iodide as catalyst; cf. H. P. Lundgren, *J. Am. Chem. Soc.* **59,** *413–6 (1937).*

DIPHENYLCARBAZIDE as a satd. soln. in alc. may be used as an indicator in titration of iodide by means of $Hg(NO_3)_2$ soln. The end point is rendered very distinct by the presence of 10 to 15% of purified dioxane; cf. H. R. McCleary, *Ind. Eng. Chem., (Anal. Ed.)* **14,** *31 (1942).*

DIOXANE (DIETHYLENE OXIDE) commonly contains peroxides which oxidize iodide to iodine which colors the soln. and permits detc. and colmtc. detn. of small amts. of I as in iodized salt. Saifer and Hughes, *J. Biol. Chem.* **118,** *241–5 (1937); ibid.* **121,** *801 (1937).*

IRIDIUM

MALACHITE GREEN, LEUCO BASE, 1% soln. in glacial AcOH, is oxidized to the green color by $(IrCl_6)^{--}$ in an acid soln. The test is given by Ir in dilutions of 0.14 ppm in water; 1 part Ir in the presence of 3,000 parts of Pt may be detected. The reaction is not affected by moderate amounts of Rh, Os, and divalent Pd; free Cl, Au (III), and $(PdCl_6)^{--}$ must be removed; cf. L. A. Chugaev, *Ann. inst. platine No. 7, 205–7 (1929); C. A.* **24,** *2689 (1930).* Recomm. (*l. c.*).

BENZIDINE has been used for the detc. of Ir in the presence of Pt and for its approximate detn.; a deep blue color is given by tetravalent iridium; other oxidiz-

ing agents must be absent; cf. V. G. Khlopin, *Ann. inst. platine* **1**, *324–30 (1926); Snell, p. 425.*

IRON

α,α'-DIPYRIDYL, 1–2% soln. in alc. or dil. HCl, has had much usage in detc. and detn. of Fe (II) ion. The test is carried out in slightly acid soln. and gives an intense, stable, red coloration; in dil. soln. and in the absence of Cu (I) the reaction is specific; cf. F. Blau, *Ber.* **21**, *1077 (1888); Snell, pp. 310–11; Feigl, p. 96; C. A.* **35**, *2439 (1941).* For detn. of Fe in soil, cf. Dyer and McFarlane, *Can. J. Research 16B No. 3, 91–6 (1938), C. A.* **32**, *4263;* in biological materials, cf. S. H. Jackson, *Ind. Eng. Chem., (Anal. Ed.)* **10**, *302–4 (1938).* This reagt. has also been used for detn. of Fe in cereal products; Andrews and Felt, *Cereal Chem.* **18**, *819–26 (1941), C. A.* **36**, *1393.* Reagt. recomm. *(I. C.).*

o-PHENANTHROLINE is similar to α,α'-dipyridyl in regard to reaction with Fe (II). Saywell and Cunningham have used it for detn. of Fe in fruit juices, *Ind. Eng. Chem., (Anal. Ed.)* **9**, *67–9 (1937).* Hummel and Willard report no intfr. from pyrophosphate, Pb, Zn, Al, Hg, As, F, I; *ibid.* **10**, *13–15 (1938);* cf. also Fortune and Mellon, *ibid.* **10**, *60.*

DIMETHYLGLYOXIME, 1% alc. soln., gives with Fe (II) in ammoniacal soln. a red, soluble compound useful for detc. and detn. with errors of 1 to 2% in detn. on concns. of 10 to 50 ppm; Ni intfr. is prevented by addn. of KCN; Cu and Co should be absent as well as large amounts of Al and Zn; Fe (III) is kept in soln. by the use of tartrate; cf. *Snell, p. 308; Yoe I, pp. 248–9; Feigl, p. 98.* Recomm. *(I. C.).*

7-IODO-8-HYDROXYQUINOLINE-5-SULFONIC ACID (FERRON) has been found satisfactory for detn. of Fe (III). The test soln. should be acidified to pH of about 3; the reagt., in a satd. aq. soln., gives a green, stable color with Fe (III); at concns. as low as 0.1 ppm the color is perceptibly different from the yellow of the reagt. soln.; fluoride ion prevents color development but otherwise the reagt. is unaffected by any other ion in concn. comparable to that of Fe (III); cf. J. H. Yoe, *J. Am. Chem. Soc.* **54**, *4139–43 (1932);* Yoe and Hall, *ibid.* **59**, *872 (1937);* Clark and Sieling, *Ind. Eng. Chem., (Anal. Ed.)* **8**, *256–7 (1936); Snell, p. 302.* Recomm. *(I. C.).*

THIOGLYCOLIC ACID (MERCAPTOACETIC ACID), 4 ml. dissolved in 8 ml. conc. NH_4OH in 50 ml. of water, gives with Fe (III), at a pH of 8.0 to 10.0, a blue to purple coloration which may be used for estn. of Fe in milk, blood or other materials. With Fe (II) a reddish color is given. The color may fade but is restored on shaking in air. The color is given in concns. of 0.1 ppm and the errors are no larger than 2%. The reagt. soln. should be made as needed; cf. *Snell, p. 298* for details and bibliography. Swank and Mellon found this reagt. to be superior to many others in regard to freedom from intfr. by many anions which are usually troublesome, e.g. phosphate, fluoride, tartrate; cf. *Ind. Eng. Chem., (Anal. Ed.)* **10**, *7–9 (1938).*

SALICYLIC ACID, 10% aq. soln. of the sodium salt, is a reagt. which gives an amethyst color with Fe (III) ion but no color with Fe (II) ion; strong acids decompose the colored compound and sunlight causes fairly rapid fading; phosphate, fluoride, and ions which form complexes with Fe (III) intfr. in detc. and detn. The test is made in a soln. slightly acid with AcOH and the sample should contain less than 0.2 mg. Fe (III); cf. J. P. Mehlig, *Ind. Eng. Chem., (Anal. Ed.)* **10**, *136–9 (1938)* and *Yoe I, pp. 243–5; Snell, p. 301.* Recomm. *(I.C.).* **SALICYLSULFONIC ACID** has been used for detn. of minute amounts of Fe in sputum; cf. *Snell, p. 302.* **THIOSALICYLIC ACID,** which gives a yellow coloration with minute amounts of Fe in ammoniacal soln., has been used for Fe detn. on 0.1 ml. of blood; cf. *Snell, p. 300;* cf. also *C. A.* **32**, *1207 (1938).*

CUPFERRON (AMMONIUM SALT OF NITROSOPHENYLHYDROXYLAMINE), 6% aq. soln., is widely used for sepg. iron (also V, Zr, Ti, Sn, Cb, Ta) from other elements such as Al, Be, P, Mn, Ni, and hexivalent U. The pptn. is carried out in an acid soln. and the pptd. Cu may be dissolved out of the ppt. with NH_4OH: cf. O. Baudisch, *Chem. Ztg.* **33**, *1298 (1909);* Baudisch and King, *Ind. Eng. Chem.* **3**, *629*

(1911); E. Benedetti, *Rev. facultad cienc. quim. (Univ. La Plata)* **9**, *59–68 (1934)*, *C. A.* **29**, *3624 (1935)*; cf. also Hillebrand and Lundell, *Applied Inorganic Analysis*, *pp. 109–14 (1929)*.

p-n-**BUTYLPHENYLARSONIC ACID**, 0.75% aq. soln., is useful as a precipitant for detg. or sepg. Fe; most of the metals commonly associated with Fe do not intfr., although Zr, Sn, Ti, Th, UO_2, Ce, and the anions of F, PO_4, tartrate, and citrate should be absent; pptn. is from a soln. approximately 0.4 *N* in a mineral acid and at a temperature of 80–90° C.; cf. Craig and Chandlee, *J. Am. Chem. Soc.* **56**, *1278–9 (1934)*.

In volmtc. methods of iron detn., titration of Fe (II) with oxidizing solns. may be made convenient by the use of internal indicators such as **DIPHENYLAMINE SULFONIC ACID**; cf. Sarver and Kolthoff, *J. Am. Chem. Soc.* **53**, *2902–6 (1931)*; **o-PHENANTHROLINE**; cf. Walden, Hammett, and Chapman, *J. Am. Chem. Soc.* **55**, *2649 (1933)*; **α,α'-DIPYRIDYL**; cf. Nieuwenburg and Blumendal, *Mikrochemie* **18**, *39 (1935)*; and **PHENYLANTHRANILIC ACID** (**o-DIPHENYLAMINE CARBOXYLIC ACID**); cf. Suirokomskii and Stepin, *J. Am. Chem. Soc.* **58**, *928–9 (1936)*.

DIISONITROSOACETONE, 1% aq. soln., gives an intensely blue color with Fe (II) even in very dil. solns.; Co and Ni intfr.; xs. Mn reduces sensitivity; cf. Dubsky and Kuras, *Chem. Listy* **23**, *496 (1929)*; *C. A.* **24**, *801 (1930)*. Recomm. (*I. C.*).

ACETYLACETONE, 0.5% freshly prepared alc. or aq. soln., gives with as little as 3 mcg. of Fe a distinctly red soln. which may be used for estn. of Fe; the sample should contain between 3 and 60 mcg. Fe; the color is stable for weeks and the reagt. may be used wherever thiocyanate is applicable; the test is made in slightly acid soln.; cf. A. Combes, *Compt. rend.* **105**, *868 (1887)*; H. V. Pulsifer, *J. Am. Chem. Soc.* **26**, *967 (1904)*; cf. also *Snell, p. 303* and *Yoe I, pp. 245–8*.

DINITROSORESORCINOL, aq. soln., gives green colors or ppts. with Fe (II) and Fe (III) in neutral soln.; Co and Cu also react; cf. Nichols and Cooper, *J. Am. Chem. Soc.* **47**, *1268 (1925)*; for use of this reagt. as a specific stain for iron in tissues, cf. A. A. Humphrey, *Arch. Path.* **20**, *256–8 (1935)*, *C. A.* **29**, *8035 (1935)*.

LANTHANUM

8-HYDROXYQUINOLINE (OXINE) when added to a dil. AcOH soln. contg. La ppts. $La(C_9H_6ON)_3$ upon addition of NH_3; the ppt. may be dried for gravmtc. detn. or dissolved for titration with $KBrO_3$-KBr; cf. Th. I. Pirtea, *Z. anal. Chem.* **107**, *191–3 (1936)*.

LEAD

DIPHENYLTHIOCARBAZONE (DITHIZONE), 1 to 10 mg. dissolved in 100 ml. CCl_4 or $CHCl_3$, is a soln. which may be preserved for 4 to 8 weeks when care is taken to prevent contamination, oxidation, and long exposure to sunlight. The reagt. is widely used for detc., sepn., colmtc. and titrimetc. detn. of minute amounts of Pb; in soln. contg. KCN, NH_3, and citric acid at pH of about 9.5, Pb leaves the aq. phase to form a chloroform-soluble, red, dithizonate; other metals, except Sn (II), Bi, and Tl, do not intfr. unless present in great xs.; cf. *A. O. A. C., pp. 394–409*; *A. P. H. A., pp. 241–5*; *Snell, pp. 202–4*; *Feigl, p. 31*. For survey of use of dithizone in analysis for Pb and other metals, cf. *Prodinger, pp. 117–141*. For Pb in sugar products, cf. T. D. Gray, *Ind. Eng. Chem.*, (*Anal. Ed.*) **14**, *110–4 (1942)*; in biological materials, K. Bambach, *ibid.* **11**, *401 (1939)* and *C. A.* **33**, *73, 7234*. See also Biefeld and Patrick, *Ind. Eng. Chem.*, (*Anal. Ed.*) **14**, *275–8 (1942)*. Reagt. recomm. (*I. C.*).

s-**DIPHENYLCARBAZIDE** is used indirectly for detn. of Pb by pptn. as the chromate which is then dissolved for colmtc. estn. of the chromate, or xs. standard chromate may be used for pptn. and the xs. detd.; cf. under *chromium*; *Snell, pp.*

198–200; Yoe I, pp. 255–7. For use of this method in detg. Pb in blood, tissues, and excreta, cf. Letonoff and Reinhold, *Ind. Eng. Chem.*, (*Anal. Ed.*) **12,** *280–4* (*1940*), and Letonoff, *ibid.* **13,** *631* (*1941*).

TETRAMETHYLDIAMINODIPHENYLMETHANE, 1% soln. in glacial AcOH, forms a blue diphenylmethane dye with PbO_2; 5 mcg. Pb will produce the color and the intensity may be used for colmtc. estn.; other oxidizing agents give the same reaction; cf. *Snell, pp. 200–2.* Recomm. (*I. C.*). **BENZIDINE** may be used in a similar way and is likewise non-specific for PbO_2; cf. *Feigl, p. 29.*

CARMINIC ACID, 0.5% soln. in dil NH_4OH, is a reagt. for detc. of Pb by spot test. The test soln. is added to paper previously impregnated with the reagt., exposed to NH_3, and allowed to dry; a violet spot distinctly different from the red color of the reagt. denotes at least 1 mcg. of Pb in the drop used; Cu prevents test; intfr. of Ag, Bi, and Cd may be prevented; cf. F. Pavelka, *Mikrochemie* **7,** *301* (*1929*); *Feigl, p. 32.* Recomm. (*I. C.*).

With **GALLOCYANINE** (0.1% aq. soln.) and **PYRIDINE** (1% aq. soln.) a violet spot is obtained when a drop of the test soln. is put on paper, followed by pyridine soln., then by gallocyanine, and finally several more drops of pyridine soln. In the presence of Ag, Cu, Cd, and Bi, Pb may be pptd. in the paper as $PbSO_4$ and other ions removed by washing with several drops of water, after which pyridine and gallocyanine are added as directed above; cf. F. Pavelka, *Mikrochemie* **7,** *301* (*1929*); *Feigl, p. 32.* Pyridine with NH_4CNS may be used for rapid gravmtc. detn. of Pb; *Prodinger, p. 160.*

ANTHRANILIC ACID, 3% soln. in dil. NaOH soln., ppts. $Pb(C_7H_6O_2N)_2$ which may be dried and weighed or may be dissolved in NH_4OAc soln. and titrated with $KBrO_3$-KBr in an acid soln.; Zn, Cu, and Mn also ppt.; cf. Funk and Römer, *Z. anal. Chem.* **101,** *85–8* (*1935*); *Prodinger, p. 37.*

SALICYLALDOXIME as a 1% soln. in dil. alc. may be used for the quant. sepn. of Pb from Cu, Zn, Ag, Cd in strongly ammoniacal soln.; Biefeld and Ligett, *Ind. Eng. Chem.*, (*Anal. Ed.*) **14,** *359–61* (*1942*).

THIOUREA as the solid or as satd. soln. in *N* HNO_3 ppts. Pb and permits its sepn. from Ag, Hg, Cu, Bi, Zn, Ba, Cr, Mn, Al, Co, Ni, Fe, Sn, As, Sb, and Cd. Cf. *Prodinger, p. 154,* and Mahr and Ohle, *Z. anorg. Chem.* **234,** *224–8* (*1937*).

LITHIUM

AMMONIUM STEARATE, prepared by passing NH_3 into an ether soln. of stearic acid until all the ammonium stearate has pptd., is dried and redissolved in amyl alcohol; the reagt. must be made up fresh every day. Li stearate differs from all other alkali stearates in being much less soluble in amyl alcohol; for procedure in detn. of Li cf. E. R. Caley, *J. Am. Chem. Soc.* **52,** *2754–8* (*1930*); *Snell, p. 447.* **2-ETHYLHEXANOL** is said to be superior to amyl alc. as a solvent for the amm. stearate; Caley and Axilrod, *Ind. Eng. Chem.*, (*Anal. Ed.*) **14,** *242* (*1942*).

MAGNESIUM

8-HYDROXYQUINOLINE (OXINE), 2 to 5% alc. or AcOH soln., is a reagt. used extensively for macro- and micro-detn. and for the sepn. of Mg from metals of the alkali and alkaline earth groups. It gives a green-yellow ppt. from an ammoniacal soln. which may contain Ca, Ba, Sr, but must not contain Fe, Al, Mn, Cu, Zn, Ti, and phosphate. The ppt. when dried at 130–40° C. has the composition $Mg(C_9H_6ON)_2$; at lower temperatures it retains water of crystallization. By heating with oxalic acid, the ppt. may be ignited to the oxide for weighing. Many colmtc. methods are available for detn. of Mg in the presence of Ca as in urine, blood, etc.; for details and bibliography cf. *Snell, pp. 471–5;* Hillebrand and Lundell, *Applied Inorganic Analysis, pp. 114–5* (*1929; Wiley, New York*); cf. also *C. A. indexes.*

TITAN YELLOW (CLAYTON YELLOW, THIAZOLE YELLOW), 0.1 to 0.2% aq. soln., is a reagt. which is added to a neutral or acid soln. which is then made

alkaline with NaOH and in the presence of Mg produces an orange to red color or ppt. The method is suitable for colmtc. estn. of 0.001 to 0.015 mg. Mg. Dialyzed agar may be used as an aid in the prevention of pptn.; the filtrate from pptn. with oxalate may be used. Ca has a slight intensifying effect on color; Al, Ni, Co, Mn, Sn, Zn, and a high concn. of NH_4 salts intfr. The method is recommended for Mg detn. in urine (0.1 ml. sample is sufficient), blood, serum, milk, meat, and soil extracts; cf. *Snell, p. 476;* recomm. (*I. C.*). Gillam reports this reagt. to be good for Mg in photoelectric colmty., *Ind. Eng. Chem.*, (*Anal. Ed.*) **13,** *499–50* (*1941*), and Otto and Otto, *ibid., p. 65* (*1941*), find it good for detc. by test tube or spot plate methods after removal of most of metal ions.

Magnesium in pptd. $MgNH_4PO_4$ may be detd. colmtcly. by reduction of the phosphomolybdate to the usual blue color by means of reducing agents such as $SnCl_2$, **HYDROQUINONE,** or **AMINONAPHTHOLSULFONIC ACID;** the method is suitable for detn. of 0.015 mg. Mg; for details of the method and for bibliography cf. *Snell, pp. 468–9; Yoe I, pp. 264–6,* and biochemical laboratory manuals.

***p*-NITROBENZENEAZORESORCINOL (MAGNESON),** 0.5% soln. in 1% NaOH soln. (for low concns. of Mg dilute reagt. 5 to 10 times), is added to an acid soln. which is then made alkaline with NaOH to form a bright blue color or ppt. suitable for detc. of as little as 0.002 mg. Mg after removal of Ag, Cu-Sn, Fe, Co-Ni groups. Al and Ba, Sr, and Ca do not intfr; arsenate, chromate, and permanganate anions intfr. as does NH_4 when in concn. 70 times higher than Mg; cf. Newell, Pike, and Ficklen, *Z. anorg. allgem. Chem.* **225,** *284–4* (*1935*), and Mehlig and Johnson, *Ind. Eng. Chem.*, (*Anal. Ed.*) **12,** *30* (*1940*). Test papers may be made by soaking filter paper in 0.01% alc. soln. of reagt. and allowing to dry. For test, add a drop of unknown and then one of 1% NaOH; compare with a blank; cf. I. Stone, *Science* **72,** *322* (*1930*). ***p*-NITROBENZENEAZO-α-NAPHTHOL** is considerably more sensitive to Mg than the preceding reagt.; cf. *Feigl, p. 143.* Other similar compounds have been suggested; cf. *C. A.* **30,** *6302* (*1936*).

QUINALIZARIN, (1,2,5,8-TETRAHYDROXYANTHRAQUINONE), 10 to 20 mg. in 100 ml. alc., gives a blue color or ppt. with Mg when the reagt. soln. is added to a neutral or slightly acid test soln., then 2 *N* NaOH added in drops until alkaline. This reagt. is not as sensitive nor as specific as the reagts. previously listed. Alkaline earths, as well as metals of higher groups, must be removed by pptn. before making the test and a blank must be run; cf. Hahn, *Ber.* **57B,** *1394–6* (*1924*); *Feigl, p. 142,* cf. also *C. A.* **29,** *7214 and* **30,** *4116* (*1936*). Recomm. (*I. C.*).

CURCUMIN, 1% alc. soln., gives a yellow to orange color useful for colmtc. detn. of Mg in amounts approximating 0.05 mg; the color is formed when the reagt. is added to the test soln. and made alk. with NaOH; starch glycerite is used as a protective colloid. Phosphate in large amount does not intfr. if approximately equal amount is used in standards; borates in small amounts do not intfr.; Fe and other metals giving colored hydroxides intfr.; cf. I. M. Kolthoff, *J. Am. Chem. Soc.* **50,** *395* (*1928*); W. E. Thrun, *Ind. Eng. Chem.*, (*Anal. Ed.*) **4,** *426* (*1932*); *Snell, p. 477.*

OLEIC ACID, 2 g. and 0.5 g. KOH per liter 60% alc., is a reagt. for a nephelometric method suitable for detg. 0.02 to 0.1 mg. Mg; Ca must be absent; cf. *Snell, p. 478.*

MANGANESE

FORMALDOXIME (Deniges reagt.), prepd. by dissolving 20 g. trioxymethylene and 47 g. hydroxylamine sulfate in 100 ml. H_2O by boiling, gives a red coltn. to an alk. soln. of Mn (II). This color is suitable to the estn. of Mn in plant, soil, and biological materials. Colorations by Co, Cu, Fe, Cr, and Ni may be masked; cf. C. P. Sideris, *Ind. Eng. Chem.*, (*Anal. Ed.*) **9,** *445* (*1937*), and **12,** *307* (*1940*). Also see *C. A.* **32,** *77.* Recomm. (*I. C.*).

BENZIDINE, 2.3 g. dissolved in 100 ml. 5% HCl, may be used for detc. and detn. of Mn when the concn. of the element is too low for a satisfactory use of permanganate colorimetry. A blue-green color is given by manganate ion in concns. as

low as 0.008 ppm; the color fades within 2 minutes and a color comparison is made with artificial standards of $CuSO_4$ and picric acid. Other oxidizing agents give a similar reaction and must be absent; the sample should contain 0.1 to 1.0 mcg. Mn; cf. *Snell, pp. 343–4;* cf. also N. A. Clark, *Ind. Eng. Chem.*, (*Anal. Ed.*) **5**, *241* (*1933*). As a spot test, conditions may be controlled to make the reagt. practically specific among common metallic ions; cf. *Feigl, pp. 106–8.* Recomm. (*I. C.*).

TETRAMETHYLDIAMINODIPHENYLMETHANE, dissolved in $CHCl_3$ or in dilute AcOH, is oxidized by Mn in its higher valences to form a blue color which is much more stable than that obtained with benzidine; the reaction is carried out in a soln. acid with AcOH; for the spot test, cf. *Feigl, p. 105.* Recomm. (*I. C.*). For the colmtc. detn., cf. R. G. Harry, *J. Soc. Chem. Ind.* **50**, *434–6T* (*1931*); *Snell, p. 342.*

***o*-TOLIDINE** may, in the absence of free chlorine and other intfrnces., be used for colmtc. detc. and detn. of Mn as manganate; cf. *Snell, p. 341;* L. Forman, *J. Am. Water Works Assoc.* **21**, *1212–7* (*1929*).

STRYCHNINE, 1% soln. in conc. H_2SO_4, gives a blue-violet, changing to red, color with Mn which has been evaporated to dryness in the presence of NaOH. The test is specific in the absence of Co, chromate, and ferrocyanide; by the use of drop quantities, it is said to be sensitive to 0.2 mcg. Mn; cf. S. Augusti, *Ann. chim. applicata* **24**, *535–8* (*1934*).

ANTHRANILIC ACID may be used for the gravmtc. detn. of Mn in the absence of Zn, Cd, Ni, Co, and Cu which contaminate the ppt.; pptn. should be made at a pH above 5.2; cf. Funk and Demmel, *Z. anal. Chem.* **96**, *335–8* (*1934*); H. Goto, *J. Chem. Soc. Japan* **55**, *1156–63* (*1934*); *C. A.* **29**, *1029* (*1935*).

MERCURY

DIPHENYLTHIOCARBAZONE (DITHIZONE), 10 to 50 mg. per liter $CHCl_3$ or CCl_4, may be used for the detc., detn., and sepn. of small amounts of Hg which is extracted from acidic aq. phase by shaking with the reagt. soln. with consequent change in color from the original bluish-green to yellowish-orange; in soln. approximately pH 3, Cu is the only metal likely to intfr.; cf. Fischer and Leopoldi; *Z. anal. Chem.* **103**, *241* (*1935*); *Feigl, p. 23; A. O. A. C., pp. 409–412; Prodinger, p. 126.* Recomm. (*I. C.*). **DI-β-NAPHTHYLTHIOCARBAZONE** is similar to dithizone but is said to give a more distinctive color with Hg and to be superior for its colmtc. detn., D. M. Hubbard, *Ind. Eng. Chem.*, (*Anal. Ed.*) **12**, *768–71* (*1940*).

DIPHENYLCARBAZIDE (saturated soln. in alc.) and **DIPHENYLCARBAZONE** (saturated soln. in alc.) are also used in colmtc. detc. and detn. of Hg and as indicators in mercurimetric titration. Hg (II) gives a violet or blue color in neutral or slightly acid soln.; Zn, Fe, Co, Ni, Pb, Cu, Ag, chromate, cyanide, chloride, bromide, and iodide ions intfr.; cf. Stock and Zimmermann, *Z. angew. Chem.* **41**, *546–8* (*1928*); *Snell, p. 180,* and *Feigl, p. 22;* for adaptation to qual. scheme, cf. A. W. Scott, *J. Am. Chem. Soc.* **51**, *3351* (*1929*); for use as indicator, cf. Dubsky and Trtilek, *Chem. Listy* **27**, *385–8* (*1933*). If acidity and other conditions be controlled carefully, the carbazide may be used for colmtc. detn. of low concns. of Hg; cf. Laird and Smith, *Ind. Eng. Chem.*, (*Anal. Ed.*) **10**, *576* (*1938*). Recomm. (*I. C.*).

PROPYLENEDIAMINE with $CuSO_4$ gives with neutral or amm. soln. contg. about 0.1% Hg and xs. KI a ppt. of $HgI_4 \cdot Cu(Pn)_2$ which may be dried and weighed for detn.; Spacu and Spacu, *Z. anal. Chem.* **89**, *188* (*1932*). **ETHYLENEDIAMINE** may be used in a similar way; cf. Spacu and Sucui, *Z. anal. Chem.* **92**, *247* (*1933*).

For a determination using **PYRIDINE** with dichromate, cf. Spacu and Dick, *Z. anal. Chem.* **76**, *273* (*1929*); Furman and State, *Ind. Eng. Chem.*, (*Anal. Ed.*) **8**, *467* (*1936*), and *C. A.* **35**, *6892* (*1941*).

***p*-DIMETHYLAMINOBENZALRHODANINE,** satd. alc. soln., may be used as a drop test for detc. of Hg (II) in nearly neutral soln. free of Ag; a red color is formed; cf. Heller and Krumholz, *Mikrochemie* **7**, *217* (*1929*); *Feigl, pp. 24–7;* Kolthoff, *J. Am. Chem. Soc.* **52**, *2222* (*1930*).

ANTHRANILIC ACID ppts. Hg (II) as a slightly soluble salt which may be weighed for detn. of the metal; cf. Funk and Romer, *Z. anal. Chem.* **101**, *88 (1935)*. **THIOGLYCOLIC ACID β-AMINONAPHTHALIDE (THIONALID)** is also useful as a quant. precipitant of Hg; cf. Berg and Roebling, *Z. angew. Chem.* **48**, *430, 597 (1935)*. *Prodinger, pp. 38, 90.*

MOLYBDENUM, MOLYBDATE

POTASSIUM ETHYL XANTHATE (POTASSIUM XANTHATE) may be prepared as needed or the solid may be used as a reagt. giving a red colored complex soluble in $CHCl_3$. The reagt. is added to a neutral soln. contg. about 1 mcg. Mo per liter and the mixture is acidified to produce the color; for a colmtc. detn. the mixture is extracted with $CHCl_3$. The detn. is accurate to within about 8% and is specific fo Mo; it is used for detn. of small amounts of Mo in W; cf. D. Hall, *J. Am. Chem. Soc.* **44**, *1462 (1922); Snell, p. 383; Feigl, p. 64.* For spot test to detect Mo in steel, cf. *C. A.* **31**, *2120 (1937)*.

α-BENZOINOXIME (CUPRON), 2% alc. soln., is used for the pptn. and detn. of Mo in steel; the sample should contain about 0.15 g. Mo in hexivalent state and pptn. is made in a cold, slightly acid soln. which must not contain W, Pb, chromate, pentavalent V, or Ta; cf. H. B. Knowles, *Bur. Standards J. Research* **9**, *1 (1932)*.

CINCHONINE, 12.5% soln. in 6 *N* HCl, may be used to increase the extent and rapidity of pptn. by means of KCNS and a reducing agent such as $SnCl_2$; cf. C. M. Johnson, *Iron Age* **132**, *No. 2, 16 (1933)*.

PHENYLHYDRAZINE, in soln. in AcOH or dil. H_2SO_4, gives a red to rose coloration when warmed with molybdate soln. which is highly sensitive and specific; the color is suitable for detn. as well as detc. Iodates give free iodine, vanadates a green color, and permanganates are decolorized; tungstate is without effect; cf. E. Montignie, *Bull. soc. chim.* (4) **47**, *128 (1930); Snell, p. 389; Feigl, p. 65.*

TANNIC ACID, 0.5% aq. soln. freshly prepared, gives with a molybdate soln. contg. xs. AcOH a red, brown, or yellow color which is suitable for detn.; the sample should contain no more than 20 mg. Mo, W must have been sepd. previously; cf. G. Spurge, *Chem. Eng. Mining Rev.* **11**, *258 (1919); Snell, p. 389; Yoe I, p. 284.*

NICKEL

DIMETHYLGLYOXIME, 1 to 1.5% soln. in alc., is widely used for detc., gravmtc., titrimetric, and colmtc. detn. and sepn. of Ni. For a quant. pptn., the reagt. is added to a slightly acid soln. contg. no more than 30 mg. Ni, then NH_4OH or NaOAc is added to raise the pH to approximately 7. Co gives a brown, soluble complex; Fe (II) and a few other metals may contaminate the ppt. if they are present in excessive amounts or if the soln. is made too basic; ordinarily, however, Pd is the only element likely to intfr.; cf. Chugaev, *Ber.* **38**, *2520 (1905)*. For a discussion of the accuracy and limitation as a reagt., cf. E. G. Righellato, *Chem. Age* **28**, *574 (1933)*; for a summary of the use and precautions in pptn., cf. Hillebrand and Lundell, *Applied Inorganic Analysis, pp. 313–8 (1929, Wiley, New York)*; for spot tests by means of this reagt. with and without an accompanying oxidizing agent cf. *Feigl, pp. 88–92*; for detn. by colorimetry, cf. *Yoe I, p. 295*, and *Prodinger, 53*; for colorimetry in conjunction with an oxidizing agent (bromine water) which gives a red soluble complex making possible detn. of 0.015 to 0.5 mg. Ni without pptn., cf. *Snell, pp. 314–7*; for titrimetric method, cf. *C. A.* **29**, *1748 (1935)*; for detn. of Ni in soils, cf. *C. A.* **30**, *6488 (1936)*. Reagt. recomm. (*I.C.*).

A number of other reagts. have been suggested for Ni; for **α-BENZILDIOXIME (DIPHENYLGLYOXIME)**, cf. F. W. Atack, *Analyst* **38**, *316, (1913)*; for **METHYLBENZOYLGLYOXIME**, cf. H. Holzer, *Z. anal. Chem.* **95**, *392 (1933)*; for **CYCLOHEXANEDIONEDIOXIME**, which is very similar to dimethylglyoxime but has the advantage of high water solubility, cf. O. Wallach, *Ann.* **437**, *148 (1924)*, *C. A.* **19**, *487 (1925)*; **α-FURILDIOXIME** is also soluble in water and has an added advantage

in gravmtc. detn. of Ni in that Ni makes up only 11.81% of its compound with the reagt. whereas with dimethylglyoxime the percentage is 20.31; cf. Soule, *J. Am. Chem. Soc.* **47**, *981 (1925)*. For critical comparison of Ni reagts., cf. Wenger, et al., *Helv. Chim. Acta* **24**, *889–99 (1941)*, *C. A.* **36**, *2225*.

SALICYLALDOXIME, prepd. as described under *copper*, quant. ppts. Ni at pH 7; the ppt. may be contaminated by iron if this element is present in test soln.; cf. Biefeld and Howe, *Ind. Eng. Chem.*, (*Anal. Ed.*) **14**, *251–3 (1942)*.

DITHIOOXAMIDE (RUBEANIC ACID), 1% alc. soln., may be used as a sensitive spot reagt. and gives a blue-violet spot in ammoniacal soln.; Co, Fe, and Cu intfr.; cf. *Feigl, p. 92*. Recomm. (*I. C.*).

FORMALDOXIME, made as needed by boiling a mixture of 7 g. hydrazine hydrochloride, 15 ml. water, and 3 g. trioxymethylene, may be used for detc. and detn. of as low as 0.1% Ni in Co salts; it gives a brown color; cf. G. Deniges, *C. A.* **27**, *927 (1933)*. Recomm. (*I. C.*).

POTASSIUM DITHIOOXALATE, 0.1% aq. soln. made up fresh every few days, is said to be better for colorimetry than dimethylglyoxime. It gives a deep bluish-red color. The sample should contain about 1 mg. Ni; the color develops in a slightly acid soln. Co and Fe must be removed and most of the common metals intfr. if present in appreciable amounts; Mg, alkaline earths, Al, and phosphate do not intfr.; cf. *Snell, pp. 317–9, Yoe I, p. 298–303*.

ANTHRANILIC ACID ppts. a slightly soluble Ni salt from a slightly acid soln.; Cu, Mn, Zn, and Co intfr.; Funk and Ditt, *Z. anal. Chem.* **93**, *241–7(1933)*.

ETHYLENEDIAMINE with thiosulfate may be used for a spot test for Ni and gives a violet ppt.; cf. G. Spacu and P. Spacu, *Z. anal. Chem.* **89**, *192 (1932)*.

NITRATE, NITRITE

Various reagts. are precipitants for nitrate. **NITRON,** 1 g. in 10 ml. 5% AcOH, is a reagt. which is unstable and must be prepared as needed; a formic acid soln. is said to be more stable. This reagt. forms a nitrate which is soluble only to the extent of 9.9 mg. per 100 ml. water; perchlorate and some other anions similarly give slightly soluble salts and intfr. in detn.; cf. Busch, *Ber.* **38**, *861 (1905)*; Cope and Barab, *J. Am. Chem. Soc.* **39**, *504–14 (1917)*. **DI-(α-NAPHTHYLMETHYL)-AMINE,** about 10% in 50% AcOH, is said to be a more effective precipitant than nitron but it is likewise non-specific; only its acetate, sulfate, and phosphate are soluble in water; cf. Rupe and Becherer, *Helv. Chim. Acta* **6**, *674* and *885 (1923)*; F. Konek, *Z. anal. Chem.* **97**, *416–8 (1934)*. For **α-PHENYL-β-DIETHYLAMINOETHYL-*p*-NITROBENZOATE** see under *chlorine* and *perchlorate*.

PHENOLDISULFONIC ACID, prepared by dissolving pure **PHENOL** in conc. H_2SO_4, gives a yellow color with minute amounts of nitrate in alk. soln.; for detn. in water of low chlorine content and samples contg. 0.05 mg. or less of nitrate, cf. *A. O. A. C., p. 527; A. P. H. A., pp. 48–9; Yoe I, pp. 313–6; Snell, pp. 629–35*. The color of **INDIGO CARMINE** is bleached by nitrate and this is used to detc. nitrate impurities in various salts; cf. *U. S. Pharmacopoeia XI, p. 493*; **DIPHENYLAMINE** or **DIPHENYLBENZIDINE** in sulfuric acid gives blue colors by reaction with nitrate in acid soln.; 0.5 to 5 mcg. may be detected and determined; for details and bibliography, cf. *Snell, pp. 637–41; Yoe I, p. 316; Feigl, p. 211*; for detc. of nitrate in milk, cf. *C. A.* **29**, *7510 (1935)*, and in wines, cf. *A. O. A. C., p. 170*.

BRUCINE, 0.02% soln. in H_2SO_4 for spot test, and 5% soln. in $CHCl_3$ for colmtc. detn. gives a red color with nitrate in acid soln. which changes to a stable yellow useful for colmtc. detn. The sample should contain 0.01 to 0.2 mg. nitrate nitrogen; nitrite reacts similarly if acid concn. is low; cf. *Feigl, p. 212; Snell, p. 635; Yoe I, p. 318*. **STRYCHNINE** also gives a very delicate test; cf. *Snell, p. 636, Yoe I, p. 320*.

For detn. of nitrate in nitrite the latter is destroyed by sodium azide then the nitrate reacted with **NITROBENZENE** to obtain dinitrobenzene which is detd. by

means of acetone and alkali, cf. W. Seaman, et al., *Ind. Eng. Chem.*, (*Anal. Ed.*) **14,** *420–22 (1942).*

AZORUBIN, 0.01% aq. soln., with H_2SO_4 is decolorized by nitrate or nitrite, and has the advantage over many of the other reagts. in that Fe (III) ion has no effect; cf. J. Skutil, *Chem. Listy* **30,** *74 (1936).*

Nitrite is usually detc. or determined colmtcly. by its diazotization of amines which are then coupled with other amines or phenols to form colored azo compounds; **α-NAPHTHYLAMINE** and **SULFANILIC ACID** are widely used for this purpose; for nitrite in flour, cf. *A. O. A. C.*, p. *222;* for nitrite in water, cf. *A. O. A. C., p. 527; A. P. H. A., p. 46; Yoe I, p. 308; Snell, p. 644; Feigl, p. 215.* **DIMETHYL-α-NAPHTHYLAMINE** is said to be superior to the naphthylamine in the preceding reaction; cf. F. G. Germuth, *Ind. Eng. Chem.*, (*Anal. Ed.*) **1,** *28 (1929).* **SULFANILAMIDE** with ***N*-(1-NAPHTHYL)-ETHYLENEDIAMINE DIHYDROCHLORIDE** have recently been found superior reagts. for nitrite; Martha B. Shinn, *Ind. Eng. Chem.*, (*Anal. Ed.*) **13,** *33 (1941).* This procedure has been adapted to waterworks usage, cf. Kershaw and Chamberlin, *Ind. Eng. Chem.*, (*Anal. Ed.*) **14,** *312 (1942).*

OSMIUM

THIOUREA when boiled with sodium chloroosmate and xs. HCl gives an intense red color when the concn. is above 10 ppm; cf. Chugaev, *Z. anorg. allgem. Chem.* **148,** *65 (1925);* for complete procedure for Os, Ru, Pt, Pd, Rh, and Ir, cf. Gilchrist and Wichers, *J. Am. Chem. Soc.* **57,** *2565–73 (1935).* For reaction with **NICKEL ACETATE,** see under *palladium.*

OXALATE

DIPHENYLAMINE, as the solid, may be mixed and heated with the unknown and the residue extracted with a little alc. to get a blue soln. if oxalate was present in the sample. Recomm. (*I. C.*). *Feigl, p. 336–8.*

INDIGO is not bleached by $K_2Cr_2O_7$ alone but in the presence of as little as 0.03 mg. oxalate, both oxalate and indigo are oxidized with consequent loss in color of the indigo; cf. Tavanaev and Budkevich, *Z. anal. Chem.* **103,** *353 (1935); ibid.,* **104,** *413 (1936).*

Oxalic acid may be reduced to glycolic acid by the use of Mg powder, and this glycolic acid may be detected by the use of **2,7-DIHYDROXYNAPHTHALENE** in H_2SO_4; cf. *Feigl, p. 335.*

OXYGEN

A mixture of $Mn(OH)_2$ and KI may be used for detc. or detn. of oxygen in a gaseous mixture; after absorption of oxygen, acid and **STARCH** are added and the detn. is made by comparison of the color of the starch-iodine complex; cf. *Snell, pp. 133–6; C. A.* **28,** *5778* and *6889 (1934).*

PYROGALLOL, in alkaline soln. is in general use for removal of oxygen from other gases and is also used for the estn. of oxygen-supplying power of soil; cf. Hutchins and Livingston, *J. Agr. Research* **25,** *133 (1923).*

For dissolved oxygen, the yellow leuco base of **INDIGO CARMINE** has been successfully used on 1 ml. samples of liquid; errors are low; extreme care must be taken to prevent contact of the reagt. soln. with air; for preparation of reagt. and details of procedure, cf. V. V. Efimov, *Biochem. Z.* **155,** *371–5 (1925)* or *Snell, p. 137.* **ADUROL** has been used for approximate estn.; cf. *Snell, p. 136* or *Yoe 1, p. 330.* **AMIDOL (2,4-DIAMINOPHENOL HYDROCHLORIDE)** has been used for a field method in determining oxygen in water and sewage; cf. *A. P. H. A., p. 237;* M. L. Isaacs, *Sewage Works J.* **7,** *435–43 (1935);* F. W. Gilcreas, *J. Am. Water Works Assoc.* **27,** *1166 (1935).*

ORGANIC REAGENTS FOR INORGANIC ANALYSIS

PALLADIUM

DIMETHYLGLYOXIME gives a bright yellow ppt. from acid soln. of Pd and provides a method for separating Pd from Os, Ru, Pt, Rh, and Ir, and for its subsequent detn.; Au must be absent as it is pptd. as the metal; cf. Gilchrist and Wichers, *J. Am. Chem. Soc.* **57**, *2565–73 (1935)*. Recomm. (*I. C.*). **β-BENZILDIOXIME** may also be used and gives a ppt. with 3 mcg. Pd per ml.; cf. Dwyer and Mellor, *C. A.* **29**, *4690 (1935)*; other oximes which may be used are **BENZOYL-METHYLGLYOXIME**, cf. *Chem. News* **131**, *401 (1925)* and **SALICYLALDOXIME**, cf. Holzer, *Z. anal. Chem.* **95**, *398 (1933)*. **β-FURFURALDOXIME** may be better than the dimethylglyoxime in detc. and detn. of Pd, cf. Hayes and Chandlee, *Ind. Eng. Chem.*, (*Anal. Ed.*) **14**, *491–3 (1942)*.

***p*-DIMETHYLAMINOBENZALRHODANINE**, satd. alc. soln. gives a reddish-violet ppt. with Pd in neutral or sl. acid soln. contg. at least 0.1 ppm Pd; Pt, Au, Ag, and Hg also ppt.; cf. *Feigl, pp. 18–81.* **5-(4-SULFO-1-NAPHTHYLAZO)-8-HYDROXYQUINOLINE**, alc. soln., gives an orange color or red ppt. with as little as 2 mcg. Pd in dil HNO_3 soln. and is specific; cf. Gutzeit and Monnier, *Helv. Chim. Acta* **16**, *233 (1933)*; *Feigl, p. 81.* **6-NITROQUINOLINE** gives a yellow ppt. of $Pd(C_9H_6N \cdot NO_2)_2$ which may be dried for gravmtc. detn. and which is specific in the platinum group; cf. Ogburn and Riesmeyer, *J. Am. Chem. Soc.* **50**, *3018 (1928)*. ***p*-NITROSODIPHENYLAMINE** and related compounds have been found of merit in detc. and colmtc. detn. of Pd (II); cf. Yoe and Overholser, *J. Am. Chem. Soc.* **61**, *2058–63 (1939)*, and **63**, *3224 (1941)*.

The reduction of nickel in **NICKEL ACETATE** by sodium hypophosphite is catalyzed by Pd and this property may be used as a means of detecting Pd. The test is made in a clean test tube to which is added 1% soln. of $Ni(OAc)_2$, satd. NaH_2PO_2, and unknown. When warmed in boiling water, the Ni is deposited as a black powder or as a mirror within 2–30 min. A blank shows test only after a long time. Pt, Ru, and Os also give test but not as quickly; cf. *Feigl, p. 75.* Recomm. (*I. C.*).

PHOSPHORUS, PHOSPHATE

For amounts up to 1 or 2 mg. phosphate, detn. may generally be made most satisfactorily by formation of phosphomolybdate which is subsequently reduced by such reagts. as **1-AMINO-2-NAPHTHOL-4-SULFONIC ACID, HYDROQUINONE,** or **BENZIDINE** to produce colors suitable for colmtc. estn.; cf. *A. O. A. C., p. 133; A. P. H. A., pp. 109–11; Feigl, p. 216.* For a comprehensive review of colmtc. methods, cf. *Snell, pp. 480–516*, and for a comparison of various pptn., titrimetric, and colmtc. methods with bibliography, cf. Peters and Van Slyke, *Quantitative Clinical Chemistry, p. 857 ff (1932, Williams and Wilkins, Baltimore)*. For the use of **STRYCHNINE MOLYBDATE** in nephelometry of phosphate, cf. *Yoe II, pp. 148–54.* The 1-amino-2-naphthol-4-sulfonic acid—ammonium molybdate reaction has been used for the detn. of phosphorus in soils; cf. Mildred S. Sherman, *Ind. Eng. Chem.*, (*Anal. Ed.*) **14**, *182 (1942)*.

PLATINUM

NICKEL ACETATE, see under *palladium.* Recomm. (*I. C.*). For analysis scheme for platinum metals, cf. Beamish and Scott, *Ind. Eng. Chem.*, (*Anal. Ed.*) **9**, *460–3 (1937)*.

POTASSIUM

***p*-DIPICRYLAMINE (HEXANITRODIPHENYLAMINE or "AURANTIA"),** 0.2 g. in 20 ml. water contg. 2 ml. of *N* Na_2CO_3, gives an orange-red crystalline ppt. with K in sl. alk. sol.; as a spot test it will detect 3 mcg. K. NH_4 in large xs. must be removed but Li, Na, Mg, Ca, Sr, and Ba do not ppt.; cf. Poluektov, *Mikrochemie* **14**, *265–6 (1934)*; *Feigl, p. 149.* The Mg salt of the amine may be used instead of the Na

salt as formed in Na_2CO_3 and has been satisfactorily used in gravmtc., volmtc., and colmtc. detn. of K in macro and micro amts.; cf. Kolthoff and Bendix, *Ind. Eng. Chem.*, (*Anal. Ed.*) **11**, *94–8 (1939)*. See also E. Amdur, *ibid.* **12**, *731–4 (1940)*. Recomm. (*I. C.*).

PICRIC ACID, saturated soln. in alc., ppts. K (as well as NH_4, Rb, and Cs) and the ppt. may be dissolved in water for colmtc. estn.; sulfates must be removed but Ca, Mg, Al, Fe, phosphates, and silicates do not intfr.; cf. E. R. Caley, *J. Am. Chem. Soc.* **53**, *539–45 (1931)*; *Snell, p. 437*; *C. A.* **29**, *1031 (1935)*; other nitrophenols have been tried, cf. Rosenthaler, *Mikrochemie* **2**, *29–32 (1924)*.

The familiar qual. reagt., sodium cobaltinitrite, may be used for sepn. of K and subsequent colmtc. detn. by reaction with many of the nitrite reagts.; cf. *Snell, pp. 432–7*. Washing of ppt. during sepn. should be done with 1% $Al_2(SO_4)_3$; W. E. Thrun, *Ind. Eng. Chem.*, (*Anal. Ed.*) **5**, *79 (1933)*. For indirect detn. of K in ppt. cf. C. P. Sideris, *ibid.* **9**, *145 (1937)*.

NAPHTHOL YELLOW S (2,4-DINITRO-1-NAPHTHOL-7-SULFONIC ACID), satd. aq. soln., gives a yellow ppt. with a soln. contg. as much as 400 ppm K; NH_4 and Na do not ppt.; cf. Clark and Willits, *Ind. Eng. Chem.*, (*Anal. Ed.*) **8**, *209 (1936)*.

SODIUM 5-NITRO-6-CHLOROTOLUENE-3-SULFONATE, satd. aq. soln., may be used for pptn. and detn. of K in the absence of NH_4 and Rb which are also pptd. by the reagt.; the K salt is 1/40 as sol. as the reagt.; cf. Davies and Davies, *J. Chem. Soc.* **123**, *2976–82 (1923)*.

"GARDINOL," "DREFT," or "DRENE," 3% aq. soln., form K salts which are much less soluble than the corresponding Li, NH_4 Mg, Ca, Na, and Ca salts, and may therefore be used as tests for K; cf. E. A. Wildman, *C. A.* **30**, *407 (1936)*; B. Reichert, *C. A.* **29**, *3939 (1935)*.

The hydrogen **TARTRATE** ion is in common use as a precipitant for K. The reagt. soln. is prepared by mixing 50 ml. of 2 *N* tartaric acid, 25 ml. 0.5 *N* NaOH, 25 ml. 96% alc. and allowing the mixture to stand until clear; cf. *C. A.* **23**, *1588 (1929)*; Clarke and Davidson, *Ind. Eng. Chem.*, (*Anal. Ed.*) **3**, *258–9* and *324–5 (1931)*; for use in conjunction with sodium cobaltinitrite, cf. Wikul, *Z. anorg. allgem. Chem.* **151**, *338 (1926)*.

RUBIDIUM

For the use of **5-NITRO-6-CHLOROTOLUENE-3-SULFONATE** see under *potassium*.

RUTHENIUM

RUBEANIC ACID (DITHIOOXAMIDE), 2.5% soln. in glacial AcOH, gives a blue soln. with as little as 0.2 mcg. of Ru in aq. soln.; other Pt metals do not give permanent colorations; H_2PtCl_6 gives a red soln. which soon yields a brownish-red ppt.; cf. Wölbling and Steiger, *Mikrochemie* **15**, *295–301 (1934)*. For a complete analysis of the Pt group, cf. Gilchrist and Wichers, *J. Am. Chem. Soc.* **57**, *2565–73 (1935)*.

THIONALID (THIOGLYCOLIC β-AMINONAPHTHALIDE) has been used in detn. of Ru; cf. W. J. Rogers, et al., *Ind. Eng. Chem.*, (*Anal. Ed.*) **12**, *561–3 (1940)*.

SCANDIUM

MORIN with minute amts. of Sc gives a green fluorescence in ultraviolet light. For review of tests for Sc, cf. G. Beck, *Mikrochim. Acta* **2**, *9–12*, *287–90 (1937)*; *C. A.* **32**, *452*, *1606 (1937)*.

SELENIUM

THIOUREA in the absence of excess nitrate and Cu gives a red ppt. of free Se from HCl solns. contg. minute amounts; Se may be separated from Te by this reagt.

and may be detd. by weighing the pptd. Se; cf. P. Falciola, *Ann. chim. applicata* **17**, *357–8 (1927); Feigl, p. 231.* Recomm. (*I. C.*).

PYRROLE, 1% soln. in alc., added to a soln. of the unknown in syrupy phosphoric acid contg. a little $FeCl_3$ gives a deep blue color when the concn. of Se as H_2SeO_3 is over 0.1 ppm; the color is suitable for estn.; silicic acid acts similarly; selenic, tellurous and telluric acids do not intfr.; cf. Berg and Teitelbaum, *Mikrochemie, Emich Festschr. 23–6 (1930); Snell, p. 604; Feigl, p. 336.*

CODEINE PHOSPHATE, 4% aq. soln., has been used for detc. and colmtc. detn. of SeO_2 as an impurity in conc. H_2SO_4. When 0.1 ml. of the reagt. soln. is added to 10 ml. sample, a blue coloration is obtained when the concn. of SeO_2 is over 0.00005%; As_2O_5 gives no color in concn. below 1%; Fe (III) gives a blue color when concn. is above 0.0015%; cf. Tz. Raikhinstein, *C. A.* **23**, *2391 (1929).*

For other methods, cf. Dudley and Byers, *Ind. Eng. Chem., (Anal. Ed.)* **7**, *3 (1935);* Williams and Byers, *Ind. Eng. Chem.* **28**, *912 (1936).*

SILICON, SILICATE

Ammonium molybdate with silicate in acid soln. gives the complex silicomolybdic acid which, after warming, gives with **BENZIDINE** a blue color in sl. ammoniacal soln.; phosphates and arsenates react similarly; cf. *Feigl, p. 219.* Recomm. (*I. C.*).

For use of **PYRROLE** see under *SELENIUM.*

SILVER

***p*-DIMETHYLAMINOBENZALRHODANINE,** satd. soln. in acetone, when added to a soln. slightly acid with HNO_3 gives a reddish-violet color or ppt. if the concn. of Ag is above 0.4 ppm; other metals, Hg, Au, Pt, Pd, and Cu, also react; in the presence of KCN only Cu is likely to intfr.; cf. *Feigl, pp. 16–19; Z. anal. Chem.* **74**, *380–6 (1928); Mikrochemie* **3**, *165–73 (1931);* Kolthoff, *J. Am. Chem. Soc.* **52**, *2222–6 (1930).* Recomm. (*I. C.*). For a spot test to detect Ag in galenites, cf. R. Jirkovsky, *Mikrochemie* **17**, *135–40 (1935);* for a colmtc. detn. of minute amounts of Ag, cf. *I. C.* Schoonover, *J. Research Natl. Bu. Standards* **15**, *377–84 (1935).*

DIPHENYLTHIOCARBAZONE (DITHIZONE), in $CHCl_3$ soln., gives a violet color with 0.05 to 0.1 mcg. Ag in acid soln.; Cu and Hg give similar reactions; cf. Fischer, Leopoldi and von Uslar, *Z. anal. Chem.* **101**, *1–23 (1935); Feigl, p. 21.* Recomm. (*I. C.*).

2-THIO-5-KETO-4-CARBETHOXY-1,3-DIHYDROPYRIMIDINE, as a freshly made 0.01% soln. in acetone, may be superior to the dimethylaminobenzalrhodanine in detc. and detn. of Ag. The yellow soln. gives a purple coloration with Ag concns. over about 0.4 ppm. At pH 2.0, Hg (I) and Hg (II) intfr. and must be absent; Cu and Fe (III) in comparatively large amts. intfr. Yoe and Overholser, *Ind. Eng. Chem., (Anal. Ed.)* **14**, *148 (1942).*

With Ag in sl. alk. soln. many reducing agents, such as **DEXTRINE, GUM ARABIC, SUGAR, STARCH,** and **GLYCEROL,** reduce the silver ion to the element in colloidal form suitable for colmtc. estn.; cf. *Yoe I, p. 683.*

SODIUM

ZINC or **MAGNESIUM URANYL ACETATE,** see references for methods of preparing the reagt., may be used for the detc., gravmtc. and colmtc. detn. of Na; Ca, Mg, Sr, Ba, and Fe do not intfr.; K, unless present in an amount over 5 times that of the Na, does not ppt.; phosphate is pptd. by adding lime to prevent intfr.; proteins may be pptd. by $HgCl_2$; cf. Barber and Kolthoff, *J. Am. Chem. Soc.* **50**, *1625–31 (1928); ibid.,* **51**, *3233–7 (1929);* Caley and Foulk, *J. Am. Chem. Soc.* **51**, *1664–74 (1929);* also cf. *Snell, pp. 439–42, Feigl, p. 147;* Peters and Van Slyke, *Quantitative Clinical Chemistry, Vol. II, p. 732 (1932, Williams and Wilkins, Baltimore);* for **COBALT URANYL ACETATE,** cf. *U. S. Pharmacopoeia XI, p. 453.*

6,8-DICHLOROBENZOYLENEUREA (SHEIBLEY'S REAGENT) in soln. in dil. KOH may be used for detc. of Na in presence of other alkali metals, cf. F. E. Sheibley, *J. Org. Chem.* **3**, *414–23 (1938); C. A.* **33**, *2895 (1939)*.

STRONTIUM

SODIUM RHODIZONATE, 5% aq. soln. made up when needed, gives a red-brown ppt. or red color in neutral soln. of Sr; the color disappears on acidulation; Ca does not intfr. and Ba interference is prevented by pptn. as chromate; cf. Feigl, *Mikrochemie* **2**, *187 (1924); Feigl, p. 138;* G. Gutzeit, *Helv. Chim. Acta* **12**, *829 (1929)*.

SULFUR, SULFIDE, SULFATE

Free sulfur may be detected by heating the substance in a melting point tube for 5 minutes at 210° C. with **BENZYLIMIDO-DI (4-METHOXYPHENYL)-METHANE** which forms a blue color that may be extracted with benzene; cf. Schonberg and Urban, *Ber.* **67B**, *1999–2003 (1935)*.

For detn. of S in petroleum distillates, a reagt. freshly prepared from 10 vol. freshly distilled CS_2 and 1 vol. **PYRIDINE** is used. When heated with a sample contg. S it gives a pink color with an intensity varying with S content; cf. Thornton and Latta, *Ind. Eng. Chem., (Anal. Ed.)* **4**, *441–2 (1932); Snell, p. 600*.

***p*-AMINODIMETHYLANILINE**, dry or 1% soln., with a little 0.1 *N* $FeCl_3$ may be used to detect 1 mcg. or to determine 0.1 to 1 ppm sulfur as sulfide because of the formation of methylene blue; cf. *Feigl, p. 198; Yoe 1, pp. 373–7; Snell, pp. 593–6; C. A.* **29**, *1745 (1935)*. Recomm. *(I. C.)*.

BENZIDINE, as the free base or as the hydrochloride dissolved in dil. HCl, is widely used for pptn. of sulfate as benzidine sulfate; the detn. may then be made by titration with standard NaOH to phenolphthalein end point, or may be made colmtcly. by various means; see references. Phosphate, if present, is removed with magnesium carbonate. For routine analysis of boiler waters, cf. *A. P. H. A., pp. 106–8;* Schroeder, *Ind. Eng. Chem., (Anal. Ed.)* **5**, *6* and *403 (1933)*. See also Peters and Van Slyke, *Quantitative Clinical Chemistry, Vol. II, pp. 892–6* and *902 (1932, Williams and Wilkins, Baltimore); Snell, pp. 621–4;* Marsden and Pollard, *J. Soc. Chem. Ind.* **56**, *464–8T (1937)*.

BARIUM RHODIZONATE is not dissolved by acids; sulfuric acid or sulfate ion, however, bleach the red color of the insoluble barium salt by formation of $BaSO_4$. This may be used as a spot test for sulfate; cf. *Feigl, p. 204;* or, the reaction is the basis for use of sodium rhodizonate as an indicator for titration with $BaCl_2$; cf. Strebinger and Zombory, *Z. anal. Chem.* **105**, *346–50 (1936)*. **TETRAHYDROXYQUINONE** may be used in the same way to detect sulfate up to 30,000 ppm and has the advantage of being more stable; cf. Sheen and Kahler, *Ind. Eng. Chem., (Anal. Ed.)* **8**, *127–30 (1936)*, and Peabody and Fisher, *ibid*, **10**, *651 (1938); A. P. H. A., pp. 108–9;* **EOSIN** has been tried as an indicator for titration of sulfate with $Pb(NO_3)_2$; cf. J. E. Ricci, *Ind. Eng. Chem., (Anal. Ed.)* **8**, *130–2 (1936)*.

Sulfite may be identified by its bleaching effect on such dyes as **MALACHITE GREEN, MELDOLA BLUE,** and **FUCHSIN**; cf. *Feigl, p. 201;* G. Gutzeit, *Helv. Chim. Acta* **12**, *736 (1929);* V. E. Malinovskii, *C. A.* **25**, *2076 (1931)*. Sulfite in thiosulfate soln. may be detected by use of **FORMALDEHYDE** which releases alkali as shown by phenolphthalein; *Feigl, 202*. Recomm. *(I. C.)*.

Thiosulfate may be detected by its formation of a ppt. in a neutral soln. with a reagt. made by adding **ETHYLENEDIAMINE** to a soln. of $Ni(NO_3)_2$ until a violet color develops; cf. G. Spacu and P. Spacu, *Z. anal. Chem.* **89**, *192–6 (1932)*.

TANTALUM

For tests and reagts. see under *columbium*.

ORGANIC REAGENTS FOR INORGANIC ANALYSIS

TARTRATE

GALLIC ACID, 0.01 g. in 100 ml. concd. H_2SO_4, gives blue to yellow-green coloration with tartrate sepd. out as the Ca salt and heated to 120°–150° C. Formaldehyde, carbohydrates, glycolic acid and certain other acids intfr. by giving colorations but malic, cinnamic, salicylic, and the fatty acids do not. *Feigl, 338.* Recomm. (*I. C.*).

RESORCINOL, 2% aq. soln., gives a red color when heated with a sample contg. tartrate to which concn. H_2SO_4 is added; oxidizing agents intfr.; oxalate gives a blue color. For detc. of tartrate in cheese, cf. *A. O. A. C., p. 302.* If KBr be used with reagt. under controlled conditions of acidity and temperature, the reaction becomes specific except for chloral; cf. Ware, *Chemist and Druggist* **120,** *74–129 (1934);* Pesez, *J. pharm. chim.* **21,** *542 (1935).*

TELLURIUM

THIOUREA gives a yellow crystalline ppt. with acid or neutral solns. contg. Te in concns. of over 2–5 ppm. Se, Bi, and Sb may intfr. Cf. P. Falciola, *Ann. chim. applicata* **17,** *359–60 (1927); C. A.* **21,** *3580 (1927).* Recomm. (*I. C.*).

THALLIUM

DIPHENYLTHIOCARBAZONE (DITHIZONE), 0.01% soln. in $CHCl_3$ may be used for detn. of 0.005 to 0.2 mg. Tl in the presence of not over 100 mg. of Hg, Ni, or Zn, nor over 0.6 mg. Pb or Bi; Tl is extracted from an ammoniacal soln. by the reagt.; cf. L. A. Haddock, *Analyst* **60,** *394–9 (1935).*

THIONALID (THIOGLYCOLIC ACID β-AMINONAPHTHALIDE), in alk. soln. contg. cyanide or tartrate, is practically specific for Tl and ppts. in concns. as low as 0.1 ppm; the ppt. is suitable for gravmtc., volmtc., or colmtc. methods; cf. Berg, and Roebling, *Z. angew. Chem.* **48,** *430* and *597 (1935).*

For a summary of the action of many reagts. on Tl (I) and Tl (III), cf. Munch and Ward, *J. Am. Pharm. Assoc.* **24,** *351–8 (1935).*

THORIUM

1-AMINO-4-HYDROXYANTHRAQUINONE as a 0.1% soln. in alc. gives with Th in weakly acid solns. a red fluorescence. Ga reacts similarly but is very much weaker in effect. Other metal ions do not intfr. unless they oxidize the reagt.; phosphate, fluoride, and sulfate intfr.; White and Lowe, *Ind. Eng. Chem., (Anal. Ed.)* **13,** *809 (1941).*

CUPFERRON (AMMONIUM NITROSOPHENYLHYDROXYLAMINE) gives a quant. pptn. of Th in acetic acid soln.; Ag, Pb, Hg, Sn, Bi, W, and Ce intfr.; cf. Baudisch, *Chem. Ztg.* **33,** *1298 (1908);* W. M. Thornton, *Chem. News* **114,** *13 (1916).*

PICROLONIC ACID, 2.6 g. per liter, gives a ppt. of Th salt which is less soluble than Ca and Pb salts; pptn. is from a soln. acid with AcOH. The reagt. does not serve to separate Th from other rare earths but in their absence is satisfactory for gravmtc. detn. of Th; cf. Hecht and Ehrmann, *Z. anal. Chem.* **100,** *87–8 (1935).* **8-HYDROXYQUINOLINE (OXINE)** gives a pptn. from AcOH soln. buffered with NH_4OAc which is said to provide a more convenient macro- and micro-detn. than that with picrolonic acid; cf. F. Hecht, *Z. anal. Chem.* **100,** *98–103 (1935).*

PHENYLARSONIC ACID may be used to separate Th from Zr; the former gives a ppt. only in a soln. buffered with acetate; cf. Rice, Fogg, and James, *J. Am. Chem. Soc.* **48,** *895 (1926).*

TIN

CACOTHELINE, satd. aq. soln., gives a violet color with Sn (II) which may be used as a spot test or for colmtc. detn. The reaction is most sensitive in the presence

of HCl; thiosulfate, sulfite, Cu (I), and lower oxides of Mo and W give the same test; cf. G. Gutzeit, *Helv. Chim. Acta* **12,** *720 (1929); Feigl, p. 59; Snell, p. 258;* Newell, Ficklen and Maxfield, *Ind. Eng. Chem., (Anal. Ed.)* **7,** *40 (1935);* cf. also *C. A.* **30,** *4783 (1936).* Recomm. *(I. C.).*

DIMETHYLGLYOXIME with $FeCl_3$ added to an acid soln. of unknown and then made ammoniacal gives red Fe (II) dimethylglyoxime from reduction of Fe (III) by Sn (II) or any other strong reducing agent; tartrate is added before the ammonia to prevent pptn. of $Fe(OH)_3$; cf. *Feigl, p. 60.* Recomm. *(I. C.).*

CUPFERRON (AMMONIUM NITROSOPHENYLHYDROXYLAMINE) may be used for gravmtc. detn. of Sn and for its separation from As, Sb, Pb, Mn, Zn, Co, and Ni; cf. N. H. Furman, *Ind. Eng. Chem.* **15,** *1071 (1923);* Pinkus and Claessens, *Bull. soc. chim. Belg.* **36,** *413 (1927); Prodinger, p. 82.*

4-CHLORO-1,2-DIMERCAPTOBENZENE (1-CHLOROBENZENE-3,4-DITHIOL) as 0.2% soln. in NaOH soln. gives a pink or red color with acid soln. contg. Sn (II). Sn (IV) slowly gives the test also. The test soln. may contain as much as 15% HCl. If xs. reagt. is used in test tube, only Cu, Bi and Ni intfr. Mills and Clark, *J. Chem. Soc.* **149,** *175 (1936);* Clark, *Tech. Pub. Intern. Tin Research Development Council, Ser. A, No. 41 (1936).* Recomm. *(I. C.).*

TITANIUM

CUPFERRON (AMMONIUM NITROSOPHENYLHYDROXYLAMINE), freshly prepared 6% aq. soln. ppts. the reddish-brown Ti compound from an acid soln. which may contain Al, Cr, Mn, and Ni without intfrnce.; Zr, Fe, V, W, and rare earths ppt. under the same conditions; cf. T. R. Cunningham, *Ind. Eng. Chem., (Anal. Ed.)* **5,** *305 (1933).*

For the use of **8-HYDROXYQUINOLINE (OXINE)** as a pptant. of Ti, cf. Berg and Teitelbaum, *Z. anal. Chem.* **81,** *1 (1930); Prodinger, p. 110.*

THYMOL, 5 g. dissolved in 5 ml. dil AcOH, then mixed with 95 ml. conc. H_2SO_4 and protected from sunlight, is a reagt. for colmtc. detn. of 0.2 to 2.5 mg. TiO_2. It gives a yellow to red color depending on the concn. and errors average 5%; only W is likely to intfr.; cf. Lehner and Crawford, *J. Am. Chem. Soc.* **35,** *138–41 (1913); Snell p. 363.*

DIHYDROXYMALEIC ACID prevents the formation of an orange color with V and H_2O_2, but does not affect the coloration arising from interaction of Ti and H_2O_2. Consequently Ti in admixture with V, in acid solns., may be detected by this reagt.; cf. Fenton, *J. Chem. Soc.* **93,** *1064 (1908); Snell, p. 365.*

GALLIC ACID, 1% aq. soln., may be used for colmtc. detn. of minute amounts of Ti in neutral solns. to which NaOAc soln. is added after addn. of the reagt.; yellow to red colors are produced and the reaction is 20 times more sensitive than H_2O_2 test; Fe, Mo, U, W, Cr, Ce, Al, Be, Th, Zr, Mn, Zn, Ni, Co, and Ca must be absent; cf. *C. A.* **29,** *7219 (1935).*

PYROCATECHOL, 10% aq. soln. contg. a small amount of H_2SO_4 and freshly prepared, gives an orange coloration with Ti in concns. over 50 ppm; no intfrnce. is caused by Al, NH_4, Ba, Be, Cd, Ce, Cs, Co, La, Pb, Mn, Mo, K, Rb, Na, Sr, Te, W, Zn, chloride, nitrate, nitrite, sulfate or sulfite; Sb, As, Bi, Cr, Cu, Fe, Li, Mg, Hg, Ni, Ag, Sn, Tl, Th, U, V, Se, phosphate do intfr.; *Feigl, p. 122;* Pike, Ficklen, and Newell, *Ber.* **68B,** *1023–6 (1935).*

CHROMOTROPIC ACID, 5% aq. soln., gives a brown-red color with HCl or H_2SO_4 solns. of titanic compounds; the test is interfered with by several metals; cf. *Feigl, p. 123.*

***p*-HYDROXYPHENYLARSONIC ACID,** 4% aq. soln., is useful in sepg. Ti from Fe (II), Fe (III), Al, Zn, Co, Ni, Be, Cr, Na, K, NH_4, PO_4, MoO_4 CrO_4, VO_4, uranyl. H_2O_2 must be absent; Zr and Sn intfr. Simpson and Chandlee, *Ind. Eng. Chem., (Anal. Ed.)* **10,** *642 (1938);* cf. also *C. A.* **35,** *4702 (1941).*

ORGANIC REAGENTS FOR INORGANIC ANALYSIS

TUNGSTEN, TUNGSTATE

CINCHONINE, 125 g. in 1 liter HCl soln. made from 500 ml. conc. HCl, 500 ml. water, is added in the digestion of an alloy or mineral of W with HCl or HNO_3 to increase the rapidity and completeness of pptn.; the ppt. is ignited to WO_3 for detn. and is a standard procedure; cf. Hillebrand and Lundell, *Applied Inorganic Analysis, pp. 548 ff (1929, Wiley, New York).* Simpson, Schumb, and Sieminski, *Ind. Eng. Chem., (Anal. Ed.)* **10,** *243–5 (1938)* have found that even small amts. of phosphate cause erratic results in the cinchonine method.

α-BENZOINOXIME (CUPRON), 5% alc. soln., may be used for the quant. sepn. of W (as tungstate) from Mo and V; cf. H. B. Knowles, *Bur. Standards J. Research* **9,** *1 (1932).*

RHODAMINE B, 0.01% aq. soln., is changed in color from a yellowish-red to a bluish-red by W in dil. HCl soln. and this may be used for detc. and rough estn. Mo does not intfr. unless in great xs.; Sb (V) gives the same coloration; cf. E. Eegriwe, *Z. anal. Chem.* **70,** *400 (1927);* G. Heyne, *Z. angew. Chem.* **44,** *237–8 (1931).* G. Heyne has also suggested the use of **HYDROQUINONE** in sulfuric acid which gives a red color with tungstate; Fe, Ti, Mo, nitrate, and chromate intfr.; the errors are not as large as with rhodamine B, but Mo intfrnce. is greater; cf. *Snell, p. 378.*

The tungstate ion catalyzes the reduction of **MALACHITE GREEN** by titanous chloride and this may be used as a means of detecting W; E. B. Sandell, *Ind. Eng. Chem., (Anal. Ed.)* **10,** *667 (1938).*

URANIUM

CUPFERRON (AMMONIUM NITROSOPHENYLHYDROXYLAMINE) does not ppt. hexavalent uranium (i.e. UO_2^{++}) and in H_2SO_4 acid soln. V, Fe, Ti, and Zr may be separated from U by pptn. with this reagt. When reduced to U^{4+}, however, it is pptd. and may in this manner be separated from Al, Cr, Mn, and P; cf. Hillebrand and Lundell, *Applied Inorganic Analysis, pp. 109–12 (1929, Wiley, New York).*

α-QUINALDINIC ACID, 5% aq. soln. of Na salt, may be used for the quant. pptn. of hexavalent U; cf. Ray and Bose, *Z. anal. Chem.* **95,** *400–14 (1933),* *C. A.* **28,** *1625 (1934).*

SALICYLIC ACID, 2% aq. soln. of the sodium salt, gives a red coloration with uranyl ion which may be used for estn.; errors may be as high as 7% and Fe must be absent; the reaction takes place in a neutral or sl. acid soln.; cf. Muller, *Chem. Ztg.* **43,** *739–40 (1919); Snell, p. 394.*

VANADIUM, VANADATE

DIMETHYLGLYOXIME with $FeCl_3$ reacts with tetravalent V in the same manner as Sn (II); vanadate (pentavalent) may be reduced to vanadium (IV) by boiling with concd. HCl, then test may be made by adding $FeCl_3$ and reagt. and making alkaline with NH_4OH. *Feigl, 68.* Recomm. *(I. C.).*

CACOTHELINE, satd. aq. soln., gives violet coloration with V (III) in HCl soln. Vanadate may be reduced to V (III) by means of Zn in HCl. Molybdates and tungstates intfr. by giving colored reduction products; Fe (II) in presence of PO_4^{---} or F^- also intfrs. by reducing reagt. Sn must be absent. *Feigl, p. 69.* Recomm. *(I. C.).*

8-HYDROXYQUINOLINE (OXINE) may be used for detc. of vanadate; in AcOH soln. a yellow pptn. occurs which on warming becomes a deep blue colored soln.; Mo, W, Ti and Fe may be removed to prevent intfrnce.; cf. *Feigl, p. 69; C. A.* **28,** *3409 (1934).*

AMMONIUM BENZOATE, satd. aq. soln., may be used for a gravmtc. detn. on a sample contg. 0.10 to 0.15 g. V_2O_5; the results are accurate to 0.001% and are not affected by the presence of Mg, Al, Cu, Mo, W, or Ti; Fe and Cr must be removed; for details, cf. F. M. Shemyakin, *C. A.* **29,** *2880 (1935).*

CUPFERRON (AMMONIUM NITROSOPHENYLHYDROXYLAMINE), ppts. pentavalent V in cold, dil. H_2SO_4 soln. from Cr, As, P, Al, and uranyl; in the absence of appreciable amounts of Fe, Ti, and Zr this may be used for detn. of V; for references see under *uranium.*

ZINC

α-QUINALDINIC ACID, aq. soln. of the ammonium salt, ppts. Zn from a soln. alk. to methyl red-methylene blue indicator; Fe (III), Al, Cr, Be, Ti, and uranyl do not ppt. in the presence of tartrate and Zn may be detd. in their presence; the ppt. is dried at 125° C. and weighed as $Zn(C_{10}H_6O_2N)_2 \cdot H_2O$; cf. Ray and Majundar, *Z. anal. Chem.* **100,** *324–7 (1935);* also *Mikrochemie* **18,** *89 (1935),* and Shennan, *Analyst* **64,** *14 (1939); Prodinger, p. 58.* For use of **5-NITROQUINALDINIC ACID** in colmtc. detn. of micro amts. of Zn see W. L. Lott, *Ind. Eng. Chem.,* (*Anal. Ed.*) **10,** *335–8 (1938).*

8-HYDROXYQUINOLINE (OXINE), 2% alc. soln., gives a quant. pptn. of Zn; in acetate buffer solns. (pH 5–6) Zn may be sepd. from alkaline earths, Pb and Mn. In alk. soln. Zn is said to be separable from Al, Cr, Fe, Sb, As, Bi, Co, Ni, Mn; cf. Berg, *Z. anal. Chem.* **71,** *171 (1927);* Spacu and Dick, *ibid.* **73,** *356 (1928),* and *Prodinger, p. 107.* For use in detn. of Zn in soils, cf. J. S. Hosking, *C. A.* **30,** *6488 (1936).*

ANTHRANILIC ACID ppts. Zn from neutral or sl. acid soln.; the ppt. may be dried as $Zn(C_7H_6O_2N)_2$ for gravmtc. detn. or may be titrated with KBr–$KBrO_3$ soln.; cf. Funk and Ditt, *Z. anal. Chem.* **91,** *332–7 (1933);* Cimerman and Wenger, *Mikrochemie* **18,** *53 (1935); Prodinger, p. 31.* For use of reagt. in detn. of Zn in "white metal" alloys cf. C. W. Anderson, *Ind. Eng. Chem.,* (*Anal. Ed.*) **13,** *367 (1941)*

DIPHENYLTHIOCARBAZONE (DITHIZONE) may be used for detc. and detn. of mcg. amounts of Zn. The Zn is extracted quant. by the reagt. in $CHCl_3$ soln. from the aq. soln. buffered to pH of about 5 and this results in changing the color of the reagt. soln. to red; cf. Fischer and Leopoldi, *Z. anal. Chem.* **97,** *385–95 (1934);* see also Fischer and Leopoldi for a method of preventing intfr. by any metal, *ibid.,* **107,** *241–69 (1937); C. A.* **31,** *969 (1937);* cf. also P. L. Hibbard, *Ind. Eng. Chem.,* (*Anal. Ed.*) **9,** *127–31 (1937); Snell, pp. 350–2.* For detn. of Zn in foods, in plant materials, and for a general discussion of specificity of the reagt. cf. Holland and Ritchie, *J. Assoc. Official Agr. Chem.* **22,** *333 (1939);* Cowling and Miller, *Ind. Eng. Chem.,* (*Anal. Ed.*) **13,** *145–9 (1941);* Wichmann, *ibid.* **11,** *66–72 (1939).* For spot test, cf. *Feigl, p. 110.* Reagt. recomm. (*I. C.*).

Potassium ferricyanide may be used with a number of easily oxidized amines to ppt. zinc ferrocyanide by interaction of amine and ferricyanide; the oxidation product of the amine is simultaneously absorbed by the zinc ferrocyanide. **DIETHYLANILINE, DIPHENYLAMINE, DIPHENYLBENZIDINE, METANIL YELLOW, ORANGE IV (TROPAEOLIN OO)** have been used in detc. of Zn and as titrimetric indicators; cf. Cone and Cady, *J. Am. Chem. Soc.* **49,** *356* and *2214 (1927);* E. Eegriwe, *Z. anal. Chem.* **74,** *225–31 (1928); Feigl, p. 109.* For detn. of Zn in rubber compds., ***p*-ETHOXYCHRYSOIDINE** (***p*-ETHOXYPHENYLAZO-*m*-PHENYLENEDIAMINE**) as a 0.2% soln. in about 60% H_2SO_4 has been found superior to the reagts. listed above as an indicator in titration with standard $K_4Fe(CN)_6$ soln., cf. W. P. Tyler, *Ind. Eng. Chem.,* (*Anal. Ed.*) **14,** *114–118 (1942).*

ZIRCONIUM

PHENYLARSONIC ACID, 2.5% soln., has been used for pptn. and detn. of Zr; cf. P. Klinger, *Tech. Mitt. Krupp.* **3,** *1–4 (1935). C. A.* **29,** *5039 (1935).* **PROPYLARSONIC ACID** yields a white ppt. from $ZrCl_4$ in dil. HCl soln.; Th, Ti, Mn, Ni, Fe, Al, Ce, V, Cr, Cu, Mg, Zn, U, Mo, Co, Be, and Cd do not intfr.; Sb, Bi, and Sn do intfr.; cf. Arnold and Chandlee, *J. Am. Chem. Soc.* **57,** *8* and *591,* (*1935*). ***p*-DIMETHYLAMINOAZOPHENYLARSONIC ACID** has found use as a spot reagt.; cf. *Feigl, p. 126* and for a rapid colmtc. detn. of Zr in steel, cf. Hayes and Jones, *Ind. Eng. Chem.,* (*Anal. Ed.*) **13,** *603 (1941).* Recomm. (*I. C.*). ***p*-HYDROXY-**

ORGANIC REAGENTS FOR INORGANIC ANALYSIS

PHENYLARSONIC ACID is useful in detn. of Zr as it is for Ti (q.v.); intfr. by Ti is eliminated by addn. of H_2O_2; Sn and PO_4 ions intfr. Cf. reference under Ti.

β-NITROSO-α-NAPHTHOL, 1% alc. soln., is used for detc. in dil. HCl soln. contg. at least 0.1 mg. Zr per ml.; a red color is given; Fe, sulfates, xs. of Ti must be removed before making the test; Al, Th, Ce, and La do not intfr.; cf. Bellucci and Savoia, *C. A.* **18,** *3333 (1924);* Oshman and Zerchaninova, *C. A.* **29,** *2881 (1935); Feigl, p. 124.* Recomm. (*I. C.*).

SODIUM ALIZARIN SULFONATE (ALIZARIN S), in aq. soln., gives a violet-red color with Zr. The reagt. should be added to a neutral test soln. which is then boiled and acidified with a little dil. HCl. The colors given by Al, Th, Be, and Ti salts disappear under these conditions leaving only the Zr. F, PO_4, SO_4 ions intfr. Cf. de Boer, *Chem. Weekblad* **21,** *404 (1924); Feigl, p. 125;* F. Pavelka, *Mikrochemie* **8,** *345-51 (1930).* Recomm. (*I. C.*).

CUPFERRON (AMMONIUM NITROSOPHENYLHYDROXYLAMINE) may be used in H_2SO_4 medium for separating Zr from Al, Cr, uranyl, and B; in the absence of many other elements, such as Ti, Th, Ce, Fe, V, Cb, Ta, W, and Si, it may be used directly for gravmtc. detn.; cf. Lundell and Knowles, *Ind. Eng. Chem.* **12,** *344 (1920); J. Am. Chem. Soc.* **42,** *1439 (1920).*

CONCENTRATIONS OF LABORATORY REAGENTS

COMMONLY USED ACIDS AND AMMONIA*

Freshly opened bottles of these reagents are uniformly of the concentrations indicated below. This may not be true of bottles long opened and this is especially true of ammonia which rapidly loses its strength. In preparing volumetric solutions, it is well to be on the safe side and take a little more than the calculated volume of the concentrated reagent, since it is much easier to dilute a concentrated solution than to strengthen one that is too weak. The *5N* solutions present obvious advantages over the usual indefinite dilutions for use as shelf reagents; however, it is not necessary that these shelf reagents be highly accurate.

	HCl	HNO_3	H_2SO_4	NH_4OH	$HC_2H_3O_2$
Mol. wt.	36.46	63.02	98.07	35.04	60.03
Average sp. gr. of conc. reagent	1.19	1.42	1.84	0.90	1.06
Average % present in conc. reagent	36.0	69.5	96.0	58.6	99.5
Grams active ingredient per ml.	0.426	0.985	1.77	0.527	1.055
Normality of conc. reagent	11.7	15.6	36.1	15.1	17.6
Ml. conc. reagent/liter *N* solution	85.5	64.0	27.8	66.5	56.9
Ml. to dilute to 500 cc. for use as shelf reagent (*5N*)	214	160	70	166	143

* Schollenberger, *Chemist Analyst* 18, No. 6, p. 8 (1929); reprinted by permission of J. T. Baker Chemical Co.

Routine Normal Solutions †

A concentrated C. P. acid usually comes to the laboratory in a bottle having a label which states: its molecular weight, M; its specific gravity, d; and its percentage assay, p. When such an acid is used in preparing an aqueous solution of desired normality, N, a convenient formula to employ is:

$$V = \frac{100\ MN}{bpd}$$

wherein b is the basicity of the acid and V is the number of milliliters of concentrated acid required for one liter of the dilute solution.

Example.—Acid Sulfuric is dibasic and has the molecular weight 98.08. If the concentrated acid assays 95.5% and has the specific gravity 1.84, the volume required for one liter of a 0.2 normal solution is:

$$V = \frac{100 \times 98.08 \times 0.2}{2 \times 95.5 \times 1.84} = 5.58 \text{ ml.}$$

Such a solution may often be used just as it stands. Where accuracy is required, it is most conveniently standardized by comparison with a high grade Potassium Biphthalate or other primary standard, *q.v.*

† Hague, *Chemist Analyst* 30, No. 1, p. 21 (1941); reprinted by permission of J. T. Baker Chemical Co.

LABORATORY SOLUTIONS

General Reagents and Special Solutions

Unless otherwise stated, the term *g per liter* signifies grams of the formula indicated dissolved in water and made up to a liter of solution. See also *Standard Volumetric Solutions.*

Acetic acid, $HC_2H_3O_2$—6 *N*: 350 cc glacial acetic acid per liter.

Alcohol, amyl, $C_5H_{11}OH$: use as purchased.

Alcohol, ethyl, C_2H_5OH; 95% alcohol, as purchased.

Aluminon (qualitative test for aluminum). The reagent consists of 0.1% solution of the ammonium salt of aurin tricarboxylic acid. A bright red precipitate, persisting in alkaline solution, indicates aluminum. See special table: *Organic Reagents for Inorganic Analysis.*

Aluminum chloride, $AlCl_3$—0.5 *N*: 22 g per liter.

Aluminum nitrate, $Al(NO_3)_3 \cdot 7.5H_2O$ —0.5 *N*: 58 g per liter.

Aluminum sulfate, $Al_2(SO_4)_3 \cdot 18H_2O$ —0.5 *N*: 55 g per liter.

Ammonium acetate, $NH_4C_2H_3O_2$— 3 *N*: 231 g per liter.

Ammonium carbonate, $(NH_4)_2CO_3 \cdot H_2O$—3 *N*: 171 g per liter; for the anhydrous salt: 144 g per liter.

Ammonium chloride, NH_4Cl—3 *N*: 161 g per liter.

Ammonium hydroxide, NH_4OH— 15 *N*: the concentrated solution which contains 28% NH_3; for 6 *N*: 400 cc per liter.

Ammonium molybdate, $(NH_4)_2MoO_4$—*N*: dissolve 88.3 g of solid $(NH_4)_6Mo_7O_{24} \cdot 4H_2O$ in 100 cc 6 *N* NH_4OH. Add 240 g of solid NH_4NO_3 and dilute to one liter. Another method is to take 72 g of MoO_3, and 130 cc of water and 75 cc of 15 *N* NH_4OH; stir mechanically until nearly all has dissolved, then add it to a solution of 240 cc concentrated HNO_3 and 500 cc of water; stir continuously while solutions are being mixed; allow to stand 3 days, filter, and use the clear filtrate.

Ammonium nitrate, NH_4NO_3—*N*: 80 g per liter.

Ammonium oxalate, $(NH_4)_2C_2O_4 \cdot H_2O$—0.5 *N*: 40 g per liter.

Ammonium polysulfide (yellow ammonium sulfide), $(NH_4)_2S_x$: allow the colorless $(NH_4)_2S$ to stand, or add sulfur.

Ammonium sulfate, $(NH_4)_2SO_4$— 0.5 *N*: 33 g per liter; saturated: dissolve 780 g of $(NH_4)_2SO_4$ in water and make up to a liter.

Ammonium sulfide (colorless), $(NH_4)_2S$—saturated: pass H_2S through 200 cc of concentrated NH_4OH in the cold until no more gas is dissolved, add 200 cc NH_4OH and dilute with water to a liter; the addition of 15 g of sulfur is sufficient to make the polysulfide.

Ammonium thiocyanate: see *Volumetric Solutions.*

Antimony pentachloride, $SbCl_5$— 0.5 *N*: 30 g per liter.

Antimony trichloride, $SbCl_3$—0.5 *N*: 38 g per liter.

Aqua regia: mix 3 parts of concentrated HCl and 1 part of concentrated HNO_3 just before ready to use.

Arsenic acid, $H_3AsO_4 \cdot 0.5H_2O$—0.5 *N* $(= \frac{1}{2}H_3AsO_4 \div 5)$: 15 g per liter.

Arsenous oxide, As_2O_3—0.25 *N*: 8 g per liter for saturation. See also *Volumetric Solutions.*

Aurichloric acid, $HAuCl_4 \cdot 3H_2O$: dissolve in ten parts of water.

Azolitmin solution (indicator): make up a 1% solution of azolitmin by boiling in water for 5 minutes; it may be necessary to add a small amount of NaOH to make the solution neutral.

Bang's reagent (for glucose estimation): dissolve 100 g of K_2CO_3, 66 g of KCl, and 160 g of $KHCO_3$ in the order given in about 700 cc of water at 30°C. Add 4.4 g of copper sulfate and dilute to 1000 cc after the CO_2 is evolved. This solution should be shaken only in such a manner as not to allow the entry of air. After 24 hours 300 cc are diluted to a liter with saturated KCl solution, shaken gently and used after 24 hours; 50 cc ≈ 10 mg glucose.

Barfoed's reagent (test for glucose):

dissolve 66 g of cupric acetate and 10 cc of glacial acetic acid in water and dilute to one liter.

Barium and Calcium chlorides: see *Precipitation reagent.*

Barium chloride, $BaCl_2 \cdot 2H_2O$—0.5 *N*: 61 g per liter.

Barium hydroxide, $Ba(OH)_2 \cdot 8H_2O$—0.2 *N*: 32 g per liter for saturation.

Barium nitrate, $Ba(NO_3)_2$—0.5 *N*: 65 g per liter.

Baudisch's reagent: see *Cupferron.*

Benedict's qualitative reagent (for glucose): dissolve 173 g of sodium citrate and 100 g of anhydrous sodium carbonate in about 600 cc of water, and dilute to 850 cc; dissolve 17.3 g of $CuSO_4 \cdot 5H_2O$ in 100 cc of water and dilute to 150 cc; this solution is added to the citrate-carbonate solution with constant stirring. See also the quantitative reagent below.

Benedict's quantitative reagent (sugar in urine): This solution contains 18 g copper sulfate, 100 g of anhydrous sodium carbonate, 200 g of potassium citrate, 125 g of potassium thiocyanate, and 0.25 g of potassium ferrocyanide per liter; 1 cc of this solution $\approx$0.002 g sugar.

Benzidine hydrochloride solution (for sulfate determination): mix 6.7 g of benzidine $[C_{12}H_8(NH_2)_2]$ or 8.0 g of the hydrochloride $[C_{12}H_8(NH_2)_2 \cdot 2HCl]$ into a paste with 20 cc of water; add 20 cc of HCl (sp. gr. 1.12) and dilute the mixture to one liter with water; each cc of this solution is equivalent to 0.00357 g H_2SO_4.

Bertrand's reagents (glucose estimation): (*a*) 40 *g* of copper sulfate diluted to one liter; (*b*) rochelle salt 200 g, NaOH 150 g and sufficient water to make one liter; (*c*) ferric sulfate 50 g, H_2SO_4 200 g and sufficient water to make one liter; (*d*) $KMnO_4$ 5 g and sufficient water to make one liter.

Bial's reagent (for pentoses): dissolve 1 g of orcinol in 500 cc of 30% HCl to which 30 drops of a 10% ferric chloride solution have been added.

Bismuth chloride, $BiCl_3$—0.5 *N*: 52 g per liter, using 1:5 HCl in place of water.

Bismuth nitrate, $Bi(NO_3)_3 \cdot 5H_2O$—0.25 *N*: 40 g per liter, using 1:5 HNO_3 in place of water.

Bismuth standard solution (quantitative color test for Bi): dissolve 1 g of bismuth in a mixture of 3 cc of concentrated HNO_3 and 2.8 cc of H_2O and make up to 100 cc with glycerol. Also dissolve 5 g of KI in 5 cc of water and make up to 100 cc with glycerol. The two solutions are used together in the colorimetric estimation of Bi.

Boutron-Boudet solution: see *Soap solution.*

Bromine water, saturated solution: to 400 cc of water add 20 cc of bromine; use a glass stopper coated with vaseline.

Brucke's reagent (protein precipitant): dissolve 50 *g* of KI in 500 cc of water, saturate with HgI_2 (about 120 g), and dilute to one liter.

Cadmium chloride, $CdCl_2$—0.5 *N*: 46 g per liter.

Cadmium nitrate, $Cd(NO_3)_2 \cdot 4H_2O$—0.5 *N*: 77 g per liter.

Cadmium sulfate, $CdSO_4 \cdot 4H_2O$—0.5 *N*: 70 g per liter.

Calcium chloride, $CaCl_2 \cdot 6H_2O$—0.5 *N*: 55 *g* per liter.

Calcium hydroxide, $Ca(OH)_2$—0.04 *N*: 10 g per liter for saturation.

Calcium nitrate, $Ca(NO_3)_2 \cdot 4H_2O$—0.5 *N*: 59 *g* per liter.

Calcium sulfate, $CaSO_4 \cdot 2H_2O$—0.03 *N*: mechanically stir 10 g in a liter of water for 3 hours; decant and use the clear liquid.

Carbon disulfide, (CS_2): commercial grade which is colorless.

Chloride reagent: dissolve 1.7 g of $AgNO_3$ and 25 g KNO_3 in water, add 17 cc of concentrated NH_4OH and make up to one liter with water.

Chlorine water, saturated solution: pass chlorine gas into small amounts of water as needed; solutions deteriorate on standing.

Chloroform, $CHCl_3$: commercial grade.

Chloroplatinic acid, $H_2PtCl_6 \cdot 6H_2O$—10% solution: dissolve 1 gram in 9 cc of

water; keep in a dropping bottle.

Chromic chloride, $CrCl_3$—0.5 *N*: 26 g per liter.

Chromic nitrate, $Cr(NO_3)_3$—0.5 *N*: 40 g per liter.

Chromic sulfate, $Cr_2(SO_4)_3 \cdot 18H_2O$—0.5 *N*: 60 g per liter.

Cobaltous nitrate, $Co(NO_3)_2 \cdot 6H_2O$—0.5 *N*: 73 g per liter.

Cobaltous sulfate, $CoSO_4 \cdot 7H_2O$—0.5 *N*: 70 g per liter.

Cupferron (iron analysis): dissolve 6 g of ammonium nitrosophenyl-hydroxylamine (cupferron) in water and dilute to 100 cc. This solution is stable for about one week if protected from light. See special table: *Organic Reagents for Inorganic Analysis.*

Cupric chloride, $CuCl_2 \cdot 2H_2O$—0.5 *N*: 43 g per liter.

Cupric nitrate, $Cu(NO_3)_2 \cdot 6H_2O$—0.5 *N*: 74 g per liter.

Cupric sulfate, $CuSO_4 \cdot 5H_2O$—0.5 *N*: 62 g per liter.

Cuprous chloride, CuCl—0.5 *N*: 50 g per liter, using 1:5 HCl in place of water.

Cuprous chloride, acid (for gas analysis, absorption of CO): cover the bottom of a two-liter bottle with a layer of copper oxide ⅜ inch deep, and place a bundle of copper wire an inch thick in the bottle so that it extends from the top to the bottom. Fill the bottle with HCl (sp. gr. 1.10). The bottle is shaken occasionally, and when the solution is colorless or nearly so, it is poured into half-liter bottles containing copper wire. The large bottle may be filled with hydrochloric acid, and by adding the oxide or wire when either is exhausted, a constant supply of the reagent is available.

Cuprous chloride, ammoniacal: this solution is used for the same purpose, and is made in the same manner as the acid cuprous chloride above, except that the acid solution is treated with ammonia until a faint odor of ammonia is perceptible. Copper wire should be kept with the solution as in the acid reagent.

Dimethyl glyoxime, $(CH_3CNOH)_2$—0.01 *N*: 6 g in 500 cc of 95% alcohol.

See special table: *Organic Reagents for Inorganic Analysis.*

Esbach's reagent (estimation of proteins): dissolve 10 g of picric acid and 20 g of citric acid in water and dilute to one liter.

Eschka's Mixture (sulfur in coal): mix 2 parts of porous calcined MgO with 1 part of anhydrous Na_2CO_3; not a solution but a dry mixture.

Ether, $(C_2H_5)_2O$—use commercial grade.

Fehling's solution (sugar detection and estimation): (*a*) Copper sulfate solution: dissolve 34.639 g of $CuSO_4 \cdot 5H_2O$ in water and dilute to 500 cc. (*b*) Alkaline tartrate solution: dissolve 173 g of rochelle salts ($KNaC_4H_4O_6 \cdot 4H_2O$) and 125 g of KOH in water and dilute to 500 cc. Equal volumes of the two solutions are mixed just prior to use. The Methods of the Assoc. of Official Agricultural Chemists give 50 g of NaOH in place of the 125 g KOH.

Ferric chloride, $FeCl_3$—0.5 *N*: 27 g per liter.

Ferric nitrate, $Fe(NO_3)_3 \cdot 9H_2O$—0.5 *N*: 67 g per liter.

Ferrous ammonium sulfate, Mohr's salt, $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$—0.5 *N*: 98 g per liter. See also *Volumetric Solutions.*

Ferrous sulfate, $FeSO_4 \cdot 7H_2O$—0.5 *N*: 80 g per liter; add a few drops of H_2SO_4.

Folin's mixture (for uric acid): dissolve 500 g of ammonium sulfate, 5 g of uranium acetate, and 6 cc of glacial acetic acid, in 650 cc of water. The volume is about a liter.

Formal or Formalin: use the commercial 40% solution of formaldehyde.

Froehde's reagent (gives characteristic colorations with certain alkaloids and glucosides): dissolve 0.01 g of sodium molybdate in 1 cc of concentrated H_2SO_4; use only a freshly prepared solution.

Glyoxylic acid solution (protein detection): cover 10 g of magnesium powder with water, and add slowly 250 cc of a saturated oxalic acid solution, keeping the mixture cool; filter off the magnesium oxalate, acidify the filtrate with acetic

acid and make up to a liter with water.

Guaiacum tincture: dissolve 1 g of guaiacum in 100 cc of alcohol.

Gunzberg's reagent (detection of HCl in gastric juice): dissolve 4 g of phloroglucinol and 2 g of vanillin in 100 cc of absolute alcohol; use only a freshly prepared solution.

Hager's reagent (for alkaloids): this reagent is a saturated solution of picric acid in water.

Hanus solution (for determination of iodine number): dissolve 13.2 g of iodine in a liter of glacial acetic acid that will not reduce chromic acid; add sufficient bromine to double the halogen content determined by titration (3 cc is about the right amount). The iodine may be dissolved with the aid of heat, but the solution must be cold when the bromine is added.

Hydriodic acid, HI—0.5 *N*: 64 g per liter.

Hydrobromic acid, HBr—0.5 *N*: 40 g per liter.

Hydrochloric acid, HCl—5 *N*: 182 g per liter; sp. gr. 1.084. See also *Volumetric Solutions.*

Hydrofluoric acid, H_2F_2—48% solution: use as purchased, and keep in the special container.

Hydrogen peroxide, H_2O_2—3% solution: use as purchased.

Hydrogen sulfide, H_2S: prepare a saturated aqueous solution.

Iodic acid, HIO_3—0.5 *N* ($HIO_3/12$): 15 g per liter.

Iodine: see *Tincture of iodine*; see also *Volumetric Solutions.*

Litmus solution (indicator): powder the litmus and make up a 2% solution, boiling for 5 minutes.

Lead acetate, $Pb(C_2H_3O_2)_2 \cdot 3H_2O$—0.5 *N*: 95 g per liter.

Lead chloride, $PbCl_2$—saturated solution is 1/7 *N*.

Lead nitrate, $Pb(NO_3)_2$—0.5 *N*: 83 g per liter.

Lime water: see *calcium hydroxide.*

Magnesia mixture: 100 g of $MgSO_4$, 200 g of NH_4Cl, 400 cc of NH_4OH, 800 cc of water; each cc ≈ 0.01 g phosphorus (P).

Magnesium chloride, $MgCl_2 \cdot 6H_2O$—0.5 *N*: 50 g per liter.

Magnesium nitrate, $Mg(NO_3)_2 \cdot 6H_2O$—0.5 *N*: 64 g per liter.

Magnesium sulfate, epsom salts, $MgSO_4 \cdot 7H_2O$—0.5 *N*: 62 g per liter; saturated solution: dissolve 600 g of the salt in water and dilute to one liter.

Manganous chloride, $MnCl_2 \cdot 4H_2O$—0.5 *N*: 50 g per liter.

Manganous nitrate, $Mn(NO_3)_2 \cdot 6H_2O$—0.5 *N*: 72 g per liter.

Manganous sulfate, $MnSO_4 \cdot 7H_2O$—0.5 *N*: 69 g per liter.

Marme's reagent (gives yellowish-white precipitate with salts of alkaloids): saturate a boiling solution of 4 parts of KI in 12 parts of water with CdI_2; then add an equal volume of cold saturated KI solution.

Marquis reagent (gives a purple-red coloration, then violet, then blue with morphine, codeine, dionine, and heroine): mix 3 cc of concentrated H_2SO_4 with 3 drops of a 35% formaldehyde solution.

Mayer's reagent (gives white precipitate with most alkaloids in a slightly acid solution): dissolve 13.55 g of $HgCl_2$ and 50 g of KI in a liter of water.

Mercuric chloride, $HgCl_2$—0.5 *N*: 68 g per liter.

Mercuric nitrate, $Hg(NO_3)_2$—0.5 *N*: 81 g per liter.

Mercuric sulfate, $HgSO_4$—0.5 *N*: 74 g per liter.

Mercurous nitrate, $HgNO_3$: mix 1 part of $HgNO_3$, 20 parts of H_2O, and 1 part of HNO_3.

Methyl orange (indicator): dissolve 1 g of methyl orange in a liter of water.

Methyl red (indicator): dissolve 2 g of methyl red in a liter of alcohol. See also special section on *Acid-Base Indicators.*

Millon's reagent (gives a red precipitate with certain proteins and with

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various phenols): dissolve 1 part of mercury in 1 part of HNO_3 (sp. gr. 1.40) with gentle heating, then add 2 parts of water; a few crystals of KNO_3 help to maintain the strength of the reagent.

Mohr's salt: see ferrous ammonium sulfate.

α-Naphthol solution: dissolve 144 g of α-naphthol in enough alcohol to make a liter of solution.

Nessler's reagent (for free ammonia): dissolve 50 g of KI in the least possible amount of cold water; add a saturated solution of $HgCl_2$ until a very slight excess is indicated; add 400 cc of a 50% solution of KOH; allow to settle, make up to a liter with water, and decant.

Nickel chloride, $NiCl_2 \cdot 6H_2O$—0.5 *N*: 59 g per liter.

Nickel nitrate, $Ni(NO_3)_2 \cdot 6H_2O$—0.5 *N*: 73 g per liter.

Nickel sulfate, $NiSO_4 \cdot 6H_2O$—0.5 *N*: 66 g per liter.

Nitric acid, HNO_3—5 *N*: 315 g per liter; sp. gr. 1.165. See also *Volumetric Solutions.*

Nitrohydrochloric acid: see *aqua regia.*

Nitroso-β-naphthol, $HOC_{10}H_6NO$—saturated solution: saturate 100 cc of 50% acetic acid with the solid.

Nylander's solution (detection of glucose): dissolve 40 g of rochelle salt and 20 g of bismuth subnitrate in 1000 cc of an 8% NaOH solution.

Obermayer's reagent (detection of indoxyl in urine): dissolve 4 g of $FeCl_3$ in a liter of concentrated HCl.

Oxalic acid, $H_2C_2O_4 \cdot 2H_2O$: dissolve in ten parts of water. See also *Volumetric Solutions.*

Pavy's solution (estimation of glucose): mix 120 cc of Fehling's solution and 300 cc of ammonium hydroxide (sp. gr. 0.88), and dilute to a liter with water.

Perchloric acid, $HClO_3$—60%: use as purchased.

Phenol solution: dissolve 20 g of phenol (carbolic acid) in a liter of water.

Phenolphthalein solution (indicator): dissolve 1 g of phenolphthalein in 50 cc of alcohol and add 50 cc of water. See also special section on *Acid-Base Indicators.*

Phenol sulfonic acid (determination of nitrogen as nitrate; water analysis for nitrate): dissolve 25 grams of pure, white phenol in 150 cc of pure concentrated H_2SO_4, add 75 cc of fuming H_2SO_4 (15% SO_3), stir well and heat for two hours at 100°C.

Phosphoric acid, *ortho,* H_3PO_4—0.5 *N*: 16 g per liter.

Potassium acid antimonate, KH_2SbO_4—0.1 *N*: boil 23 g of the salt with 950 cc of water for 5 minutes, cool rapidly and add 35 cc of 6 *N* KOH; allow to stand for one day, filter, dilute filtrate to a liter.

Potassium arsenate, K_3AsO_4—0.5 *N* ($K_3AsO_4/10$): 26 g per liter.

Potassium arsenite, $KAsO_2$—0.5 *N* ($KAsO_2/6$): 24 g per liter.

Potassium bromate, $KBrO_3$—0.5 *N* ($KBrO_3/12$): 14 g per liter.

Potassium bromide, KBr—0.5 *N*: 60 g per liter.

Potassium carbonate, K_2CO_3—3 *N*: 207 g per liter.

Potassium chloride, KCl—0.5 *N*: 37 g per liter.

Potassium chromate, K_2CrO_4—0.5 *N*: 49 g per liter.

Potassium cyanide, KCN—0.5 *N*: 33 g per liter. See also *Volumetric Solutions.*

Potassium dichromate, $K_2Cr_2O_7$—0.5 *N* ($K_2Cr_2O_7/8$): 38 g per liter. See also *Volumetric Solutions.*

Potassium ferricyanide, $K_3Fe(CN)_6$—0.5 *N*: 55 g per liter.

Potassium ferrocyanide, $K_4Fe(CN)_6 \cdot 3H_2O$—0.5 *N*: 53 g per liter.

Potassium hydroxide, KOH—5 *N*: 312 g per liter. See also *Volumetric Solutions.*

Potassium iodate, KIO_3—0.5 *N* ($KIO_3/12$): 18 g per liter. See also *Volumetric Solutions.*

Potassium iodide, KI—0.5 *N*: 83 g per liter.

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Potassium nitrate, KNO_3—0.5 *N*: 50 g per liter.

Potassium nitrite, KNO_2—6 *N*: 510 g per liter.

Potassium permanganate, $KMnO_4$—0.5 *N* ($KMnO_4/10$): 16 g per liter. See also *Volumetric Solutions.*

Potassium pyrogallate (oxygen in gas ananlysis): weigh out 5 g of pyrogallol (pyrogallic acid), and pour upon it 100 cc of a KOH solution. If the gas contains less than 28% of oxygen, the KOH solution should be 500 g KOH in a liter of water; if there is more than 28% of oxygen in the gas, the KOH solution should be 120 g of KOH in 100 cc of water.

Potassium sulfate, K_2SO_4—0.5 *N*: 44 g per liter.

Potassium thiocyanate, KCNS—0.5 *N*: 49 g per liter.

Precipitating reagent (for group II, anions): dissolve 61 g of $BaCl_2 \cdot 2H_2O$ and 52 g of $CaCl_2 \cdot 6H_2O$ in water and dilute to one liter. If the solution becomes turbid, filter and use filtrate.

Scheibler's reagent (precipitates alkaloids, albumoses and peptones): dissolve sodium tungstate in boiling water containing half its weight of phosphoric acid (sp. gr. 1.13); on evaporation of this solution, crystals of phosphotungstic acid are obtained. A 10% solution of phosphotungstic acid in water constitutes the reagent.

Schweitzer's reagent (dissolves cotton, linen, and silk, but not wool): add NH_4Cl and NaOH to a solution of copper sulfate. The blue precipitate is filtered off, washed, pressed, and dissolved in ammonia (sp. gr. 0.92).

Silver nitrate, $AgNO_3$—0.25 *N*: 43 g per liter. See also *Volumetric Solutions.*

Silver sulfate, Ag_2SO_4—*N*/13 (saturated solution): stir mechanically 10 g of the salt in a liter of water for 3 hours; decant and use the clear liquid.

Soap solution (for hardness in water): (*a*) *Clark's or A.P.H.A. Stand. Methods*—prepare stock solution of 100 g of pure powdered castile soap in a liter of 80% ethyl alcohol; allow to stand over night and decant. Titrate against $CaCl_2$ solution (0.5 g $CaCO_3$ dissolved in a concentrated HCl, neutralized with NH_4OH to slight alkalinity using litmus as the indicator, make up to 500 cc; 1 cc of this solution is equivalent to 1 mg $CaCO_3$) and dilute with 80% alcohol until 1 cc of the resulting solution is equivalent to 1 cc of the standard $CaCl_2$ making due allowance for the lather factor (the lather factor is that amount of standard soap solution required to produce a permanent lather in a 50 cc portion of distilled water). One cc of this solution after subtracting the lather factor is equivalent to 1 mg of $CaCO_3$. (*b*) *Boutron-Boudet*—dissolve 100 g of pure castile soap in about 2500 cc of 56% ethyl alcohol and adjust so that 2.4 cc will give a permanent lather with 40 cc of a solution containing 0.59 g $Ba(NO_3)_2$ per liter of water; 2.4 cc of this solution is equivalent to 22 French degrees or 220 parts per million of hardness (as $CaCO_3$) on a 40 cc sample of water.

Sodium acetate, $NaC_2H_3O_2 \cdot 3H_2O$: dissolve 1 part of the salt in 10 parts of water.

Sodium acetate, acid: dissolve 100 g of sodium acetate and 30 cc of glacial acetic acid in water and dilute to one liter.

Sodium bismuthate (oxidation of manganese): heat 20 parts of NaOH nearly to redness in an iron or nickel crucible, and add slowly 10 parts of basic bismuth nitrate which has been previously dried. Add 2 parts of sodium peroxide, and pour the brownish-yellow fused mass on an iron plate to cool. When cold break up in a mortar, extract with water, and collect on an asbestos filter.

Sodium carbonate, Na_2CO_3—3 *N*: 159 g per liter; one part Na_2CO_3, or 2.7 parts of the crystalline $Na_2CO_3 \cdot 10H_2O$ in 5 parts of water.

Sodium chloride, NaCl—0.5 *N*: 29 g per liter. See also *Volumetric Solutions.*

Sodium chloroplatinite, Na_2PtCl_4: dissolve 1 part of the salt in 12 parts of water.

Sodium cobaltinitrite, $Na_3Co(NO_2)_6$—0.3 *N*: dissolve 230 g of $NaNO_2$ in 500 cc of water, add 160 cc of 6 *N* acetic acid

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and 35 g of $Co(NO_3)_2 \cdot 6H_2O$. Allow to stand one day, filter, and dilute the filtrate to a liter.

Sodium hydrogen phosphate, $Na_2HPO_4 \cdot 12H_2O$—0.5 *N*: 60 g per liter.

Sodium hydroxide, NaOH—5 *N*: 220 g per liter. See also *Volumetric Solutions*.

Sodium hydroxide, alcoholic: dissolve 20 g of NaOH in alcohol and dilute to one liter with alcohol.

Sodium hypobromite: dissolve 100 g of NaOH in 250 cc of water and add 25 cc of bromine.

Sodium nitrate, $NaNO_3$—0.5 *N*: 43 g per liter.

Sodium nitroprusside (for sulfur detection): dissolve about one gram of sodium nitroprusside in 10 cc of water; as the solution deteriorates on standing, only freshly prepared solutions should be used. This compound is also called sodium nitroferricyanide and has the formula $Na_2Fe(NO)(CN)_5 \cdot 2H_2O$.

Sodium polysulfide, Na_2S_x: dissolve 480 g of $Na_2S \cdot 9H_2O$ in 500 cc of water, add 40 g of NaOH and 18 g of sulfur, stir mechanically and dilute to one liter with water.

Sodium sulfate, Na_2SO_4—0.5 *N*: 35 g per liter.

Sodium sulfide, Na_2S; saturate NaOH solution with H_2S, then add as much NaOH as was used in the original solution.

Sodium sulfite, $Na_2SO_3 \cdot 7H_2O$—0.5 *N*: 63 g per liter.

Sodium sulfite, acid (saturated): dissolve 600 g of $NaHSO_3$ in water and dilute to one liter; for the preparation of addition compounds with aldehydes and ketones: prepare a saturated solution of sodium carbonate in water and saturate with sulfur dioxide.

Sodium tartrate, acid, $NaHC_4H_4O_6$: dissolve 1 part of the salt in 10 parts of water.

Sodium thiosulfate, $Na_2S_2O_3 \cdot 5H_2O$: one part of the salt in 40 parts of water. See also *Volumetric Solutions*.

Sonnenschein's reagent (alkaloid detection): a nitric acid solution of ammonium molybdate is treated with phosphoric acid. The precipitate so produced is washed and boiled with aqua regia until the ammonium salt is decomposed. The solution is evaporated to dryness and the residue is dissolved in 10% HNO_3.

Stannic chloride, $SnCl_4$—0.5 *N*: 33 g per liter.

Stannous chloride, $SnCl_2 \cdot 2H_2O$—0.5 *N*: 56 g per liter. The water should be acid with HCl and some metallic tin should be kept in the bottle.

Starch solution (iodine indicator): dissolve 5 g of soluble starch in cold water, pour the solution into 2 liters of water and boil for a few minutes. Keep in a glass-stoppered bottle.

Starch solution (other than soluble): make a thin paste of the starch with cold water, then stir in 200 times its weight of boiling water, and boil for a few minutes. A few drops of chloroform added to the solution acts as a preservative.

Stoke's reagent: dissolve 30 g of ferrous sulfate and 20 g of tartaric acid in water and dilute to one liter. When required for use, add strong ammonia until the precipitate first formed is dissolved.

Strontium chloride, $SrCl_2 \cdot 6H_2O$—0.5 *N*: 67 g per liter.

Strontium nitrate, $Sr(NO_3)_2$—0.5 *N*: 53 g per liter.

Strontium sulfate, $SrSO_4$: prepare a saturated solution.

Sulfanilic acid (for detection of nitrites): dissolve 8 g of sulfanilic acid in one liter of acetic acid (sp. gr. 1.04).

Sulfuric acid, H_2SO_4—5 *N*: 245 g per liter, sp. gr. 1.153. See also *Volumetric Solutions*.

Sulfurous acid, H_2SO_3: saturate water with sulfur dioxide.

Tartaric acid, $H_2C_4H_4O_6$: dissolve one part of the acid in 3 parts of water; for a saturated solution dissolve 750 g of tartaric acid in water and dilute to one liter.

Tannic acid: dissolve one g of tannic

acid in one cc of alcohol and make up to 10 cc with water.

Tincture of iodine (antiseptic): add 70 g of iodine and 50 g of KI to 50 cc of water; make up to one liter with alcohol.

***o*-Tolidine solution** (for residual chlorine in water analysis): dissolve 1 g of pulverized *o*-tolidine, m.p. 129°C., in one liter of dilute hydrochloric acid (100 cc conc. HCl diluted to one liter).

Trichloroacetic acid: dissolve 100 g of the acid in water and dilute to one liter.

Turmeric paper (gives a rose-brown coloration with boric acid): wash the ground root of turmeric with water and discard the washings. Digest with alcohol and filter, using the clear filtrate to impregnate white, unsized paper, which is then dried.

Uffelmann's reagent (gives a yellow coloration in the presence of lactic acid): add a ferric chloride solution to a 2% phenol solution until the solution becomes violet in color.

Wagner's solution (phosphate rock analysis): dissolve 25 g of citric acid and one g of salicylic acid in water, and make up to one liter. Twenty-five to 50 cc of this reagent prevents precipitation of iron and aluminum.

Wijs solution (for iodine number): dissolve 13 g of resublimed iodine in one liter of glacial acetic acid (99.5%), and pass in washed and dried (over or through H_2SO_4) chlorine gas until the original thio titration of the solution is not quite doubled. There should be only a slight excess of iodine and no excess of chlorine. Preserve the solution in amber colored bottles sealed with paraffin. Do not use the solution after it has been prepared for more than 30 days.

Xylene cyanole-methyl orange indicator, Schoepfle modification (for partially color blind operators): dissolve 0.75 g of xylene cyanole FF (Eastman No. T 1579) and 1.50 g methyl orange in one liter of water.

Zinc chloride, $ZnCl_2$—0.5 *N*: 34 g per liter.

Zinc nitrate, $Zn(NO_3)_2 \cdot 6H_2O$—0.5 *N*: 74 g per liter.

Zinc sulfate, $ZnSO_4 \cdot 7H_2O$—0.5 *N*: 72 g per liter.

TRUE CAPACITY OF GLASS VESSELS

Based on 25×10^{-6} as the coefficient of cubical expansion of glass.

The capacity of a vessel may be obtained by determining the weight of a contained liquid. The true capacity of glass vessels when their contents of water or mercury are weighed in air with brass weights can be found by means of the following equation:

$$V t^\circ = W t^\circ \times C \text{ at } t^\circ$$

where Vt° is the true volume of the vessel at t° when it contains W grams of water or mercury at t°. Thus, if the contents of a flask filled with water weigh 100 grams at 15°, then the true volume of the flask at 15° is 100×1.001935, or 100.1935 cc.

If it is desired to find the true volume of a flask at 18° or at 25° when its contents are weighed at some other temperature, t°, the equation becomes $V_{18}^\circ = W t^\circ \times C_{18}^\circ$ at t°, or $V_{25}^\circ = W t^\circ \times C_{25}^\circ$ at t°. Thus, if the water in a flask weighed 100 grams at 15°, the true volume of the flask at 25° is 100×1.002186, or 100.2186 cc.

	Water			Mercury		
t°C.	C	C_{18}°	C_{25}°	C	C_{18}°	C_{25}°
0	1.001193	1.001643	1.001818	0.0735501	0.0735832	0.0735960
1	1.001133	1.001559	1.001734	0.0735636	0.0735949	0.0736077
2	1.001092	1.001492	1.001668	0.0735771	0.0736066	0.0736194
3	1.001068	1.001443	1.001618	0.0735907	0.0736183	0.0736311
4	1.001060	1.001410	1.001586	0.0736037	0.0736294	0.0736423
5	1.001068	1.001394	1.001569	0.0736172	0.0736411	0.0736540
6	1.001092	1.001392	1.001568	0.0736308	0.0736529	0.0736657
7	1.001131	1.001406	1.001581	0.0736492	0.0736695	0.0736824
8	1.001184	1.001435	1.001610	0.0736628	0.0736812	0.0736941
9	1.001252	1.001477	1.001652	0.0736763	0.0736929	0.0737058
10	1.001333	1.001534	1.001709	0.0736894	0.0737042	0.0737171
11	1.001428	1.001603	1.001779	0.0736975	0.0737104	0.0737233
12	1.001536	1.001686	1.001862	0.0737111	0.0737222	0.0737351
13	1.001657	1.001782	1.001957	0.0737241	0.0737333	0.0737463
14	1.001790	1.001890	1.002066	0.0737377	0.0737451	0.0737581
15	1.001935	1.002010	1.002186	0.0737513	0.0737569	0.0737698
16	1.002092	1.002143	1.002318	0.0737644	0.0737681	0.0737810
17	1.002261	1.002286	1.002462	0.0737780	0.0737798	0.0737927
18	1.002441	1.002441	1.002617	0.0737911	0.0737911	0.0738039
19	1.002633	1.002608	1.002783	0.0738047	0.0738028	0.0738157
20	1.002835	1.002785	1.002960	0.0738183	0.0738146	0.0738275
21	1.003047	1.002972	1.003148	0.0738314	0.0738258	0.0738398
22	1.003271	1.003170	1.003346	0.0738450	0.0738376	0.0738505
23	1.003504	1.003379	1.003554	0.0738581	0.0738489	0.0738618
24	1.003748	1.003597	1.003773	0.0738717	0.0738607	0.0738736
25	1.004001	1.003825	1.004001	0.0738848	0.0738719	0.0738848
26	1.004264	1.004063	1.004239	0.0738985	0.0738837	0.0738966
27	1.004537	1.004310	1.004486	0.0739116	0.0738950	0.0739079
28	1.004819	1.004567	1.004743	0.0739253	0.0739068	0.0739197
29	1.005110	1.004833	1.005009	0.0739384	0.0739181	0.0739310
30	1.005410	1.005109	1.005284	0.0739520	0.0739299	0.0739428

STANDARD VOLUMETRIC (TITRIMETRIC) SOLUTIONS

International Atomic Weights of 1941 *.

Alkaline arsenite, 0.1N. As^{3} to As^{5}. Dissolve 4.9455 g. of sublimed As_2O_3 in a concentrated solution of NaOH, being careful not to warm the solution over 60°C. Add this mixture to 100 ml. of a saturated $NaHCO_3$ solution, and dilute to one liter. Standardize against a standard iodine solution using a starch indicator. One ml. of 0.1N arsenite is equal to 0.012692 g. of iodine.

Ammonium thiocyanate, 0.1N. Dissolve 7.6118 g. of NH_4CNS in water and dilute to a liter. Standardize against standard silver nitrate solution, using a ferric alum indicator.

Ferrous ammonium sulfate (Mohr's salt), 0.1N. Fe^{2} to Fe^{3}. Dissolve 39.2146 g. of $FeSo_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$ in water and dilute to a liter. Standardize against standard potassium permanganate or dichromate solution.

Hydrochloric acid, HCl. This acid may be standardized by the method of Hulett and Bonner as modified by Foulk and Hollingsworth (J. Am. Chem. Soc. 31, 390, (1909); *ibid.* 45, 1227 (1923)). For the preparation of a standard acid, HCl of approximately 1.10 density (as determined with a hydrometer) should be distilled at the rate of 3 to 4 ml. a minute. After three-fourths of the liquid has distilled the portion to be used as constant-boiling mixture should be collected. Distillation must, however, not be carried so far that less than 50 to 60 ml. of liquid remains in the flask. This acid is of constant composition, is not noticeably hygroscopic or volatile, and can be accurately weighed into a small flask, using a capillary pipette to obtain the exact weight desired. The preceding table by Foulk and Hollingsworth is based upon the atomic weights Ag = 107.88; Cl = 35.46; H = 1.008. Thus, to make 0.1N acid when the barometer reads 760 mm weigh out 18.0193 g. of distillate and dilute to a liter. For N acid use 180.193 g. Another method of making N acid is to mix one volume of the concentrated acid with 11 volumes of water and standardize by the precipitation of AgCl. For 0.1N acid use a 1 to 110 mixture.

Barometer Pressure, mm of Hg	%HCl Vacuum weight basis	Grams (air-wt.) of const.-boiling distillate that contains 1 mole (vac.) of HCl
770	20.197	180.407
760	20.221	180.193
750	20.245	179.979
740	20.269	179.766
730	20.293	179.555

Iodine, 0.1N. I^{0} to I^{-1}. Dissolve 12.692 g. of resublimed iodine in a saturated solution of 16 g. of KI, and dilute to a liter. This solution can be used as a primary standard if the weighing is carefully done, or it can be checked against a known sodium thiosulfate solution, using a starch indicator.

Nitric acid, N. Normal acid contains 63.016 g. of HNO_3 per liter. Use a colorless acid, which can be made from the yellow acid by adding water and boiling. About 65 ml. of 1.42 sp. gr. acid diluted to a liter is nearly normal. Standardize by titration with a standard alkali.

Oxalic acid, N. Normal acid should contain 63.034 g. of $H_2C_2O_4 \cdot 2H_2O$ (or 45.018 g. of the anhydrous acid) per liter. Because of the uncertainty in the amount of water of crystallization oxalic acid solutions must be checked against a known alkali, using a phenolphthalein indicator. This acid is not commonly used in volumetric work, as the weaker solutions are unstable, and the more concentrated solutions tend to give a precipitate if they are allowed to become too cold.

Potassium cyanide, for nickel titration, 0.1N = 0.4 × KCN = 26.0456 g. per liter. To make up this solution dissolve 26.0456 g. of KCN in water, add 10 g. of KOH to prevent hydrolysis, and dilute to a liter. For silver titration, 0.1N = 0.2 × KCN. In this case use 13.0228 g. of KCN and 5 g. of KOH.

Potassium dichromate, 0.1N. Cr^{6} to Cr^{3}. Weigh out 4.9035 g. of $K_2Cr_2O_7$ that has been oven-dried and cooled in a desiccator, and dilute with water to a liter. This 0.1N solution may be used in standardizing a sodium thiosulfate solution. Before using in an iron analysis,

**For the most recent atomic weights see inside of back cover.*

the dichromate should be checked against a known iron sample. In this titration an external indicator of $K_3Fe(CN)_6$ is used.

Potassium hydroxide, 0.1N. This solution should contain 5.6104 g. of KOH per liter, but it is best to dissolve about 7 g. in a half-liter of water, add enough $BaCl_2$ to precipitate any carbonate that may be present, allow the $BaCO_3$ to settle, filter into a liter flask and dilute to the mark with CO_2-free water. Standardize with succinic, sulfuric, or hydrochloric acid, using a phenolphthalein or methyl orange indicator. The solution made up in this manner is slightly more than 0.1N, but it can easily be adjusted after an acid titration. Alkali solutions must be protected from air by having the bottle stoppers coated with vaseline.

Potassium iodate, 0.1N. I^{+5} to I^{-1}. Dry the KIO_3 in an oven at 120°C., cool in a desiccator, and weigh out exactly 3.567 g. of KIO_3 and about 15 g. of KI, dissolve in distilled water and dilute to a liter. This solution can be used as a standard if the iodate is pure and is carefully weighed.

Potassium permanganate, 0.1N. Mn^7 to Mn^2. A tenth normal solution contains 3.1605 g. of $KMnO_4$ per liter. Dissolve a little more than the calculated amount (about 3.3 g.) in a liter of distilled water. Allow this to stand for 2 or 3 days, then siphon it carefully through clean glass tubes into the container in which it is to be kept, discarding the first 25 ml. and allowing the last inch of liquid to remain in the bottle. In this way any dust or reducing substance in the water is oxidized, and the MnO_2 so formed is left out of the final solution. Permanganate solutions should never be allowed to touch rubber, filter paper, or any other organic matter. To standardize the $KMnO_4$, weigh out several samples of about 0.3 g. of pure, dry sodium oxalate into Erlenmeyer flasks, add 150 ml. of distilled water and 4 ml. of concentrated H_2SO_4, and heat nearly to boiling. When all has been dissolved, run in the $KMnO_4$ from a burette not faster than 15 ml. per minute. The last ml. should be added drop by drop until a faint, permanent pink color is obtained. The temperature should be kept around 70°C. throughout this titration. Each ml. of 0.1N $KMnO_4$ is equal to 0.0067007 g. of sodium oxalate. The equation is $2KMnO_4 + 5Na_2C_2O_4 + 8H_2SO_4 \rightarrow K_2SO_4 + 2MnSO_4 + 5Na_2SO_4 + 10\ CO_2 + 8H_2O$.

Silver nitrate, 0.1N. A tenth normal solution contains 16.9888 g. of $AgNO_3$ per liter. Weigh out about 17.1 g. of $AgNO_3$ and dissolve in a liter of distilled water. Standardize against a standard NaCl solution by the method of Mohr or Volhard, or by precipitating and weighing AgCl.

Sodium chloride, 0.1N. This solution contains 5.8454 g. of NaCl per liter. If the salt is dried, weighed, and diluted to a definite volume it may be used as a primary standard.

Sodium hydroxide, 0.1N. This solution contains 4.0005 g. of NaOH per liter. It is prepared in the same manner as the potassium hydroxide solution, using about 6 g. for the 0.1N solution, and about 42 g. for the normal solution.

Sodium thiosulfate, 0.1N. This solution contains 24.8194 g. per liter. Weigh out 25 g. of $Na_2S_2O_3 \cdot 5H_2O$ and dilute to a liter. Let stand for two weeks, and if any sulfur has settled decant the clear liquid. Standardize against resublimed iodine in the following manner: weigh out 0.5 g. of pure iodine and dissolve in a solution of 3 g. of KI dissolved in as little water as possible. Dilute to about 200 ml. and titrate with the thiosulfate using a starch indicator. Each ml. of 0.1N thio is equal to 0.012692 g. of iodine.

Succinic acid, 0.1N. This acid can be used as a primary standard if it is carefully weighed and diluted to a definite volume. Dry about 6 g. of $H_2C_4H_4O_4$ in an oven at 105°C. and cool in a desiccator. Weigh out exactly 5.9044 g. and dilute to a liter. This solution is exactly 0.1N.

Sulfuric acid, N. This solution contains 49.038 g. of H_2SO_4 per liter. The 0.1N. solution contains 4.9038 g. per liter. Pour 30 ml. (3 ml. for the 0.1N.) of pure concentrated sulfuric acid of density 1.84 into 3 or 4 volumes of water. This must be done slowly and carefully. Cool the mixture and dilute to a liter. Standardize against a known KOH or NaOH solution, using a phenolphthalein indicator.

See also the table: *Volumetric (Titrimetric) Primary Standards.*

DECI-NORMAL SOLUTIONS OF SALTS AND OTHER REAGENTS

Name	At. or Mol. Wt.	Hydrogen Equivalent	Grams per cc of 1/10 normal solution
Acetic Acid	60.05	$HC_2H_3O_2$	0.006005
Ammonia	17.03	NH_3	0.001703
Ammonium	18.04	NH_4	0.001804
Ammonium Chloride	53.50	NH_4Cl	0.005350
Ammonium Hydroxide	35.05	NH_4OH	0.003505
Ammonium Nitrate	80.05	NH_4NO_3	0.008005
Ammonium Sulfate	132.14	$\frac{1}{2}(NH_4)_2SO_4$	0.006607
Ammonium Thiocyanate	76.12	NH_4CNS	0.007612
Barium	137.36	$\frac{1}{2}Ba$	0.006868
Barium Carbonate	197.37	$\frac{1}{2}BaCO_3$	0.009869
Barium Chloride	244.31	$\frac{1}{2}BaCl_2 \cdot 2H_2O$	0.012215
Barium Hydroxide	171.38	$\frac{1}{2}Ba(OH)_2$	0.008569
Barium Oxide	153.36	$\frac{1}{2}BaO$	0.007668
Boric Acid	61.84	$\frac{1}{3}H_3BO_3$	0.002061
Bromine	79.92	Br	0.007992
Calcium	40.08	$\frac{1}{2}Ca$	0.002004
Calcium Carbonate	100.09	$\frac{1}{2}CaCO_3$	0.005005
Calcium Chloride	110.99	$\frac{1}{2}CaCl_2$	0.005550
Calcium Chloride	219.09	$\frac{1}{2}CaCl_2 \cdot 6H_2O$	0.010955
Calcium Hydroxide	74.10	$\frac{1}{2}Ca(OH)_2$	0.003705
Calcium Oxide	56.08	$\frac{1}{2}CaO$	0.002804
Carbon Dioxide	44.01	$\frac{1}{2}CO_2$	0.002201
Chlorine	35.46	Cl	0.003546
Citric Acid	210.14	$\frac{1}{3}C_6H_8O_7 \cdot H_2O$	0.007005
Cobalt	58.94	$\frac{1}{2}Co$	0.002947
Copper	63.57	$\frac{1}{2}Cu$	0.003179
Copper Oxide	79.57	$\frac{1}{2}CuO$	0.003979
Copper Sulfate	249.71	$\frac{1}{2}CuSO_4 \cdot 5H_2O$	0.012486
Cyanogen	26.02	CN	0.002602
Hydrobromic Acid	80.92	HBr	0.008092
Hydrochloric Acid	36.47	HCl	0.003647
Hydrocyanic Acid	27.03	HCN	0.002703
Hydroiodic Acid	127.93	HI	0.012793
Iodine	126.92	I	0.012692
Lactic Acid	90.08	$C_3H_6O_3$	0.009008
Lead	207.21	$\frac{1}{2}Pb$	0.010361
Lead Carbonate	267.22	$\frac{1}{2}PbCO_3$	0.013361
Lead Oxide	223.21	$\frac{1}{2}PbO$	0.011161
Magnesium	24.32	$\frac{1}{2}Mg$	0.001216
Magnesium Carbonate	84.33	$\frac{1}{2}MgCO_3$	0.004217
Magnesium Chloride	95.23	$\frac{1}{2}MgCl_2$	0.004762
Magnesium Chloride	203.33	$\frac{1}{2}MgCl_2 \cdot 6H_2O$	0.010167
Magnesium Oxide	40.32	$\frac{1}{2}MgO$	0.002016
Malic Acid	134.09	$\frac{1}{2}C_4H_6O_5$	0.006704
Manganese	54.93	$\frac{1}{2}Mn$	0.002747
Manganese Sulfate	150.99	$\frac{1}{2}MnSO_4$	0.007550
Mercuric Chloride	271.52	$\frac{1}{2}HgCl_2$	0.013576
Nickel	58.69	$\frac{1}{2}Ni$	0.002935
Nitric Acid	63.02	HNO_3	0.006302
Nitrogen	14.01	N	0.001401
Nitrogen Pentoxide	108.02	$\frac{1}{2}N_2O_5$	0.005401
Nitrous Acid	47.02	HNO_2	0.004702
Oxalic Acid	90.04	$\frac{1}{2}H_2C_2O_4$	0.004502
Oxalic Acid	126.07	$\frac{1}{2}H_2C_2O_4 \cdot 2H_2O$	0.006303

DECI-NORMAL SOLUTIONS OF SALTS AND OTHER REAGENTS

Name	At. or Mol. Wt.	Hydrogen Equivalent	Grams per cc of 1/10 normal solution
Oxalic Anhydride	72.02	$\frac{1}{2}C_2O_3$	0.003601
Phosphoric Acid	98.00	$\frac{1}{3}H_3PO_4$	0.003267
Potassium	39.10	K	0.003910
Potassium Bicarbonate	100.11	$KHCO_3$	0.010011
Potassium Bitartrate	188.18	$KHC_4H_4O_6$	0.018818
Potassium Carbonate	138.20	$\frac{1}{2}K_2CO_3$	0.006910
Potassium Chloride	74.55	KCl	0.007455
Potassium Cyanide	65.11	KCN	0.006511
Potassium Dichromate	294.21	$\frac{1}{6}K_2Cr_2O_7$	0.004904
Potassium Hydroxide	56.10	KOH	0.005610
Potassium Oxide	94.19	$\frac{1}{2}K_2O$	0.004710
Potassium Permanganate for Co estimation	158.03	$\frac{1}{5}KMnO_4$	0.003161
Potassium Permanganate for Mn estimation	158.03	$\frac{1}{3}KMnO_4$	0.005268
Potassium Tartrate	226.26	$\frac{1}{2}K_2H_4C_4O_6$	0.011314
Potassium Tetroxalate	254.19	$\frac{1}{3}KH_3(C_2O_4)_2 \cdot 2H_2O$	0.008473
Silver	107.88	Ag	0.010788
Silver Nitrate	169.89	$AgNO_3$	0.016989
Sodium	23.00	Na	0.002300
Sodium Bicarbonate	84.02	$NaHCO_3$	0.008402
Sodium Carbonate	106.00	$\frac{1}{2}Na_2CO_3$	0.005300
Sodium Chloride	58.45	NaCl	0.005845
Sodium Hydroxide	40.01	NaOH	0.004001
Sodium Oxide	61.99	$\frac{1}{2}Na_2O$	0.003100
Sodium Phosphate (di)	141.98	$\frac{1}{2}Na_2HPO_4$	0.007099
Sodium Phosphate (tri)	163.97	$\frac{1}{3}Na_3PO_4$	0.005466
Sodium Sulfide	78.05	$\frac{1}{2}Na_2S$	0.003903
Sodium Tetraborate	201.27	$\frac{1}{2}Na_2B_4O_7$	0.010064
Sodium Tetraborate	381.44	$\frac{1}{2}Na_2B_4O_7 \cdot 10H_2O$	0.019072
Succinic Acid	118.09	$\frac{1}{2}H_2C_4H_4O_4$	0.005904
Sulfuric Acid	98.08	$\frac{1}{2}H_2SO_4$	0.004904
Sulfuric Trioxide	80.06	$\frac{1}{2}SO_3$	0.004003
Tartaric Acid	150.09	$\frac{1}{2}C_4H_6O_6$	0.007504
Zinc	65.38	$\frac{1}{2}Zn$	0.003269
Zinc Sulfate	287.55	$\frac{1}{2}ZnSO_4 \cdot 7H_2O$	0.014378

A METHOD FOR BALANCING EQUATIONS FOR OXIDATION -REDUCTION REACTIONS

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The rule for balancing equations in which oxidation and reduction takes place was originated by O. C. Johnson in 1880 (Chem. News 42, 51). It is an excellent and useful rule if a term such as "oxidation number" is substituted for the term "bond." The oxidation number of an element is often the same number as its valence; in many cases, however, the two numbers are entirely different. The oxidation number of an element is determined by the following simple rules:

(a) Hydrogen has an oxidation number of + 1.

(b) Oxygen has an oxidation number of − 2, except in H_2O_2 and peroxides.

(c) Free elements have an oxidation number of 0.

(d) The sum of the oxidation numbers of the elements in a compound is 0.

Examples: (1) Find the oxidation number of P in H_3PO_4. Three of hydrogen have an oxidation number of + 3, four of oxygen have an oxidation number of − 8, the atom of phosphorus must have an oxidation number of + 5 in order that the sum shall be 0. The valence of phosphorus is also 5.

(2) Find the oxidation number of C in CH_2O. Two of hydrogen have an oxidation number of + 2, one of oxygen has an oxidation number of − 2, therefore the oxidation number of the atom of carbon is 0. The valence of carbon is 4.

(3) Find the oxidation number of As in Ag_3AsO_3. This salt is derived from H_3AsO_3. The rules are applied to this acid.

The total gain in oxidation number for all of the atoms in one molecule of the reducing agent is the number of molecules of the oxidizing agent to be taken; the total loss in oxidation number for all of the atoms in one molecule of the oxidizing agent is the number of molecules of the reducing agent to be taken. After obtaining these two numbers the rest of the equation can be balanced by inspection.

Oxidation equations may be divided into three classes:

(a) in which the oxidizing agent and reducing agent simply oxidizes and reduces;

(b) in which part of the oxidizing agent or reducing agent also enters into combination without being oxidized or reduced;

(c) in which all of the elements oxidized and reduced are present in the same molecule.

Example of (a):

$3\,As_4 + 20\,HNO_3 + 8\,H_2O = 12\,H_3AsO_4 + 20\,NO$. Four atoms of arsenic in metallic arsenic have an oxidation number of 0, in H_3AsO_4, the four atoms of arsenic have an oxidation number of +20; the total gain for the molecule (As_4) is 20, and therefore 20 of HNO_3 are taken. One atom of nitrogen in HNO_3 has an oxidation number of + 5, in NO it has an oxidation number of +2; the total loss for the molecule (HNO_3) is 3, and therefore 3 of As_4 are taken.

Example of (b):

$3\,Cu + 8\,HNO_3 = 3\,Cu(NO_3)_2 + 2\,NO + 4\,H_2O$. One of Cu gains 2 and therefore 2 of HNO_3 are required to oxidize it. One of N loses 3 and therefore 3 of Cu are taken. This indicates that 3 of $Cu(NO_3)_2$ and 2 of NO are formed. Six of HNO_3 are evidently required to unite with the copper, and these are added to the two required to oxidize it.

Example of (c):

$3\,HClO_3 = HClO_4 + 2\,ClO_2 + H_2O$. The $HClO_3$ should be written twice, considering the one part to be the oxidizer and the other the reducer. $2\,HClO_3$ (oxidizing) $+ HClO_3$ (reducing) $= HClO_4 + 2ClO_2 + H_2O$. The oxidizing $HClO_3$ changes to ClO_2, the reducing to $HClO_4$. On application of the rule, it is found that two molecules of the oxidizing $HClO_3$ are to be taken and this indicates that two molecules of ClO_2 are formed; since it is found that one molecule of the reducing $HClO_3$ is to be taken, one of $HClO_4$ is formed.

It should be kept in mind that more than one element in the same molecule may change in oxidation number.

EQUATIONS AND EQUIVALENTS FOR VOLUMETRIC (TITRIMETRIC) ANALYSIS

Aluminum

(1) $Al_2(SO_4)_3 + 6KOH = 2Al(OH)_3 + 3K_2SO_4$

$$KOH \approx \frac{Al}{3} \approx \frac{Al_2O_3}{6} \approx \frac{Al_2(SO_4)_3}{6}$$

(2) $Al_2(SO_4)_3 + 5KI + KIO_3 + 3H_2O = 2Al(OH)_3 + 3K_2SO_4 + 3I_2$

$$I \approx \frac{Al}{3} \approx \frac{Al_2(SO_4)_3}{6}$$

Antimony

(3) $H_3SbO_4 + 2HI = H_3SbO_3 + H_2O + I_2$

$$I \approx \frac{Sb}{2} \approx \frac{H_3SbO_4}{2}$$

(4) $SbCl_5 + 2KI = SbCl_3 + 2KCl + I_2$

$$I \approx \frac{Sb}{2} \approx \frac{Sb_2O_5}{4}$$

(5) $Sb_2O_5 + 4HI = Sb_2O_3 + 2H_2O + 2I_2$

$$I \approx \frac{Sb}{2} \approx \frac{Sb_2O_5}{4}$$

(6) $Sb_2S_5 + 6HCl = 2SbCl_3 + 2S + 3H_2S$

$$3H_2S + 3I_2 = 6HI + 3S$$

$$I \approx \frac{Sb}{3} \approx \frac{Sb_2S_5}{6}$$

(7) $2H_3SbO_3 + KIO_3 + 2HCl = 2H_3SbO_4 + KCl + ICl + H_2O$

$$\frac{KIO_3}{6} \approx \frac{Sb}{3} \approx \frac{H_3SbO_3}{3}$$

(8) $2NaSbO_3 + 4HI = 2NaSbO_2 + 2H_2O + 2I_2$

$$I \approx \frac{NaSbO_3}{2}$$

(9) $H_3SbO_3 + I_2 + H_2O = H_3SbO_4 + 2HI$

$$I \approx \frac{Sb}{2} \approx \frac{H_3SbO_3}{2}$$

(10) $Sb_2O_3 + 2I_2 + 2H_2O = Sb_2O_5 + 4HI$

$$I \approx \frac{Sb}{2} \approx \frac{Sb_2O_3}{4}$$

EQUATIONS AND EQUIVALENTS FOR TITRIMETRIC ANALYSIS

(11) $SbCl_3+I_2+2HCl=SbCl_5+2HI$

$$I \backsimeq \frac{Sb}{2} \backsimeq \frac{SbCl_3}{2}$$

(12) $Sb_2S_3+6HCl=2SbCl_3+3H_2S$

$$3H_2S+3I_2=6HI+3S$$

$$I \backsimeq \frac{Sb}{3} \backsimeq \frac{Sb_2S_3}{6} \backsimeq \frac{H_2S}{2}$$

(13) $5Sb_2(SO_4)_3+4KMnO_4+24H_2O=10H_3SbO_4+2K_2SO_4+4MnSO_4+9H_2SO_4$

$$\frac{KMnO_4}{5} \backsimeq \frac{Sb}{2} \backsimeq \frac{Sb_2O_3}{4} \backsimeq \frac{Sb_2(SO_4)_3}{4}$$

(14) $2NaSbO_2+2I_2+2H_2O=NaSbO_3+4HI$

$$I \backsimeq \frac{NaSbO_2}{2}$$

(15) $NaSbO_2+2K_3Fe(CN)_6+2KOH=NaSbO_3+2K_4Fe(CN)_6+H_2O$

$5K_4Fe(CN)_6+KMnO_4+4H_2SO_4=5K_3Fe(CN)_6+3K_2SO_4+MnSO_4+4H_2O$

$$\frac{KMnO_4}{5} \backsimeq \frac{Sb}{2} \backsimeq \frac{NaSbO_2}{2}$$

Arsenic

(16) $As_2O_3+2H_2O+2I_2$ same as equation **10.**

(17) $AsCl_3+I_2+2HCl$ same as equation **11.**

(18) As_2S_3+6HCl same as equation **12.**

(19) $2Na_3AsO_4 \backsimeq As_2O_5$

$$I \backsimeq \frac{Na_3AsO_4}{2} \backsimeq \frac{As_2O_5}{4}$$

(20) $2Na_2HAsO_4 \backsimeq As_2O_5$

$$I \backsimeq \frac{Na_2HAsO_4}{2} \backsimeq \frac{As_2O_5}{4}$$

(21) $2NaH_2AsO_4 \backsimeq As_2O_5$

$$I \backsimeq \frac{NaH_2AsO_4}{2} \backsimeq \frac{As_2O_5}{4}$$

(22) $2H_3AsO_3+KIO_3+2HCl$ same as equation **7.**

(23) $H_3AsO_3+I_2+H_2O$ same as equation **9.**

(24) $2NaAsO_2+2I_2+2H_2O$ same as equation **14.**

(25) $2NaAsO_2+4K_3Fe(CN)_6+4KOH$ same as equation **15.**

EQUATIONS AND EQUIVALENTS FOR VOLUMETRIC ANALYSIS

(26) $2Na_3AsO_3 \Rightarrow As_2O_3$

$$I \Rightarrow \frac{Na_3AsO_3}{2} \Rightarrow \frac{As_2O_3}{4}$$

(27) $2Na_2HAsO_3 \Rightarrow As_2O_3$

$$I \Rightarrow \frac{Na_2HAsO_3}{2} \Rightarrow \frac{As_2O_3}{4}$$

(28) $2NaH_2AsO_3 \Rightarrow As_2O_3$

$$I \Rightarrow \frac{NaH_2AsO_3}{2} \Rightarrow \frac{As_2O_3}{4}$$

Boron

(29) $Na_2B_4O_7+2HCl+5H_2O+(Glycerol)=4H_3BO_3+2NaCl$

$H_3BO_3+NaOH=NaBO_2+2H_2O$

$$NaOH \Rightarrow B \Rightarrow \frac{B_2O_3}{2} \Rightarrow H_3BO_3$$

(30) $6HBO_2+KIO_3+5KI+(Mannitol)=6KBO_2+3H_2O+3I_2$

$$I \Rightarrow HBO_2 \Rightarrow H_3BO_3$$

Bromine

(31) $Br_2+2KI=2KBr+I_2$

$$I \Rightarrow Br$$

(32) $KBrO_3+6KI+6HBr=7KBr+3I_2+3H_2O$

$$I \Rightarrow \frac{KBrO_3}{6}$$

(33) $Ba(BrO_3)_2+6H_3AsO_3=BaBr_2+6H_3AsO_4$

$$I \Rightarrow \frac{Ba(BrO_3)_2}{12} \Rightarrow \frac{H_3AsO_3}{2}$$

Cadmium

(34) $CdS+I_2+2HCl=CdCl_2+2HI+S$

$$I \Rightarrow \frac{Cd}{2} \Rightarrow \frac{CdS}{2} \Rightarrow \frac{S}{2}$$

Calcium

(35) $5CaC_2O_4+2KMnO_4+8H_2SO_4=5CaSO_4+K_2SO_4+2MnSO_4+10CO_2+8H_2O$

$$\frac{KMnO_4}{5} \Rightarrow \frac{Ca}{2} \Rightarrow \frac{CaC_2O_4}{2} \Rightarrow \frac{CaCO_3}{2}$$

(36) $CaCO_3+2HCl=CaCl_2+CO_2+H_2O$

$$HCl \Rightarrow \frac{CaO}{2} \Rightarrow \frac{CaCO_3}{2}$$

EQUATIONS AND EQUIVALENTS FOR TITRIMETRIC ANALYSIS

Carbon

(37) $Na_2CO_3+2HCl=2NaCl+CO_2+H_2O$

$$HCl \simeq \frac{Na_2CO_3}{2}$$

(38) $Na_2CO_3+H_2SO_4=Na_2SO_4+CO_2+H_2O$

$$H_2SO_4 \simeq Na_2CO_3$$

(39) $NaHCO_3+HCl=NaCl+CO_2+H_2O$

$$HCl \simeq NaHCO_3$$

(40) $2NaHCO_3+H_2SO_4=Na_2SO_4+2CO_2+2H_2O$

$$H_2SO_4 \simeq 2NaHCO_3$$

(41) $H_2C_2O_4\cdot 2H_2O+2NaOH=Na_2C_2O_4+4H_2O$

$$NaOH \simeq \frac{H_2C_2O_4\cdot 2H_2O}{2}$$

(42) $KHC_2O_4+KOH=K_2C_2O_4+H_2O$

$$KOH \simeq KHC_2O_4$$

(43) $5Na_2C_2O_4+2KMnO_4+8H_2SO_4=5Na_2SO_4+2MnSO_4+K_2SO_4+10CO_2+8H_2O$

$$\frac{KMnO_4}{5} \simeq \frac{Na_2C_2O_4}{2}$$

(44) $KCN+I_2=KI+CNI$

$$I \simeq \frac{KCN}{2}$$

(45) $5K_4Fe(CN)_6+KMnO_4+4H_2SO_4=5K_3Fe(CN)_6+MnSO_4+3K_2SO_4+4H_2O$

$$\frac{KMnO_4}{5} \simeq K_4Fe(CN)_6$$

(46) $2K_3Fe(CN)_6+2KI=2K_4Fe(CN)_6+I_2$

$$I \simeq K_3Fe(CN)_6$$

(47) $3KCNS+4Al+18HCl=3KCl+4AlCl_3+3NH_4Cl+3C+3H_2S$

$$I \simeq \frac{KCNS}{2} \simeq \frac{H_2S}{2}$$

(48) $5HCNS+6KMnO_4+4H_2SO_4=6MnSO_4+3K_2SO_4+5HCN+4H_2O$

$$\frac{KMnO_4}{5} \simeq \frac{HCNS}{6}$$

EQUATIONS AND EQUIVALENTS FOR VOLUMETRIC ANALYSIS

Cerium

(49) $2K_3Fe(CN)_6+Ce_2O_3+2KOH=2K_4Fe(CN)_6+2CeO_2+H_2O$

$$\frac{KMnO_4}{5} \backsimeq K_4Fe(CN)_6 \backsimeq Ce \backsimeq \frac{Ce_2O_3}{2}$$

(50) $2CeO_2+2KI+8HCl=2CeCl_3+2KCl+I_2+4H_2O$

$$I \backsimeq Ce \backsimeq CeO_2$$

Chlorine

(51) $Cl_2+2KI=2KCl+I_2$
$I_2+2Na_2S_2O_3=2NaI+Na_2S_4O_6$

$$I \backsimeq Cl$$

(52) $CaOCl_2+2HCl=CaCl_2+Cl_2+H_2O$

$$I \backsimeq Cl \backsimeq \frac{CaOCl_2}{2}$$

(53) $NaClO+2KI+H_2O=NaCl+2KOH+I_2$

$$I \backsimeq \frac{NaClO}{2}$$

(54) $NaCl+AgNO_3=AgCl+NaNO_3$

$$NaCl \backsimeq Cl$$

(55) $KClO_3+6FeSO_4+3H_2SO_4=KCl+3Fe_2(SO_4)_3+3H_2O$

$$\frac{KMnO_4}{5} \backsimeq \frac{KClO_3}{6}$$

(56) $KClO_3+6HI+H_2SO_4=KHSO_4+HCl+3I_2+3H_2O$

$$I \backsimeq \frac{KClO_3}{6}$$

(57) $KClO_4=KCl+2O_2$
$2O_2+8HI=4I_2+4H_2O$

$$I \backsimeq \frac{KClO_4}{8}$$

Chromium

(58) $Cr_2(SO_4)_3+5KI+KIO_3+3H_2O=2Cr(OH)_3+3K_2SO_4+3I_2$

$$I \backsimeq \frac{Cr}{3} \backsimeq \frac{Cr_2(SO_4)_3}{6}$$

(59) $K_2Cr_2O_7+6FeSO_4+8H_2SO_4=Cr_2(SO_4)_3+3Fe_2(SO_4)_3+2KHSO_4+7H_2O$

$$\frac{KMnO_4}{5} \backsimeq \frac{K_2Cr_2O_7}{6} \backsimeq \frac{Cr}{3} \backsimeq \frac{Cr_2O_3}{6}$$

(60) $K_2Cr_2O_7+6FeCl_2+14HCl=2CrCl_3+6FeCl_3+2KCl+7H_2O$

$$Fe \simeq \frac{K_2Cr_2O_7}{6} \simeq \frac{Cr_2O_3}{6} \simeq \frac{Cr}{3}$$

(61) $K_2Cr_2O_7+6KI+7H_2SO_4=Cr_2(SO_4)_3+4K_2SO_4+3I_2+7H_2O$

$$I \simeq \frac{Cr}{3} \simeq \frac{Cr_2O_3}{6} \simeq \frac{K_2Cr_2O_7}{6}$$

(62) $K_2Cr_2O_7+2KOH=2K_2CrO_4+H_2O$

$$KOH \simeq \frac{K_2Cr_2O_7}{2}$$

(63) $2K_2CrO_4+6KI+16HCl=2CrCl_3+10KCl+3I_2+8H_2O$

$$I \simeq \frac{Cr}{3} \simeq \frac{CrO_3}{3} \simeq \frac{K_2CrO_4}{3}$$

(64) $2BaCrO_4+6FeSO_4+8H_2SO_4=2BaSO_4+Cr_2(SO_4)_3+3Fe_2(SO_4)_3+8H_2O$

$$\frac{KMnO_4}{5} \simeq FeSO_4 \simeq \frac{Cr}{3} \simeq \frac{CrO_3}{3} \simeq \frac{K_2CrO_4}{3} \simeq \frac{BaCrO_4}{3}$$

Cobalt

(65) $3CoSO_4+5KI+KIO_3+3H_2O=3Co(OH)_2+3K_2SO_4+3I_2$

$$I \simeq \frac{Co}{2} \simeq \frac{CoSO_4}{2}$$

(66) $6CoCl_2+5HgO+2KMnO_4+10H_2O=6Co(OH)_3+5HgCl_2+2MnO_2+2KCl+H_2O$

$$\frac{KMnO_4}{5} \simeq \frac{3Co}{5} \simeq \frac{3CoCl_2}{5}$$

Copper

(67) $2CuSO_4+4KI=2CuI+K_2SO_4+I_2$

$$I \simeq Cu \simeq CuSO_4$$

(68) $2Cu(C_2H_3O_2)_2+4KI=2CuI+4KC_2H_3O_2+I_2$

$$I \simeq Cu \simeq Cu(C_2H_3O_2)_2$$

(69) $2CuSO_4+2KCNS+H_2SO_3+H_2O=2CuCNS+K_2SO_4+2H_2SO_4$

$CuCNS+KOH=KCNS+CuOH$

$5KCNS+6KMnO_4+4H_2SO_4=3K_2SO_4+6MnSO_4+5KCN+4H_2O$

$$\frac{KMnO_4}{5} \simeq \frac{Cu}{6} \simeq \frac{CuSO_4}{6} \simeq \frac{KCNS}{6}$$

EQUATIONS AND EQUIVALENTS FOR TITRIMETRIC ANALYSIS

(70) $2CuSO_4+NH_4OH=CuSO_4\cdot Cu(OH)_2+(NH_4)_2SO_4$

$CuSO_4\cdot Cu(OH)_2+6NH_3+(NH_4)_2SO_4=2Cu(NH_3)_4SO_4\cdot H_2O$

$2Cu(NH_3)_4SO_4\cdot H_2O+7KCN=K_3NH_4Cu_2(CN)_6+NH_4CNO+6NH_3+2K_2SO_4+H_2O$

$$\frac{KCN}{2} \backsimeq \frac{Cu}{7} \backsimeq \frac{CuSO_4}{7} \backsimeq \frac{Cu(NH_3)_4SO_4\cdot H_2O}{7}$$

Fluorine

(71) $6NaF+FeCl_3=Na_3FeF_6+3NaCl$

$$FeCl_3 \backsimeq 6NaF$$

Gold

(72) $AuCl_3+2KI=AuCl+2KCl+I_2$

$$I \backsimeq \frac{Au}{2} \backsimeq \frac{AuCl_3}{2}$$

Iodine

(73) $I_2+2Na_2S_2O_3=2NaI+Na_2S_4O_6$

$$I \backsimeq Na_2S_2O_3$$

(74) $10KI+2KMnO_4+16HCl=12KCl+2MnCl_2+5I_2+8H_2O$

$$\frac{KMnO_4}{5} \backsimeq I \backsimeq KI$$

(75) $KIO_3+5KI+6HCl=6KCl+3I_2+3H_2O$

$$I \backsimeq \frac{KIO_3}{6} \backsimeq \frac{5KI}{6}$$

(76) $Ca(IO_3)_2+10KI+12HCl=CaCl_2+10KCl+6I_2+6H_2O$

$$I \backsimeq \frac{Ca(IO_3)_2}{12}$$

(77) $KIO_4+7KI+8HCl=8KCl+4I_2+4H_2O$

$$I \backsimeq \frac{KIO_3}{8}$$

Iron

(78) $6FeCl_2+K_2Cr_2O_7+14HCl=6FeCl_3+2CrCl_3+2KCl+7H_2O$

$$\frac{K_2Cr_2O_7}{6} \backsimeq Fe \backsimeq FeCl_2 \backsimeq \frac{Fe_2O_3}{2}$$

(79) $10FeSO_4+2KMnO_4+8H_2SO_4=5Fe_2(SO_4)_3+2MnSO_4+K_2SO_4+8H_2O$

$$\frac{KMnO_4}{5} \backsimeq Fe \backsimeq FeSO_4 \backsimeq \frac{Fe_2O_3}{2}$$

EQUATIONS AND EQUIVALENTS FOR VOLUMETRIC ANALYSIS

(80) $2FeCl_3+2KI=2KCl+2FeCl_2+I_2$

$$I \backsimeq Fe \backsimeq FeCl_3 \backsimeq \frac{Fe_2O_3}{2}$$

(81) $Fe_2(SO_4)_3+2KI=2FeSO_4+K_2SO_4+I_2$

$$I \backsimeq Fe \backsimeq \frac{Fe_2(SO_4)_3}{2} \backsimeq \frac{Fe_2O_3}{2}$$

(82) $2FeCl_3+SnCl_2=2FeCl_2+SnCl_4$
$SnCl_2+2HgCl_2=SnCl_4+2HgCl$
$2FeCl_2+I_2+2HCl=2FeCl_3+2HI$

$$I \backsimeq Fe \backsimeq FeCl_3 \backsimeq \frac{Fe_2O_3}{2}$$

Lead

(83) $2Pb(C_2H_3O_2)_2+K_2Cr_2O_7+H_2O=2PbCrO_4+2KC_2H_3O_2+2HC_2H_3O_2$

$$Pb \backsimeq \frac{K_2Cr_2O_7}{2}$$

(83) $2Pb(C_2H_3O_2)_2+K_2Cr_2O_7+H_2O=2PbCrO_4+2KC_2H_3O_2+2HC_2H_3O_2$
$2PbCrO_4+6KI+16HCl=2PbCl_2+2CrCl_3+6KCl+8H_2O+3I_2$

$$\frac{K_2Cr_2O_7}{6} \backsimeq \frac{Pb}{3} \backsimeq \frac{PbCrO_4}{3} \backsimeq I$$

(84) $PbO_2+4HI=PbI_2+I_2+2H_2O$

$$I \backsimeq \frac{Pb}{2} \backsimeq \frac{PbO_2}{2}$$

(85) $PbO_2+H_2C_2O_4=PbO+2CO_2+H_2O$
$5H_2C_2O_4+2KMnO_4+3H_2SO_4=10CO_2+2MnSO_4+K_2SO_4+8H_2O$

$$\frac{KMnO_4}{5} \backsimeq \frac{H_2C_2O_4}{2} \backsimeq \frac{Pb}{2} \backsimeq \frac{PbO_2}{2}$$

(86) $PbO_2+H_2O_2+2HNO_3=Pb(NO_3)_2+2H_2O+O_2$
$5H_2O_2+2KMnO_4+6HNO_3=2Mn(NO_3)_2+2KNO_3+8H_2O+5O_2$

$$\frac{KMnO_4}{5} \backsimeq \frac{H_2O_2}{2} \backsimeq \frac{Pb}{2} \backsimeq \frac{PbO_2}{2}$$

(87) $Pb_3O_4+4HC_2H_3O_2=PbO_2+2Pb(C_2H_3O_2)_2+2H_2O$
$PbO_2+4KI=PbI_2+2K_2O+I_2$

$$I \backsimeq \frac{Pb}{2} \backsimeq \frac{Pb_3O_4}{2} \backsimeq \frac{PbO_2}{2}$$

EQUATIONS AND EQUIVALENTS FOR TITRIMETRIC ANALYSIS

Magnesium

(88) $MgNH_4PO_4 + H_2SO_4 = MgSO_4 + NH_4H_2PO_4$

$$H_2SO_4 \Rightarrow MgNH_4PO_4$$

Manganese

(89) $MnO_2 + H_2C_2O_4 + H_2SO_4 = MnSO_4 + 2CO_2 + 2H_2O$

$$\frac{KMnO_4}{5} \Rightarrow \frac{H_2C_2O_4}{2} \Rightarrow \frac{Mn}{2} \Rightarrow \frac{MnO_2}{2}$$

(90) Bismuthate Method:

$2Mn(NO_3)_2 + 5NaBiO_3 + 16HNO_3 = 2HMnO_4 + 5Bi(NO_3)_3 + 5NaNO_3 + 7H_2O$

$2HMnO_4 + 5Na_3AsO_3 + 4HNO_3 = 2Mn(NO_3)_2 + 5Na_3AsO_4 + 3H_2O$

$$\frac{HMnO_4}{5} \Rightarrow \frac{Na_3AsO_3}{2} \Rightarrow \frac{Mn}{5}$$

(91) Ford Williams Method:

$MnO_2 + 2FeSO_4 + 2H_2SO_4 = MnSO_4 + Fe_2(SO_4)_3 + 2H_2O$

$$FeSO_4 \Rightarrow \frac{KMnO_4}{5} \Rightarrow \frac{MnO_2}{2} \Rightarrow \frac{Mn}{2}$$

(92) Lead Dioxide Method:

$2MnSO_4 + 5PbO_2 + 6HNO_3 = 2HMnO_4 + 2PbSO_4 + 3Pb(NO_3)_2 + 2H_2O$

$2HMnO_4 + 5Na_3AsO_3 + 4HNO_3 = 2Mn(NO_3)_2 + 5Na_3AsO_4 + 3H_2O$

$$\frac{Na_3AsO_3}{2} \Rightarrow \frac{KMnO_4}{5} \Rightarrow \frac{HMnO_4}{5} \Rightarrow \frac{Mn}{5}$$

(93) Persulfate Method:

$2Mn(NO_3)_2 + 5(NH_4)_2S_2O_8 + 8H_2O = 2HMnO_4 + 5(NH_4)_2SO_4 + 5H_2SO_4 + 4HNO_3$

$2HMnO_4 + 10FeSO_4 + 7H_2SO_4 = 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$

$$FeSO_4 \Rightarrow \frac{KMnO_4}{5} \Rightarrow \frac{HMnO_4}{5} \Rightarrow \frac{Mn}{5}$$

(94) Volhard Method:

$3MnSO_4 + 2KMnO_4 + 2H_2O = 5MnO_2 + K_2SO_4 + 2H_2SO_4$

$6MnSO_4 + 5ZnSO_4 + 4KMnO_4 + 14H_2O = 5Zn(OH)_2 \cdot 2MnO_2 + 4KHSO_4 + 7H_2SO_4$

$$\frac{KMnO_4}{5} \Rightarrow \frac{3MnSO_4}{10} \Rightarrow \frac{3Mn}{10}$$

(95) $2KMnO_4 + 5H_2C_2O_4 + 3H_2SO_4 = 2MnSO_4 + K_2SO_4 + 10CO_2 + 8H_2O$

$$\frac{KMnO_4}{5} \Rightarrow \frac{H_2C_2O_4}{2}$$

(96) $K_2MnO_4 + 2H_2C_2O_4 + 2H_2SO_4 = MnSO_4 + K_2SO_4 + 4CO_2 + 4H_2O$

$$\frac{KMnO_4}{5} \backsimeq \frac{H_2C_2O_4}{2} \backsimeq \frac{K_2MnO_4}{4}$$

Mercury

(97) $2HgCl + 6KI + I_2 = 2K_2HgI_4 + 2KCl$

$$I \backsimeq HgCl \backsimeq Hg$$

(98) $3HgCl_2 + 2Na_2S_2O_3 + 2H_2O = 2HgCl_2 \cdot HgS + 2Na_2SO_4 + 4HCl$

$$I \backsimeq Na_2S_2O_3 \backsimeq \frac{3HgCl_2}{2} \backsimeq \frac{3Hg}{2}$$

(99) $2HgCl_2 + 2FeCl_2 = 2HgCl + 2FeCl_3$

$$\frac{KMnO_4}{5} \backsimeq FeCl_2 \backsimeq HgCl_2 \backsimeq Hg$$

(100) $Hg(CN)_2 + 2I_2 = HgI_2 + 2CNI$

$$I \backsimeq \frac{Hg(CN)_2}{4} \backsimeq \frac{Hg}{4}$$

Molybdenum

(101) $2MoO_3 + 3Zn + 3H_2SO_4 = Mo_2O_3 + 3ZnSO_4 + 3H_2O$

$5Mo_2O_3 + 6KMnO_4 + 9H_2SO_4 = 10MoO_3 + 6MnSO_4 + 3K_2SO_4 + 9H_2O$

$$\frac{KMnO_4}{5} \backsimeq \frac{Mo_2O_3}{6} \backsimeq \frac{MoO_3}{3} \backsimeq \frac{Mo}{3}$$

(102) $2MoO_3 + 4KI + 4HCl = 2MoO_2I + 4KCl + I_2 + 2H_2O$

$$I \backsimeq MoO_3 \backsimeq Mo$$

Nickel

(103) $2NiSO_4 + 12NH_4OH = 2Ni(NH_3)_6SO_4 + 12H_2O$

$Ni(NH_3)_6SO_4 + 4KCN = K_2Ni(CN)_4 + K_2SO_4 + 6NH_3$

$$\frac{KCN}{2} \backsimeq \frac{Ni(NH_3)_6SO_4}{8} \backsimeq \frac{Ni}{8}$$

(104) $3NiSO_4 + 5KI + KIO_3 + 3H_2O = 3Ni(OH)_2 + 3K_2SO_4 + 3I_2$

$$I \backsimeq \frac{NiSO_4}{2} \backsimeq \frac{Ni}{2}$$

Nitrogen

(105) $2HNO_3 + 6HI = 2NO + I_2 + 4H_2O$

$$I \backsimeq \frac{HNO_3}{3} \backsimeq \frac{N_2O_5}{6}$$

EQUATIONS AND EQUIVALENTS FOR TITRIMETRIC ANALYSIS

(106) $HNO_3+3HCl=NOCl+Cl_2+2H_2O$

$$I \Rightarrow Cl \Rightarrow \frac{HNO_3}{2} \Rightarrow \frac{N_2O_5}{4}$$

(107) $2HNO_3+3MnCl_2+6HCl=2NO+3MnCl_4+4H_2O$
$3MnCl_4=3MnCl_2+3Cl_2$

$$I \Rightarrow Cl \Rightarrow \frac{HNO_3}{3} \Rightarrow \frac{N_2O_5}{6}$$

(108) $4FeSO_4+2HNO_3+3H_2SO_4=2Fe_2(SO_4)_3+N_2O_3+3H_2O$

$$\frac{K_2Cr_2O_7}{6} \Rightarrow \frac{HNO_3}{2} \Rightarrow \frac{N_2O_5}{4}$$

(109) $6FeSO_4+2HNO_3+3H_2SO_4=3Fe_2(SO_4)_3+2NO+4H_2O$

$$\frac{K_2Cr_2O_7}{6} \Rightarrow \frac{HNO_3}{3} \Rightarrow \frac{N_2O_5}{6}$$

(110) $2HNO_2+2HI=2NO+I_2+2H_2O$

$$I \Rightarrow HNO_2 \Rightarrow \frac{N_2O_3}{2}$$

(111) $2HNO_2+MnCl_2+2HCl=2NO+MnCl_4+2H_2O$
$MnCl_4=MnCl_2+Cl_2$

$$I \Rightarrow Cl \Rightarrow HNO_2 \Rightarrow \frac{N_2O_3}{2}$$

(112) $2KMnO_4+5HNO_2+3H_2SO_4=2MnSO_4+5HNO_3+K_2SO_4+3H_2O$

$$\frac{KMnO_4}{5} \Rightarrow \frac{HNO_2}{2} \Rightarrow \frac{N_2O_3}{4}$$

Oxygen

(113) $O_3+2KI+H_2O=O_2+I_2+2KOH$

$$I \Rightarrow \frac{O_3}{2}$$

(114) $BaO_2+4HCl=BaCl_2+2H_2O+Cl_2$

$$I \Rightarrow Cl \Rightarrow \frac{BaO_2}{2}$$

(115) $2KI+H_2O_2=2KOH+I_2$

$$I \Rightarrow \frac{H_2O_2}{2}$$

(116) $5H_2O_2+2KMnO_4+4H_2SO_4=2MnSO_4+2KHSO_4+5O_2+8H_2O$

$$\frac{KMnO_4}{5} \Rightarrow \frac{H_2O_2}{2}$$

EQUATIONS AND EQUIVALENTS FOR VOLUMETRIC ANALYSIS

Phosphorus

(117) $H_3PO_4 + 12(NH_4)_2MoO_4 + 21HNO_3 = (NH_4)_3PO_4 \cdot 12MoO_3 + 21NH_4NO_3 + 12H_2O$

$2(NH_4)_3PO_4 \cdot 12MoO_3 + 46NaOH + H_2O = 2(NH_4)_2HPO_4 + (NH_4)_2MoO_4 + 23Na_2MoO_4 + 23H_2O$

$$NaOH \simeq \frac{(NH_4)_3PO_4 \cdot 12MoO_3}{23} \simeq \frac{P_2O_5}{46} \simeq \frac{P}{23}$$

(118) $2(NH_4)_3PO_4 \cdot 12MoO_3 + 46NH_4OH + H_2O = 24(NH_4)_2MoO_4 + 2(NH_4)_2HPO_4 + 23H_2O$

$(NH_4)_2MoO_4 + H_2SO_4 = (NH_4)_2SO_4 + H_2MoO_4$

$2MoO_3 + 3Zn + 3H_2SO_4 = Mo_2O_3 + 3ZnSO_4 + 3H_2O$

$5Mo_2O_3 + 6KMnO_4 + 9H_2SO_4 = 10MoO_3 + 6MnSO_4 + 3K_2SO_4 + 9H_2O$

$$\frac{KMnO_4}{5} \simeq \frac{(NH_4)_3PO_4 \cdot 12MoO_3}{36} \simeq \frac{Mo_2O_3}{6} \simeq \frac{P_2O_5}{72} \simeq \frac{P}{36}$$

(119) Ferric alum absent:
First three equations as in 118

$12Mo_2O_3 + O = Mo_{24}O_{37}$

$Mo_{24}O_{37} + 14KMnO_4 + 21H_2SO_4 = 24MoO_3 + 14MnSO_4 + 7K_2SO_4 + 21H_2O$

$$\frac{14KMnO_4}{70} \simeq \frac{Mo_{24}O_{37}}{70} \simeq \frac{(NH_4)_3PO_4 \cdot 12MoO_3}{35} \simeq \frac{P_2O_5}{70} \simeq \frac{P}{35}$$

(120) With methyl orange:

$Na_2HPO_4 + HCl = NaH_2PO_4 + NaCl$

$$HCl \simeq Na_2HPO_4$$

(121) With methyl orange:

$H_3PO_4 + NaOH = NaH_2PO_4 + H_2O$

$$NaOH \simeq H_3PO_4$$

(122) With phenolphthalein:

$NaH_2PO_4 + NaOH = Na_2HPO_4 + H_2O$

$$NaOH \simeq NaH_2PO_4$$

(123) With phenolphthalein:

$H_3PO_4 + 2NaOH = Na_2HPO_4 + 2H_2O$

$$NaOH \simeq \frac{H_3PO_4}{2}$$

Potassium

(124) $10K_2NaCo(NO_2)_6 + 22KMnO_4 + 58H_2SO_4 = 21K_2SO_4 + 5Na_2SO_4 + 10CoSO_4 + 22MnSO_4 + 60HNO_3 + 28H_2O$

$$\frac{KMnO_4}{5} \simeq \frac{K_2O}{11}$$

EQUATIONS AND EQUIVALENTS FOR TITRIMETRIC ANALYSIS

Selenium

(125) $K_2SeO_4 + 4HCl = 2KCl + H_2SeO_3 + Cl_2 + H_2O$

$$I \backsimeq Cl \backsimeq \frac{K_2SeO_4}{2} \backsimeq \frac{Se}{2} \backsimeq \frac{SeO_3}{2}$$

(126) $K_2SeO_3 + 4KI + 6HCl = 6KCl + Se + 2I_2 + 3H_2O$

$$I \backsimeq \frac{K_2SeO_3}{4} \backsimeq \frac{Se}{4} \backsimeq \frac{SeO_2}{4}$$

Silicon

(127) $H_2SiF_6 + 6NaOH = 6NaF + Si(OH)_4 + 2H_2O$

$$NaOH \backsimeq \frac{H_2SiF_6}{6}$$

Sulfur

(128) $H_2S + I_2 = 2HI + S$

$$I \backsimeq \frac{H_2S}{2} \backsimeq \frac{S}{2}$$

(129) $Na_2SO_3 + I_2 + H_2O = Na_2SO_4 + 2HI$

$$I \backsimeq \frac{Na_2SO_3}{2} \backsimeq \frac{SO_2}{2} \backsimeq \frac{S}{2}$$

(130) $2H_2SO_3 + KIO_3 + 2HCl = 2H_2SO_4 + KCl + ICl + H_2O$

$$\frac{KIO_3}{6} \backsimeq \frac{H_2SO_3}{3} \backsimeq \frac{SO_2}{3}$$

(131) $2Na_2S_2O_3 + I_2 = Na_2S_4O_6 + 2NaI$

$$I \backsimeq Na_2S_2O_3$$

(132) $Na_2S_2O_3 + 2KIO_3 + 2HCl = Na_2SO_4 + K_2SO_4 + 2ICl + H_2O$

$$\frac{KIO_3}{6} \backsimeq \frac{Na_2S_2O_3}{12}$$

(133) $K_2S_2O_8 + H_2C_2O_4 = K_2SO_4 + H_2SO_4 + 2CO_2$

$$\frac{KMnO_4}{5} \backsimeq \frac{H_2C_2O_4}{2} \backsimeq \frac{K_2S_2O_8}{2}$$

(134) $K_2S_2O_8 + 2FeSO_4 = Fe_2(SO_4)_3 + K_2SO_4$

$$\frac{KMnO_4}{5} \backsimeq FeSO_4 \backsimeq \frac{K_2S_2O_8}{2}$$

(135) $3Na_2S_2O_3 + 8KMnO_4 + H_2O = 3Na_2SO_4 + 3K_2SO_4 + 8MnO_2 + 2KOH$

$$\frac{KMnO_4}{5} \backsimeq \frac{3Na_2S_2O_3}{40}$$

(136) $2BaS_2O_3+I_2=BaI_2+BaS_4O_6$

$$I \Rightarrow BaS_2O_3$$

(137) $2Na_2S_2O_3+I_2=2NaI+Na_2S_4O_6$

$$I \Rightarrow Na_2S_2O_3$$

(138) With phenolphthalein:

$H_2SO_3+2NaOH=Na_2SO_3+2H_2O$

$$NaOH \Rightarrow \frac{H_2SO_3}{2} \Rightarrow \frac{SO_2}{2}$$

(139) With methyl orange:

$H_2SO_3+NaOH=NaHSO_3+H_2O$

$$NaOH \Rightarrow H_2SO_3 \Rightarrow SO_2$$

Tellurium

(140) $Na_2TeO_3+4NaI+6HCl=6NaCl+Te+3H_2O+2I_2$

$$I \Rightarrow \frac{Na_2TeO_3}{4} = \frac{TeO_2}{4} \Rightarrow \frac{Te}{4}$$

(141) $Na_2TeO_4+4HCl=H_2TeO_3+2NaCl+Cl_2+H_2O$

$$I \Rightarrow Cl \Rightarrow \frac{Na_2TeO_4}{2} \Rightarrow \frac{TeO_3}{2} \Rightarrow \frac{Te}{2}$$

Tin

(142) $SnCl_2+I_2+2HCl=SnCl_4+2HI$

$$I \Rightarrow \frac{SnCl_2}{2} \Rightarrow \frac{Sn}{2}$$

(143) $SnCl_2+2K_3Fe(CN)_6+2KCl=SnCl_4+2K_4Fe(CN)_6$

$$\frac{KMnO_4}{5} \Rightarrow K_4Fe(CN)_6 \Rightarrow \frac{SnCl_2}{2} \Rightarrow \frac{Sn}{2}$$

(144) $SnCl_2+2FeCl_3=SnCl_4+2FeCl_2$

$$\frac{KMnO_4}{5} \Rightarrow \frac{SnCl_2}{2} \Rightarrow \frac{Sn}{2}$$

Titanium

(145) $Ti_2(SO_4)_3+Fe_2(SO_4)_3=2Ti(SO_4)_2+2FeSO_4$

$$\frac{KMnO_4}{5} \Rightarrow FeSO_4 \Rightarrow \frac{Ti_2(SO_4)_3}{2} \Rightarrow Ti$$

Tungsten

(146) $WO_3+2NaOH=Na_2WO_4+H_2O$

$$NaOH \Rightarrow \frac{W}{2} \Rightarrow \frac{WO_3}{2}$$

EQUATIONS AND EQUIVALENTS FOR TITRIMETRIC ANALYSIS

Uranium

(147) $U_3O_8+4H_2SO_4=2(UO_2)SO_4+U(SO_4)_2+4H_2O$

$5U(SO_4)_2+2KMnO_4+2H_2O=2KHSO_4+2MnSO_4+5(UO_2)SO_4+2MnSO_4$

$$\frac{KMnO_4}{5} \backsimeq \frac{U}{2} \backsimeq \frac{UO_2}{2} \backsimeq \frac{U(SO_4)_2}{2}$$

$$U_3O_8 \backsimeq 2UO_3+UO_2$$

$$\frac{KMnO_4}{5} \backsimeq \frac{3U}{2} \backsimeq \frac{U_3O_8}{2}$$

(148) $3UO_2(NO_3)_2+5KI+KIO_3+3H_2O=3UO_2(OH)_2+6KNO_3+3I_2$

$$I \backsimeq \frac{U}{2} \backsimeq \frac{UO_2}{2} \backsimeq \frac{UO_2(NO_3)_2}{2}$$

Vanadium

(149) $V_2O_5+2KI+2HCl=V_2O_4+2KCl+I_2+H_2O$

$$I \backsimeq \frac{V_2O_5}{2} \backsimeq V$$

(150) $V_2O_5+H_2C_2O_4=V_2O_4+2CO_2+H_2O$

$$\frac{KMnO_4}{5} \backsimeq \frac{H_2C_2O_4}{2} \backsimeq \frac{V_2O_5}{2} \backsimeq V$$

(151) $V_2O_5+3Zn(+H_3PO_4)+3H_2SO_4=V_2O_5+3ZnSO_4+3H_2O$

$5V_2O_2+6KMnO_4+9H_2SO_4=5V_2O_5+6MnSO_4+3K_2SO_4+9H_2O$

$$\frac{KMnO_4}{5} \backsimeq \frac{V_2O_5}{6} \backsimeq \frac{V_2O_2}{6} \backsimeq \frac{V}{3}$$

(152) $V_2O_5+SO_2=V_2O_4+SO_3$

$5V_2O_4+2KMnO_4+3H_2SO_4=5V_2O_5+2MnSO_4+K_2SO_4+3H_2O$

$$\frac{KMnO_4}{5} \backsimeq \frac{V_2O_5}{2} \backsimeq \frac{V_2O_4}{2} \backsimeq V$$

$V_2O_4+2HI=V_2O_3+I_2+H_2O$

$$I \backsimeq \frac{V_2O_4}{2} \backsimeq V$$

$V_2O_4+I_2+H_2O=V_2O_5+2HI$

$$I \backsimeq \frac{V_2O_4}{2} \backsimeq V$$

$V_2O_4+2K_3Fe(CN)_6+2KOH=V_2O_5+2K_4Fe(CN)_6+H_2O$

$$\frac{KMnO_4}{5} \backsimeq K_4Fe(CN)_6 \backsimeq \frac{V_2O_4}{2} \backsimeq V$$

(153) $2H_3VO_4+2FeSO_4+3H_2SO_4=V_2O_2(SO_4)_2+Fe_2(SO_4)_3+6H_2O$
$2FeSO_4+MnO_2+2H_2SO_4=Fe_2(SO_4)_3+MnSO_4+2H_2O$
$5V_2O_2(SO_4)_2+2KMnO_4+22H_2O=10H_3VO_4+2MnSO_4+K_2SO_4+7H_2SO_4$

$$\frac{KMnO_4}{5} \backsimeq \frac{V_2O_2(SO_4)_2}{2} \backsimeq \frac{V_2O_5}{2} \backsimeq V$$

Zinc

(154) $Zn+Fe_2(SO_4)_3=ZnSO_4+2FeSO_4$

$$\frac{KMnO_4}{5} \backsimeq FeSO_4 \backsimeq \frac{Zn}{2}$$

(155) $15Zn+30NaOH=15Na_2ZnO_2+15H_2$
$5KIO_3+15H_2=5KI+15H_2O$
$5KI+KIO_3+3H_2SO_4=3K_2SO_4+I_2+3H_2O$

$$\frac{KIO_3}{6} \backsimeq I \backsimeq \frac{15Zn}{6}$$

(156) $3Zn+K_2Cr_2O_7+7H_2SO_4=3ZnSO_4+Cr_2(SO_4)_3+K_2SO_4+7H_2O$
$K_2Cr_2O_7+6FeSO_4+8H_2SO_4=Cr_2(SO_4)_3+3Fe_2(SO_4)_3+2KHSO_4+7H_2O$

$$\frac{K_2Cr_2O_7}{6} \backsimeq \frac{Zn}{2}$$

(157) $3ZnCl_2+2K_4Fe(CN)_6=K_2Zn_3[Fe(CN)_6]_2+6KCl$

$$K_4Fe(CN)_6 \backsimeq \frac{3Zn}{2} \backsimeq \frac{3ZnCl_2}{2}$$

(158) $15ZnSO_4+20KI+4KIO_3+12H_2O=3Zn_5(OH)_8SO_4+12K_2SO_4+12I_2$

$$I \backsimeq \frac{15ZnSO_4}{24} \backsimeq \frac{15Zn}{24}$$

(159) $Na_2ZnO_2+4HCl=ZnCl_2+2NaCl+2H_2O$

$$HCl \backsimeq \frac{Na_2ZnO_2}{4}$$

TITRIMETRIC FACTORS AND THEIR LOGARITHMS

ACIDS*

The following factors are the equivalent of one milliliter of *normal acid*. Where the normality of the solution which is being used is other than normal multiply the factors given in the table below by the normality of the solution employed.

The equivalents of the esters are based on the results of saponification.

The indicators methyl orange and phenolphthalein are indicated by the abbreviations MO and PH respectively.

Substance	Formula	Grams	Logarithm −10
Ammonia	NH_3	0.017032	8.23127
Ammonium	NH_4	0.018040	8.25624
Ammonium chloride	NH_4Cl	0.53497	8.72833
Ammonium hydroxide	NH_4OH	0.35048	8.54467
Ammonium oleate	$C_{17}H_{33}CO_2NH_4$	0.29948	9.47637
Ammonium oxide	$(NH_4)_2O$	0.026040	8.41564
Amyl acetate	$CH_3CO_2C_5H_{11}$	0.13018	9.11454
Barium carbonate (MO)	$BaCO_3$	0.09869	8.99423
Barium hydroxide	$Ba(OH)_2$	0.085688	8.93292
Barium oxide	BaO	0.07668	8.88468
Bornyl acetate	$CH_3CO_2C_{10}H_{17}$	0.19628	9.29288
Calcium carbonate (MO)	$CaCO_3$	0.05005	8.69940
Calcium hydroxide	$Ca(OH)_2$	0.037048	8.56877
Calcium oleate	$(C_{17}H_{33}CO_2)_2Ca$	0.30148	9.47926
Calcium oxide	CaO	0.02804	8.44778
Calcium stearate	$(C_{17}H_{35}CO_2)_2Ca$	0.30350	9.48216
Casein (N 6.38)	.....	0.089371	8.95120
Ethyl acetate	$CH_3CO_2C_2H_5$	0.088104	8.94500
Glue (N 5.60)	.....	0.078445	8.89457
Hydrochloric acid	HCl	0.036465	8.56188
Magnesium carbonate (MO)	$MgCO_3$	0.04217	8.62500
Magnesium oxide	MgO	0.02016	8.30449
Menthyl acetate	$CH_3CO_2C_{10}H_{19}$	0.19830	9.29732
Methyl acetate	$CH_3CO_2CH_3$	0.074079	8.86970
Nicotine	$C_{10}H_{14}N_2$	0.16223	9.21013
Nitrogen	N	0.014008	8.14638
Potassium carbonate (MO)	K_2CO_3	0.06910	8.83948
Potassium carbonate, acid (MO)	$KHCO_3$	0.10011	9.00048
Potassium nitrate	KNO_3	0.10111	9.00479
Potassium oleate	$C_{17}H_{33}CO_2K$	0.32054	9.50588
Potassium oxide	K_2O	0.04710	8.67302
Potassium stearate	$C_{17}H_{35}CO_2K$	0.32256	9.50861
Protein (N 5.70)	.....	0.079846	8.90225
Protein (N 6.25)	.....	0.087550	8.94226
Sodium acetate	CH_3CO_2Na	0.082041	8.91403
Sodium acetate	$CH_3CO_2Na{\cdot}3H_2O$	0.13609	9.13383
Sodium borate, tetra- (MO)	$Na_2B_4O_7$	0.10064	9.00277
Sodium borate, tetra- (MO)	$Na_2B_4O_7{\cdot}10H_2O$	0.19072	9.28040
Sodium carbonate (MO)	Na_2CO_3	0.053002	8.72429
Sodium carbonate (MO)	$Na_2CO_3{\cdot}H_2O$	0.062010	8.79246
Sodium carbonate (MO)	$Na_2CO_3{\cdot}10H_2O$	0.14308	9.15558
Sodium carbonate, acid (MO)	$NaHCO_3$	0.084015	8.92436
Sodium hydroxide	$NaOH$	0.040005	8.60211
Sodium oleate	$C_{17}H_{33}CO_2Na$	0.30444	9.48350
Sodium oxalate	$Na_2C_2O_4$	0.067007	8.82612
Sodium oxide	Na_2O	0.030997	8.49132
Sodium phosphate (MO)	Na_2HPO_4	0.14198	9.15223

*Based on the 1941 International Atomic Weights.

VOLUMETRIC FACTORS AND THEIR LOGARITHMS

ACIDS (Continued)

Substance	Formula	Grams	Logarithm −10
Sodium phosphate (MO)	$Na_2HPO_4 \cdot 12H_2O$	0.35817	9.55409
Sodium phosphate (MO)	Na_3PO_4	0.081986	8.91374
Sodium phosphate (PH)	Na_3PO_4	0.16397	9.21476
Sodium silicate	$Na_2Si_4O_9$	0.15112	9.17932
Sodium stearate	$C_{17}H_{35}CO_2Na$	0.30646	9.48637
Sodium sulfide (MO)	Na_2S	0.039027	8.59137

ALKALI

The following factors are the equivalent of one milliliter of *normal alkali*. Where the normality of the solution which is being used is other than normal multiply the factors given in the table below by the normality of the solution employed.

The equivalents of the esters are based on the results of saponification.

The indicators methyl orange and phenolphthalein are indicated by the abbreviations MO and PH respectively.

Substance	Formula	Grams	Logarithm −10
Abietic acid (PH)	$HC_{20}H_{29}O_2$	0.30244	9.48064
Acetic acid (PH)	CH_3CO_2H	0.06005	8.77853
Acetic anhydride (PH)	$(CH_3CO)_2O$	0.051044	8.70794
Aluminum sulfate	$Al_2(SO_4)_3$	0.05702	8.75603
Amyl acetate	$CH_3CO_2C_5H_{11}$	0.13018	9.11454
Benzoic acid (PH)	$C_6H_5CO_2H$	0.12212	9.08679
Borate tetra- (PH)	B_4O_7	0.03882	8.58906
Boric acid (PH)	H_3BO_3	0.061844	8.79130
Boric anhydride (PH)	B_2O_3	0.03482	8.54183
Bornyl acetate	$CH_3CO_2C_{10}H_{17}$	0.19628	9.29288
Butyric acid (PH)	$C_3H_7CO_2H$	0.088104	8.94500
Calcium acetate	$(CH_3CO_2)_2Ca$	0.079084	8.89809
Calcium oleate	$(C_{17}H_{33}CO_2)_2Ca$	0.30148	9.47926
Calcium stearate	$(C_{17}H_{35}CO_2)_2Ca$	0.30350	9.48216
Carbon dioxide (PH)	CO_2	0.022005	8.34252
Chlorine	Cl	0.035457	8.54970
Citric acid (PH)	$H_3C_6H_5O_7 \cdot H_2O$	0.070047	8.84539
Ethyl acetate	$CH_3CO_2C_2H_5$	0.088104	8.94500
Formaldehyde	HCHO	0.030026	8.47750
Formic acid (PH)	HCO_2H	0.046026	8.66300
Glycerol (sap. of acetyl)	$C_3H_5(OH)_3$	0.030698	8.48711
Hydriodic acid	HI	0.12793	9.10697
Hydrobromic acid	HBr	0.080924	8.90808
Hydrochloric acid	HCl	0.036465	8.56188
Lactic acid (PH)	$HC_3H_5O_3$	0.090078	8.95462
Lead acetate	$(CH_3CO_2)_2Pb \cdot 3H_2O$	0.18967	9.27800
Maleic acid (PH)	$(CHCO_2H)_2$	0.058036	8.76370
Malic acid (PH)	$H_2C_4H_4O_5$	0.067044	8.82636
Menthol (sap. of acetyl)	$C_{10}H_{19}OH$	0.15626	9.19385
Menthyl acetate	$CH_3CO_2C_{10}H_{19}$	0.19830	9.29732
Methyl acetate	$CH_3CO_2CH_3$	0.074078	8.86969
Nitrate	NO_3	0.062008	8.79245
Nitric acid	HNO_3	0.063016	8.79945
Nitrogen	N	0.014008	8.14638
Nitrogen pentoxide	N_2O_5	0.054008	8.73246
Oleic acid (PH)	$C_{17}H_{33}CO_2H$	0.28245	9.45094

TITRIMETRIC FACTORS AND THEIR LOGARITHMS

ALKALI (Continued)

Substance	Formula	Grams	Logarithm −10
Oxalic acid (PH)	$(CO_2H)_2$	0.045018	8.65339
Oxalic acid (PH)	$(CO_2H)_2 \cdot 2H_2O$	0.063034	8.79957
Phosphoric acid (MO)	H_3PO_4	0.098004	8.99124
Phosphoric acid (PH)	H_3PO_4	0.049002	8.69021
Potassium carbonate, acid (MO)	$KHCO_3$	0.10011	9.00048
Potassium oleate	$C_{17}H_{33}CO_2K$	0.32054	9.50588
Potassium oxalate, acid (PH)	KHC_2O_4	0.12812	9.10762
Potassium phthalate, acid (PH)	$HC_8H_4O_4K$	0.20422	9.31010
Potassium stearate	$C_{17}H_{35}CO_2K$	0.32256	9.50861
Sodium benzoate	$C_6H_5CO_2Na$	0.14411	9.15869
Sodium borate, tetra- (PH)	$Na_2B_4O_7$	0.950319	8.70173
Sodium borate, tetra- (PH)	$Na_2B_4O_7 \cdot 10H_2O$	0.095359	8.97936
Sodium carbonate, acid (MO)	$NaHCO_3$	0.084015	8.92436
Sodium oleate	$C_{17}H_{33}CO_2Na$	0.30444	9.48350
Sodium salicylate	$C_6H_5OCO_2Na$	0.16011	9.20442
Stearic acid (PH)	$C_{17}H_{35}CO_2H$	0.28447	9.45404
Succinic acid (PH)	$(CH_2CO_2H)_2$	0.059044	8.77118
Sulfate	SO_4	0.04803	8.68151
Sulfur dioxide (PH)	SO_2	0.03203	8.50556
Sulfur trioxide	SO_3	0.04003	8.60239
Sulfuric acid	H_2SO_4	0.049038	8.69053
Sulfurous acid (PH)	H_2SO_3	0.041038	8.61319
Tartaric acid (PH)	$H_2C_4H_4O_6$	0.075044	8.87532
Tartaric acid (PH)	$H_2C_4H_4O_6 \cdot H_2O$	0.084052	8.92455

IODINE

The following factors are the equivalent of one milliliter of *normal iodine*. Where the normality of the solution which is being used is other than normal multiply the factors given in the table below by the normality of the solution employed.

Substance	Formula	Grams	Logarithm −10
Acetone	$(CH_3)_2CO$	0.0096798	7.98587
Ammonium chromate	$(NH_4)_2CrO_4$	0.050697	8.70498
Antimony	Sb	0.06088	8.78448
Antimony trioxide	Sb_2O_3	0.07288	8.86261
Arsenic	As	0.037455	8.57351
Arsenic pentoxide	As_2O_5	0.057455	8.75933
Arsenic trioxide	As_2O_3	0.049455	8.69421
Arsenite	AsO_3	0.061455	8.78856
Bleaching powder	$CaOCl_2$	0.063497	8.80275
Bromine	Br	0.079916	8.90264
Chlorine	Cl	0.035457	8.54970
Chromic oxide	Cr_2O_3	0.02534	8.40381
Chromium trioxide	CrO_3	0.033337	8.52293
Copper	Cu	0.06357	8.80325
Copper oxide	CuO	0.07957	8.90075
Copper sulfate	$CuSO_4$	0.15963	9.20312
Copper sulfate	$CuSO_4 \cdot 5H_2O$	0.24971	9.39744
Ferric iron	Fe^{+++}	0.05585	8.74702
Ferric oxide	Fe_2O_3	0.07985	8.90227
Hydrosulfuric acid	H_2S	0.017038	8.23142
Iodine	I	0.126920	9.10353

VOLUMETRIC FACTORS AND THEIR LOGARITHMS

IODINE (Continued)

Substance	Formula	Grams	Logarithm
			−10
Lead chromate	$PbCrO_4$	0.10774	9.03238
Lead dioxide	PbO_2	0.11961	9.07777
Nitrous acid	HNO_2	0.023508	8.37122
Oxygen	O	0.0080000	7.90309
Potassium chlorate	$KClO_3$	0.020426	8.31018
Potassium chromate	K_2CrO_4	0.064734	8.81113
Potassium dichromate	$K_2Cr_2O_7$	0.049035	8.69051
Potassium nitrite	KNO_2	0.042552	8.62892
Potassium permanganate	$KMnO_4$	0.031605	8.49976
Red lead	Pb_3O_4	0.34282	9.53507
Sodium chromate	Na_2CrO_4	0.054001	8.73240
Sodium dichromate	$Na_2Cr_2O_7$	0.043669	8.64017
Sodium dichromate	$Na_2Cr_2O_7 \cdot 2H_2O$	0.049675	8.69614
Sodium nitrite	$NaNO_2$	0.034503	8.53786
Sodium sulfide	Na_2S	0.039027	8.59137
Sodium sulfide	$Na_2S \cdot 9H_2O$	0.12009	9.07951
Sodium sulfite	Na_2SO_3	0.063027	8.79953
Sodium sulfite	$Na_2SO_3 \cdot 7H_2O$	0.12608	9.10065
Sodium thiosulfate	$Na_2S_2O_3$	0.15811	9.19896
Sulfur	S	0.01603	8.20493
Sulfur dioxide	SO_2	0.03203	8.50556
Sulfurous acid	H_2SO_3	0.041038	8.61319
Tin	Sn	0.05935	8.77342

POTASSIUM DICHROMATE

The following factors are the equivalent of one milliliter of *normal potassium dichromate*. Where the normality of the solution which is being used is other than normal multiply the factors given in the table below by the normality of the solution employed.

Substance	Formula	Grams	Logarithm
			−10
Chromic oxide	Cr_2O_3	0.025337	8.40375
Chromium trioxide	CrO_3	0.03334	8.52297
Ferrous iron	Fe^{++}	0.05585	8.74702
Ferrous oxide	FeO	0.07185	8.85643
Ferroso-ferric oxide	Fe_3O_4	0.077183	8.88752
Ferrous sulfate	$FeSO_4$	0.15191	9.18159
Ferrous sulfate	$FeSO_4 \cdot 7H_2O$	0.27802	9.44408
Glycerol	$C_3H_5(OH)_3$	0.0065782	7.81811
Lead chromate	$PbCrO_4$	0.10774	9.03238
Zinc	Zn	0.03269	8.51442

POTASSIUM PERMANGANATE

The following factors are the equivalent of one milliliter of *normal potassium permanganate*. Where the normality of the solution which is being used is other than normal multiply the factors given in the table below by the normality of the solution employed.

Substance	Formula	Grams	Logarithm
			−10
Ammonium oxalate	$(NH_4)_2C_2O_4$	0.062050	8.79274
Ammonium oxalate	$(NH_4)_2C_2O_4 \cdot H_2O$	0.071058	8.85161
Ammonium persulfate	$(NH_4)_2S_2O_8$	0.11410	9.05729

TITRIMETRIC FACTORS AND THEIR LOGARITHMS

POTASSIUM PERMANGANATE (Continued)

Substance	Formula	Grams	Logarithm −10
Antimony	Sb	0.06088	8.78448
Barium peroxide	BaO_2	0.08468	8.92778
Barium peroxide	$BaO_2 \cdot 8H_2O$	0.15674	9.19518
Calcium carbonate	$CaCO_3$	0.050045	8.69936
Calcium oxide	CaO	0.02804	8.44778
Calcium peroxide	CaO_2	0.03604	8.55679
Calcium sulfate	$CaSO_4$	0.06807	8.83296
Calcium sulfate	$CaSO_4 \cdot 2H_2O$	0.086086	8.93493
Ferric oxide	Fe_2O_3	0.07985	8.90227
Ferroso-ferric oxide	Fe_3O_4	0.077183	8.88756
Ferrous ammonium sulfate	$Fe(NH_4)_2(SO_4)_2 \cdot 6H_2O$	0.39215	9.59342
Ferrous oxide	FeO	0.07185	8.85643
Ferrous sulfate	$FeSO_4$	0.15191	9.18159
Ferrous sulfate	$FeSO_4 \cdot 7H_2O$	0.27802	9.44408
Formic acid	HCO_2H	0.023013	8.36197
Hydrogen peroxide	H_2O_2	0.017008	8.23065
Iodine	I	0.126920	9.10353
Iron	Fe	0.05585	8.74702
Manganese	Mn	0.010986	8.04084
Manganese dioxide	MnO_2	0.043465	8.63814
Manganous oxide (Volhard)	MnO	0.035465	8.54980
Molybdenum trioxide titration from yellow ppt. after reduction	MoO_3	0.047983	8.68109
Oxalic acid	$(CO_2H)_2$	0.045018	8.65339
Oxalic acid	$(CO_2H)_2 \cdot 2H_2O$	0.063034	8.79957
Phosphorous titration from yellow ppt. after reduction	P	0.0008606	6.93480
Phosphorous pentoxide titration from yellow ppt. after reduction	P_2O_5	0.001971	7.29469
Potassium dichromate	$K_2Cr_2O_7$	0.049035	8.69051
Potassium nitrite	KNO_2	0.042552	8.62892
Potassium persulfate	$K_2S_2O_8$	0.13516	9.13085
Sodium nitrite	$NaNO_2$	0.034503	8.53786
Sodium oxalate	$Na_2C_2O_4$	0.066997	8.82606
Sodium persulfate	$Na_2S_2O_8$	0.11906	9.07577
Tin	Sn	0.05935	8.77342

SILVER NITRATE

The following factors are the equivalent of one milliliter of *normal silver nitrate*. Where the normality of the solution which is being used is other than normal multiply the factors given in the table below by the normality of the solution employed.

Substance	Formula	Grams	Logarithm −10
Ammonium bromide	NH_4Br	0.097956	8.99103
Ammonium chloride	NH_4Cl	0.053497	8.72833
Ammonium iodide	NH_4I	0.14496	9.16125
Ammonium thiocyanate	NH_4CNS	0.076118	8.88149
Barium chloride	$BaCl_2$	0.10414	9.01762
Barium chloride	$BaCl_2 \cdot 2H_2O$	0.12216	9.08693
Bromine	Br	0.079916	8.90263
Cadmium chloride	$CdCl_2$	0.091662	8.96219
Cadmium iodide	CdI_2	0.18313	9.26276

VOLUMETRIC FACTORS AND THEIR LOGARITHMS

SILVER NITRATE (Continued)

Substance	Formula	Grams	Logarithm
			−10
Calcium chloride	$CaCl_2$	0.055497	8.74427
Chlorine	Cl	0.035457	8.54970
Ferric chloride	$FeCl_3$	0.05407	8.73296
Ferrous chloride	$FeCl_2$	0.063382	8.80197
Hydriodic acid	HI	0.12793	9.10697
Hydrobromic acid	HBr	0.080924	8.90808
Hydrochloric acid	HCl	0.036465	8.56188
Iodine	I	0.126920	9.10353
Lithium chloride	LiCl	0.042397	8.62734
Lead chloride	$PbCl_2$	0.13906	9.14320
Magnesium chloride	$MgCl_2$	0.047617	8.67776
Magnesium chloride	$MgCl_2 \cdot 6H_2O$	0.10167	9.00719
Potassium bromide	KBr	0.11901	9.07558
Potassium chloride	KCl	0.074553	8.87247
Potassium iodide	KI	0.16602	9.22016
Potassium oxide	K_2O	0.047096	8.67298
Potassium thiocyanate	KCNS	0.097174	8.98755
Silver	Ag	0.10788	9.03294
Silver iodide	AgI	0.23480	9.37070
Silver nitrate	$AgNO_3$	0.16989	9.23016
Sodium bromide	NaBr	0.10291	9.01246
Sodium bromide	$NaBr \cdot 2H_2O$	0.13895	9.14286
Sodium chloride	NaCl	0.058454	8.76681
Sodium iodide	NaI	0.14992	9.17586
Sodium iodide	$NaI \cdot 2H_2O$	0.18595	9.26940
Sodium oxide	Na_2O	0.030997	8.49132
Strontium chloride	$SrCl_2$	0.079272	8.89912
Strontium chloride	$SrCl_2 \cdot 6H_2O$	0.13332	9.12490
Zinc chloride	$ZnCl_2$	0.068147	8.83345

SODIUM THIOSULFATE

The following factors are the equivalent of one milliliter of *normal sodium thiosulfate*. Where the normality of the solution which is being used is other than normal multiply the factors given in the table below by the normality of the solution employed.

Substance	Formula	Grams	Logarithm
			−10
Acetone	$(CH_3)_2CO$	0.0096797	7.98586
Ammonium chromate	$(NH_4)_2CrO_4$	0.050697	8.70498
Antimony	Sb	0.06088	8.78448
Antimony trioxide	Sb_2O_3	0.07288	8.86261
Bleaching powder	$CaOCl_2$	0.063497	8.80275
Bromine	Br	0.079916	8.90264
Chlorine	Cl	0.035457	8.54970
Chromic oxide	Cr_2O_3	0.02534	8.40381
Chromium trioxide	CrO_3	0.033337	8.52293
Copper	Cu	0.06357	8.80325
Copper oxide	CuO	0.07957	8.90075
Copper sulfate	$CuSO_4$	0.15963	9.20312
Copper sulfate	$CuSO_4 \cdot 5H_2O$	0.24971	9.39744
Iodine	I	0.12692	9.10353
Lead chromate	$PbCrO_4$	0.10774	9.03238
Lead dioxide	PbO_2	0.11961	9.07777

TITRIMETRIC FACTORS AND THEIR LOGARITHMS

SODIUM THIOSULFATE (Continued)

Substance	Formula	Grams	Logarithm −10
Nitrous acid	HNO_2	0.023508	8.37122
Potassium chromate	K_2CrO_4	0.064734	8.8113
Potassium dichromate	$K_2Cr_2O_7$	0.049035	8.69051
Red lead	Pb_3O_4	0.34282	9.53507
Sodium chromate	Na_2CrO_4	0.054001	8.73240
Sodium dichromate	$Na_2Cr_2O_7$	0.043669	8.64017
Sodium dichromate	$Na_2Cr_2O_7 \cdot 2H_2O$	0.049674	8.69613
Sodium nitrite	$NaNO_2$	0.034503	8.53786
Sodium thiosulfate	$Na_2S_2O_3$	0.15811	9.19896
Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$	0.24819	9.39478
Sulfur	S	0.01603	8.20493
Sulfur dioxide	SO_2	0.03203	8.50556
Tin	Sn	0.05935	8.77342

VOLUMETRIC (TITRIMETRIC) PRIMARY STANDARDS

Based on the 1941 International Atomic Weights.**

Name	Formula	Formula Weight	Equivalent Weight					
			Al.	Ac.	O	I	CNS	Ag
Benzoic acid	$HC_7H_5O_2$	122.118	1	...	...	...	...	...
Copper	Cu	63.57	...	...	...	1	...	...
Cyanogen iodide	CNI	76.469	...	...	...	½	...	...
s-Diphenylguanidine†	$C_{13}H_{13}N_3$	211.258	...	1	...	...	...	...
Hydrazine sulfate	$N_2H_4 \cdot H_2SO_4$	130.124	½	...	...	¼	...	...
Hydrochloric acid*	HCl	36.465	1	...	...	...	...	...
Iodine	I	126.92	...	...	...	1	...	...
Maleic acid	$H_2C_4H_2O_4$	116.072	½	...	...	...	...	...
Mercury	Hg	200.61	...	...	...	...	½	...
Mercury oxide (ic)	HgO	216.61	...	½	...	...	½	...
Potassium acid carbonate	$HKCO_3$	100.114	...	1	...	...	...	...
Potassium acid oxalate	HKC_2O_4	128.124	1	...	...	...	...	...
Potassium acid phthalate	$HKC_8H_4O_4$	204.216	1	...	...	...	...	...
Potassium acid tartrate	$HKC_4H_4O_6$	188.176	1	...	...	...	...	...
Potassium bromate	$KBrO_3$	167.016	...	...	...	⅙	...	...
Potassium bromide	KBr	119.016	...	...	...	...	...	1
Potassium chloride	KCl	74.557	...	...	...	...	...	1
Potassium dichromate	$K_2Cr_2O_7$	294.22	...	...	...	⅙	...	...
Potassium ferricyanide	$K_3Fe(CN)_6$	329.246	...	...	...	1	...	...
Potassium ferrocyanide	$K_4Fe(CN)_6 \cdot 3H_2O$	422.390	...	...	1	...	...	...
Potassium iodate	KIO_3	214.02	...	⅙	...	⅙	...	...
Potassium tetroxalate	$H_3K(C_2O_4)_2 \cdot 2H_2O$	254.192	⅓	...	...	...	...	...
Silver	Ag	107.88	...	...	1	...	1	...
Silver nitrate	$AgNO_3$	169.888	...	...	...	...	1	...
Sodium carbonate	Na_2CO_3	105.994	...	½	...	...	...	...
Sodium chloride	NaCl	58.454	...	...	...	...	...	1
Sodium oxalate	$Na_2C_2O_4$	133.994	...	...	½	...	...	...
Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$	248.194	...	...	...	1	...	...
Succinic acid	$H_2C_4H_4O_4$	118.088	½	...	...	...	...	...

*See section on: Standard Volumetric (Titrimetric) Solutions.

**For the most recent atomic weights see inside of back cover.

†In alcoholic soln., using methyl red or bromothymol blue as the indicator.

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Based on the 1941 International Atomic Weights.*

In the table below the elements are arranged in alphabetical order.

Example:—To convert a given weight of Al_2O_3 to its equivalent of Al multiply by the factor at the right, 0.52914; similarly to convert Al to Al_2O_3, multiply by the factor at the left, 1.8899. For convenience in computation, the corresponding logarithms are given in each case.

Log. of factor −10	Factor		Factor	Log. of factor −10
		ALUMINUM **Al = 26.97**		
9.87485	0.74964	$Al \leftrightarrow Al_4C_3$	1.3340	10.12515
9.81833	0.65816	$Al \leftrightarrow AlN$	1.5194	10.18167
10.27643	1.8899	$Al_2O_3 \leftrightarrow Al$	0.52914	9.72357
10.15129	1.4167	$Al_2O_3 \leftrightarrow Al_4C_3$	0.70585	9.84871
9.58235	0.38225	$Al_2O_3 \leftrightarrow AlCl_3$	2.6161	10.41765
9.62099	0.41782	$Al_2O_3 \leftrightarrow AlPO_4$	2.3934	10.37901
9.47417	0.29797	$Al_2O_3 \leftrightarrow Al_2(SO_4)_3$	3.3561	10.52583
9.18460	0.15297	$Al_2O_3 \leftrightarrow Al_2(SO_4)_3 \cdot 18H_2O$	6.5373	10.81540
9.03119	0.10745	$Al_2O_3 \leftrightarrow K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	9.3071	10.96881
9.05090	0.11244	$Al_2O_3 \leftrightarrow (NH_4)_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	8.8939	10.94910
10.65530	4.5217	$AlPO_4 \leftrightarrow Al$	0.22116	9.34470
10.14451	1.3948	$CaF_2 \leftrightarrow AlF_3$	0.71696	9.85549
9.76495	0.58204	$P_2O_5 \leftrightarrow AlPO_4$	1.7181	10.23505
		AMMONIUM **NH_4 = 18.040**		
10.04191	1.1013	$Ag \leftrightarrow NH_4Br$	0.90801	9.95809
10.30461	2.0165	$Ag \leftrightarrow NH_4Cl$	0.49590	9.69539
9.87169	0.74420	$Ag \leftrightarrow NH_4I$	1.3437	10.12831
10.28265	1.9171	$AgBr \leftrightarrow NH_4Br$	0.52161	9.71735
10.42803	2.6793	$AgCl \leftrightarrow NH_4Cl$	0.37323	9.57197
10.20945	1.6198	$AgI \leftrightarrow NH_4I$	0.61738	9.79055
10.24710	1.7665	$BaSO_4 \leftrightarrow (NH_4)_2SO_4$	0.56610	9.75290
9.91160	0.81583	$Br \leftrightarrow NH_4Br$	1.2257	10.08840
10.29347	1.9655	$Cl \leftrightarrow NH_4$	0.50879	9.70655
9.82137	0.66278	$Cl \leftrightarrow NH_4Cl$	1.5088	10.17863
9.83355	0.68163	$HCl \leftrightarrow NH_4Cl$	1.4671	10.16645
9.94228	0.87555	$I \leftrightarrow NH_4I$	1.1421	10.05772
11.15867	14.410	$MgNH_4PO_4 \cdot 6H_2O \leftrightarrow NH_3$	0.069396	8.84133
11.13370	13.605	$MgNH_4PO_4 \cdot 6H_2O \leftrightarrow NH_4$	0.073502	8.86630
10.97430	9.4253	$MgNH_4PO_4 \cdot 6H_2O \leftrightarrow (NH_4)_2O$	0.10610	9.02570
9.91511	0.82247	$N \leftrightarrow NH_3$	1.2159	10.08489
9.89014	0.77650	$N \leftrightarrow NH_4$	1.2878	10.10986
9.41804	0.26184	$N \leftrightarrow NH_4Cl$	3.8191	10.58196
9.24303	0.17500	$N \leftrightarrow NH_4NO_3$	5.7145	10.75697
9.73074	0.53794	$N \leftrightarrow (NH_4)_2O$	1.8589	10.26926
9.32637	0.21202	$N \leftrightarrow (NH_4)_2SO_4$	4.7166	10.67363
9.97503	0.94412	$NH_3 \leftrightarrow NH_4$	1.0592	10.02497
9.54962	0.35451	$NH_3 \leftrightarrow (NH_4)_2CO_3$	2.8208	10.45038
9.33332	0.21544	$NH_3 \leftrightarrow NH_4HCO_3$	4.6417	10.66668
9.32792	0.21278	$NH_3 \leftrightarrow NH_4NO_3$	4.6998	10.67208
9.81562	0.65407	$NH_3 \leftrightarrow (NH_4)_2O$	1.5289	10.18438
9.68660	0.48596	$NH_3 \leftrightarrow NH_4OH$	2.0578	10.31340
9.41126	0.25779	$NH_3 \leftrightarrow (NH_4)_2SO_4$	3.8792	10.58874
10.49706	3.1409	$NH_4Cl \leftrightarrow NH_3$	0.31838	9.50294
10.47209	2.9655	$NH_4Cl \leftrightarrow NH_4$	0.33722	9.52791
10.31269	2.0544	$NH_4Cl \leftrightarrow (NH_4)_2O$	0.48676	9.68731
10.18367	1.5264	$NH_4Cl \leftrightarrow NH_4OH$	0.65514	9.81633

* For the most recent atomic weights see inside of back cover.

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	AMMONIUM (Continued) $NH_4 = 18.040$	Factor	Log. of factor −10
10.39829	2.5020	$NH_4OH \leftrightarrow N$	0.39968	9.60171
10.28843	1.9428	$NH_4OH \leftrightarrow NH_4$	0.51472	9.71157
11.11514	13.036	$(NH_4)_2PtCl_6 \leftrightarrow NH_3$	0.076712	8.88486
11.09017	12.307	$(NH_4)_2PtCl_6 \leftrightarrow NH_4$	0.081252	8.90983
10.61807	4.1502	$(NH_4)_2PtCl_6 \leftrightarrow NH_4Cl$	0.24095	9.38193
10.44305	2.7737	$(NH_4)_2PtCl_6 \leftrightarrow NH_4NO_3$	0.36054	9.55695
10.93076	8.5262	$(NH_4)_2PtCl_6 \leftrightarrow (NH_4)_2O$	0.11729	9.06924
10.80174	6.3349	$(NH_4)_2PtCl_6 \leftrightarrow NH_4OH$	0.15785	9.19826
10.52640	3.3605	$(NH_4)_2PtCl_6 \leftrightarrow (NH_4)_2SO_4$	0.29758	9.47360
10.12947	1.3473	$(NH_4)_2SO_4 \leftrightarrow H_2SO_4$	0.74221	9.87053
10.50119	3.1710	$N_2O_5 \leftrightarrow NH_3$	0.31536	9.49881
9.82911	0.67469	$N_2O_5 \leftrightarrow NH_4NO_3$	1.4822	10.17089
10.31682	2.0740	$N_2O_5 \leftrightarrow (NH_4)_2O$	0.48215	9.68318
10.75825	5.7313	$Pt \leftrightarrow NH_3$	0.17448	9.24175
10.73328	5.4110	$Pt \leftrightarrow NH_4$	0.18481	9.26672
10.26119	1.8247	$Pt \leftrightarrow NH_4Cl$	0.54804	9.73881
10.08617	1.2195	$Pt \leftrightarrow NH_4NO_3$	0.82004	9.91383
10.57388	3.7487	$Pt \leftrightarrow (NH_4)_2O$	0.26676	9.42612
10.44485	2.7852	$Pt \leftrightarrow NH_4OH$	0.35904	9.55515
10.16951	1.4774	$Pt \leftrightarrow (NH_4)_2SO_4$	0.67685	9.83049
10.37112	2.3503	$SO_3 \leftrightarrow NH_3$	0.42548	9.62888
9.78238	0.60587	$SO_3 \leftrightarrow (NH_4)_2SO_4$	1.6505	10.21762
		ANTIMONY $Sb = 121.76$		
9.56184	0.36462	$Sb \leftrightarrow KSbO \cdot C_4H_4O_6 \cdot \frac{1}{2}H_2O$	2.7426	10.43816
9.92187	0.83535	$Sb \leftrightarrow Sb_2O_3$	1.1971	10.07813
9.87663	0.75272	$Sb \leftrightarrow Sb_2O_5$	1.3285	10.12337
9.63997	0.43649	$Sb_2O_3 \leftrightarrow KSbO \cdot C_4H_4O_6 \cdot \frac{1}{2}H_2O$	2.2910	10.36003
9.95477	0.90109	$Sb_2O_3 \leftrightarrow Sb_2O_5$	1.1098	10.04523
9.85848	0.72191	$Sb_2O_3 \leftrightarrow Sb_2S_5$	1.3852	10.14152
9.66318	0.46045	$Sb_2O_4 \leftrightarrow KSbO \cdot C_4H_4O_6 \cdot \frac{1}{2}H_2O$	2.1718	10.33682
10.10134	1.2628	$Sb_2O_4 \leftrightarrow Sb$	0.79188	9.89866
10.02321	1.0549	$Sb_2O_4 \leftrightarrow Sb_2O_3$	0.94797	9.97679
9.97797	0.95054	$Sb_2O_4 \leftrightarrow Sb_2O_5$	1.0520	10.02203
9.95678	0.90527	$Sb_2O_4 \leftrightarrow Sb_2S_3$	1.1046	10.04322
9.88169	0.76153	$Sb_2O_4 \leftrightarrow Sb_2S_5$	1.3132	10.11831
9.90371	0.80115	$Sb_2O_5 \leftrightarrow Sb_2S_5$	1.2482	10.09629
9.70640	0.50863	$Sb_2S_3 \leftrightarrow KSbO \cdot C_4H_4O_6 \cdot \frac{1}{2}H_2O$	1.9661	10.29360
10.14456	1.3950	$Sb_2S_3 \leftrightarrow Sb$	0.71687	9.85544
10.06643	1.1653	$Sb_2S_3 \leftrightarrow Sb_2O_3$	0.85817	9.93357
10.02119	1.0500	$Sb_2S_3 \leftrightarrow Sb_2O_5$	0.95237	9.97881
10.21965	1.6583	$Sb_2S_5 \leftrightarrow Sb$	0.60304	9.78035
		ARSENIC $As = 74.91$		
10.12069	1.3204	$As_2O_3 \leftrightarrow As$	0.75735	9.87931
9.93488	0.86076	$As_2O_3 \leftrightarrow As_2O_5$	1.1618	10.06512
10.18582	1.5340	$As_2O_5 \leftrightarrow As$	0.65190	9.81418
10.21537	1.6420	$As_2S_3 \leftrightarrow As$	0.60902	9.78463
10.09468	1.2436	$As_2S_3 \leftrightarrow As_2O_3$	0.80415	9.90532
10.02954	1.0704	$As_2S_3 \leftrightarrow As_2O_5$	0.93423	9.97046
9.89940	0.79324	$As_2S_3 \leftrightarrow As_2S_5$	1.2607	10.10060
10.31597	2.0700	$As_2S_5 \leftrightarrow As$	0.48310	9.68403
10.19526	1.5677	$As_2S_5 \leftrightarrow As_2O_3$	0.63788	9.80474
10.13014	1.3494	$As_2S_5 \leftrightarrow As_2O_5$	0.74106	9.86986

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	ARSENIC (Continued) As = 74.91	Factor	Log. of factor −10
10.66969	4.6740	$BaSO_4 \leftrightarrow As$	0.21395	9.33031
10.54898	3.5399	$BaSO_4 \leftrightarrow As_2O_3$	0.28250	9.45102
10.48387	3.0470	$BaSO_4 \leftrightarrow As_2O_5$	0.32819	9.51613
10.45464	2.8487	$BaSO_4 \leftrightarrow AsO_3$	0.35104	9.54536
10.40150	2.5206	$BaSO_4 \leftrightarrow AsO_4$	0.39674	9.59850
10.31644	2.0722	$Mg_2As_2O_7 \leftrightarrow As$	0.48257	9.68356
10.19573	1.5694	$Mg_2As_2O_7 \leftrightarrow As_2O_3$	0.63718	9.80427
10.13062	1.3509	$Mg_2As_2O_7 \leftrightarrow As_2O_5$	0.74026	9.86938
10.10139	1.2630	$Mg_2As_2O_7 \leftrightarrow AsO_3$	0.79179	9.89861
10.04824	1.1175	$Mg_2As_2O_7 \leftrightarrow AsO_4$	0.89487	9.95176
10.10108	1.2620	$Mg_2As_2O_7 \leftrightarrow As_2S_3$	0.79236	9.89892
10.40485	2.5401	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O \leftrightarrow As$	0.39369	9.59515
10.28415	1.9238	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O \leftrightarrow As_2O_3$	0.51982	9.71585
10.21903	1.6559	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O \leftrightarrow As_2O_5$	0.60390	9.78097
10.18980	1.5481	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O \leftrightarrow AsO_3$	0.64595	9.81020
10.13666	1.3698	$MgNH_4AsO_4 \cdot \frac{1}{2}H_2O \leftrightarrow AsO_4$	0.73004	9.86334
		BARIUM Ba = 137.36		
10.15742	1.4369	$BaCO_3 \leftrightarrow Ba$	0.69595	9.84258
9.97665	0.94765	$BaCO_3 \leftrightarrow BaCl_2$	1.0552	10.02335
9.88132	0.76088	$BaCO_3 \leftrightarrow Ba(HCO_3)_2$	1.3143	10.11868
10.10957	1.2870	$BaCO_3 \leftrightarrow BaO$	0.77702	9.89043
10.26589	1.8446	$BaCrO_4 \leftrightarrow Ba$	0.54213	9.73411
10.08512	1.2165	$BaCrO_4 \leftrightarrow BaCl_2$	0.82201	9.91488
10.10847	1.2838	$BaCrO_4 \leftrightarrow BaCO_3$	0.77898	9.89153
10.21804	1.6521	$BaCrO_4 \leftrightarrow BaO$	0.60528	9.78196
10.30840	2.0342	$BaSiF_6 \leftrightarrow Ba$	0.49159	9.69160
10.20233	1.5934	$BaSiF_6 \leftrightarrow BaF_2$	0.62759	9.79767
10.26055	1.8220	$BaSiF_6 \leftrightarrow BaO$	0.54885	9.73945
10.23028	1.6993	$BaSO_4 \leftrightarrow Ba$	0.58847	9.76972
10.04950	1.1207	$BaSO_4 \leftrightarrow BaCl_2$	0.89227	9.95050
9.98020	0.95544	$BaSO_4 \leftrightarrow BaCl_2 \cdot 2H_2O$	1.0466	10.01980
10.07286	1.1827	$BaSO_4 \leftrightarrow BaCO_3$	0.84556	9.92714
9.95087	0.89304	$BaSO_4 \leftrightarrow Ba(NO_3)_2$	1.1198	10.04913
10.18243	1.5220	$BaSO_4 \leftrightarrow BaO$	0.65701	9.81757
10.13933	1.3783	$BaSO_4 \leftrightarrow BaO_2$	0.72556	9.86067
10.13917	1.3778	$BaSO_4 \leftrightarrow BaS$	0.72582	9.86083
9.45784	0.28697	$CO_2 \leftrightarrow BaO$	3.4847	10.54216
9.34827	0.22299	$CO_2 \leftrightarrow BaCO_3$	4.4847	10.65173
		BERYLLIUM Be = 9.02		
10.94753	8.8619	$BeCl_2 \leftrightarrow Be$	0.11284	9.05247
10.44308	2.7738	$BeO \leftrightarrow Be$	0.36051	9.55692
9.49556	0.31301	$BeO \leftrightarrow BeCl_2$	3.1948	10.50444
9.14996	0.14124	$BeO \leftrightarrow BeSO_4 \cdot 4H_2O$	7.0801	10.85004
		BISMUTH Bi = 209.00		
9.95279	0.89700	$Bi \leftrightarrow Bi_2O_3$	1.1148	10.04721
10.22132	1.6647	$BiAsO_4 \leftrightarrow Bi$	0.60073	9.77868
10.17411	1.4932	$BiAsO_4 \leftrightarrow Bi_2O_3$	0.66971	9.82589
9.68152	0.48031	$Bi_2O_3 \leftrightarrow Bi(NO_3)_3 \cdot 5H_2O$	2.0820	10.31848
9.90946	0.81182	$Bi_2O_3 \leftrightarrow BiONO_3$	1.2318	10.09054
10.09559	1.2462	$BiOCl \leftrightarrow Bi$	0.80244	9.90441

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	BISMUTH (Continued) Bi = 209.00	Factor	Log. of factor −10
9.72990	0.53691	$BiOCl \leftrightarrow Bi(NO_3)_3 \cdot 5H_2O$	1.8625	10.27010
10.04838	1.1178	$BiOCl \leftrightarrow Bi_2O_3$	0.89458	9.95162
9.95784	0.90749	$BiOCl \leftrightarrow BiONO_3$	1.1019	10.04216
10.08994	1.2301	$Bi_2S_3 \leftrightarrow Bi$	0.81295	9.91006
10.04273	1.1034	$Bi_2S_3 \leftrightarrow Bi_2O_3$	0.90630	9.95727
		BORON B = 10.82		
10.50760	3.2181	$B_2O_3 \leftrightarrow B$	0.31074	9.49240
9.91018	0.81317	$B_2O_3 \leftrightarrow BO_2$	1.2298	10.08982
9.77230	0.59198	$B_2O_3 \leftrightarrow BO_3$	1.6893	10.22770
9.95277	0.89696	$B_2O_3 \leftrightarrow B_4O_7$	1.1149	10.04723
9.75053	0.56302	$B_2O_3 \leftrightarrow H_3BO_3$	1.7761	10.24947
9.56247	0.36515	$B_2O_3 \leftrightarrow Na_2B_4O_7 \cdot 10H_2O$	2.7386	10.43753
11.06585	11.637	$KBF_4 \leftrightarrow B$	0.085930	8.93415
10.55825	3.6162	$KBF_4 \leftrightarrow B_2O_3$	0.27653	9.44175
10.30878	2.0360	$KBF_4 \leftrightarrow H_3BO_3$	0.49116	9.69122
10.12072	1.3204	$KBF_4 \leftrightarrow Na_2B_4O_7 \cdot 10H_2O$	0.75732	9.87928
		BROMINE Br = 79.916		
10.13031	1.3499	$Ag \leftrightarrow Br$	0.74079	9.86969
9.92602	0.84337	$Ag \leftrightarrow BrO_3$	1.1857	10.07398
10.12486	1.3331	$Ag \leftrightarrow HBr$	0.75013	9.87514
10.37105	2.3499	$AgBr \leftrightarrow Br$	0.42555	9.62895
10.16676	1.4681	$AgBr \leftrightarrow BrO_3$	0.68114	9.83324
10.36561	2.3206	$AgBr \leftrightarrow HBr$	0.43091	9.63439
9.74628	0.55754	$Br \leftrightarrow AgCl$	1.7936	10.25372
10.99954	9.9895	$Br \leftrightarrow O$	0.10011	9.00046
10.07398	1.1857	$BrO_3 \leftrightarrow Ag$	0.84337	9.92602
		CADMIUM Cd = 112.41		
9.78759	0.61318	$Cd \leftrightarrow CdCl_2$	1.6309	10.21241
9.67711	0.47546	$Cd \leftrightarrow Cd(NO_3)_2$	2.1032	10.32289
10.05779	1.1423	$CdO \leftrightarrow Cd$	0.87540	9.94221
9.84538	0.70045	$CdO \leftrightarrow CdCl_2$	1.4276	10.15462
9.73490	0.54313	$CdO \leftrightarrow Cd(NO_3)_2$	1.8412	10.26510
10.10897	1.2852	$CdS \leftrightarrow Cd$	0.77809	9.89103
9.89656	0.78806	$CdS \leftrightarrow CdCl_2$	1.2689	10.10344
9.78608	0.61106	$CdS \leftrightarrow Cd(NO_3)_2$	1.6365	10.21392
10.05118	1.1251	$CdS \leftrightarrow CdO$	0.88884	9.94882
9.84073	0.69300	$CdS \leftrightarrow CdSO_4$	1.4430	10.15927
10.26824	1.8546	$CdSO_4 \leftrightarrow Cd$	0.53921	9.73176
10.05582	1.1372	$CdSO_4 \leftrightarrow CdCl_2$	0.87938	9.94418
9.94535	0.88176	$CdSO_4 \leftrightarrow Cd(NO_3)_2$	1.1341	10.05465
10.21044	1.6235	$CdSO_4 \leftrightarrow CdO$	0.61596	9.78956
		CALCIUM Ca = 40.08		
10.50996	3.2357	$BaSO_4 \leftrightarrow CaS$	0.30906	9.49004
10.23415	1.7146	$BaSO_4 \leftrightarrow CaSO_4$	0.58324	9.76585
10.13217	1.3557	$BaSO_4 \leftrightarrow CaSO_4 \cdot 2H_2O$	0.73761	9.86783
9.55763	0.36110	$Ca \leftrightarrow CaCl_2$	2.7693	10.44237
9.71039	0.51332	$Ca \leftrightarrow CaF_2$	1.9481	10.28961

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	CALCIUM (Continued) Ca = 40.08	Factor	Log. of factor −10
9.85412	0.71469	$Ca \leftrightarrow CaO$	1.3992	10.14588
10.39746	2.4973	$CaCO_3 \leftrightarrow Ca$	0.40048	9.60254
9.95509	0.90176	$CaCO_3 \leftrightarrow CaCl_2$	1.1089	10.04491
9.79056	0.61740	$CaCO_3 \leftrightarrow Ca(HCO_3)_2$	1.6197	10.20944
10.25158	1.7849	$CaCO_3 \leftrightarrow CaO$	0.56029	9.74842
9.86640	0.73520	$CaCO_3 \leftrightarrow CaSO_4$	1.3602	10.13360
9.76443	0.58134	$CaCO_3 \leftrightarrow CaSO_4 \cdot 2H_2O$	1.7202	10.23557
10.13748	1.3724	$CaCO_3 \leftrightarrow HCl$	0.72865	9.86252
10.14588	1.3992	$CaO \leftrightarrow Ca$	0.71469	9.85412
9.70351	0.50525	$CaO \leftrightarrow CaCl_2$	1.9792	10.29649
9.74842	0.56030	$CaO \leftrightarrow CaCO_3$	1.7848	10.25158
9.85627	0.71824	$CaO \leftrightarrow CaF_2$	1.3923	10.14373
9.53898	0.34593	$CaO \leftrightarrow Ca(HCO_3)_2$	2.8908	10.46102
9.87901	0.75686	$CaO \leftrightarrow Ca(OH)_2$	1.3213	10.12099
9.61482	0.41193	$CaO \leftrightarrow CaSO_4$	2.4276	10.38518
9.51284	0.32572	$CaO \leftrightarrow CaSO_4 \cdot 2H_2O$	3.0701	10.48716
10.26571	1.8438	$Ca_3(PO_4)_2 \leftrightarrow CaO$	0.54236	9.73429
9.88053	0.75951	$Ca_3(PO_4)_2 \leftrightarrow CaSO_4$	1.3166	10.11947
10.53106	3.3967	$CaSO_4 \leftrightarrow Ca$	0.29440	9.46894
10.08869	1.2266	$CaSO_4 \leftrightarrow CaCl_2$	0.81529	9.91131
10.13360	1.3602	$CaSO_4 \leftrightarrow CaCO_3$	0.73520	9.86640
10.24145	1.74360	$CaSO_4 \leftrightarrow CaF_2$	0.57353	9.75855
10.38518	2.4276	$CaSO_4 \leftrightarrow CaO$	0.41193	9.61482
10.24780	1.7693	$Cl \leftrightarrow Ca$	0.56519	9.75220
9.80543	0.63890	$Cl \leftrightarrow CaCl_2$	1.5652	10.19457
10.10192	1.2645	$Cl \leftrightarrow CaO$	0.79082	9.89808
9.89474	0.78477	$CO_2 \leftrightarrow CaO$	1.2743	10.10526
9.64316	0.43970	$CO_2 \leftrightarrow CaCO_3$	2.2743	10.35684
9.89206	0.77993	$Mg_2As_2O_7 \leftrightarrow Ca_3(AsO_4)_2$	1.2822	10.10794
9.85671	0.71897	$MgO \leftrightarrow CaO$	1.3909	10.14329
9.85588	0.71760	$Mg_2P_2O_7 \leftrightarrow Ca_3(PO_4)_2$	1.3935	10.14412
11.08274	12.099	$(NH_4)_3PO_4 \cdot 12MoO_3 \leftrightarrow Ca_3(PO_4)_2$	0.082652	8.91726
9.81839	0.65825	$N_2O_5 \leftrightarrow Ca(NO_3)_2$	1.5192	10.18161
9.66052	0.45764	$P_2O_5 \leftrightarrow Ca_3(PO_4)_2$	2.1851	10.33948
10.15461	1.4276	$SO_3 \leftrightarrow CaO$	0.70047	9.84539
9.76943	0.58807	$SO_3 \leftrightarrow CaSO_4$	1.7005	10.23057
9.66745	0.46500	$SO_3 \leftrightarrow CaSO_4 \cdot 2H_2O$	2.1505	10.33255
9.90595	0.80528	$WO_3 \leftrightarrow CaWO_4$	1.2418	10.09405
		CARBON C = 12.01		
10.60116	3.9917	$Ag \leftrightarrow HCN$	0.25051	9.39883
10.21927	1.6568	$Ag \leftrightarrow KCN$	0.60358	9.78073
10.69499	4.9544	$AgCN \leftrightarrow HCN$	0.20184	9.30500
10.31310	2.0564	$AgCN \leftrightarrow KCN$	0.48630	9.68690
10.21574	16.434	$BaCO_3 \leftrightarrow C$	0.060850	8.78426
10.65173	4.4848	$BaCO_3 \leftrightarrow CO_2$	0.22298	9.34827
10.51706	3.2890	$BaCO_3 \leftrightarrow CO_3$	0.30405	9.48294
10.54216	3.4847	$BaO \leftrightarrow CO_2$	0.28697	9.45784
10.24113	1.7423	$BaO \leftrightarrow CO_2$, bicarbonate	0.57394	9.75887
9.28850	0.19431	$CN \leftrightarrow AgCN$	5.1464	10.71150
9.38233	0.24118	$CN \leftrightarrow Ag$	4.1464	10.61767
9.54391	0.34987	$CNS \leftrightarrow AgCNS$	2.8582	10.45609
9.67891	0.47743	$CNS \leftrightarrow CuCNS$	2.0946	10.32109
9.39587	0.24881	$CNS \leftrightarrow BaSO_4$	4.0191	10.60413
10.10526	1.2743	$CaO \leftrightarrow CO_2$	0.78477	9.89474
9.80423	0.63713	$CaO \leftrightarrow$ Bicarbonate CO_2	1.5695	10.19577

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	CARBON (Continued) C = 12.01	Factor	Log. of factor −10
9.53062	0.33933	$CO_2 \leftrightarrow Ba(HCO_3)_2$	2.9470	10.46938
10.56401	3.6644	$CO_2 \leftrightarrow C$	0.27289	9.43599
9.64316	0.43970	$CO_2 \leftrightarrow CaCO_3$	2.2743	10.35684
9.73476	0.54295	$CO_2 \leftrightarrow Ca(HCO_3)_2$	1.8418	10.26524
9.86533	0.73338	$CO_2 \leftrightarrow CO_3$	1.3636	10.13467
9.13056	0.13507	$CO_2 \leftrightarrow Cs_2CO_3$	7.4035	10.86944
9.35591	0.22694	$CO_2 \leftrightarrow CsHCO_3$	4.4064	10.64409
9.57962	0.37986	$CO_2 \leftrightarrow FeCO_3$	2.6326	10.42038
9.69444	0.49481	$CO_2 \leftrightarrow Fe(HCO_3)_2$	2.0210	10.30556
9.50304	0.31845	$CO_2 \leftrightarrow K_2CO_3$	3.1402	10.49696
9.64306	0.43960	$CO_2 \leftrightarrow KHCO_3$	2.2748	10.35694
9.66954	0.46724	$CO_2 \leftrightarrow K_2O$	2.1402	10.33046
9.77497	0.59562	$CO_2 \leftrightarrow Li_2CO_3$	1.6789	10.22503
9.81131	0.64761	$CO_2 \leftrightarrow LiHCO_3$	1.5441	10.18869
10.16817	1.4695	$CO_2 \leftrightarrow Li_2O$	0.67894	9.83183
9.71757	0.52188	$CO_2 \leftrightarrow MgCO_3$	1.9162	10.28243
9.77917	0.60141	$CO_2 \leftrightarrow Mg(HCO_3)_2$	1.6628	10.22083
10.03803	1.0915	$CO_2 \leftrightarrow MgO$	0.91616	9.96197
9.53308	0.38290	$CO_2 \leftrightarrow MnCO_3$	2.6117	10.41692
9.69669	0.49738	$CO_2 \leftrightarrow Mn(HCO_3)_2$	2.0105	10.30331
9.79272	0.62047	$CO_2 \leftrightarrow MnO$	1.6117	10.20728
9.61823	0.41517	$CO_2 \leftrightarrow Na_2CO_3$	2.4086	10.38177
9.71919	0.52383	$CO_2 \leftrightarrow NaHCO_3$	1.9090	10.28081
9.85120	0.70991	$CO_2 \leftrightarrow Na_2O$	1.4086	10.14880
9.66087	0.45801	$CO_2 \leftrightarrow (NH_4)_2CO_3$	2.1834	10.33913
9.74560	0.55668	$CO_2 \leftrightarrow NH_4HCO_3$	1.7964	10.25440
9.21668	0.16470	$CO_2 \leftrightarrow PbCO_3$	6.0718	10.78332
9.28000	0.19054	$CO_2 \leftrightarrow Rb_2CO_3$	5.2481	10.72000
9.47772	0.30041	$CO_2 \leftrightarrow RbHCO_3$	3.3287	10.52228
9.37180	0.23540	$CO_2 \leftrightarrow Rb_2O$	4.2481	10.62820
9.47435	0.29809	$CO_2 \leftrightarrow SrCO_3$	3.3547	10.52565
9.62305	0.41981	$CO_2 \leftrightarrow Sr(HCO_3)_2$	2.3820	10.37695
9.62807	0.42468	$CO_2 \leftrightarrow SrO$	2.3547	10.37193
		CERIUM Ce = 140.13		
9.55752	0.36101	$Ce \leftrightarrow Ce(NO_3)_4$	2.7700	10.44248
9.39350	0.24746	$Ce \leftrightarrow Ce(NO_3)_4 \cdot 2NH_4NO_3 \cdot H_2O$	4.0412	10.60650
9.91067	0.81409	$Ce \leftrightarrow CeO_2$	1.2284	10.08933
9.93134	0.85377	$Ce \leftrightarrow Ce_2O_3$	1.1713	10.06866
9.69288	0.49303	$Ce \leftrightarrow Ce_2(SO_4)_3$	2.0283	10.30712
10.02228	1.0526	$Ce_2(C_2O_4)_3 \cdot 3H_2O \leftrightarrow Ce_2(SO_4)_3$	0.94998	9.97772
10.32941	2.1350	$Ce_2(C_2O_4)_3 \cdot 3H_2O \leftrightarrow Ce$	0.46837	9.67059
9.64684	0.44345	$CeO_2 \leftrightarrow Ce(NO_3)_4$	2.2551	10.35316
9.48283	0.30397	$CeO_2 \leftrightarrow Ce(NO_3)_4 \cdot 2NH_4NO_3 \cdot H_2O$	3.2898	10.51717
9.62617	0.42284	$Ce_2O_3 \leftrightarrow Ce(NO_3)_4$	2.3650	10.37383
9.46216	0.28984	$Ce_2O_3 \leftrightarrow Ce(NO_3)_4 \cdot 2NH_4NO_3 \cdot H_2O$	3.4502	10.53784
9.97933	0.95352	$Ce_2O_3 \leftrightarrow CeO_2$	1.0487	10.02067
9.76153	0.57748	$Ce_2O_3 \leftrightarrow Ce_2(SO_4)_3$	1.7317	10.23847
		CESIUM Cs = 132.91		
9.93010	0.85134	$AgCl \leftrightarrow CsCl$	1.1746	10.06990
9.42614	0.26677	$Cl \leftrightarrow Cs$	3.7485	10.57386

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	CESIUM (Continued) Cs = 132.91	Factor	Log. of factor −10
9.32345	0.21059	Cl ↔ CsCl	4.7485	10.67655
9.89730	0.78941	Cs ↔ CsCl	1.2668	10.10270
9.91160	0.81582	Cs ↔ Cs_2CO_3	1.2258	10.08840
9.97462	0.94323	Cs ↔ Cs_2O	1.0602	10.02538
9.92268	0.83692	Cs_2O ↔ CsCl	1.1949	10.07732
9.89141	0.77877	Cs_2O ↔ Cs_2SO_4	1.2841	10.10859
10.40394	2.5348	Cs_2PtCl_6 ↔ Cs	0.39451	9.59606
10.30124	2.0010	Cs_2PtCl_6 ↔ CsCl	0.49976	9.69876
10.31553	2.0679	Cs_2PtCl_6 ↔ Cs_2CO_3	0.48469	9.68447
10.37855	2.3909	Cs_2PtCl_6 ↔ Cs_2O	0.41826	9.62145
10.13398	1.3614	Cs_2SO_4 ↔ Cs	0.73455	9.86602
10.03128	1.0747	Cs_2SO_4 ↔ CsCl	0.93051	9.96872
10.04557	1.1106	Cs_2SO_4 ↔ Cs_2CO_3	0.90038	9.95443
9.45344	0.28408	SO_3 ↔ Cs_2O	3.5201	10.54656
		CHLORINE Cl = 35.457		
10.48324	3.0426	Ag ↔ Cl	0.32867	9.51676
10.47106	2.9584	Ag ↔ HCl	0.33802	9.52894
10.60666	4.0426	AgCl ↔ Cl	0.24737	9.39334
10.59448	3.9308	AgCl ↔ HCl	0.25440	9.40552
10.55302	3.5729	$BaCrO_4$ ↔ Cl	0.27988	9.44698
9.75220	0.56519	Ca ↔ Cl	1.7693	10.24780
9.98782	0.97235	Cl ↔ HCl	1.0284	10.01218
9.76510	0.58224	ClO_3 ↔ AgCl	1.7175	10.23490
10.04897	1.1194	ClO_3 ↔ KCl	0.89336	9.95103
10.15465	1.4277	ClO_3 ↔ NaCl	0.70041	9.84535
9.84128	0.69387	ClO_4 ↔ AgCl	1.4412	10.15872
10.12515	1.3340	ClO_4 ↔ KCl	0.74964	9.87485
10.23082	1.7015	ClO_4 ↔ NaCl	0.58773	9.76918
10.04243	1.1026	K ↔ Cl	0.90692	9.95757
10.32276	2.1026	KCl ↔ Cl	0.47559	9.67724
9.29166	0.19573	Li ↔ Cl	5.1091	0.70834
9.53523	0.34295	Mg ↔ Cl	2.9159	10.46477
10.12806	1.3430	$MgCl_2$ ↔ Cl	0.74463	9.87194
10.08844	1.2259	MnO_2 ↔ Cl	0.81576	9.91156
9.81197	0.64859	Na ↔ Cl	1.5418	10.18803
10.21711	1.6486	NaCl ↔ Cl	0.60658	9.78289
9.70654	0.50879	NH_4 ↔ Cl	1.9655	10.29346
10.16646	1.4671	NH_4Cl ↔ HCl	0.68162	9.83354
10.25813	1.8119	$(NH_4)_2SO_4$ ↔ HCl	0.55192	9.74187
10.65877	4.5579	$PbCrO_4$ ↔ Cl	0.21940	9.34123
		CHROMIUM Cr = 52.01		
10.68767	4.8716	$BaCrO_4$ ↔ Cr	0.20527	9.31233
10.52288	3.3340	$BaCrO_4$ ↔ Cr_2O_3	0.30000	9.47712
10.40371	2.5334	$BaCrO_4$ ↔ CrO_3	0.39472	9.59629
10.33926	2.1840	$BaCrO_4$ ↔ CrO_4	0.45787	9.66074
9.84957	0.70725	$BaCrO_4$ ↔ $Cr_2(SO_4)_3 \cdot 18H_2O$	1.4139	10.15043
10.28396	1.9229	CrO_3 ↔ Cr	0.52005	9.71604
10.16478	1.4614	Cr_2O_3 ↔ Cr	0.68425	9.83522
9.88083	0.76002	Cr_2O_3 ↔ CrO_3	1.3157	10.11917
9.81638	0.65522	Cr_2O_3 ↔ CrO_4	1.5262	10.18362
10.57217	3.7339	K_2CrO_4 ↔ Cr	0.26781	9.42783
10.28821	1.9418	K_2CrO_4 ↔ CrO_3	0.51498	9.71179
10.16759	1.4709	$K_2Cr_2O_7$ ↔ CrO_3	0.67985	9.83241

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	CHROMIUM (Continued) Cr = 52.01	Factor	Log. of factor −10
10.79341	6.2146	$PbCrO_4 \leftrightarrow Cr$	0.16091	9.20659
10.62863	4.2523	$PbCrO_4 \leftrightarrow Cr_2O_3$	0.23516	9.37137
10.50945	3.2319	$PbCrO_4 \leftrightarrow CrO_3$	0.30942	9.49055
10.44500	2.7861	$PbCrO_4 \leftrightarrow CrO_4$	0.35892	9.55500
9.95532	0.90223	$PbCrO_4 \leftrightarrow Cr_2(SO_4)_3 \cdot 18H_2O$	1.1084	10.04468
10.22124	1.6643	$PbCrO_4 \leftrightarrow K_2CrO_4$	0.60084	9.77876
10.34187	2.1972	$PbCrO_4 \leftrightarrow K_2Cr_2O_7$	0.45513	9.65813
		COBALT Co = 58.94		
9.30644	0.20251	$Co \leftrightarrow Co(NO_3)_2 \cdot 6H_2O$	4.9381	10.69356
9.89570	0.78650	$Co \leftrightarrow CoO$	1.2715	10.10430
9.32153	0.20967	$Co \leftrightarrow CoSO_4 \cdot 7H_2O$	4.7695	10.67847
10.88499	7.6735	$Co(NO_2)_3 \cdot (KNO_2)_3 \leftrightarrow Co$	0.13032	9.11501
10.78069	6.0352	$Co(NO_2)_3 \cdot (KNO_2)_3 \leftrightarrow CoO$	0.16570	9.21931
10.13416	1.3620	$Co_3O_4 \leftrightarrow Co$	0.73424	9.86584
10.02986	1.0712	$Co_3O_4 \leftrightarrow CoO$	0.93356	9.97014
10.41992	2.6298	$CoSO_4 \leftrightarrow Co$	0.38026	9.58008
10.31562	2.0683	$CoSO_4 \leftrightarrow CoO$	0.48348	9.68438
10.57417	3.7512	$CoSO_4 \cdot 7H_2O \leftrightarrow CoO$	0.26658	9.42583
10.84908	7.0644	$(CoSO_4)_2 \cdot (K_2SO_4)_3 \leftrightarrow Co$	0.14155	9.15092
10.74477	5.5562	$(CoSO_4)_2 \cdot (K_2SO_4)_3 \leftrightarrow CoO$	0.17998	9.25523
		COLUMBIUM Cb = 92.91		
10.15550	1.4305	$Cb_2O_5 \leftrightarrow Cb$	0.69904	9.84450
		COPPER Cu = 63.57		
9.39935	0.25081	$Cu \leftrightarrow Cu_2C_2H_3O_2 \cdot (AsO_2)_3$	3.9870	10.60065
9.90250	0.79892	$Cu \leftrightarrow CuO$	1.2517	10.09750
9.40581	0.25457	$Cu \leftrightarrow CuSO_4 \cdot 5H_2O$	3.9281	10.59419
10.28185	1.9136	$CuCNS \leftrightarrow Cu$	0.52257	9.71815
10.18436	1.5288	$CuCNS \leftrightarrow CuO$	0.65410	9.81564
10.09750	1.2517	$CuO \leftrightarrow Cu$	0.79892	9.90250
9.50331	0.31865	$CuO \leftrightarrow CuSO_4 \cdot 5H_2O$	3.1383	10.49669
10.05148	1.1258	$Cu_2O \leftrightarrow Cu$	0.88822	9.94852
10.09766	1.2522	$Cu_2S \leftrightarrow Cu$	0.79862	9.90234
10.00016	1.0004	$Cu_2S \leftrightarrow CuO$	0.99962	9.99984
10.04618	1.1122	$Cu_2S \leftrightarrow Cu_2O$	0.89912	9.95382
9.50348	0.31877	$Cu_2S \leftrightarrow CuSO_4 \cdot 5H_2O$	3.1371	10.49652
9.96316	0.91868	$Mg_2As_2O_7 \leftrightarrow Cu_2C_2H_3O_2 \cdot (AsO_2)_3$	1.0885	10.03684
		ERBIUM Er = 167.2		
10.05939	1.1465	$Er_2O_3 \leftrightarrow Er$	0.87220	9.94061
		FLUORINE F = 19.00		
10.20233	1.5934	$BaSiF_6 \leftrightarrow BaF_2$	0.62759	9.79767
10.38935	2.4511	$BaSiF_6 \leftrightarrow F$	0.40799	9.61065
10.36690	2.3276	$BaSiF_6 \leftrightarrow 6HF$	0.42963	9.63310
10.28767	1.9394	$BaSiF_6 \leftrightarrow H_2SiF_6$	0.51563	9.71233
10.42897	2.6852	$BaSiF_6 \leftrightarrow SiF_4$	0.37241	9.57103
10.29379	1.9669	$BaSiF_6 \leftrightarrow SiF_6$	0.50841	9.70621
10.21107	1.6258	$CaF_2 \leftrightarrow H_2SiF_6$	0.61508	9.78893

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	FLUORINE (Continued) F = 19.00	Factor	Log. of factor −10
10.21719	1.6489	$CaF_2 \leftrightarrow SiF_6$	0.60647	9.78281
10.55420	3.5826	$CaSO_4 \leftrightarrow F$	0.27912	9.44580
10.53175	3.4021	$CaSO_4 \leftrightarrow HF$	0.29393	9.46825
9.68724	0.48668	$F \leftrightarrow CaF_2$	2.0547	10.31276
9.70970	0.51250	$HF \leftrightarrow CaF_2$	1.9512	10.29030
10.10169	1.2638	$H_2SiF_6 \leftrightarrow F$	0.79125	9.89831
10.55636	3.6004	$H_2SiF_6 \leftrightarrow 2HF$	0.27774	9.44364
10.07924	1.2001	$H_2SiF_6 \leftrightarrow 6HF$	0.83323	9.92076
10.14131	1.3845	$H_2SiF_6 \leftrightarrow SiF_4$	0.72226	9.85869
10.00612	1.0142	$H_2SiF_6 \leftrightarrow SiF_6$	0.98601	9.99388
10.28603	1.9321	$K_2SiF_6 \leftrightarrow F$	0.51757	9.71397
10.26356	1.8347	$K_2SiF_6 \leftrightarrow HF$	0.54505	9.73644
10.18433	1.5287	$K_2SiF_6 \leftrightarrow H_2SiF_6$	0.65124	9.81567
10.27776	1.8956	$K_2SiF_6 \leftrightarrow KF$	0.52753	9.72224
10.19046	1.5505	$K_2SiF_6 \leftrightarrow SiF_6$	0.64497	9.80954
		GALLIUM Ga = 69.72		
10.12847	1.3442	$Ga_2O_3 \leftrightarrow Ga$	0.74392	9.87153
10.22782	1.6898	$Ga_2S_3 \leftrightarrow Ga$	0.59180	9.77218
		GERMANIUM Ge = 72.60		
10.15860	1.4408	$GeO_2 \leftrightarrow Ge$	0.69407	9.84140
10.56197	3.6473	$K_2GeF_6 \leftrightarrow Ge$	0.27418	9.43803
		GOLD Au = 197.2		
9.81265	0.64960	$Au \leftrightarrow AuCl_3$	1.5394	10.18735
9.67990	0.47852	$Au \leftrightarrow HAuCl_4 \cdot 4H_2O$	2.0898	10.32010
9.74056	0.55025	$Au \leftrightarrow KAu(CN)_4 \cdot H_2O$	1.8174	10.25944
		HYDROGEN H = 1.0080		
10.95117	8.9365	$H_2O \leftrightarrow H$	0.11190	9.04883
10.89964	7.9367	$O \leftrightarrow H$	0.12600	9.10036
9.55149	0.35603	$HCNS \leftrightarrow AgCNS$	2.8087	10.44851
9.68638	0.48571	$HCNS \leftrightarrow CuCNS$	2.0588	10.31362
9.40335	0.25313	$HCNS \leftrightarrow BaSO_4$	3.9505	10.59665
		INDIUM In = 114.76		
10.08247	1.2091	$In_2O_3 \leftrightarrow In$	0.82704	9.91753
10.15200	1.4190	$In_2S_3 \leftrightarrow In$	0.70470	9.84800
		IODINE I = 126.92		
9.92597	0.84329	$Ag \leftrightarrow HI$	1.1858	10.07403
9.92941	0.84998	$Ag \leftrightarrow I$	1.1765	10.07059
10.05283	1.1293	$AgCl \leftrightarrow I$	0.88547	9.94717
10.26373	1.8354	$AgI \leftrightarrow HI$	0.54484	9.73627
10.26717	1.8500	$AgI \leftrightarrow I$	0.54055	9.73283
10.12786	1.3423	$AgI \leftrightarrow IO_3$	0.74497	9.87214
10.08985	1.2298	$AgI \leftrightarrow IO_4$	0.81312	9.91015
10.14819	1.4067	$AgI \leftrightarrow I_2O_5$	0.71090	9.85181
10.10844	1.2836	$AgI \leftrightarrow I_2O_7$	0.77905	9.89156

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	IODINE (Continued) I = 126.92	Factor	Log. of factor −10
9.62017	0.41703	Pd ↔ HI	2.3979	10.37983
9.62360	0.42034	Pd ↔ I	2.3790	10.37640
10.14896	1.4092	PdI_2 ↔ HI	0.70965	9.85104
10.15239	1.4203	PdI_2 ↔ I	0.70406	9.84761
10.01308	1.0306	PdI_2 ↔ IO_3	0.97032	9.98692
9.97507	0.94422	PdI_2 ↔ IO_4	1.0591	10.02493
10.03342	1.0800	PdI_2 ↔ I_2O_5	0.92594	9.96658
9.99366	0.98551	PdI_2 ↔ I_2O_7	1.0147	10.00634
10.41327	2.5898	TlI ↔ HI	0.38613	9.58673
10.41670	2.6104	TlI ↔ I	0.38308	9.58330
10.27740	1.8941	TlI ↔ IO_3	0.52796	9.72260
10.23938	1.7353	TlI ↔ IO_4	0.57626	9.76062
10.29773	1.9848	TlI ↔ I_2O_5	0.50382	9.70227
10.25797	1.8112	TlI ↔ I_2O_7	0.55211	9.74203
		IRON Fe = 55.85		
10.35408	2.2599	Ag ↔ $Fe_7(CN)_{18}$ (Prussian blue)	0.44251	9.64592
9.73641	0.54502	CN ↔ $Fe_7(CN)_{18}$	1.8348	10.26359
9.78712	0.61253	CO_2 ↔ FeO	1.6326	10.21288
9.57962	0.37986	CO_2 ↔ $FeCO_3$	2.6326	10.42038
9.69444	0.49481	CO_2 ↔ $Fe(HCO_3)_2$	2.0210	10.30556
9.49688	0.31397	Fe ↔ $Fe(HCO_3)_2$	3.1851	10.50312
9.64403	0.44058	Fe ↔ $FeCl_2$	2.2697	10.35597
9.89060	0.77731	Fe ↔ FeO	1.2865	10.10940
9.84475	0.69944	Fe ↔ Fe_2O_3	1.4297	10.15525
9.56544	0.36765	Fe ↔ $FeSO_4$	2.7200	10.43456
9.30294	0.20088	Fe ↔ $FeSO_4 \cdot 7H_2O$	4.9780	10.69706
9.15358	0.14242	Fe ↔ $FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$	7.0214	10.84642
9.79249	0.62014	FeO ↔ $FeCO_3$	1.6125	10.20751
9.60629	0.40391	FeO ↔ $Fe(HCO_3)_2$	2.4758	10.39371
9.95415	0.89980	FeO ↔ Fe_2O_3	1.1114	10.04585
9.69219	0.49226	Fe_2O_3 ↔ $FeCl_3$	2.0314	10.30781
9.83834	0.68919	Fe_2O_3 ↔ $FeCO_3$	1.4510	10.16166
9.65213	0.44888	Fe_2O_3 ↔ $Fe(HCO_3)_2$	2.2278	10.34787
9.52405	0.33424	Fe_2O_3 ↔ $Fe(HCO_3)_3$	2.9919	10.47595
10.04585	1.1114	Fe_2O_3 ↔ FeO	0.89980	9.95415
10.01475	1.0346	Fe_2O_3 ↔ Fe_3O_4	0.96660	9.98525
9.72379	0.52940	Fe_2O_3 ↔ $FePO_4$	1.8889	10.27621
9.72069	0.52564	Fe_2O_3 ↔ $FeSO_4$	1.9024	10.27931
9.45820	0.28721	Fe_2O_3 ↔ $FeSO_4 \cdot 7H_2O$	3.4818	10.54180
9.30883	0.20362	Fe_2O_3 ↔ $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$	4.9110	10.69117
9.60138	0.39937	Fe_2O_3 ↔ $Fe_2(SO_4)_3$	2.5039	10.39862
10.43146	2.7006	$FePO_4$ ↔ Fe	0.37028	9.56854
10.32206	2.0992	$FePO_4$ ↔ FeO	0.47636	9.67794
10.19702	1.5740	FeS ↔ Fe	0.63531	9.80298
10.08761	1.2235	FeS ↔ FeO	0.81731	9.91239
10.04176	1.1009	FeS ↔ Fe_2O_3	0.90832	9.95824
9.90148	0.79703	$Mg_2As_2O_7$ ↔ $FeAsO_4$	1.2547	10.09852
10.04699	1.1143	SO_3 ↔ FeO	0.89745	9.95301
9.72183	0.52702	SO_3 ↔ $FeSO_4$	1.8975	10.27817
		LANTHANUM La = 138.92		
10.06921	1.1728	La_2O_3 ↔ La	0.85269	9.93079

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	LEAD Pb = 207.21	Factor	Log. of factor −10
9.88954	0.77543	$Pb \leftrightarrow PbCO_3$	1.2896	10.11046
9.90386	0.80141	$Pb \leftrightarrow (PbCO_3)_2 \cdot Pb(OH)_2$	1.2478	10.09614
9.93399	0.85899	$Pb \leftrightarrow Pb(OH)_2$	1.1642	10.06601
9.96770	0.92832	$Pb \leftrightarrow PbO$	1.0772	10.03230
10.12783	1.3422	$PbCl_2 \leftrightarrow Pb$	0.74502	9.87217
10.09553	1.2460	$PbCl_2 \leftrightarrow PbO$	0.80255	9.90447
10.19309	1.5599	$PbCrO_4 \leftrightarrow Pb$	0.64108	9.80691
9.93046	0.85204	$PbCrO_4 \leftrightarrow Pb(C_2H_3O_2)_2 \cdot 3H_2O$	1.1737	10.06954
10.09694	1.2501	$PbCrO_4 \leftrightarrow (PbCO_3)_2 \cdot Pb(OH)_2$	0.79994	9.90306
10.16078	1.4481	$PbCrO_4 \leftrightarrow PbO$	0.69058	9.83922
10.15053	1.4143	$PbCrO_4 \leftrightarrow Pb_3O_4$	0.70708	9.84947
10.02767	1.0658	$PbCrO_4 \leftrightarrow PbSO_4$	0.93828	9.97233
9.92184	0.83530	$PbO \leftrightarrow PbCO_3$	1.1972	10.07816
9.82859	0.67389	$PbO \leftrightarrow Pb(NO_3)_2$	1.4839	10.17141
9.96993	0.93311	$PbO \leftrightarrow PbO_2$	1.0717	10.03007
10.06237	1.1544	$PbO_2 \leftrightarrow Pb$	0.86623	9.93752
9.85865	0.72220	$PbO_2 \leftrightarrow Pb(NO_3)_2$	1.3847	10.14135
10.06248	1.1547	$PbS \leftrightarrow Pb$	0.86601	9.93752
10.03017	1.0720	$PbS \leftrightarrow PbO$	0.93288	9.96983
9.89706	0.78897	$PbS \leftrightarrow PbSO_4$	1.2675	10.10294
10.11369	1.2992	$PbSO_4 \leftrightarrow BaSO_4$	0.76968	9.88631
10.16542	1.4636	$PbSO_4 \leftrightarrow Pb$	0.68325	9.83458
9.90279	0.79945	$PbSO_4 \leftrightarrow Pb(C_2H_3O_2)_2 \cdot 3H_2O$	1.2509	10.09721
10.05496	1.1349	$PbSO_4 \leftrightarrow PbCO_3$	0.88113	9.94504
10.06928	1.1729	$PbSO_4 \leftrightarrow (PbCO_3)_2 \cdot Pb(OH)_2$	0.85256	9.93072
9.96171	0.91560	$PbSO_4 \leftrightarrow Pb(NO_3)_2$	1.0922	10.03829
10.13312	1.3587	$PbSO_4 \leftrightarrow PbO$	0.73601	9.86688
10.10305	1.2678	$PbSO_4 \leftrightarrow PbO_2$	0.78877	9.89695
10.12286	1.3270	$PbSO_4 \leftrightarrow Pb_3O_4$	0.75360	9.87714
		LITHIUM Li = 6.940		
9.77497	0.59562	$CO_2 \leftrightarrow Li_2CO_3$	1.6789	10.22503
9.81131	0.64761	$CO_2 \leftrightarrow LiHCO_3$	1.5442	10.18869
10.16817	1.4729	$CO_2 \leftrightarrow Li_2O$	0.67894	9.83183
10.78598	6.1091	$LiCl \leftrightarrow Li$	0.16369	9.21402
10.45298	2.8378	$LiCl \leftrightarrow Li_2O$	0.35238	9.54702
10.72620	5.3235	$Li_2CO_3 \leftrightarrow Li$	0.18785	9.27380
9.94022	0.87141	$Li_2CO_3 \leftrightarrow LiCl$	1.1476	10.05978
9.73531	0.54364	$Li_2CO_3 \leftrightarrow LiHCO_3$	1.8394	10.26469
10.39321	2.4729	$Li_2CO_3 \leftrightarrow Li_2O$	0.40438	9.60679
10.65789	4.5487	$LiHCO_3 \leftrightarrow Li_2O$	0.21984	9.34211
10.33299	2.1527	$Li_2O \leftrightarrow Li$	0.46452	9.66701
9.43422	0.27178	$Li_2O \leftrightarrow Li_2SO_4$	3.6794	10.56578
10.74523	5.5620	$Li_3PO_4 \leftrightarrow Li$	0.17979	9.25477
9.95925	0.91044	$Li_3PO_4 \leftrightarrow LiCl$	1.0984	10.04075
10.01903	1.0448	$Li_3PO_4 \leftrightarrow Li_2CO_3$	0.95712	9.98097
9.75435	0.56800	$Li_3PO_4 \leftrightarrow LiHCO_3$	1.7606	10.24565
10.41224	2.5837	$Li_3PO_4 \leftrightarrow Li_2O$	0.38705	9.58776
9.84646	0.70220	$Li_3PO_4 \leftrightarrow Li_2SO_4$	1.4240	10.15354
9.78056	0.60333	$Li_3PO_4 \leftrightarrow Li_2SO_4 \cdot H_2O$	1.6575	10.21944
10.89877	7.9207	$Li_2SO_4 \leftrightarrow Li$	0.12625	9.10123
10.11279	1.2966	$Li_2SO_4 \leftrightarrow LiCl$	0.77128	9.88721
10.42804	2.6794	$SO_3 \leftrightarrow Li_2O$	0.37322	9.57196
9.86226	0.72822	$SO_3 \leftrightarrow Li_2SO_4$	1.3732	10.13774

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	MAGNESIUM Mg = 24.32	Factor	Log. of factor −10
10.28758	1.9390	$BaSO_4 \leftrightarrow MgSO_4$	0.51572	9.71242
9.97633	0.94696	$BaSO_4 \leftrightarrow MgSO_4 \cdot 7H_2O$	1.0560	10.02367
10.81770	6.5720	$Br \leftrightarrow Mg$	0.15216	9.18230
9.93849	0.86794	$Br \leftrightarrow MgBr_2$	1.1522	10.06151
9.73791	0.54690	$Br \leftrightarrow MgBr_2 \cdot 6H_2O$	1.8284	10.26209
10.46477	2.9159	$Cl \leftrightarrow Mg$	0.34295	9.53523
9.87194	0.74463	$Cl \leftrightarrow MgCl_2$	1.3430	10.12806
9.54253	0.34876	$Cl \leftrightarrow MgCl_2 \cdot 6H_2O$	2.8673	10.45747
9.71757	0.52188	$CO_2 \leftrightarrow MgCO_3$	1.9162	10.28243
10.03803	1.0915	$CO_2 \leftrightarrow MgO$	0.91616	9.96197
11.01860	10.438	$I \leftrightarrow Mg$	0.09584	8.98140
9.96027	0.91257	$I \leftrightarrow MgI_2$	1.0958	10.03973
9.40717	0.25537	$Mg \leftrightarrow MgCl_2$	3.9159	10.59283
9.45998	0.28839	$Mg \leftrightarrow MgCO_3$	3.4675	10.54002
9.76057	0.57620	$MgCO_3 \leftrightarrow Mg(HCO_3)_2$	1.7355	10.23943
11.00398	10.092	$MgNH_4PO_4 \cdot 6H_2O \leftrightarrow Mg$	0.099088	8.99602
10.78442	6.0872	$MgNH_4PO_4 \cdot 6H_2O \leftrightarrow MgO$	0.16428	9.21558
10.21956	1.6579	$MgO \leftrightarrow Mg$	0.60318	9.78044
9.67954	0.47812	$MgO \leftrightarrow MgCO_3$	2.0915	10.32046
9.44012	0.27550	$MgO \leftrightarrow Mg(HCO_3)_2$	3.6298	10.55988
9.52497	0.33494	$MgO \leftrightarrow MgSO_4$	2.9856	10.47503
10.66053	4.5765	$Mg_2P_2O_7 \leftrightarrow Mg$	0.21851	9.33947
10.06770	1.1687	$Mg_2P_2O_7 \leftrightarrow MgCl_2$	0.85565	9.93230
9.73829	0.54738	$Mg_2P_2O_7 \leftrightarrow MgCl_2 \cdot 6H_2O$	1.8269	10.26171
9.60263	0.40053	$Mg_2P_2O_7 \leftrightarrow MgCl_2 \cdot KCl \cdot 6H_2O$	2.4967	10.39737
10.12051	1.3198	$Mg_2P_2O_7 \leftrightarrow MgCO_3$	0.75768	9.87949
9.88108	0.76047	$Mg_2P_2O_7 \leftrightarrow Mg(HCO_3)_2$	1.3150	10.11892
10.44097	2.7604	$Mg_2P_2O_7 \leftrightarrow MgO$	0.36226	9.55903
9.96594	0.92457	$Mg_2P_2O_7 \leftrightarrow MgSO_4$	1.0816	10.03406
9.65469	0.45153	$Mg_2P_2O_7 \leftrightarrow MgSO_4 \cdot 7H_2O$	2.2147	10.34531
10.69459	4.9498	$MgSO_4 \leftrightarrow Mg$	0.20203	9.30541
10.29790	1.9856	$SO_3 \leftrightarrow MgO$	0.50362	9.70210
9.82286	0.66506	$SO_3 \leftrightarrow MgSO_4$	1.5036	10.17714
9.51161	0.32480	$SO_3 \leftrightarrow MgSO_4 \cdot 7H_2O$	3.0789	10.48839
		MANGANESE Mn = 54.93		
10.18919	1.5459	$BaSO_4 \leftrightarrow MnSO_4$	0.64686	9.81081
9.58308	0.38290	$CO_2 \leftrightarrow MnCO_3$	2.6127	10.41692
9.79272	0.62047	$CO_2 \leftrightarrow MnO$	1.6117	10.20728
9.67934	0.47790	$Mn \leftrightarrow MnCO_3$	2.0925	10.32066
9.88898	0.77443	$Mn \leftrightarrow MnO$	1.2913	10.11102
9.80064	0.63189	$Mn \leftrightarrow MnO_2$	1.5826	10.19936
9.84257	0.69593	$Mn \leftrightarrow Mn_2O_3$	1.4369	10.15743
9.88152	0.76124	$MnCO_3 \leftrightarrow MnSO_4$	1.3136	10.11848
10.18742	1.5396	$Mn(HCO_3)_2 \leftrightarrow MnCO_3$	0.64951	9.81258
9.79036	0.61710	$MnO \leftrightarrow MnCO_3$	1.6205	10.20964
9.60294	0.40081	$MnO \leftrightarrow Mn(HCO_3)_2$	2.4949	10.39706
9.95359	0.89864	$MnO \leftrightarrow Mn_2O_3$	1.1128	10.04641
9.67188	0.46977	$MnO \leftrightarrow MnSO_4$	2.1287	10.32812
10.14251	1.3884	$Mn_3O_4 \leftrightarrow Mn$	0.72027	9.85749
9.82184	0.66351	$Mn_3O_4 \leftrightarrow MnCO_3$	1.5071	10.17816
9.63443	0.43095	$Mn_3O_4 \leftrightarrow Mn(HCO_3)_2$	2.3205	10.36557
10.03149	1.0752	$Mn_3O_4 \leftrightarrow MnO$	0.93007	9.96851

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	MANGANESE (Continued) Mn = 54.93	Factor	Log. of factor −10
9.98507	0.96621	$Mn_3O_4 \leftrightarrow Mn_2O_3$	1.0350	10.01493
9.94315	0.87730	$Mn_3O_4 \leftrightarrow MnO_2$	1.1399	10.05685
9.70337	0.50509	$Mn_3O_4 \leftrightarrow MnSO_4$	1.9799	10.29663
10.41220	2.5835	$Mn_2P_2O_7 \leftrightarrow Mn$	0.38708	9.58780
10.09154	1.2346	$Mn_2P_2O_7 \leftrightarrow MnCO_3$	0.80995	9.90846
10.30118	2.0007	$Mn_2P_2O_7 \leftrightarrow MnO$	0.49982	9.69882
10.21284	1.6325	$Mn_2P_2O_7 \leftrightarrow MnO_2$	0.61257	9.78716
9.97306	0.93986	$Mn_2P_2O_7 \leftrightarrow MnSO_4$	1.0640	10.02694
10.19966	1.5837	$MnS \leftrightarrow Mn$	0.63145	9.80034
9.87900	0.75683	$MnS \leftrightarrow MnCO_3$	1.3213	10.12100
10.08864	1.2264	$MnS \leftrightarrow MnO$	0.81538	9.91136
9.76052	0.57613	$MnS \leftrightarrow MnSO_4$	1.7357	10.23948
10.43914	2.7488	$MnSO_4 \leftrightarrow Mn$	0.36380	9.56086
10.05259	1.1287	$SO_3 \leftrightarrow MnO$	0.88596	9.94741
9.72447	0.53023	$SO_3 \leftrightarrow MnSO_4$	1.8860	10.27253
		MERCURY Hg = 200.61		
9.86854	0.73883	$Hg \leftrightarrow HgCl_2$	1.3535	10.13146
9.96667	0.92613	$Hg \leftrightarrow HgO$	1.0798	10.03333
9.93561	0.86221	$Hg \leftrightarrow HgS$	1.1598	10.06439
10.07068	1.1767	$HgCl \leftrightarrow Hg$	0.84980	9.92932
9.93923	0.86942	$HgCl \leftrightarrow HgCl_2$	1.1502	10.06077
9.95371	0.89890	$HgCl \leftrightarrow HgNO_3$	1.1125	10.04629
10.05370	1.1316	$HgCl \leftrightarrow Hg_2O$	0.88369	9.94630
10.03736	1.0898	$HgCl \leftrightarrow HgO$	0.91758	9.96264
10.00629	1.0146	$HgCl \leftrightarrow HgS$	0.98561	9.99371
9.99371	0.98561	$HgS \leftrightarrow HgCl$	1.0146	10.00629
9.93293	0.85690	$HgS \leftrightarrow HgCl_2$	1.1670	10.06707
9.96423	0.92093	$HgS \leftrightarrow Hg(CN)_2$	1.0859	10.03577
9.94742	0.88596	$HgS \leftrightarrow HgNO_3$	1.1287	10.05258
9.85536	0.71673	$HgS \leftrightarrow Hg(NO_3)_2$	1.3952	10.14464
9.83190	0.67905	$HgS \leftrightarrow Hg(NO_3)_2 \cdot H_2O$	1.4727	10.16810
10.04741	1.1153	$HgS \leftrightarrow Hg_2O$	0.89659	9.95259
10.03106	1.0741	$HgS \leftrightarrow HgO$	0.93098	9.96894
9.89447	0.78427	$HgS \leftrightarrow HgSO_4$	1.2751	10.10553
		MOLYBDENUM Mo = 95.95		
10.17617	1.5003	$MoO_3 \leftrightarrow Mo$	0.66655	9.82383
9.86589	0.73432	$MoO_3 \leftrightarrow (NH_4)_2MoO_4$	1.3618	10.13441
10.30155	2.0024	$MoS_3 \leftrightarrow Mo$	0.50055	9.69845
10.12538	1.3347	$MoS_3 \leftrightarrow MoO_3$	0.74923	9.87462
9.99127	0.98010	$MoS_3 \leftrightarrow (NH_4)_2MoO_4$	1.0203	10.00873
10.03596	1.0863	$(NH_4)_3PO_4 \cdot 12MoO_3 \leftrightarrow MoO_3$	0.92054	9.96404
9.90184	0.79771	$(NH_4)_3PO_4 \cdot 12MoO_3 \leftrightarrow (NH_4)_2MoO_4$	1.2536	10.09816
10.58281	3.8266	$PbMoO_4 \leftrightarrow Mo$	0.26133	9.41719
10.40664	2.5506	$PbMoO_4 \leftrightarrow MoO_3$	0.39206	9.59336
10.27253	1.8730	$PbMoO_4 \leftrightarrow (NH_4)_2MoO_4$	0.53391	9.72747
		NEODYMIUM Nd = 144.27		
10.06683	1.1664	$Nd_2O_3 \leftrightarrow Nd$	0.85737	9.93317
		NICKEL Ni = 58.69		
9.30792	0.20320	$Ni \leftrightarrow$ Ni-glyoxime	4.9213	10.69208
9.30496	0.20182	$Ni \leftrightarrow Ni(NO_3)_2 \cdot 6H_2O$	4.9549	10.69504

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor		Factor	Log. of factor −10
		NICKEL (Continued)		
		Ni = 58.69		
9.89530	0.78578	$Ni \leftrightarrow NiO$	1.2726	10.10470
9.32007	0.20896	$Ni \leftrightarrow NiSO_4 \cdot 7H_2O$	4.7856	10.67993
10.58738	3.8671	Ni-glyoxime $\leftrightarrow NiO$	0.25859	9.41262
9.40966	0.25684	$NiO \leftrightarrow Ni(NO_3)_2 \cdot 6H_2O$	3.8934	10.59034
9 42477	0.26593	$NiO \leftrightarrow NiSO_4 \cdot 7H_2O$	3.7604	10.57523
10.42107	2.6367	$NiSO_4 \leftrightarrow Ni$	0.37926	9.57893
9.72603	0.53215	$NiSO_4 \leftrightarrow Ni(NO_3)_2 \cdot 6H_2O$	1.8792	10.27397
10.31637	2.0719	$NiSO_4 \leftrightarrow NiO$	0.48265	9.68363
9.74114	0.55098	$NiSO_4 \leftrightarrow NiSO_4 \cdot 7H_2O$	1.8149	10.25886
		NITROGEN		
		N = 14.008		
10.51496	3.2731	$AgNO_2 \leftrightarrow HNO_2$	0.30552	9.48504
10.60733	4.0488	$AgNO_2 \leftrightarrow N_2O_3$	0.24698	9.39267
10.27231	1.8720	$KNO_3 \leftrightarrow N_2O_5$	0.53418	9.72769
9.34693	0.22230	$N \leftrightarrow HNO_3$	4.4985	10.65307
9.48354	0.30447	$N \leftrightarrow NO_2$	3.2844	10.51646
9.56650	0.36855	$N \leftrightarrow N_2O_3$	2.7133	10.43350
9.35393	0.22591	$N \leftrightarrow NO_3$	4.4266	10.64607
9.41392	0.25937	$N \leftrightarrow N_2O_5$	3.8555	10.58608
10.78307	6.0683	$NaNO_3 \leftrightarrow N$	0.16479	9.21693
10.19699	1.5739	$NaNO_3 \leftrightarrow N_2O_5$	0.63535	9.80301
9.67779	0.47620	$NO \leftrightarrow HNO_3$	2.0999	10.32221
9.81440	0.65223	$NO \leftrightarrow NO_2$	1.5332	10.18560
9.89736	0.78952	$NO \leftrightarrow N_2O_3$	1.2666	10.10264
9.68479	0.48394	$NO \leftrightarrow NO_3$	2.0664	10.31521
9.74478	0.55562	$NO \leftrightarrow N_2O_5$	1.7998	10.25522
9.43181	0.27028	$NH_3 \leftrightarrow HNO_3$	3.6999	10.56819
10.08489	1.2159	$NH_3 \leftrightarrow N$	0.82245	9.91511
9.49881	0.31536	$NH_3 \leftrightarrow N_2O_5$	3.1710	10.50119
9.43882	0.27467	$NH_3 \leftrightarrow NO_3$	3.6407	10.56118
9.92888	0.84894	$NH_4Cl \leftrightarrow HNO_3$	1.1779	10.07112
9.93588	0.86275	$NH_4Cl \leftrightarrow NO_3$	1.1591	10.06412
9.99587	0.99055	$NH_4Cl \leftrightarrow N_2O_5$	1.0095	10.00413
10.58195	3.8190	$NH_4Cl \leftrightarrow N$	0.26185	9.41805
10.54695	3.5233	$(NH_4)_2PtCl_6 \leftrightarrow HNO_3$	0.28382	9.45305
11.20003	15.850	$(NH_4)_2PtCl_6 \leftrightarrow N$	0.063092	8.79997
10.61395	4.1110	$(NH_4)_2PtCl_6 \leftrightarrow N_2O_5$	0.24325	9.38605
10.55396	3.5807	$(NH_4)_2PtCl_6 \leftrightarrow NO_3$	0.27928	9.44604
10.67363	4.7166	$(NH_4)_2SO_4 \leftrightarrow N$	0.21202	9.32637
10.08755	1.2233	$(NH_4)_2SO_4 \leftrightarrow N_2O_5$	0.81743	9.91245
10.19007	1.5491	$Pt \leftrightarrow HNO_3$	0.64555	9.80993
10.84314	6.9685	$Pt \leftrightarrow N$	0.14350	9.15686
10.19707	1.5742	$Pt \leftrightarrow NO_3$	0.63523	9.80293
10.25706	1.8074	$Pt \leftrightarrow N_2O_5$	0.55328	9.74294
9.80294	0.63524	$SO_3 \leftrightarrow HNO_3$	1.5742	10.19706
10.45601	2.8577	$SO_3 \leftrightarrow N$	0.34994	9.54399
9.86993	0.74119	$SO_3 \leftrightarrow N_2O_5$	1.3492	10.13007
		OSMIUM		
		Os = 190.2		
10.12597	1.3365	$OsO_4 \leftrightarrow Os$	0.74823	9.87403
		PALLADIUM		
		Pd = 106.7		
9.69847	0.49942	$Pd \leftrightarrow PdCl_2 \cdot 2H_2O$	2.0023	10.30153
9.66509	0.46247	$Pd \leftrightarrow Pd(NO_3)_2$	2.1623	10.33491

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	PALLADIUM (Continued) Pd = 106.7	Factor	Log. of factor −10
10.52879	3.3790	$PdI_2 \leftrightarrow Pd$	0.29594	9.47121
10.57132	3.7267	$K_2PdCl_6 \leftrightarrow Pd$	0.26834	9.42868
10.26979	1.8612	$K_2PdCl_6 \leftrightarrow PdCl_2 \cdot 2H_2O$	0.53729	9.73021
		PHOSPHORUS P = 30.98		
11.13074	13.513	$Ag_3PO_4 \leftrightarrow P$	0.074005	8.86926
10.64419	4.4075	$Ag_3PO_4 \leftrightarrow PO_4$	0.22689	9.35581
10.77068	5.8977	$Ag_3PO_4 \leftrightarrow P_2O_5$	0.16956	9.22932
10.98999	9.7721	$Ag_4P_2O_7 \leftrightarrow P$	0.10233	9.01001
10.50344	3.1874	$Ag_4P_2O_7 \leftrightarrow PO_4$	0.31373	9.49656
10.62993	4.2651	$Ag_4P_2O_7 \leftrightarrow P_2O_5$	0.23446	9.37007
9.85618	0.71809	$Al_2O_3 \leftrightarrow P_2O_5$	1.3926	10.14382
10.10855	1.2840	$AlPO_4 \leftrightarrow PO_4$	0.77884	9.89145
10.23505	1.7181	$AlPO_4 \leftrightarrow P_2O_5$	0.58204	9.76495
10.33948	2.1851	$Ca_3(PO_4)_2 \leftrightarrow P_2O_5$	0.45764	9.66052
10.20086	1.5880	$FePO_4 \leftrightarrow PO_4$	0.62972	9.79914
10.32735	2.1250	$FePO_4 \leftrightarrow P_2O_5$	0.47060	9.67265
9.89426	0.78396	$Mg_2P_2O_7 \leftrightarrow Na_2HPO_4$	1.2757	10.10574
9.49240	0.31074	$Mg_2P_2O_7 \leftrightarrow Na_2HPO_4 \cdot 12H_2O$	3.2181	10.50760
9.72616	0.53231	$Mg_2P_2O_7 \leftrightarrow NaNH_4HPO_4 \cdot 4H_2O$	1.8786	10.27384
10.55541	3.5926	$Mg_2P_2O_7 \leftrightarrow P$	0.27835	9.44459
10.06886	1.1718	$Mg_2P_2O_7 \leftrightarrow PO_4$	0.85337	9.93114
10.19536	1.5680	$Mg_2P_2O_7 \leftrightarrow P_2O_5$	0.63774	9.80464
11.78227	60.572	$(NH_4)_3PO_4 \cdot 12MoO_3 \leftrightarrow P$	0.016509	8.21773
11.29572	19.757	$(NH_4)_3PO_4 \cdot 12MoO_3 \leftrightarrow PO_4$	0.050616	8.70428
11.42221	26.437	$(NH_4)_3PO_4 \cdot 12MoO_3 \leftrightarrow P_2O_5$	0.037826	8.57779
9.80464	0.63774	$P_2O_5 \leftrightarrow Mg_2P_2O_7$	1.5680	10.19536
9.69890	0.49992	$P_2O_5 \leftrightarrow Na_2HPO_4$	2.0003	10.30110
9.29704	0.19817	$P_2O_5 \leftrightarrow Na_2HPO_4 \cdot 12H_2O$	5.0462	10.70296
9.53080	0.33947	$P_2O_5 \leftrightarrow NaNH_4HPO_4 \cdot 4H_2O$	2.9458	10.46920
10.36005	2.2912	$P_2O_5 \leftrightarrow P$	0.43646	9.63995
11.76380	58.050	$P_2O_5 \cdot 24MoO_3 \leftrightarrow P$	0.017227	8.23620
11.27725	18.978	$P_2O_5 \cdot 24MoO_3 \leftrightarrow PO_4$	0.052814	8.72275
11.40375	25.336	$P_2O_5 \cdot 24MoO_3 \leftrightarrow P_2O_5$	0.039469	8.59625
11.06165	11.525	$U_2P_2O_{11} \leftrightarrow P$	0.086767	8.93835
10.57510	3.7592	$U_2P_2O_{11} \leftrightarrow PO_4$	0.26601	9.42490
10.70159	5.0303	$U_2P_2O_{11} \leftrightarrow P_2O_5$	0.19880	9.29841
		PLATINUM Pt = 195.23		
9.97238	0.93839	$K_2PtCl_6 \leftrightarrow H_2PtCl_6 \cdot 6H_2O$	1.0657	10.02762
10.39624	2.4902	$K_2PtCl_6 \leftrightarrow Pt$	0.40157	9.60376
10.15908	1.4424	$K_2PtCl_6 \leftrightarrow PtCl_4$	0.69330	9.84092
10.05621	1.1382	$K_2PtCl_6 \leftrightarrow PtCl_4 \cdot 5H_2O$	0.87859	9.94379
10.35689	2.2745	$(NH_4)_2PtCl_6 \leftrightarrow Pt$	0.43966	9.64311
10.11973	1.3174	$(NH_4)_2PtCl_6 \leftrightarrow PtCl_4$	0.75905	9.88027
10.03680	1.0884	$(NH_4)_2PtCl_6 \leftrightarrow PtCl_6$	0.91875	9.96320
9.57615	0.37683	$Pt \leftrightarrow H_2PtCl_6 \cdot 6H_2O$	2.6537	10.42385
9.76284	0.57922	$Pt \leftrightarrow PtCl_4$	1.7265	10.23716
9.65998	0.45707	$Pt \leftrightarrow PtCl_4 \cdot 5H_2O$	2.1879	10.34002
		POTASSIUM K = 39.096		
9.95735	0.90646	$Ag \leftrightarrow KBr$	1.1032	10.04265
10.16048	1.4470	$Ag \leftrightarrow KCl$	0.69107	9.83952
9.94462	0.88027	$Ag \leftrightarrow KClO_3$	1.1360	10.05538

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log of factor −10	Factor	POTASSIUM (Continued) K = 39.096	Factor	Log. of factor −10
9.89133	0.77862	$Ag \leftrightarrow KClO_4$	1.2843	10.10867
10.21927	1.6568	$Ag \leftrightarrow KCN$	0.60358	9.78073
9.81279	0.64982	$Ag \leftrightarrow KI$	1.5389	10.18721
10.19810	1.5780	$AgBr \leftrightarrow KBr$	0.63373	9.80190
10.05094	1.1244	$AgBr \leftrightarrow KBrO_3$	0.88933	9.94906
10.28389	1.9226	$AgCl \leftrightarrow KCl$	0.52012	9.71611
10.06803	1.1696	$AgCl \leftrightarrow KClO_3$	0.85500	9.93197
10.01474	1.0345	$AgCl \leftrightarrow KClO_4$	0.96662	9.98526
10.31310	2.0564	$AgCN \leftrightarrow KCN$	0.48630	9.68690
10.15055	1.4143	$AgI \leftrightarrow KI$	0.70705	9.84945
10.04025	1.0971	$AgI \leftrightarrow KIO_3$	0.91148	9.95975
10.11550	1.3047	$BaCrO_4 \leftrightarrow K_2CrO_4$	0.76648	9.88450
10.23612	1.7224	$BaCrO_4 \leftrightarrow K_2Cr_4O_7$	0.58060	9.76388
10.23408	1.7143	$BaSO_4 \leftrightarrow KHSO_4$	0.58334	9.76592
10.32575	2.1171	$BaSO_4 \leftrightarrow K_2S$	0.47233	9.67425
10.12696	1.3396	$BaSO_4 \leftrightarrow K_2SO_4$	0.74652	9.87304
10.31050	2.0441	$Br \leftrightarrow K$	0.48921	9.68950
9.82704	0.67150	$Br \leftrightarrow KBr$	1.4892	10.17296
9.61779	0.41475	$CaF_2 \leftrightarrow KF{\cdot}2H_2O$	2.4111	10.38221
9.85924	0.72316	$CaSO_4 \leftrightarrow KF{\cdot}2H_2O$	1.3828	10.14076
9.95757	0.90692	$Cl \leftrightarrow K$	1.1026	10.04243
9.67724	0.47559	$Cl \leftrightarrow KCl$	2.1026	10.32276
9.46138	0.28932	$Cl \leftrightarrow KClO_3$	3.4564	10.53862
9.40809	0.25591	$Cl \leftrightarrow KClO_4$	3.9076	10.59191
9.87672	0.75287	$Cl \leftrightarrow K_2O$	1.3283	10.12328
9.66954	0.46724	$CO_2 \leftrightarrow K_2O$	2.1402	10.33046
9.50307	0.31847	$CO_2 \leftrightarrow K_2CO_3$	3.1400	10.49693
9.88338	0.76450	$I \leftrightarrow KI$	1.3080	10.11662
9.77308	0.59304	$I \leftrightarrow KIO_3$	1.6862	10.22692
9.50381	0.31901	$K \leftrightarrow KClO_3$	3.1347	10.49619
9.91915	0.83013	$K \leftrightarrow K_2O$	1.2046	10.08085
9.58736	0.38669	$K \leftrightarrow KNO_3$	2.5860	10.41264
10.48346	3.0441	$KBr \leftrightarrow K$	0.32850	9.51654
10.40261	2.5270	$KBr \leftrightarrow K_2O$	0.39572	9.59739
10.28033	1.9069	$KCl \leftrightarrow K$	0.52441	9.71967
10.03301	1.0790	$KCl \leftrightarrow K_2CO_3$	0.92680	9.96699
9.70483	0.50680	$KCl \leftrightarrow K_2Cr_2O_7$	1.9732	10.29517
9.87197	0.74468	$KCl \leftrightarrow KHCO_3$	1.3429	10.12803
9.86770	0.73739	$KCl \leftrightarrow KNO_3$	1.3561	10.13230
10.19948	1.5830	$KCl \leftrightarrow K_2O$	0.63171	9.80052
9.93232	0.85569	$KCl \leftrightarrow K_2SO_4$	1.1686	10.06768
10.21586	1.6438	$KClO_3 \leftrightarrow KCl$	0.60833	9.78414
10.54948	3.5439	$KClO_4 \leftrightarrow K$	0.28217	9.45052
10.26915	1.8584	$KClO_4 \leftrightarrow KCl$	0.53808	9.73085
10.46863	2.9419	$KClO_4 \leftrightarrow K_2O$	0.33991	9.53137
10.62802	4.2464	$KI \leftrightarrow K$	0.23550	9.37198
10.54717	3.5251	$KI \leftrightarrow K_2O$	0.28368	9.45283
9.58466	0.38429	$K_2O \leftrightarrow KClO_3$	2.6022	10.41534
9.83353	0.68160	$K_2O \leftrightarrow K_2CO_3$	1.4671	10.16647
9.50535	0.32015	$K_2O \leftrightarrow K_2Cr_2O_7$	3.1235	10.49465
9.67249	0.47042	$K_2O \leftrightarrow KHCO_3$	2.1257	10.32751
9.66822	0.46582	$K_2O \leftrightarrow KNO_3$	2.1468	10.33178
9.90951	0.81191	$KOH \leftrightarrow K_2CO_3$	1.2317	10.09049
10.07601	1.1913	$KOH \leftrightarrow K_2O$	0.83944	9.92399
10.79362	6.2176	$K_2PtCl_6 \leftrightarrow K$	0.16083	9.20638

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	POTASSIUM (Continued) K = 39.096	Factor	Log. of factor −10
10.54630	3.5180	$K_2PtCl_6 \leftrightarrow K_2CO_3$	0.28425	9.45370
10.51329	3.2605	$K_2PtCl_6 \leftrightarrow KCl$	0.30670	9.48671
10.38526	2.4281	$K_2PtCl_6 \leftrightarrow KHCO_3$	0.41185	9.61474
10.38098	2.4043	$K_2PtCl_6 \leftrightarrow KNO_3$	0.41593	9.61902
10.71277	5.1614	$K_2PtCl_6 \leftrightarrow K_2O$	0.19375	9.28723
10.44561	2.7900	$K_2PtCl_6 \leftrightarrow K_2SO_4$	0.35842	9.55439
9.70963	0.51242	$K_2PtCl_6 \leftrightarrow K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	1.9515	10.29037
9.68729	0.48673	$K_2PtCl_6 \leftrightarrow K_2SO_4 \cdot Cr_2(SO_4)_3 \cdot 24H_2O$	2.0545	10.31271
10.10069	1.2609	$K_2SO_4 \leftrightarrow K_2CO_3$	0.79306	9.89931
9.93965	0.87027	$K_2SO_4 \leftrightarrow KHCO_3$	1.1491	10.06035
9.80609	0.63986	$K_2SO_4 \leftrightarrow KHSO_4$	1.5628	10.19391
10.01020	1.0237	$K_2SO_4 \leftrightarrow KNO_2$	0.97679	9.98980
9.93538	0.86175	$K_2SO_4 \leftrightarrow KNO_3$	1.1604	10.06462
10.34802	2.2285	$K_2SO_4 \leftrightarrow K$	0.44874	9.65198
10.26716	1.8500	$K_2SO_4 \leftrightarrow K_2O$	0.54055	9.73284
10.19879	1.5805	$K_2SO_4 \leftrightarrow K_2S$	0.63272	9.80121
9.78240	0.60590	$Mg_2As_2O_7 \leftrightarrow K_3AsO_4$	1.6504	10.21760
9.85230	0.71171	$Mg_2As_2O_7 \leftrightarrow K_2HAsO_4$	1.4051	10.14770
9.60251	0.40041	$Mn_2O_3 \leftrightarrow K_2MnO_4$	2.4974	10.39749
9.69851	0.49947	$Mn_2O_3 \leftrightarrow KMnO_4$	2.0021	10.30149
9.64473	0.44130	$MnS \leftrightarrow K_2MnO_4$	2.2660	10.35527
9.74074	0.55048	$MnS \leftrightarrow KMnO_4$	1.8166	10.25926
9.14161	0.13855	$N \leftrightarrow KNO_3$	7.2176	10.85839
9.22650	0.16846	$NH_3 \leftrightarrow KNO_3$	5.9361	10.77350
9.47247	0.29680	$NO \leftrightarrow KNO_3$	3.3692	10.52753
9.64992	0.44661	$N_2O_3 \leftrightarrow KNO_2$	2.2391	10.35008
10.05947	1.1468	$N_2O_5 \leftrightarrow K_2O$	0.87202	9.94053
9.72769	0.53418	$N_2O_5 \leftrightarrow KNO_3$	1.8720	10.27231
10.39738	2.4968	$Pt \leftrightarrow K$	0.40051	9.60262
10.11705	1.3093	$Pt \leftrightarrow KCl$	0.76375	9.88295
10.31653	2.0727	$Pt \leftrightarrow K_2O$	0.48247	9.68347
9.59035	0.38936	$SiO_2 \leftrightarrow K_2SiO_3$	2.5683	10.40965
9.66224	0.45945	$SO_3 \leftrightarrow K_2SO_4$	2.1765	10.33776
		PRASEODYMIUM Pr = 140.92		
10.06830	1.1703	$Pr_2O_3 \leftrightarrow Pr$	0.85448	9.93170
		RHODIUM Rh = 102.91		
9.42740	0.26755	$Rh \leftrightarrow Na_3RhCl_6$	3.7377	10.57260
9.69173	0.49173	$Rh \leftrightarrow RhCl_3$	2.0336	10.30827
		RUBIDIUM Rb = 85.48		
10.22449	1.6768	$AgCl \leftrightarrow Rb$	0.59636	9.77551
10.07381	1.1853	$AgCl \leftrightarrow RbCl$	0.84370	9.92619
9.61784	0.41480	$Cl \leftrightarrow Rb$	2.4108	10.38216
9.46716	0.29320	$Cl \leftrightarrow RbCl$	3.4107	10.53284
9.84932	0.70684	$Rb \leftrightarrow RbCl$	1.4148	10.15068
9.86934	0.74018	$Rb \leftrightarrow Rb_2CO_3$	1.3510	10.13066
9.96115	0.91442	$Rb \leftrightarrow Rb_2O$	1.0936	10.03885
9.80635	0.64025	$Rb \leftrightarrow Rb_2SO_4$	1.5619	10.19365
10.02002	1.0472	$RbCl \leftrightarrow Rb_2CO_3$	0.95495	9.97998
9.95703	0.90580	$RbCl \leftrightarrow Rb_2SO_4$	1.1040	10.04297

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	RUBIDIUM (Continued) Rb = 85.48	Factor	Log. of factor −10
9.89669	0.78831	$Rb_2CO_3 \leftrightarrow RbHCO_3$	1.2685	10.10331
9.88817	0.77299	$Rb_2O \leftrightarrow RbCl$	1.2937	10.11183
9.84520	0.70017	$Rb_2O \leftrightarrow Rb_2SO_4$	1.4282	10.15480
10.52973	3.3864	$Rb_2PtCl_6 \leftrightarrow Rb$	0.29530	9.47027
10.37905	2.3936	$Rb_2PtCl_6 \leftrightarrow RbCl$	0.41778	9.62095
10.39907	2.5065	$Rb_2PtCl_6 \leftrightarrow Rb_2CO_3$	0.39896	9.60093
10.29577	1.9759	$Rb_2PtCl_6 \leftrightarrow RbHCO_3$	0.50610	9.70423
10.49088	3.0966	$Rb_2PtCl_6 \leftrightarrow Rb_2O$	0.32294	9.50912
10.06299	1.1561	$Rb_2SO_4 \leftrightarrow Rb_2CO_3$	0.86499	9.93701
9.95968	0.91134	$Rb_2SO_4 \leftrightarrow RbHCO_3$	1.0973	10.04032
		SELENIUM Se = 78.96		
9.78690	0.61221	$Se \leftrightarrow H_2SeO_3$	1.6334	10.21310
9.73611	0.54464	$Se \leftrightarrow H_2SeO_4$	1.8361	10.26389
9.85224	0.71161	$Se \leftrightarrow SeO_2$	1.4053	10.14776
9.79374	0.62193	$Se \leftrightarrow SeO_3$	1.6079	10.20626
		SILICON Si = 28.06		
10.42897	2.6852	$BaSiF_6 \leftrightarrow SiF_4$	0.37241	9.57103
10.66767	4.6523	$BaSiF_6 \leftrightarrow SiO_2$	0.21495	9.33233
10.32564	2.1166	$K_2SiF_6 \leftrightarrow SiF_4$	0.47246	9.67436
10.56433	3.6672	$K_2SiF_6 \leftrightarrow SiO_2$	0.27269	9.43567
9.88607	0.76925	$SiO_2 \leftrightarrow H_2SiO_3$	1.3000	10.11393
10.33050	2.1404	$SiO_2 \leftrightarrow Si$	0.46720	9.66950
9.76130	0.57717	$SiO_2 \leftrightarrow SiF_4$	1.7326	10.23870
9.89743	0.78964	$SiO_2 \leftrightarrow SiO_3$	1.2664	10.10257
9.81451	0.65249	$SiO_2 \leftrightarrow SiO_4$	1.5328	10.18549
10.22156	1.6656	$SiO_2 \leftrightarrow Si_2O$	0.60040	9.77844
9.79590	0.62503	$SiO_2 \leftrightarrow Si(OH)_4$	1.5999	10.20410
		SILVER Ag = 107.880		
9.80278	0.63501	$Ag \leftrightarrow AgNO_3$	1.5748	10.19722
9.96893	0.93096	$Ag \leftrightarrow Ag_2O$	1.0742	10.03107
10.24075	1.7408	$AgBr \leftrightarrow Ag$	0.57445	9.75925
10.12342	1.3287	$AgCl \leftrightarrow Ag$	0.75263	9.87658
9.92620	0.84371	$AgCl \leftrightarrow AgNO_3$	1.1852	10.07380
10.09235	1.2369	$AgCl \leftrightarrow Ag_2O$	0.80844	9.90765
10.25372	1.7936	$AgCl \leftrightarrow Br$	0.55754	9.74628
10.09383	1.2412	$AgCN \leftrightarrow Ag$	0.80569	9.90617
10.33776	2.1765	$AgI \leftrightarrow Ag$	0.45945	9.66224
10.11176	1.2935	$Ag_3PO_4 \leftrightarrow Ag$	0.77311	9.88824
10.14710	1.4031	$Ag_4P_2O_7 \leftrightarrow Ag$	0.71269	9.85290
9.86969	0.74079	$Br \leftrightarrow Ag$	1.3499	10.13031
9.62895	0.42555	$Br \leftrightarrow AgBr$	2.3499	10.37105
9.51676	0.32867	$Cl \leftrightarrow Ag$	3.0426	10.48324
9.39334	0.24737	$Cl \leftrightarrow AgCl$	4.0426	10.60666
10.07059	1.1765	$I \leftrightarrow Ag$	0.84998	9.92941
9.73283	0.54055	$I \leftrightarrow AgI$	1.8500	10.26717
		SODIUM Na = 22.997		
10.02047	1.0483	$Ag \leftrightarrow NaBr$	0.95396	9.97953
10.26613	1.8456	$Ag \leftrightarrow NaCl$	0.54184	9.73387
9.85709	0.71956	$Ag \leftrightarrow NaI$	1.3897	10.14291

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	SODIUM (Continued) Na = 22.997	Factor	Log. of factor −10
10.26122	1.8248	$AgBr \leftrightarrow NaBr$	0.54800	9.73878
10.38954	2.4521	$AgCl \leftrightarrow NaCl$	0.40781	9.61046
10.19485	1.5662	$AgI \leftrightarrow NaI$	0.63849	9.80515
10.28872	1.9441	$BaSO_4 \leftrightarrow NaHSO_4$	0.51437	9.71128
10.22800	1.6905	$BaSO_4 \leftrightarrow NaHSO_4 \cdot H_2O$	0.59156	9.77200
10.47574	2.9905	$BaSO_4 \leftrightarrow Na_2S$	0.33439	9.52426
10.26758	1.8517	$BaSO_4 \leftrightarrow Na_2SO_3$	0.54003	9.73242
9.96645	0.92565	$BaSO_4 \leftrightarrow Na_2SO_3 \cdot 7H_2O$	1.0803	10.03355
10.21568	1.6432	$BaSO_4 \leftrightarrow Na_2SO_4$	0.60858	9.78432
9.86000	0.72443	$BaSO_4 \leftrightarrow Na_2SO_4 \cdot 10H_2O$	1.3804	10.14000
9.84010	0.69199	$B_2O_3 \leftrightarrow Na_2B_4O_7$	1.4451	10.15990
9.56247	0.36515	$B_2O_3 \leftrightarrow Na_2B_4O_7 \cdot 10H_2O$	2.7386	10.43753
10.54096	3.4751	$Br \leftrightarrow Na$	0.28776	9.45904
9.89016	0.77654	$Br \leftrightarrow NaBr$	1.2878	10.10984
10.41131	2.5782	$Br \leftrightarrow Na_2O$	0.38787	9.58869
9.97746	0.94940	$CaCl_2 \leftrightarrow NaCl$	1.0533	10.02254
9.97507	0.94421	$CaCO_3 \leftrightarrow Na_2CO_3$	1.0591	10.02493
9.96829	0.92959	$CaF_2 \leftrightarrow NaF$	1.0757	10.03171
9.72349	0.52904	$CaO \leftrightarrow Na_2CO_3$	1.8902	10.27651
10.10866	1.2843	$CaSO_4 \leftrightarrow Na_2CO_3$	0.77864	9.89134
10.18803	1.5418	$Cl \leftrightarrow Na$	0.64859	9.81197
9.78289	0.60658	$Cl \leftrightarrow NaCl$	1.6486	10.21711
10.05838	1.1439	$Cl \leftrightarrow Na_2O$	0.87422	9.94162
9.61823	0.41517	$CO_2 \leftrightarrow Na_2CO_3$	2.4086	10.38177
9.85120	0.70991	$CO_2 \leftrightarrow Na_2O$	1.4086	10.14880
10.08957	1.2291	$H_3BO_3 \leftrightarrow Na_2B_4O_7$	0.81362	9.91043
9.81194	0.64855	$H_3BO_3 \leftrightarrow Na_2B_4O_7 \cdot 10H_2O$	1.5419	10.18806
10.74186	5.5190	$I \leftrightarrow Na$	0.18119	9.25814
9.92768	0.84660	$I \leftrightarrow NaI$	1.1812	10.07232
10.61225	4.0950	$I \leftrightarrow Na_2O$	0.24420	9.38775
10.39835	2.5024	$KBF_4 \leftrightarrow Na_2B_4O_7$	0.39962	9.60165
10.12072	1.3204	$KBF_4 \leftrightarrow Na_2B_4O_7 \cdot 10H_2O$	0.75732	9.87928
9.96075	0.91359	$Mg_2As_2O_7 \leftrightarrow Na_2HAsO_3$	1.0946	10.03925
9.92167	0.83496	$Mg_2As_2O_7 \leftrightarrow Na_2HAsO_4$	1.1977	10.07833
9.91095	0.81459	$MgCl_2 \leftrightarrow NaCl$	1.2276	10.08905
9.83173	0.67878	$Mg_2P_2O_7 \leftrightarrow Na_3PO_4$	1.4732	10.16827
9.89426	0.78390	$Mg_2P_2O_7 \leftrightarrow Na_2HPO_4$	1.2757	10.10574
9.49240	0.31074	$Mg_2P_2O_7 \leftrightarrow Na_2HPO_4 \cdot 12H_2O$	3.2181	10.50760
9.72616	0.53231	$Mg_2P_2O_7 \leftrightarrow NaNH_4HPO_4 \cdot 4H_2O$	1.8786	10.27384
9.69808	0.49898	$Mg_2P_2O_7 \leftrightarrow Na_4P_2O_7 \cdot 10H_2O$	2.0041	10.30192
10.65080	4.4751	$NaBr \leftrightarrow Na$	0.22346	9.34920
10.52115	3.3201	$NaBr \leftrightarrow Na_2O$	0.30120	9.47885
10.40514	2.5418	$NaCl \leftrightarrow Na$	0.39342	9.59486
10.04252	1.1029	$NaCl \leftrightarrow Na_2CO_3$	0.90673	9.95748
9.84246	0.69576	$NaCl \leftrightarrow NaHCO_3$	1.4373	10.15754
9.91561	0.82340	$NaCl \leftrightarrow Na_2HPO_4$	1.2148	10.08451
10.27549	1.8858	$NaCl \leftrightarrow Na_2O$	0.53028	9.72451
9.91539	0.82298	$NaCl \leftrightarrow Na_2SO_4$	1.2145	10.08439
9.87080	0.74268	$NaClO_3 \leftrightarrow AgCl$	1.3465	10.12920
10.26035	1.8212	$NaClO_3 \leftrightarrow NaCl$	0.54910	9.73965
9.93161	0.85431	$NaClO_4 \leftrightarrow AgCl$	1.1705	10.06839
10.32116	2.0949	$NaClO_4 \leftrightarrow NaCl$	0.47735	9.67884
10.36262	2.3047	$Na_2CO_3 \leftrightarrow Na$	0.43389	9.63738
9.79993	0.63086	$Na_2CO_3 \leftrightarrow NaHCO_3$	1.5851	10.20007
10.23297	1.7099	$Na_2CO_3 \leftrightarrow Na_2O$	0.58483	9.76703
10.12218	1.3249	$Na_2CO_3 \leftrightarrow NaOH$	0.75478	9.87782

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	SODIUM (Continued) Na = 22.997	Factor	Log. of factor −10
10.56269	3.6533	$NaHCO_3 \leftrightarrow Na$	0.27372	9.43731
10.43304	2.7104	$NaHCO_3 \leftrightarrow Na_2O$	0.36895	9.56696
10.81418	6.5190	$NaI \leftrightarrow Na$	0.15340	9.18582
10.68453	4.8365	$NaI \leftrightarrow Na_2O$	0.20676	9.31547
10.43812	2.7424	$NaNO_3 \leftrightarrow Na_2O$	0.36465	9.56188
10.12965	1.3479	$Na_2O \leftrightarrow Na$	0.74191	9.87035
9.64012	0.43663	$Na_2O \leftrightarrow Na_2HPO_4$	2.2903	10.35988
9.56188	0.36465	$Na_2O \leftrightarrow NaNO_3$	2.7424	10.43812
9.88920	0.77483	$Na_2O \leftrightarrow NaOH$	1.2906	10.11080
9.97153	0.93655	$Na_4P_2O_7 \leftrightarrow Na_2HPO_4$	1.0677	10.02847
9.56967	0.37125	$Na_4P_2O_7 \leftrightarrow Na_2HPO_4 \cdot 12H_2O$	2.6963	10.43033
10.48975	3.0885	$Na_2SO_4 \leftrightarrow Na$	0.32378	9.51025
10.12713	1.3401	$Na_2SO_4 \leftrightarrow Na_2CO_3$	0.74622	9.87287
9.69584	0.49641	$Na_2SO_4 \leftrightarrow Na_2CO_3 \cdot 10H_2O$	2.0144	10.30416
10.36010	2.2914	$Na_2SO_4 \leftrightarrow Na_2O$	0.43641	9.63990
9.21693	0.16479	$N \leftrightarrow NaNO_3$	6.0683	10.78307
9.30183	0.20037	$NH_3 \leftrightarrow NaNO_3$	4.9908	10.69817
8.91094	0.081459	$NH_3 \leftrightarrow NaNH_4HPO_4 \cdot 4H_2O$	12.276	11.08906
9.54779	0.35301	$NO \leftrightarrow NaNO_3$	2.8327	10.45221
9.80301	0.63535	$N_2O_5 \leftrightarrow NaNO_3$	1.5739	10.19699
10.24114	1.7424	$N_2O_5 \leftrightarrow Na_2O$	0.57393	9.75886
9.69890	0.49992	$P_2O_5 \leftrightarrow Na_2HPO_4$	2.0003	10.30110
9.29704	0.19817	$P_2O_5 \leftrightarrow Na_2HPO_4 \cdot 12H_2O$	5.0462	10.70296
9.53080	0.33947	$P_2O_5 \leftrightarrow NaNH_4HPO_4 \cdot 4H_2O$	2.9458	10.46920
9.78928	0.61558	$SO_2 \leftrightarrow NaHSO_3$	1.6245	10.21072
9.70603	0.50820	$SO_2 \leftrightarrow Na_2SO_3$	1.9677	10.29397
9.40491	0.25404	$SO_2 \leftrightarrow Na_2SO_3 \cdot 7H_2O$	3.9364	10.59509
10.11107	1.2914	$SO_3 \leftrightarrow Na_2O$	0.77434	9.88893
9.75096	0.56359	$SO_3 \leftrightarrow Na_2SO_4$	1.7745	10.24904
		STRONTIUM Sr = 87.63		
9.47435	0.29809	$CO_2 \leftrightarrow SrCO_3$	3.3547	10.52565
9.88793	0.77256	$SO_3 \leftrightarrow SrO$	1.2944	10.11207
9.63933	0.43584	$SO_3 \leftrightarrow SrSO_4$	2.2944	10.36067
9.61704	0.41404	$Sr \leftrightarrow Sr(NO_3)_2$	2.4152	10.38296
10.22655	1.6848	$SrCO_3 \leftrightarrow Sr$	0.59354	9.77345
9.96905	0.93122	$SrCO_3 \leftrightarrow SrCl_2$	1.0739	10.03095
9.84768	0.70417	$SrCO_3 \leftrightarrow Sr(HCO_3)_2$	1.4201	10.15232
9.84359	0.69758	$SrCO_3 \leftrightarrow Sr(NO_3)_2$	1.4335	10.15641
10.07283	1.1826	$SrO \leftrightarrow Sr$	0.84560	9.92717
9.81534	0.65364	$SrO \leftrightarrow SrCl_2$	1.5299	10.18466
9.84628	0.70191	$SrO \leftrightarrow SrCO_3$	1.4247	10.15372
9.69396	0.49426	$SrO \leftrightarrow Sr(HCO_3)_2$	2.0232	10.30604
9.68988	0.48964	$SrO \leftrightarrow Sr(NO_3)_2$	2.0423	10.31012
10.32143	2.0962	$SrSO_4 \leftrightarrow Sr$	0.47705	9.67857
10.06394	1.1586	$SrSO_4 \leftrightarrow SrCl_2$	0.86311	9.93606
10.09488	1.2442	$SrSO_4 \leftrightarrow SrCO_3$	0.80375	9.90512
9.93848	0.86791	$SrSO_4 \leftrightarrow Sr(NO_3)_2$	1.1522	10.06152
10.24860	1.7726	$SrSO_4 \leftrightarrow SrO$	0.56416	9.75140
		SULFUR S = 32.06		
10.38136	2.4064	$As_2S_3 \leftrightarrow H_2S$	0.41556	9.61864
10.40785	2.5577	$As_2S_3 \leftrightarrow S$	0.39098	9.59215
10.59010	3.8913	$BaSO_4 \leftrightarrow FeS_2$	0.25698	9.40990
10.83569	6.8499	$BaSO_4 \leftrightarrow H_2S$	0.14599	9.16431

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	SULFUR (Continued) S = 32.06	Factor	Log. of factor −10
10.45392	2.8439	$BaSO_4 \leftrightarrow H_2SO_3$	0.35162	9.54608
10.37658	2.3800	$BaSO_4 \leftrightarrow H_2SO_4$	0.42017	9.62342
10.86217	7.2807	$BaSO_4 \leftrightarrow S$	0.13735	9.13783
10.56155	3.6438	$BaSO_4 \leftrightarrow SO_2$	0.27444	9.43845
10.46472	2.9156	$BaSO_4 \leftrightarrow SO_3$	0.34299	9.53528
10.38560	2.4299	$BaSO_4 \leftrightarrow SO_4$	0.41153	9.61440
10.62733	4.2397	$CdS \leftrightarrow H_2S$	0.23587	9.37267
10.65381	4.5062	$CdS \leftrightarrow S$	0.22191	9.34619
10.08815	1.2250	$H_2SO_4 \leftrightarrow SO_3$	0.81631	9.91185
10.21762	1.6505	$(NH_4)_2SO_4 \leftrightarrow SO_3$	0.60587	9.78238
10.12947	1.3473	$(NH_4)_2SO_4 \leftrightarrow H_2SO_4$	0.74221	9.87053
10.37096	2.3494	$SO_3 \leftrightarrow H_2S$	0.42563	9.62904
		TANTALUM Ta = 180.88		
9.91323	0.81891	$Ta \leftrightarrow Ta_2O_5$	1.2211	10.08677
9.70331	0.50502	$Ta \leftrightarrow TaCl_5$	1.9801	10.29669
9.79007	0.61670	$Ta_2O_5 \leftrightarrow TaCl_5$	1.6215	10.20993
10.01602	1.0376	$Ta_2O_5 \leftrightarrow Ta_2O_4$	0.96378	9.98398
		TELLURIUM Te = 127.61		
9.81892	0.65905	$Te \leftrightarrow H_2TeO_4$	1.5173	10.18108
9.74480	0.55565	$Te \leftrightarrow H_2TeO_4 \cdot 2H_2O$	1.7997	10.25520
9.90282	0.79951	$Te \leftrightarrow TeO_2$	1.2508	10.09718
9.86134	0.72667	$Te \leftrightarrow TeO_3$	1.3761	10.13866
10.19436	1.5645	$(TeO_2)_2SO_3 \leftrightarrow Te$	0.63920	9.80564
		THALLIUM Tl = 204.39		
9.94051	0.87199	$Tl \leftrightarrow Tl_2CO_3$	1.1468	10.05949
9.93053	0.85217	$Tl \leftrightarrow TlCl$	1.1735	10.06947
9.79023	0.61692	$Tl \leftrightarrow TlI$	1.6210	10.20977
9.88493	0.76724	$Tl \leftrightarrow TlNO_3$	1.3034	10.11507
9.98333	0.96233	$Tl \leftrightarrow Tl_2O$	1.0391	10.01667
10.10850	1.2838	$Tl_2CrO_4 \leftrightarrow Tl$	0.77894	9.89150
10.16877	1.4749	$TlHSO_4 \leftrightarrow Tl$	0.67801	9.83123
10.30060	1.9980	$Tl_2PtCl_6 \leftrightarrow Tl$	5.0049	9.69940
10.23113	1.7027	$Tl_2PtCl_6 \leftrightarrow TlCl$	0.58732	9.76887
10.24111	1.7423	$Tl_2PtCl_6 \leftrightarrow Tl_2CO_3$	0.57397	9.75889
10.09083	1.2326	$Tl_2PtCl_6 \leftrightarrow TlI$	0.81129	9.90917
10.18553	1.5330	$Tl_2PtCl_6 \leftrightarrow TlNO_3$	0.65234	9.81447
10.28393	1.9228	$Tl_2PtCl_6 \leftrightarrow Tl_2O$	0.52008	9.71607
10.20894	1.6178	$Tl_2PtCl_6 \leftrightarrow Tl_2SO_4$	0.61811	9.79106
10.09166	1.2350	$Tl_2SO_4 \leftrightarrow Tl$	0.80972	9.90834
		THORIUM Th = 232.12		
10.05609	1.1379	$ThO_2 \leftrightarrow Th$	0.87884	9.94391
9.84899	0.70630	$ThO_2 \leftrightarrow ThCl_4$	1.4158	10.15101
9.65224	0.44900	$ThO_2 \leftrightarrow Th(NO_3)_4 \cdot 6H_2O$	2.2272	10.34776
		TIN Sn = 118.70		
9.79658	0.62601	$Sn \leftrightarrow SnCl_2$	1.5974	10.20342

GRAVIMETRIC FACTORS AND THEIR LOGARITHMS

Log. of factor −10	Factor	TIN (Continued) Sn = 118.70	Factor	Log. of factor −10
9.72102	0.52605	$Sn \leftrightarrow SnCl_2 \cdot 2H_2O$	1.9010	10.27898
9.65860	0.45561	$Sn \leftrightarrow SnCl_4$	2.1948	10.34140
9.50917	0.32298	$Sn \leftrightarrow SnCl_4 \cdot (NH_4Cl)_2$	3.0962	10.49083
9.94508	0.88122	$Sn \leftrightarrow SnO$	1.1348	10.05492
9.89634	0.78766	$Sn \leftrightarrow SnO_2$	1.2696	10.10366
9.90024	0.79477	$SnO_2 \leftrightarrow SnCl_2$	1.2582	10.09976
9.82469	0.66786	$SnO_2 \leftrightarrow SnCl_2 \cdot 2H_2O$	1.4973	10.17531
9.76226	0.57844	$SnO_2 \leftrightarrow SnCl_4$	1.7288	10.23774
9.61283	0.41005	$SnO_2 \leftrightarrow SnCl_4 \cdot (NH_4Cl)_2$	2.4388	10.38717
10.04875	1.1188	$SnO_2 \leftrightarrow SnO$	0.89383	9.95125
		TITANIUM Ti = 47.90		
10.22221	1.6681	$TiO_2 \leftrightarrow Ti$	0.59950	9.77779
		TUNGSTEN W = 183.92		
10.06966	1.1740	$WO_2 \leftrightarrow W$	0.85180	9.93034
10.10071	1.2610	$WO_3 \leftrightarrow W$	0.79303	9.89929
		URANIUM U = 238.07		
10.05477	1.1344	$UO_2 \leftrightarrow U$	0.88151	9.94523
10.07159	1.1792	$U_3O_8 \leftrightarrow U$	0.84802	9.92841
10.01682	1.0395	$U_3O_8 \leftrightarrow UO_2$	0.96200	9.98318
9.74744	0.55903	$U_3O_8 \leftrightarrow UO_2(NO_3)_2 \cdot 6H_2O$	1.7888	10.25256
10.17605	1.4999	$U_2P_2O_{11} \leftrightarrow U$	0.66673	9.82395
10.12128	1.3221	$U_2P_2O_{11} \leftrightarrow UO_2$	0.75635	9.87872
		VANADIUM V = 50.95		
10.25166	1.7851	$V_2O_5 \leftrightarrow V$	0.56020	9.74834
9.89829	0.79121	$V_2O_5 \leftrightarrow VO_4$	1.2639	10.10171
		YTTERBIUM Yb = 173.04		
10.05641	1.1387	$Yb_2O_3 \leftrightarrow Yb$	0.87820	9.94359
		ZINC Zn = 65.38		
10.37940	2.3955	$BaSO_4 \leftrightarrow ZnS$	0.41744	9.62060
9.90942	0.81175	$BaSO_4 \leftrightarrow ZnSO_4 \cdot 7H_2O$	1.2319	10.09058
9.90493	0.80339	$Zn \leftrightarrow ZnO$	1.2447	10.09507
10.43595	2.7287	$ZnNH_4PO_4 \leftrightarrow Zn$	0.36648	9.56405
10.34088	2.1922	$ZnNH_4PO_4 \leftrightarrow ZnO$	0.45616	9.65912
9.77604	0.59709	$ZnO \leftrightarrow ZnCl_2$	1.6748	10.22396
9.81229	0.64907	$ZnO \leftrightarrow ZnCO_3$	1.5407	10.18771
9.45180	0.28301	$ZnO \leftrightarrow ZnSO_4 \cdot 7H_2O$	3.5335	10.54820
10.36743	2.3304	$Zn_2P_2O_7 \leftrightarrow Zn$	0.42912	9.63257
10.27235	1.8722	$Zn_2P_2O_7 \leftrightarrow ZnO$	0.53413	9.72765
10.17329	1.4904	$ZnS \leftrightarrow Zn$	0.67098	9.82671
10.07822	1.1973	$ZnS \leftrightarrow ZnO$	0.83518	9.92178
9.53002	0.33886	$ZnS \leftrightarrow ZnSO_4 \cdot 7H_2O$	2.9511	10.46998
		ZIRCONIUM Zr = 91.22		
10.13059	1.3508	$ZrO_2 \leftrightarrow Zr$	0.74030	9.86941
9.66714	0.46467	$ZrO_2 \leftrightarrow ZrP_2O_7$	2.1521	10.33286

CUPROUS OXIDE AND COPPER EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE *

Method of Munson and Walker, *Jour. Amer. Chem. Soc.* 28, 663, (1906).

Twenty five ml. (25 ml.) of Fehling Solution A and 25 ml. of Fehling Solution B as modified by the Assoc. of Official Agricultural Chemists (for preparation of these solutions see under *Special Reagents and Solutions*) are added to 50 ml. of the sugar solution in a 400 ml. beaker (when a smaller volume of sugar solution must be used, sufficient water must be added to make the final volume of solution 100 ml.) and the mixture heated at such a rate that a boiling temperature is obtained in four minutes and the boiling continued for exactly two minutes longer, keeping the beaker covered with a watch glass throughout the entire time of heating; the mixture is immediately filtered with suction through a Gooch crucible, washing the precipitated cuprous oxide first with water at 60°C., then with 10 ml. of alcohol and finally with 100 ml. of ether; after drying for 30 minutes at 100°C. and cooling in a desiccator it is weighed as cuprous oxide.

(Values in the Table Expressed in Milligrams)

Cuprous Oxide (Cu_2O)	Copper (Cu)	Dextrose (*d*-Glucose)	Invert Sugar	Lactose $C_{12}H_{22}O_{11}+H_2O$	Maltose $C_{12}H_{22}O_{11}+H_2O$
10	8.9	4.0	4.5	6.3	6.2
11	9.8	4.5	5.0	6.9	7.0
12	10.7	4.9	5.4	7.5	7.9
13	11.5	5.3	5.8	8.2	8.7
14	12.4	5.7	6.3	8.8	9.5
15	13.3	6.2	6.7	9.4	10.4
16	14.2	6.6	7.2	10.0	11.2
17	15.1	7.0	7.6	10.7	12.0
18	16.0	7.5	8.1	11.3	12.9
19	16.9	7.9	8.5	11.9	13.7
20	17.8	8.3	8.9	12.5	14.6
21	18.7	8.7	9.4	13.2	15.4
22	19.5	9.2	9.8	13.8	16.2
23	20.4	9.6	10.3	14.4	17.1
24	21.3	10.0	10.7	15.0	17.9
25	22.2	10.5	11.2	15.7	18.7
26	23.1	10.9	11.6	16.3	19.6
27	24.0	11.3	12.0	16.9	20.4
28	24.9	11.8	12.5	17.6	21.2
29	25.8	12.2	12.9	18.2	22.1
30	26.6	12.6	13.4	18.8	22.9
31	27.5	13.1	13.8	19.4	23.7
32	28.4	13.5	14.3	20.1	24.6
33	29.3	13.9	14.7	20.7	25.4
34	30.2	14.3	15.2	21.4	26.2
35	31.1	14.8	15.6	22.1	27.1
36	32.0	15.2	16.1	22.8	27.9
37	32.9	15.6	16.5	23.5	28.7
38	33.8	16.1	16.9	24.2	29.6
39	34.6	16.5	17.4	24.8	30.4
40	35.5	16.9	17.8	25.5	31.3
41	36.4	17.4	18.3	26.2	32.1
42	37.3	17.8	18.7	26.9	32.9
43	38.2	18.2	19.2	27.6	33.8
44	39.1	18.7	19.6	28.3	34.6
45	40.0	19.1	20.1	28.9	35.4
46	40.9	19.6	20.5	29.6	36.3
47	41.7	20.0	21.0	30.3	37.1
48	42.6	20.4	21.4	31.0	37.9
49	43.5	20.9	21.9	31.7	38.8
50	44.4	21.3	22.3	32.3	39.6
51	45.3	21.7	22.8	33.0	40.4
52	46.2	22.2	23.2	33.7	41.3
53	47.1	22.6	23.7	34.4	42.1
54	48.0	23.0	24.1	35.1	42.9

* For better values see following table of values by Hammond.

CUPROUS OXIDE AND COPPER EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE

Cuprous Oxide (Cu_2O)	Copper (Cu)	Dextrose (*d*-Glucose)	Invert Sugar	Lactose $C_{12}H_{22}O_{11}+H_2O$	Maltose $C_{12}H_{22}O_{11}+H_2O$
55	48.9	23.5	24.6	35.8	43.8
56	49.7	23.9	25.0	36.4	44.6
57	50.6	24.3	25.5	37.1	45.4
58	51.5	24.8	25.9	37.8	46.3
59	52.4	25.2	26.4	38.5	47.1
60	53.3	25.6	26.8	39.2	48.0
61	54.2	26.1	27.3	39.9	48.8
62	55.1	26.5	27.7	40.5	49.6
63	56.0	27.0	28.2	41.2	50.5
64	56.8	27.4	28.6	41.9	51.3
65	57.7	27.8	29.1	42.6	52.1
66	58.6	28.3	29.5	43.3	53.0
67	59.5	28.7	30.0	44.0	53.8
68	60.4	29.2	30.4	44.7	54.6
69	61.3	29.6	30.9	45.3	55.5
70	62.2	30.0	31.3	46.0	56.3
71	63.1	30.5	31.8	46.7	57.1
72	64.0	30.9	32.3	47.4	58.0
73	64.8	31.4	32.7	48.1	58.8
74	65.7	31.8	33.2	48.8	59.6
75	66.6	32.2	33.6	49.4	60.5
76	67.5	32.7	34.1	50.1	61.3
77	68.4	33.1	34.5	50.8	62.1
78	69.3	33.6	35.0	51.5	63.0
79	70.2	34.0	35.4	52.2	63.8
80	71.1	34.4	35.9	52.9	64.6
81	71.9	34.9	36.3	53.6	65.5
82	72.8	35.3	36.8	54.2	66.3
83	73.7	35.8	37.3	54.9	67.1
84	74.6	36.2	37.7	55.6	68.0
85	75.5	36.7	38.2	56.3	68.8
86	76.4	37.1	38.6	57.0	69.7
87	77.3	37.5	39.1	57.7	70.5
88	78.2	38.0	39.5	58.4	71.3
89	79.1	38.4	40.0	59.0	72.2
90	79.9	38.9	40.4	59.7	73.0
91	80.8	39.3	40.9	60.4	73.8
92	81.7	39.8	41.4	61.1	74.7
93	82.6	40.2	41.8	61.8	75.5
94	83.5	40.6	42.3	62.5	76.3
95	84.4	41.1	42.7	63.2	77.2
96	85.3	41.5	43.2	63.8	78.0
97	86.2	42.0	43.7	64.5	78.8
98	87.1	42.4	44.1	65.2	79.7
99	87.9	42.9	44.6	65.9	80.5
100	88.8	43.3	45.0	66.6	81.3
101	89.7	43.8	45.5	67.3	82.2
102	90.6	44.2	46.0	68.0	83.0
103	91.5	44.7	46.4	68.7	83.8
104	92.4	45.1	46.9	69.3	84.7
105	93.3	45.5	47.3	70.0	85.5
106	94.2	46.0	47.8	70.7	86.3
107	95.0	46.4	48.3	71.4	87.2
108	95.9	46.9	48.7	72.1	88.0
109	96.8	47.3	49.2	72.8	88.8
110	97.7	47.8	49.6	73.5	89.7
111	98.6	48.2	50.1	74.2	90.5
112	99.5	48.7	50.6	74.8	91.3
113	100.4	49.1	51.1	75.5	92.2
114	101.3	49.6	51.5	76.2	93.0
115	102.2	50.0	51.9	76.9	93.9
116	103.0	50.5	52.4	77.6	94.7

CUPROUS OXIDE AND COPPER EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE

Cuprous Oxide (Cu_2O)	Copper (Cu)	Dextrose (*d*-Glucose)	Invert Sugar	Lactose $C_{12}H_{22}O_{11}+H_2O$	Maltose $C_{12}H_{22}O_{11}+H_2O$
117	103.9	50.9	52.9	78.3	95.5
118	104.8	51.4	53.3	79.0	96.4
119	105.7	51.8	53.8	79.6	97.2
120	106.6	52.3	54.3	80.3	98.0
121	107.5	52.7	54.7	81.0	98.9
122	108.4	53.2	55.2	81.7	99.7
123	109.3	53.6	55.7	82.4	100.5
124	110.1	54.1	56.1	83.1	101.4
125	111.0	54.5	56.6	83.8	102.2
126	111.9	55.0	57.0	84.5	103.0
127	112.8	55.4	57.5	85.1	103.9
128	113.7	55.9	58.0	85.8	104.7
129	114.6	56.3	58.4	86.5	105.5
130	115.5	56.8	58.9	87.2	106.4
131	116.4	57.2	59.4	87.9	107.2
132	117.3	57.7	59.8	88.6	108.0
133	118.1	58.1	60.3	89.3	108.9
134	119.0	58.6	60.8	90.0	109.7
135	119.9	59.0	61.2	90.6	110.5
136	120.8	59.5	61.7	91.3	111.4
137	121.7	60.0	62.2	92.0	112.2
138	122.6	60.4	62.6	92.7	113.0
139	123.5	60.9	63.1	93.4	113.9
140	124.4	61.3	63.6	94.1	114.7
141	125.2	61.8	64.0	94.8	115.5
142	126.1	62.2	64.5	95.5	116.4
143	127.0	62.7	65.0	96.1	117.2
144	127.9	63.1	65.4	96.8	118.0
145	128.8	63.6	65.9	97.5	118.9
146	129.7	64.0	66.4	98.2	119.7
147	130.6	64.5	66.9	98.9	120.5
148	131.5	65.0	67.3	99.6	121.4
149	132.4	65.4	67.8	100.3	122.2
150	133.2	65.9	68.3	101.0	123.0
151	134.1	66.3	68.7	101.6	123.9
152	135.0	66.8	69.2	102.3	124.7
153	135.9	67.2	69.7	103.0	125.5
154	136.8	67.7	70.1	103.7	126.4
155	137.7	68.2	70.6	104.4	127.2
156	138.6	68.6	71.1	105.1	128.0
157	139.5	69.1	71.6	105.8	128.9
158	140.3	69.5	72.0	106.5	129.7
159	141.2	70.0	72.5	107.2	130.5
160	142.1	70.4	73.0	107.9	131.4
161	143.0	70.9	73.4	108.5	132.2
162	143.9	71.4	73.9	109.2	133.0
163	144.8	71.8	74.4	109.9	133.9
164	145.7	72.3	74.9	110.6	134.7
165	146.6	72.8	75.3	111.3	135.5
166	147.5	73.2	75.8	112.0	136.4
167	148.3	73.7	76.3	112.7	137.2
168	149.2	74.1	76.8	113.4	138.0
169	150.1	74.6	77.2	114.1	138.9
170	151.0	75.1	77.7	114.8	139.7
171	151.9	75.5	78.2	115.4	140.5
172	152.8	76.0	78.7	116.1	141.4
173	153.7	76.4	79.1	116.8	142.2
174	154.6	76.9	79.6	117.5	143.0
175	155.5	77.4	80.1	118.2	143.9
176	156.3	77.8	80.6	118.9	144.7
177	157.2	78.3	81.0	119.6	145.5
178	158.1	78.8	81.5	120.3	146.4

CUPROUS OXIDE AND COPPER EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE

Cuprous Oxide (Cu_2O)	Copper (Cu)	Dextrose (*d*-Glucose)	Invert Sugar	Lactose $C_{12}H_{22}O_{11}+H_2O$	Maltose $C_{12}H_{22}O_{11}+H_2O$
179	159.0	79.2	82.0	121.0	147.2
180	159.9	79.7	82.5	121.6	148.0
181	160.8	80.1	82.9	122.3	148.9
182	161.7	80.6	83.4	123.1	149.7
183	162.6	81.1	83.9	123.7	150.5
184	163.4	81.5	84.4	124.3	151.4
185	164.3	82.0	84.9	125.1	152.2
186	165.2	82.5	85.3	125.8	153.0
187	166.1	82.9	85.8	126.5	153.9
188	167.0	83.4	86.3	127.2	154.7
189	167.9	83.9	86.8	127.9	155.5
190	168.8	84.3	87.2	128.5	156.4
191	169.7	84.8	87.7	129.2	157.2
192	170.5	85.3	88.2	129.9	158.0
193	171.4	85.7	88.7	130.6	158.9
194	172.3	86.2	89.2	131.3	159.7
195	173.2	86.7	89.6	132.0	160.5
196	174.1	87.1	90.1	132.7	161.4
197	175.0	87.6	90.6	133.4	162.2
198	175.9	88.1	91.1	134.1	163.0
199	176.8	88.5	91.6	134.8	163.9
200	177.7	89.0	92.0	135.4	164.7
201	178.5	89.5	92.5	136.1	165.5
202	179.4	89.9	93.0	136.8	166.4
203	180.3	90.4	93.5	137.5	167.2
204	181.2	90.9	94.0	138.2	168.0
205	182.1	91.4	94.5	138.9	168.9
206	183.0	91.8	94.9	139.6	169.7
207	183.9	92.3	95.4	140.3	170.5
208	184.8	92.8	95.9	141.0	171.4
209	185.6	93.2	96.4	141.7	172.2
210	186.5	93.7	96.9	142.3	173.0
211	187.4	94.2	97.4	143.0	173.8
212	188.3	94.6	97.8	143.7	174.7
213	189.2	95.1	98.3	144.4	175.5
214	190.1	95.6	98.8	145.1	176.4
215	191.0	96.1	99.3	145.8	177.2
216	191.9	96.5	99.8	146.5	178.0
217	192.8	97.0	100.3	147.2	178.9
218	193.6	97.5	100.8	147.9	179.7
219	194.5	98.0	101.2	148.6	180.5
220	195.4	98.4	101.7	149.3	181.4
221	196.3	98.9	102.2	150.0	182.2
222	197.2	99.4	102.7	150.7	183.0
223	198.1	99.9	103.2	151.3	183.9
224	199.0	100.3	103.7	152.0	184.7
225	199.9	100.8	104.2	152.7	185.5
226	200.7	101.3	104.6	153.4	186.4
227	201.6	101.8	105.1	154.1	187.2
228	202.5	102.2	105.6	154.8	188.0
229	203.4	102.7	106.1	155.5	188.8
230	204.3	103.2	106.6	156.2	189.7
231	205.2	103.7	107.1	156.9	190.5
232	206.1	104.1	107.6	157.6	191.3
233	207.0	104.6	108.1	158.3	192.2
234	207.9	105.1	108.6	159.0	193.0
235	208.7	105.6	109.1	159.6	193.8
236	209.6	106.0	109.5	160.3	194.7
237	210.5	106.5	110.0	161.0	195.5
238	211.4	107.0	110.5	161.7	196.3
239	212.3	107.5	111.0	162.4	197.2
240	213.2	108.0	111.5	163.1	198.0

CUPROUS OXIDE AND COPPER EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE

Cuprous Oxide (Cu_2O)	Copper (Cu)	Dextrose (*d*-Glucose)	Invert Sugar	Lactose $C_{12}H_{22}O_{11}+H_2O$	Maltose $C_{12}H_{22}O_{11}+H_2O$
241	214.1	108.4	112.0	163.8	198.8
242	215.0	108.9	112.5	164.5	199.7
243	215.8	109.4	113.0	165.2	200.5
244	216.7	109.9	113.5	165.9	201.3
245	217.6	110.4	114.0	166.6	202.2
246	218.5	110.8	114.5	167.3	203.0
247	219.4	111.3	115.0	168.0	203.8
248	220.3	111.8	115.4	168.7	204.7
249	221.2	112.3	115.9	169.4	205.5
250	222.1	112.8	116.4	170.1	206.3
251	223.0	113.2	116.9	170.8	207.2
252	223.8	113.7	117.4	171.5	208.0
253	224.7	114.2	117.9	172.1	208.8
254	225.6	114.7	118.4	172.8	209.7
255	226.5	115.2	118.9	173.5	210.5
256	227.4	115.7	119.4	174.2	211.3
257	228.3	116.1	119.9	174.9	212.2
258	229.2	116.6	120.4	175.6	213.0
259	230.1	117.1	120.9	176.3	213.8
260	231.0	117.6	121.4	177.0	214.7
261	231.8	118.1	121.9	177.7	215.5
262	232.7	118.6	122.4	178.4	216.3
263	233.6	119.0	122.9	179.1	217.2
264	234.5	119.5	123.4	179.8	218.0
265	235.4	120.0	123.9	180.5	218.8
266	236.3	120.5	124.4	181.2	219.7
267	237.2	121.0	124.9	181.9	220.5
268	238.1	121.5	125.4	182.6	221.3
269	238.9	122.0	125.9	183.3	222.1
270	239.8	122.5	126.4	184.0	223.0
271	240.7	122.9	126.9	184.6	223.8
272	241.6	123.4	127.4	185.3	224.6
273	242.5	123.9	127.9	186.0	225.5
274	243.4	124.4	128.4	186.7	226.3
275	244.3	124.9	128.9	187.4	227.1
276	245.2	125.4	129.4	188.1	228.0
277	246.1	125.9	129.9	188.8	228.8
278	246.9	126.4	130.4	189.5	229.6
279	247.8	126.9	130.9	190.2	230.5
280	248.7	127.3	131.4	190.9	231.3
281	249.6	127.8	131.9	191.6	232.1
282	250.5	128.3	132.4	192.3	233.0
283	251.4	128.8	132.9	193.0	233.8
284	252.3	129.3	133.4	193.7	234.6
285	253.2	129.8	133.9	194.4	235.5
286	254.0	130.3	134.4	195.1	236.3
287	254.9	130.8	134.9	195.8	237.1
288	255.8	131.3	135.4	196.5	238.0
289	256.7	131.8	135.9	197.1	238.8
290	257.6	132.3	136.4	197.8	239.6
291	258.5	132.7	136.9	198.5	240.5
292	259.4	133.2	137.4	199.2	241.3
293	260.3	133.7	137.9	199.9	242.1
294	261.2	134.2	138.4	200.6	242.9
295	262.0	134.7	138.9	201.3	243.8
296	262.9	135.2	139.4	202.0	244.6
297	263.8	135.7	140.0	202.7	246.4
298	264.7	136.2	140.5	203.4	246.3
299	265.6	136.7	141.0	204.1	247.1
300	266.5	137.2	141.5	204.8	247.9
301	267.4	137.7	142.0	205.5	248.8
302	268.3	138.2	142.5	206.2	249.6

CUPROUS OXIDE AND COPPER EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE

Cuprous Oxide (Cu_2O)	Copper (Cu)	Dextrose (*d*-Glucose)	Invert Sugar	Lactose $C_{12}H_{22}O_{11}+H_2O$	Maltose $C_{12}H_{22}O_{11}+H_2O$
303	269.1	138.7	143.0	206.9	250.4
304	270.0	139.2	143.5	207.6	251.3
305	270.9	139.7	144.0	208.3	252.1
306	271.8	140.2	144.5	209.0	252.9
307	272.7	140.7	145.0	209.7	253.8
308	273.6	141.2	145.5	210.4	254.6
309	274.5	141.7	146.1	211.1	255.4
310	275.4	142.2	146.6	211.8	256.3
311	276.3	142.7	147.1	212.5	257.1
312	277.1	143.2	147.6	213.2	257.9
313	278.0	143.7	148.1	213.9	258.8
314	278.9	144.2	148.6	214.6	259.6
315	279.8	144.7	149.1	215.3	260.4
316	280.7	145.2	149.6	216.0	261.2
317	281.6	145.7	150.1	216.6	262.1
318	282.5	146.2	150.7	217.3	262.9
319	283.4	146.7	151.2	218.0	263.7
320	284.2	147.2	151.7	218.7	264.6
321	285.1	147.7	152.2	219.4	265.4
322	286.0	148.2	152.7	220.1	266.2
323	286.9	148.7	153.2	220.8	267.1
324	287.8	149.2	153.7	221.5	267.9
325	288.7	149.7	154.3	222.2	268.7
326	289.6	150.2	154.8	222.9	269.6
327	290.5	150.7	155.3	223.6	270.4
328	291.4	151.2	155.8	224.3	271.2
329	292.2	151.7	156.3	225.0	272.1
330	293.1	152.2	156.8	225.7	272.9
331	294.0	152.7	157.3	226.4	273.7
332	294.9	153.2	157.9	227.1	274.6
333	295.8	153.7	158.4	227.8	275.4
334	296.7	154.2	158.9	228.5	276.2
335	297.6	154.7	159.4	229.2	277.0
336	298.5	155.2	159.9	229.9	277.9
337	299.3	155.8	160.5	230.6	278.7
338	300.2	156.3	161.0	231.3	279.5
339	301.1	156.8	161.5	232.0	280.4
340	302.0	157.3	162.0	232.7	281.2
341	302.9	157.8	162.5	233.4	282.0
342	303.8	158.3	163.1	234.1	282.9
343	304.7	158.8	163.6	234.8	283.7
344	305.6	159.3	164.1	235.5	284.5
345	306.5	159.8	164.6	236.2	285.4
346	307.3	160.3	165.1	236.9	286.2
347	308.2	160.8	165.7	237.6	287.0
348	309.1	161.4	166.2	238.3	287.9
349	310.0	161.9	166.7	239.0	288.7
350	310.9	162.4	167.2	239.7	289.5
351	311.8	162.9	167.7	240.1	290.4
352	312.7	163.4	168.3	241.1	291.2
353	313.6	163.9	168.8	241.8	292.0
354	314.4	164.4	169.3	242.5	292.8
355	315.3	164.9	169.8	243.2	293.7
356	316.2	165.4	170.4	243.9	294.5
357	317.1	166.0	170.9	244.6	295.3
358	318.0	166.5	171.4	245.3	296.2
359	318.9	167.0	171.9	246.0	297.0
360	319.8	167.5	172.5	246.7	297.8
361	320.7	168.0	173.0	247.4	298.7
362	321.6	168.5	173.5	248.1	299.5
363	322.4	169.0	174.0	248.8	300.3
364	323.3	169.6	174.6	249.5	301.2

CUPROUS OXIDE AND COPPER EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE

Cuprous Oxide (Cu_2O)	Copper (Cu)	Dextrose (*d*-Glucose)	Invert Sugar	Lactose $C_{12}H_{22}O_{11}+H_2O$	Maltose $C_{12}H_{22}O_{11}+H_2O$
365	324.2	170.1	175.1	250.2	302.0
366	325.1	170.6	175.6	250.9	302.8
367	326.0	171.1	176.1	251.6	303.6
368	326.9	171.6	176.7	252.3	304.5
369	327.8	172.1	177.2	253.0	305.3
370	328.7	172.7	177.7	253.7	306.1
371	329.5	173.2	178.3	254.4	307.0
372	330.4	173.7	178.8	255.1	307.8
373	331.3	174.2	179.3	255.8	308.6
374	332.2	174.7	179.8	256.5	309.5
375	333.1	175.3	180.4	257.2	310.3
376	334.0	175.8	180.9	257.9	311.1
377	334.9	176.3	181.4	258.6	312.0
378	335.8	176.8	182.0	259.3	312.8
379	336.7	177.3	182.5	260.0	313.6
380	337.5	177.9	183.0	260.7	314.5
381	338.4	178.4	183.6	261.4	315.3
382	339.3	178.9	184.1	262.1	316.1
383	340.2	179.4	184.6	262.8	316.9
384	341.1	180.0	185.2	263.5	317.8
385	342.0	180.5	185.7	264.2	318.6
386	342.9	181.0	186.2	264.9	319.4
387	343.8	181.5	186.8	265.6	320.3
388	344.6	182.0	187.3	266.3	321.1
389	345.5	182.6	187.8	267.0	321.9
390	346.4	183.1	188.4	267.7	322.8
391	347.3	183.6	188.9	268.4	323.6
392	348.2	184.1	189.4	269.1	324.4
393	349.1	184.7	190.0	269.8	325.2
394	350.0	185.2	190.5	270.5	326.1
395	350.9	185.7	191.0	271.2	326.9
396	35?.8	186.2	191.6	271.9	327.7
397	352.6	186.8	192.1	272.6	328.6
398	353.5	187.3	192.7	273.3	329.4
399	354.4	187.8	193.2	274.0	330.2
400	355.3	188.4	193.7	274.7	331.1
401	356.2	188.9	194.3	275.4	331.9
402	357.1	189.4	194.8	276.1	332.7
403	358.0	189.9	195.4	276.8	333.6
404	358.9	190.5	195.9	277.5	334.4
405	359.7	191.0	196.4	278.2	335.2
406	360.6	191.5	197.0	278.9	336.0
407	361.5	192.1	197.5	279.6	336.9
408	362.4	192.6	198.1	280.3	337.7
409	363.3	193.1	198.6	281.0	338.5
410	364.2	193.7	199.1	281.7	339.4
411	365.1	194.2	199.7	282.4	340.2
412	366.0	194.7	200.2	283.2	341.0
413	366.9	195.2	200.8	283.9	341.9
414	367.7	195.8	201.3	284.6	342.7
415	368.6	196.3	201.8	285.3	343.5
416	369.5	196.8	202.4	286.0	344.4
417	370.4	197.4	202.9	286.7	345.2
418	371.3	197.9	203.5	287.4	346.0
419	372.2	198.4	204.0	288.1	346.8
420	373.1	199.0	204.6	288.8	347.7
421	374.0	199.5	205.1	289.5	348.5
422	374.8	200.1	205.7	290.2	349.3
423	375.7	200.6	206.2	290.9	350.2
424	376.6	201.1	206.7	291.6	351.0
425	377.5	201.7	207.3	292.3	351.8
426	378.4	202.2	207.8	293.0	352.7

CUPROUS OXIDE AND COPPER EQUIVALENT OF DEXTROSE, INVERT SUGAR, LACTOSE AND MALTOSE

Cuprous Oxide (Cu_2O)	Copper (Cu)	Dextrose (*d*-Glucose)	Invert Sugar	Lactose $C_{12}H_{22}O_{11}+H_2O$	Maltose $C_{12}H_{22}O_{11}+H_2O$
427	379.3	202.8	208.4	293.7	353.5
428	380.2	203.3	208.9	294.4	354.3
429	381 1	203.8	209.5	295.1	355.1
430	382.0	204.4	210.0	295.8	356.0
431	382.8	204.9	210.6	296.5	356.8
432	383.7	205.5	211.1	297.2	357.6
433	384.6	206.0	211.7	297.9	358.5
434	385.5	206.5	212.2	298.6	359.3
435	386.4	207.1	212.8	299.3	360.1
436	387.3	207.6	213.3	300.0	361.0
437	388.2	208.2	213.9	300.7	361.8
438	389.1	208.7	214.4	301.4	362.6
439	390.0	209.2	215.0	302.1	363.4
440	390.8	209.8	215.5	302.8	364.3
441	391.7	210.3	216.1	303.5	365.1
442	392.6	210.9	216.6	304.2	365.9
443	393.5	211.4	217.2	304.9	366.8
444	394.4	212.0	217.8	305.6	367.6
445	395.3	212.5	218.3	306.3	368.4
446	396.2	213.1	218.9	307.0	369.3
447	397.1	213.6	219.4	307.7	370.1
448	397.9	214.1	220.0	308.4	370.9
449	398.8	214.7	220.5	309.1	371.7
450	399.7	215.2	221.1	309.9	372.6
451	400.6	215.8	221.6	310.6	373.4
452	401.5	216.3	222.2	311.3	374.2
453	402.4	216.9	222.8	312.0	375.1
454	403.3	217.4	223.3	312.7	375.9
455	404.2	218.0	223.9	313.4	376.7
456	405.1	218.5	224.4	314.1	377.6
457	405.9	219.1	225.0	314.8	378.4
458	406.8	219.6	225.5	315.5	379.2
459	407.7	220.2	226.1	316.2	380.0
460	408.6	220.7	226.7	316.9	380.9
461	409.5	221.3	227.3	317.6	381.7
462	410.4	221.8	227.8	318.3	382.5
463	411.3	222.4	228.3	319.0	383.4
464	412.2	222.9	228.9	319.7	384.2
465	413.0	223.5	229.5	320.4	385.0
466	413.9	224.0	230.0	321.1	385.9
467	414.8	224.6	230.6	321.8	386.7
468	415.7	225.1	231.1	322.5	387.5
469	416.6	225.7	231.7	323.2	388.3
470	417.5	226.2	232.3	323.9	389.2
471	418.4	226.8	232.8	324.6	390.0
472	419.3	227.4	233.4	325.3	390.8
473	420.2	227.9	234.0	326.0	391.7
474	421.0	228.3	234.5	326.8	392.5
475	421.9	229.0	235.1	327.5	393.3
476	422.8	229.6	235.7	328.2	394.2
477	423.7	230.1	236.2	328.9	395.0
478	424.6	230.7	236.8	329.6	395.8
479	425.5	231.3	237.4	330.3	396.6
480	426.4	231.8	237.9	331.0	397.5
481	427.3	232.4	238.5	331.7	398.3
482	428.1	232.9	239.1	332.4	399.1
483	429.0	233.5	239.6	333.1	400.0
484	429.9	234.1	240.2	333.8	400.8
485	430.8	234.6	240.8	334.5	401.6
486	431.7	235.2	241.4	335.2	402.4
487	432.6	235.7	241.9	335.9	403.3
488	433.5	236.3	242.5	336.6	404.1
489	434.4	236.9	243.1	337.3	404.9
490	435.3	237.4	243.6	338.0	405.8

MUNSON-WALKER REDUCING-SUGAR VALUES

Cf. Lester D. Hammond, *Jour. Res. Natl. Bu. Stand. 24, 579 (1940)*.

Sugars of higher purity than those originally used in making up the Munson-Walker determinations having become available, a redetermination of the earlier work has been made by Hammond. To this have been added the values for levulose, as well as the values for an additional sugar mixture containing 0.3 g. of total sugar. This latter mixture extends the adaptability of the method to include such products as simulated molasses, which contain such high percentages of invert sugar in the total sugar present that neither column of sugar-mixture values in the original Munson-Walker table was directly applicable. The invert sugar used in the determination of the values given in the following table were prepared by taking equal weights of crystalline dextrose and levulose. The conditions of the Munson-Walker method [1] were followed, except that the copper was determined electrolytically and the solution was heated by electricity.

The 400 ml. beaker is placed in an electric heater such that the 100 ml. of solution it contains is entirely surrounded by a nest of the resistance wire. The electric current is adjusted so that the solution can be brought to boiling in the 4-minute interval used in the method to within ±5 seconds.

The cuprous oxide is transferred to a Gooch crucible, washed, and then dissolved by the slow dropwise addition of 5 ml. of 1:1 nitric acid. The copper nitrate is received in a 250 ml. beaker, and 10 ml. of 1:1 nitric acid added, as well as about 5 g. of ammonium sulfate. Enough water to cover the cylindrical platinum-gauze electrodes is added, making the total volume of electrolyte about 180 ml. The electrolysis is conducted for about 36 hours [2] at a current density of approximately 0.10 amp./sq. dm.; and upon completion, as indicated by the ferrocyanide test, the electrolyte is displaced with distilled water before breaking the current. The copper deposit is washed with alcohol, dried for 15 minutes at 100°C., cooled in a desiccator, and weighed.[3]

(Values in the Table Expressed in Milligrams) [4]

Copper (Cu)	Cuprous Oxide (Cu_2O)	Dextrose (*d*-Glucose)	Invert Sugar	Invert Sugar and Sucrose			Levulose
				Weight of Total Sugar			
				0.3 g.	0.4 g.	2.0 g.	
10	11.3	4.6	5.2	3.2	2.9	.....	5.1
11	12.4	5.1	5.7	3.7	3.4	.....	5.6
12	13.5	5.6	6.2	4.2	3.9	.....	6.1
13	14.6	6.0	6.7	4.8	4.4	.....	6.7
14	15.8	6.5	7.2	5.3	4.9	.....	7.2
15	16.9	7.0	7.7	5.8	5.4	.....	7.7
16	18.0	7.5	8.2	6.3	5.9	.....	8.3
17	19.1	8.0	8.7	6.8	6.4	.....	8.8
18	20.3	8.5	9.2	7.3	6.9	.....	9.3
19	21.4	8.9	9.7	7.8	7.4	.....	9.9
20	22.5	9.4	10.2	8.3	7.9	1.9	10.4
21	23.6	9.9	10.7	8.8	8.4	2.4	10.9
22	24.8	10.4	11.2	9.3	8.9	2.9	11.5
23	25.9	10.9	11.7	9.9	9.5	3.4	12.0
24	27.0	11.4	12.3	10.4	10.0	3.9	12.5
25	28.1	11.9	12.8	10.9	10.5	4.4	13.1
26	29.3	12.3	13.3	11.4	11.0	4.9	13.6
27	30.4	12.8	13.8	11.9	11.5	5.5	14.2
28	31.5	13.3	14.3	12.4	12.0	6.0	14.7
29	32.6	13.8	14.8	12.9	12.5	6.5	15.2
30	33.8	14.3	15.3	13.4	13.0	7.0	15.8
31	34.9	14.8	15.8	14.0	13.5	7.5	16.3
32	36.0	15.3	16.3	14.5	14.1	8.0	16.8
33	37.2	15.7	16.8	15.0	14.6	8.5	17.4
34	38.3	16.2	17.3	15.5	15.1	9.0	17.9

[1] See preceding table.

[2] The electrolysis can be completed overnight by using a larger current. Cf. Sherrer, Bell, and Mogerman, *Jour. Res. Natl. Bu. Stand. 22, 697 (1939)*.

[3] In the routine analysis of sugar products, any method of determining copper which is suitable to the products may be used.

[4] The values in the table for concentrations of reducing sugar less than 20 mg are extrapolated and should be used with caution and only for approximate determinations.

MUNSON-WALKER-HAMMOND REDUCING-SUGAR VALUES

Copper (Cu)	Cuprous Oxide (Cu_2O)	Dextrose (*d*-Glucose)	Invert Sugar	Invert Sugar and Sucrose			Levulose
				Weight of Total Sugar			
				0.3 g.	0.4 g.	2.0 g.	
35	39.4	16.7	17.8	16.0	15.6	9.5	18.4
36	40.5	17.2	18.3	16.5	16.1	10.1	19.0
37	41.7	17.7	18.9	17.0	16.6	10.6	19.5
38	42.8	18.2	19.4	17.6	17.1	11.1	20.1
39	43.9	18.7	19.9	18.1	17.6	11.6	20.6
40	45.0	19.2	20.4	18.6	18.2	12.1	21.1
41	46.2	19.7	20.9	19.1	18.7	12.6	21.7
42	47.3	20.1	21.4	19.6	19.2	13.1	22.2
43	48.4	20.6	21.9	20.1	19.7	13.7	22.8
44	49.5	21.1	22.4	20.7	20.2	14.2	23.3
45	50.7	21.6	22.9	21.2	20.7	14.7	23.8
46	51.8	22.1	23.5	21.7	21.3	15.2	24.4
47	52.9	22.6	24.0	22.2	21.8	15.7	24.9
48	54.0	23.1	24.5	22.7	22.3	16.2	25.4
49	55.2	23.6	25.0	23.2	22.8	16.8	26.0
50	56.3	24.1	25.5	23.8	23.3	17.3	26.5
51	57.4	24.6	26.0	24.3	23.8	17.8	27.1
52	58.5	25.1	26.5	24.8	24.3	18.3	27.6
53	59.7	25.6	27.0	25.3	24.9	18.8	28.2
54	60.8	26.1	27.6	25.8	25.4	19.3	28.7
55	61.9	26.5	28.1	26.3	25.9	19.9	29.2
56	63.0	27.0	28.6	26.9	26.4	20.4	29.8
57	64.2	27.5	29.1	27.4	26.9	20.9	30.3
58	65.3	28.0	29.6	27.9	27.5	21.4	30.9
59	66.4	28.5	30.1	28.4	28.0	21.9	31.4
60	67.6	29.0	30.6	28.9	28.5	22.5	31.9
61	68.7	29.5	31.2	29.5	29.0	23.0	32.5
62	69.8	30.0	31.7	30.0	29.5	23.5	33.0
63	70.9	30.5	32.2	30.5	30.1	24.0	33.6
64	72.1	31.0	32.7	31.0	30.6	24.5	34.1
65	73.2	31.5	33.2	31.6	31.1	25.1	34.7
66	74.3	32.0	33.7	32.1	31.6	25.6	35.2
67	75.4	32.5	34.3	32.6	32.1	26.1	35.8
68	76.6	33.0	34.8	33.1	32.7	26.6	36.3
69	77.7	33.5	35.3	33.6	33.2	27.1	36.8
70	78.8	34.0	35.8	34.2	33.7	27.7	37.4
71	79.9	34.5	36.3	34.7	34.2	28.2	37.9
72	81.1	35.0	36.8	35.2	34.7	28.7	38.5
73	82.2	35.5	37.4	35.7	35.3	29.2	39.0
74	83.3	36.0	37.9	36.3	35.8	29.8	39.6
75	84.4	36.5	38.4	36.8	36.3	30.3	40.1
76	85.6	37.0	38.9	37.3	36.8	30.8	40.7
77	86.7	37.5	39.4	37.8	37.4	31.3	41.2
78	87.8	38.0	40.0	38.4	37.9	31.9	41.7
79	88.9	38.5	40.5	38.9	38.4	32.4	42.3
80	90.1	39.0	41.0	39.4	38.9	32.9	42.8
81	91.2	39.5	41.5	39.9	39.5	33.4	43.4
82	92.3	40.0	42.0	40.5	40.0	34.0	43.9
83	93.4	40.5	42.6	41.0	40.5	34.5	44.5
84	94.6	41.0	43.1	41.5	41.0	35.0	45.0
85	95.7	41.5	43.6	42.0	41.6	35.5	45.6
86	96.8	42.0	44.1	42.6	42.1	36.1	46.1
87	97.9	42.5	44.7	43.1	42.6	36.6	46.7
88	99.1	43.0	45.2	43.6	43.1	37.1	47.2
89	100.2	43.5	45.7	44.1	43.7	37.6	47.8
90	101.3	44.0	46.2	44.7	44.2	38.2	48.3
91	102.5	44.5	46.7	45.2	44.7	38.7	48.9
92	103.6	45.0	47.3	45.7	45.2	39.2	49.4
93	104.7	45.5	47.8	46.3	45.8	39.8	50.0
94	105.8	46.0	48.3	46.8	46.3	40.3	50.5

MUNSON-WALKER-HAMMOND REDUCING-SUGAR VALUES

Copper (Cu)	Cuprous Oxide (Cu_2O)	Dextrose (*d*-Glucose)	Invert Sugar	Invert Sugar and Sucrose			Levulose
				Weight of Total Sugar			
				0.3 g.	0.4 g.	2.0 g.	
95	107.0	46.5	48.8	47.3	46.8	40.8	51.1
96	108.1	47.0	49.4	47.8	47.4	41.3	51.6
97	109.2	47.5	49.9	48.4	47.9	41.9	52.2
98	110.3	48.0	50.4	48.9	48.4	42.4	52.7
99	111.5	48.5	50.9	49.4	48.9	42.9	53.3
100	112.6	49.0	51.5	50.0	49.5	43.5	53.8
101	113.7	49.5	52.0	50.5	50.0	44.0	54.4
102	114.8	50.0	52.5	51.0	50.5	44.5	54.9
103	116.0	50.6	53.0	51.6	51.1	45.1	55.5
104	117.1	51.1	53.6	52.1	51.6	45.6	56.0
105	118.2	51.6	54.1	52.6	52.1	46.1	56.6
106	119.3	52.1	54.6	53.1	52.7	46.7	57.1
107	120.5	52.6	55.2	53.7	53.2	47.2	57.7
108	121.6	53.1	55.7	54.2	53.7	47.7	58.2
109	122.7	53.6	56.2	54.7	54.2	48.3	58.8
110	123.8	54.1	56.7	55.3	54.8	48.8	59.3
111	125.0	54.6	57.3	55.8	55.3	49.3	59.9
112	126.1	55.1	57.8	56.3	55.8	49.9	60.4
113	127.2	55.6	58.3	56.9	56.4	50.4	61.0
114	128.3	56.1	58.9	57.4	56.9	50.9	61.6
115	129.5	56.7	59.4	57.9	57.4	51.5	62.1
116	130.6	57.2	59.9	58.5	58.0	52.0	62.7
117	131.7	57.7	60.4	59.0	58.5	52.5	63.2
118	132.8	58.2	61.0	59.5	59.0	53.1	63.8
119	134.0	58.7	61.5	60.1	59.6	53.6	64.3
120	135.1	59.2	62.0	60.6	60.1	54.1	64.9
121	136.2	59.7	62.6	61.2	60.7	54.7	65.4
122	137.4	60.2	63.1	61.7	61.2	55.2	66.0
123	138.5	60.7	63.6	62.2	61.7	55.8	66.5
124	139.6	61.3	64.2	62.8	62.3	56.3	67.1
125	140.7	61.8	64.7	63.3	62.8	56.8	67.7
126	141.9	62.3	65.2	63.8	63.3	57.4	68.2
127	143.0	62.8	65.8	64.4	63 9	57.9	68.8
128	144.1	63.3	66.3	64.9	64.4	58.4	69.3
129	145.2	63.8	66.8	65.4	64.9	59.0	69.9
130	146.4	64.3	67.4	66.0	65.5	59.5	70.4
131	147.5	64.9	67.9	66.5	66.0	60.1	71.0
132	148.6	65.4	68.4	67.1	66.6	60.6	71.6
133	149.7	65.9	69.0	67.6	67.1	61.1	72.1
134	150.9	66.4	69.5	68.1	67.6	61.7	72.7
135	152.0	66.9	70.0	68.7	68.2	62.2	73.2
136	153.1	67.4	70.6	69.2	68.7	62.8	73.8
137	154.2	68.0	71.1	69.8	69.3	63.3	74.3
138	155.4	68.5	71.6	70.3	69.8	63.9	74.9
139	156.5	69.0	72.2	70.8	70.3	64.4	75.5
140	157.6	69.5	72.7	71.4	70.9	64.9	76.0
141	158.7	70.0	73.2	71.9	71.4	65.5	76.6
142	159.9	70.5	73.8	72.5	72.0	66.0	77.1
143	161.0	71.1	74.3	73.0	72.5	66.6	77.7
144	162.1	71.6	74.9	73.5	73.0	67.1	78.3
145	163.2	72.1	75.4	74.1	73.6	67.7	78.8
146	164.4	72.6	75.9	74.6	74.1	68.2	79.4
147	165.5	73.1	76.5	75.2	74.7	68.7	80.0
148	166.6	73.7	77.0	75.7	75.2	69.3	80.5
149	167.8	74.2	77.6	76.3	75.7	69.8	81.1
150	168.9	74.7	78.1	76.8	76.3	70.4	81.6
151	170.0	75.2	78.6	77.3	76.8	70.9	82.2
152	171.1	75.7	79.2	77.9	77.4	71.5	82.8
153	172.3	76.3	79.7	78.4	77.9	72.0	83.3
154	173.4	76.8	80.3	79.0	78.5	72.6	83.9

MUNSON-WALKER-HAMMOND REDUCING-SUGAR VALUES

Copper (Cu)	Cuprous Oxide (Cu_2O)	Dextrose (*d*-Glucose)	Invert Sugar	Invert Sugar and Sucrose			Levulose
				Weight of Total Sugar			
				0.3 g.	0.4 g.	2.0 g.	
155	174.5	77.3	80.8	79.5	79.0	73.1	84.4
156	175.6	77.8	81.3	80.1	79.6	73.7	85.0
157	176.8	78.3	81.9	80.6	80.1	74.2	85.6
158	177.9	78.9	82.4	81.2	80.6	74.8	86.1
159	179.0	79.4	83.0	81.7	81.2	75.3	86.7
160	180.1	79.9	83.5	82.2	81.7	75.9	87.3
161	181.3	80.4	84.0	82.8	82.3	76.4	87.8
162	182.4	81.0	84.6	83.3	82.8	77.0	88.4
163	183.5	81.5	85.1	83.9	83.4	77.5	89.0
164	184.6	82.0	85.7	84.4	83.9	78.1	89.5
165	185.8	82.5	86.2	85.0	84.5	78.6	90.1
166	186.9	83.1	86.8	85.5	85.0	79.2	90.6
167	188.0	83.6	87.3	86.1	85.6	79.7	91.2
168	189.1	84.1	87.8	86.6	86.1	80.3	91.8
169	190.3	84.6	88.4	87.2	86.7	80.8	92.3
170	191.4	85.2	88.9	87.7	87.2	81.4	92.9
171	192.5	85.7	89.5	88.3	87.8	81.9	93.5
172	193.6	86.2	90.0	88.8	88.3	82.5	94.0
173	194.8	86.7	90.6	89.4	88.9	83.0	94.6
174	195.9	87.3	91.1	89.9	89.4	83.6	95.2
175	197.0	87.8	91.7	90.5	90.0	84.1	95.7
176	198.1	88.3	92.2	91.0	90.5	84.7	96.3
177	199.3	88.9	92.8	91.6	91.1	85.2	96.9
178	200.4	89.4	93.3	92.1	91.6	85.8	97.4
179	201.5	89.9	93.8	92.7	92.2	86.3	98.0
180	202.7	90.4	94.4	93.2	92.7	86.9	98.6
181	203.8	91.0	94.9	93.8	93.3	87.4	99.2
182	204.9	91.5	95.5	94.3	93.8	88.0	99.7
183	206.0	92.0	96.0	94.9	94.4	88.6	100.3
184	207.2	92.6	96.6	95.4	94.9	89.1	100.9
185	208.3	93.1	97.1	96.0	95.5	89.7	101.4
186	209.4	93.6	97.7	96.5	96.0	90.2	102.0
187	210.5	94.2	98.2	97.1	96.6	90.8	102.6
188	211.7	94.7	98.8	97.6	97.1	91.3	103.1
189	212.8	95.2	99.3	98.2	97.7	91.9	103.7
190	213.9	95.7	99.9	98.7	98.2	92.4	104.3
191	215.0	96.3	100.4	99.3	98.8	93.0	104.8
192	216.2	96.8	101.0	99.9	99.4	93.6	105.4
193	217.3	97.3	101.5	100.4	99.9	94.1	106.0
194	218.4	97.9	102.1	101.0	100.5	94.7	106.6
195	219.5	98.4	102.6	101.5	101.0	95.2	107.1
196	220.7	98.9	103.2	102.1	101.6	95.8	107.7
197	221.8	99.5	103.7	102.6	102.1	96.4	108.3
198	222.9	100.0	104.3	103.2	102.7	96.9	108.8
199	224.0	100.5	104.8	103.7	103.2	97.5	109.4
200	225.2	101.1	105.4	104.3	103.8	98.0	110.0
201	226.3	101.6	106.0	104.9	104.4	98.6	110.6
202	227.4	102.2	106.5	105.4	104.9	99.2	111.1
203	228.5	102.7	107.1	106.0	105.5	99.7	111.7
204	229.7	103.2	107.6	106.5	106.0	100.3	112.3
205	230.8	103.8	108.2	107.1	106.6	100.9	112.9
206	231.9	104.3	108.7	107.6	107.2	101.4	113.4
207	233.1	104.8	109.3	108.2	107.7	102.0	114.0
208	234.2	105.4	109.8	108.8	108.3	102.5	114.6
209	235.3	105.9	110.4	109.3	108.8	103.1	115.2
210	236.4	106.5	110.9	109.9	109.4	103.7	115.7
211	237.6	107.0	111.5	110.4	110.0	104.2	116.3
212	238.7	107.5	112.1	111.0	110.5	104.8	116.9
213	239.8	108.1	112.6	111.6	111.1	105.4	117.5
214	240.9	108.6	113.2	112.1	111.6	105.9	118.0

MUNSON-WALKER-HAMMOND REDUCING-SUGAR VALUES

Copper (Cu)	Cuprous Oxide (Cu_2O)	Dextrose (*d*-Glucose)	Invert Sugar	Invert Sugar and Sucrose — Weight of Total Sugar			Levulose
				0.3 g.	0.4 g.	2.0 g.	
215	242.1	109.2	113.7	112.7	112.2	106.5	118.6
216	243.1	109.7	114.3	113.2	112.8	107.1	119.2
217	244.3	110.2	114.9	113.8	113.3	107.6	119.8
218	245.4	110.8	115.4	114.4	113.9	108.2	120.3
219	246.6	111.3	116.0	114.9	114.4	108.8	120.9
220	247.7	111.9	116.5	115.5	115.0	109.3	121.5
221	248.8	112.4	117.1	116.1	115.6	109.9	122.1
222	249.9	112.9	117.6	116.6	116.1	110.5	122.6
223	251.1	113.5	118.2	117.2	116.7	111.0	123.2
224	252.2	114.0	118.8	117.7	117.3	111.6	123.8
225	253.3	114.6	119.3	118.3	117.8	112.2	124.4
226	254.4	115.1	119.9	118.9	118.4	112.7	125.0
227	255.6	115.7	120.4	119.4	119.0	113.3	125.5
228	256.7	116.2	121.0	120.0	119.5	113.9	126.1
229	257.8	116.7	121.6	120.6	120.1	114.4	126.7
230	258.9	117.3	122.1	121.1	120.7	115.0	127.3
231	260.1	117.8	122.7	121.7	121.2	115.6	127.9
232	261.2	118.4	123.3	122.3	121.8	116.2	128.4
233	262.3	118.9	123.8	122.8	122.4	116.7	129.0
234	263.4	119.5	124.4	123.4	122.9	117.3	129.6
235	264.6	120.0	124.9	124.0	123.5	117.9	130.2
236	265.7	120.6	125.5	124.5	124.1	118.4	130.8
237	266.8	121.1	126.1	125.1	124.6	119.0	131.3
238	268.0	121.7	126.6	125.7	125.2	119.6	131.9
239	269.1	122.2	127.2	126.2	125.8	120.2	132.5
240	270.2	122.7	127.8	126.8	126.3	120.7	133.1
241	271.3	123.3	128.3	127.4	126.9	121.3	133.7
242	272.5	123.8	128.9	127.9	127.5	121.9	134.2
243	273.6	124.4	129.5	128.5	128.0	122.5	134.8
244	274.7	124.9	130.0	129.1	128.6	123.0	135.4
245	275.8	125.5	130.6	129.6	129.2	123.6	136.0
246	277.0	126.0	131.2	130.2	129.8	124.2	136.6
247	278.1	126.6	131.7	130.8	130.3	124.8	137.2
248	279.2	127.1	132.3	131.3	130.9	125.3	137.7
249	280.3	127.7	132.9	131.9	131.5	125.9	138.3
250	281.5	128.2	133.4	132.5	132.0	126.5	138.9
251	282.6	128.8	134.0	133.1	132.6	127.1	139.5
252	283.7	129.3	134.6	133.6	133.2	127.6	140.1
253	284.8	129.9	135.1	134.2	133.8	128.2	140.7
254	286.0	130.4	135.7	134.8	134.3	128.8	141.3
255	287.1	131.0	136.3	135.3	134.9	129.4	141.8
256	288.2	131.6	136.8	135.9	135.5	130.0	142.4
257	289.3	132.1	137.4	136.5	136.0	130.5	143.0
258	290.5	132.7	138.0	137.1	136.6	131.1	143.6
259	291.6	133.2	138.6	137.6	137.2	131.7	144.2
260	292.7	133.8	139.1	138.2	137.8	132.3	144.8
261	293.8	134.3	139.7	138.8	138.3	132.9	145.4
262	295.0	134.9	140.3	139.4	138.9	133.4	145.9
263	296.1	135.4	140.8	139.9	139.5	134.0	146.5
264	297.2	136.0	141.4	140.5	140.1	134.6	147.1
265	298.3	136.5	142.0	141.1	140.7	135.2	147.7
266	299.5	137.1	142.6	141.7	141.2	135.8	148.3
267	300.6	137.7	143.1	142.2	141.8	136.3	148.9
268	301.7	138.2	143.7	142.8	142.4	136.9	149.5
269	302.9	138.8	144.3	143.4	143.0	137.5	150.1
270	304.0	139.3	144.8	144.0	143.5	138.1	150.6
271	305.1	139.9	145.4	144.5	144.1	138.7	151.2
272	306.2	140.4	146.0	145.1	144.7	139.3	151.8
273	307.4	141.0	146.6	145.7	145.3	139.8	152.4
274	308.5	141.6	147.1	146.3	145.9	140.4	153.0

MUNSON-WALKER-HAMMOND REDUCING-SUGAR VALUES

Copper (Cu)	Cuprous Oxide (Cu_2O)	Dextrose (*d*-Glucose)	Invert Sugar	Invert Sugar and Sucrose			Levulose
				Weight of Total Sugar			
				0.3 g.	0.4 g.	2.0 g.	
275	309.6	142.1	147.7	146.8	146.4	141.0	153.6
276	310.7	142.7	148.3	147.4	147.0	141.6	154.2
277	311.9	143.2	148.9	148.0	147.6	142.2	154.8
278	313.0	143.8	149.4	148.6	148.2	142.8	155.4
279	314.1	144.4	150.0	149.2	148.8	143.4	156.0
280	315.2	144.9	150.6	149.7	149.3	143.9	156.5
281	316.4	145.5	151.2	150.3	149.9	144.5	157.1
282	317.5	146.0	151.8	150.9	150.5	145.1	157.7
283	318.6	146.6	152.3	151.5	151.1	145.7	158.3
284	319.7	147.2	152.9	152.1	151.7	146.3	158.9
285	320.9	147.7	153.5	152.6	152.2	146.9	159.5
286	322.0	148.3	154.1	153.2	152.8	147.5	160.1
287	323.1	148.8	154.6	153.8	153.4	148.1	160.7
288	324.2	149.4	155.2	154.4	154.0	148.6	161.3
289	325.4	150.0	155.8	155.0	154.6	149.2	161.9
290	326.5	150.5	156.4	155.5	155.2	149.8	162.5
291	327.6	151.1	157.0	156.1	155.7	150.4	163.1
292	328.7	151.7	157.5	156.7	156.3	151.0	163.7
293	329.9	152.2	158.1	157.3	156.9	151.6	164.3
294	331.0	152.8	158.7	157.9	157.5	152.2	164.9
295	332.1	153.4	159.3	158.5	158.1	152.8	165.4
296	333.3	153.9	159.9	159.0	158.7	153.4	166.0
297	334.4	154.5	160.5	159.6	159.3	154.0	166.6
298	335.5	155.1	161.0	160.2	159.9	154.6	167.2
299	336.6	155.6	161.6	160.8	160.4	155.2	167.8
300	337.8	156.2	162.2	161.4	161.0	155.7	168.4
301	338.9	156.8	162.8	162.0	161.6	156.3	169.0
302	340.0	157.3	163.4	162.5	162.2	156.9	169.6
303	341.1	157.9	164.0	163.1	162.8	157.5	170.2
304	342.3	158.5	164.5	163.7	163.4	158.1	170.8
305	343.4	159.0	165.1	164.3	164.0	158.7	171.4
306	344.5	159.6	165.7	164.9	164.6	159.3	172.0
307	345.6	160.2	166.3	165.5	165.1	159.9	172.6
308	346.8	160.7	166.9	166.1	165.7	160.5	173.2
309	347.9	161.3	167.5	166.7	166.3	161.1	173.8
310	349.0	161.9	168.0	167.2	166.9	161.7	174.4
311	350.1	162.5	168.6	167.8	167.5	162.3	175.0
312	351.3	163.0	169.2	168.4	168.1	162.9	175.6
313	352.4	163.6	169.8	169.0	168.7	163.5	176.2
314	353.5	164.2	170.4	169.6	169.3	164.1	176.8
315	354.6	164.7	171.0	170.2	169.9	164.7	177.4
316	355.8	165.3	171.6	170.8	170.5	165.3	178.0
317	356.9	165.9	172.2	171.4	171.1	165.9	178.6
318	358.0	166.5	172.8	172.0	171.7	166.5	179.2
319	359.1	167.0	173.3	172.6	172.2	167.1	179.8
320	360.3	167.6	173.9	173.1	172.8	167.7	180.4
321	361.4	168.2	174.5	173.7	173.4	168.3	181.0
322	362.5	168.8	175.1	174.3	174.0	168.9	181.6
323	363.6	169.3	175.7	174.9	174.6	169.5	182.2
324	364.8	169.9	176.3	175.5	175.2	170.1	182.8
325	365.9	170.5	176.9	176.1	175.8	170.7	183.4
326	367.0	171.1	177.5	176.7	176.4	171.3	184.0
327	368.2	171.6	178.1	177.3	177.0	171.9	184.6
328	369.3	172.2	178.7	177.9	177.6	172.5	185.2
329	370.4	172.8	179.2	178.5	178.2	173.1	185.8
330	371.5	173.4	179.8	179.1	178.8	173.7	186.4
331	372.7	173.9	180.4	179.7	179.4	174.3	187.0
332	373.8	174.5	181.0	180.3	180.0	174.9	187.6
333	374.9	175.1	181.6	180.9	180.6	175.5	188.2
334	376.0	175.7	182.2	181.5	181.2	176.1	188.8

MUNSON-WALKER-HAMMOND REDUCING-SUGAR VALUES

Copper (Cu)	Cuprous Oxide (Cu_2O)	Dextrose (*d*-Glucose)	Invert Sugar	Invert Sugar and Sucrose			Levulose
				Weight of Total Sugar			
				0.3 g.	0.4 g.	2.0 g.	
335	377.2	176.3	182.8	182.1	181.8	176.7	189.4
336	378.3	176.8	183.4	182.6	182.4	177.3	190.1
337	379.4	177.4	184.0	183.2	183.0	178.0	190.7
338	380.5	178.0	184.6	183.8	183.6	178.6	191.3
339	381.7	178.6	185.2	184.4	184.2	179.2	191.9
340	382.8	179.2	185.8	185.0	184.8	179.8	192.5
341	383.9	179.7	186.4	185.6	185.4	180.4	193.1
342	385.0	180.3	187.0	186.2	186.0	181.0	193.7
343	386.2	180.9	187.6	186.8	186.6	181.6	194.3
344	387.3	181.5	188.2	187.4	187.2	182.2	194.9
345	388.4	182.1	188.8	188.0	187.8	182.8	195.5
346	389.5	182.7	189.4	188.6	188.4	183.4	196.1
347	390.7	183.2	190.0	189.2	189.0	184.0	196.7
348	391.8	183.8	190.6	189.8	189.6	184.6	197.3
349	392.9	184.4	191.2	190.4	190.2	185.3	197.9
350	394.0	185.0	191.8	191.0	190.8	185.9	198.5
351	395.2	185.6	192.4	191.6	191.4	186.5	199.2
352	396.3	186.2	193.0	192.2	192.0	187.1	199.8
353	397.4	186.8	193.6	192.8	192.6	187.7	200.4
354	398.5	187.3	194.2	193.4	193.2	188.3	201.0
355	399.7	187.9	194.8	194.0	193.8	188.9	201.6
356	400.8	188.5	195.4	194.6	194.4	189.5	202.2
357	401.9	189.1	196.0	195.2	195.0	190.2	202.8
358	403.1	189.7	196.6	195.8	195.7	190.8	203.4
359	404.2	190.3	197.2	196.4	196.3	191.4	204.0
360	405.3	190.9	197.8	197.1	196.9	192.0	204.7
361	406.4	191.5	198.4	197.7	197.5	192.6	205.3
362	407.6	192.0	199.0	198.3	198.1	193.2	205.9
363	408.7	192.6	199.6	198.9	198.7	193.9	206.5
364	409.8	193.2	200.2	199.5	199.3	194.5	207.1
365	410.9	193.8	200.8	200.1	199.9	195.1	207.7
366	412.1	194.4	201.4	200.7	200.5	195.7	208.3
367	413.2	195.0	202.0	201.3	201.1	196.3	209.0
368	414.3	195.6	202.6	201.9	201.7	196.9	209.6
369	415.4	196.2	203.2	202.5	202.4	197.6	210.2
370	416.6	196.8	203.8	203.1	203.0	198.2	210.8
371	417.7	197.4	204.4	203.7	203.6	198.8	211.4
372	418.8	198.0	205.0	204.3	204.2	199.4	212.0
373	419.9	198.5	205.7	204.9	204.8	200.0	212.6
374	421.1	199.1	206.3	205.6	205.4	200.7	213.3
375	422.2	199.7	206.9	206.2	206.0	201.3	213.9
376	423.3	200.3	207.5	206.8	206.6	201.9	214.5
377	424.4	200.9	208.1	207.4	207.3	202.5	215.1
378	425.6	201.5	208.7	208.0	207.9	203.1	215.7
379	426.7	202.1	209.3	208.6	208.5	203.8	216.3
380	427.8	202.7	209.9	209.2	209.1	204.4	217.0
381	428.9	203.3	210.5	209.8	209.7	205.0	217.6
382	430.1	203.9	211.1	210.4	210.3	205.6	218.2
383	431.2	204.5	211.8	211.1	211.0	206.3	218.8
384	432.3	205.1	212.4	211.7	211.6	206.9	219.5
385	433.5	205.7	213.0	212.3	212.2	207.5	220.1
386	434.6	206.3	213.6	212.9	212.8	208.1	220.7
387	435.7	206.9	214.2	213.5	213.4	208.8	221.3
388	436.8	207.5	214.8	214.1	214.0	209.4	221.9
389	438.0	208.1	215.4	214.7	214.7	210.0	222.6
390	439.1	208.7	216.0	215.4	215.3	210.6	223.2
391	440.2	209.3	216.7	216.0	215.9	211.3	223.8
392	441.3	209.9	217.3	216.6	216.5	211.9	224.4
393	442.5	210.5	217.9	217.2	217.1	212.5	225.1
394	443.6	211.1	218.5	217.8	217.8	213.2	225.7

MUNSON-WALKER-HAMMOND REDUCING-SUGAR VALUES

Copper (Cu)	Cuprous Oxide (Cu_2O)	Dextrose (*d*-Glucose)	Invert Sugar	Invert Sugar and Sucrose			Levulose
				Weight of Total Sugar			
				0.3 g.	0.4 g.	2.0 g.	
395	444.7	211.7	219.1	218.5	218.4	213.8	226.3
396	445.8	212.3	219.8	219.1	219.0	214.4	226.9
397	447.0	212.9	220.4	219.7	219.6	215.1	227.6
398	448.1	213.5	221.0	220.3	220.3	215.7	228.2
399	449.2	214.1	221.6	220.9	220.9	216.3	228.8
400	450.3	214.7	222.2	221.5	221.5	217.0	229.4
401	451.5	215.3	222.9	222.2	222.1	217.6	230.1
402	452.6	215.9	223.5	222.8	222.8	218.2	230.7
403	453.7	216.5	224.1	223.4	223.4	218.9	231.3
404	454.8	217.1	224.7	224.0	224.0	219.5	232.0
405	456.0	217.8	225.4	224.7	224.7	220.1	232.6
406	457.1	218.4	226.0	225.3	225.3	220.8	233.2
407	458.2	219.0	226.6	225.9	225.9	221.4	233.9
408	459.3	219.6	227.2	226.6	226.5	222.0	234.5
409	460.5	220.2	227.9	227.2	227.2	222.7	235.1
410	461.6	220.8	228.5	227.8	227.8	223.3	235.8
411	462.7	221.4	229.1	228.4	228.4	224.0	236.4
412	463.8	222.0	229.7	229.1	229.1	224.6	237.1
413	465.0	222.6	230.4	229.7	229.7	225.3	237.7
414	466.1	223.3	231.0	230.4	230.4	225.9	238.4
415	467.2	223.9	231.7	231.0	231.0	226.6	239.0
416	468.4	224.5	232.3	231.6	231.7	227.2	239.7
417	469.5	225.1	232.9	232.3	232.3	227.8	240.3
418	470.6	225.7	233.6	232.9	232.9	228.5	241.0
419	471.7	226.3	234.2	233.5	233.6	229.1	241.6
420	472.9	227.0	234.8	234.2	234.2	229.8	242.2
421	474.0	227.6	235.5	234.8	234.9	230.4	242.9
422	475.1	228.2	236.1	235.5	235.5	231.1	243.6
423	476.2	228.8	236.8	236.2	236.2	231.8	244.3
424	477.4	229.5	237.5	236.8	236.9	232.4	244.9
425	478.5	230.1	238.1	237.5	237.5	233.1	245.6
426	479.6	230.7	238.8	238.2	238.2	233.8	246.3
427	480.7	231.4	239.5	238.8	238.9	234.5	247.0
428	481.9	232.0	240.2	239.5	239.6	235.1	247.8
429	483.0	232.7	240.8	240.2	240.3	235.8	248.5
430	484.1	233.3	241.5	240.9	241.0	236.5	249.2
431	485.2	234.0	242.3	241.7	241.7	237.2	250.0
432	486.4	234.7	243.0	242.4	242.5	238.0	250.8
433	487.5	235.3	243.8	243.2	243.3	238.7	251.6
434	488.6	236.1	244.7	244.1	244.2	239.6	252.7
435	489.7	236.9	245.6	245.1	245.1	240.4	253.7

REDUCTION VALUES OF GLUCOSE IN BLOOD

Method of Hagedorn and Jensen, *Biochem. Zeit*, 135, 46; 137, 92 (1923).

Required solutions. *Aklaline ferricyanide*, 1.65 g potassium ferricyanide, and 10.6 g anhydrous sodium carbonate in 1000 cc of water; *acetic acid* (3%), 15 g glacial acetic acid in 485 cc of water; *iodide-sulfate*, 5 g potassium iodide, 50 g sodium chloride and 10 g zinc sulfate in sufficient water to make 200 cc of solution; 2.25 g *zinc sulfate* in sufficient water to make 500 cc of solution; standard 0.005 *N sodium thiosulfate*; standard 0.1 *N sodium hydroxide*; starch indicator solution.

Procedure. This method depends upon the reduction of potassium ferricyanide in alkaline solution by the glucose in the blood with subsequent titration of excess unreduced ferricyanide according to the reaction: $2H_3Fe(CN)_6 + 2HI = 2H_4Fe(CN)_6 + I_2$. One cc of 0.1 *N* sodium hydroxide and 5 cc of 0.45% zinc sulfate are mixed in a 15×150 mm test tube and to this is added 0.1 cc of blood from a capillary pipette which is then washed out with the mixture in the test tube; after heating this mixture for three minutes in a boiling water bath, then filtering through cotton into a 30×90 mm test tube and washing the filter with two 3 cc portions of distilled water, 2 cc of alkaline ferricyanide solution is added and the heating continued in the boiling water bath for 15 minutes; after cooling, adding 3 cc of the iodide-sulfate solution and 2 cc of 3% acetic acid solution, it is titrated with 0.005 *N* sodium thiosulfate with starch indicator.

Amount of Glucose in 0.1 cc of Blood Expressed in Milligrams

	Number of cubic centimeters of 0.005 *N* sodium thiosulfate									
	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.385	0.382	0.379	0.376	0.373	0.370	0.367	0.364	0.361	0.358
0.1	0.355	0.352	0.350	0.348	0.345	0.343	0.341	0.338	0.336	0.333
0.2	0.331	0.329	0.327	0.325	0.323	0.321	0.318	0.316	0.314	0.312
0.3	0.310	0.308	0.306	0.304	0.302	0.300	0.298	0.296	0.294	0.292
0.4	0.290	0.288	0.286	0.284	0.282	0.280	0.278	0.276	0.274	0.272
0.5	0.270	0.268	0.266	0.264	0.262	0.260	0.259	0.257	0.255	0.253
0.6	0.251	0.249	0.247	0.245	0.243	0.241	0.240	0.238	0.236	0.234
0.7	0.232	0.230	0.228	0.226	0.224	0.222	0.221	0.219	0.217	0.215
0.8	0.213	0.211	0.209	0.208	0.206	0.204	0.202	0.200	0.199	0.197
0.9	0.195	0.193	0.191	0.190	0.188	0.186	0.184	0.182	0.181	0.179
1.0	0.177	0.175	0.173	0.172	0.170	0.168	0.166	0.164	0.163	0.161
1.1	0.159	0.157	0.155	0.154	0.152	0.150	0.148	0.146	0.145	0.143
1.2	0.141	0.139	0.138	0.136	0.134	0.132	0.131	0.129	0.127	0.125
1.3	0.124	0.122	0.120	0.119	0.117	0.115	0.113	0.111	0.110	0.108
1.4	0.106	0.104	0.102	0.101	0.099	0.097	0.095	0.093	0.092	0.090
1.5	0.088	0.086	0.084	0.083	0.081	0.079	0.077	0.075	0.074	0.072
1.6	0.070	0.068	0.066	0.065	0.063	0.061	0.059	0.057	0.056	0.054
1.7	0.052	0.050	0.048	0.047	0.045	0.043	0.041	0.039	0.038	0.036
1.8	0.034	0.032	0.031	0.029	0.027	0.025	0.024	0.022	0.020	0.019
1.9	0.017	0.015	0.014	0.012	0.010	0.008	0.007	0.005	0.003	0.002

Methods of Somogyi, *J. Biol. Chem.* 70, 599 (1926).

For 1:10 Blood Filtrate

Required solutions. *Copper reagent*, 6.5 g crystalline copper sulfate, 12 g rochelle salt, 20 g anhydrous sodium carbonate, 10 g potassium iodide, 0.08 g potassium iodate, 18 g potassium oxalate, 25 g sodium bicarbonate and sufficient water to make one liter of solution. *Sulfuric acid*, 5 *N*. Standard sodium thiosulfate, 0.005 *N*.

Procedure. Five cc of the sugar solution (containing between 0.1 and 2.0 milligrams of glucose) is added to 5 cc of copper reagent in a 25×250 mm test tube, then heated for 15 minutes in a boiling water bath; after cooling to 35°C and mixing with 1 cc 5 *N* sulfuric acid, it is titrated two minutes later with 0.005 *N* sodium thiosulfate. A blank titration using 5 cc of water in place of the blood is run simultaneously.

REDUCTION VALUES OF GLUCOSE IN BLOOD

Amount of Glucose in 100 cc of Blood Expressed in Milligrams

	Number of cubic centimeters of 0.005 *N* sodium thiosulfate									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	...	..	21	23	26	29	31	34	36	39
1	41	44	46	49	51	53	56	58	61	63
2	65	68	70	72	75	77	80	82	84	86
3	89	92	94	97	99	101	103	106	108	110
4	113	115	117	119	121	124	126	128	130	132
5	135	137	139	141	143	146	148	150	152	154
6	157	159	161	163	165	168	170	172	174	176
7	179	181	183	185	187	190	192	194	196	199
8	201	203	205	207	210	212	214	216	218	221
9	223	225	227	230	232	234	237	239	241	243
10	245	248	250	252	254	256	259	261	263	265
11	267	270	272	274	276	279	281	283	285	288
12	290	292	294	296	299	301	303	305	308	310
13	312	314	316	318	321	323	326	328	330	332
14	334	337	339	341	343	345	347	350	352	354
15	356	359	361	363	365	367	370	372	374	376
16	378	381	383	386	388	390	392	394	396	398

For 1:15 Filtrate

Required solutions. *Sulfuric acid*, 0.067 *N* and 2 *N*. 2.5% *sodium tungstate* solution. *Copper reagent* prepared as described above. Standard *sodium thiosulfate*, 0.005 *N*.

Procedure. Two tenths (0.2) cc of blood is added to 2 cc of 0.067 *N* sulfuric acid in a test tube and the pipette washed several times with the mixture in the test tube; exactly 0.8 cc of 2.5% sodium tungstate is added, the mixture centrifugated and 2 cc of the liquid withdrawn with a pipette filtering the solution through a layer of cotton fastened over the end of the pipette; this 2 cc is added to exactly 2 cc of copper reagent in a 16×150 mm test tube, mixed and heated for 15 minutes in a boiling water bath; after cooling to 35°C, adding 1 cc of 2 *N* sulfuric acid, it is titrated with 0.005 *N* sodium thiosulfate. A blank using 0.2 cc of water in place of the blood is run simultaneously.

Amount of Glucose in 100 cc of Blood Expressed in Milligrams

	Number of cubic centimeters of 0.005 *N* sodium thiosulfate									
	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	..	..	42	53	63	74	83	91	100	108
1	117	125	134	142	150	159	168	176	185	193
2	202	210	219	227	236	245	253	262	270	279
3	288	296	305	313	322	330	339	347	355	364
4	373	381	390	399	407	416	424	433	441	450

SOLUBILITIES OF INORGANIC COMPOUNDS

This table shows the amount of anhydrous substance which is soluble in 100 grams of water at the temperature in degrees Centigrade as indicated; where the formula is preceded by † the value is expressed in grams of substance in 100 c.c. of saturated

	Substance	Formula	Solid Phase	0°C.	10°C.
1	**Aluminum** chloride	$AlCl_3$	$6H_2O$	.....	.....
2	sulfate	$Al_2(SO_4)_3$	$18H_2O$	31.2	33.5
3	**Ammonium** aluminum sulfate	$(NH_4)_2Al_2(SO_4)_4$	$24H_2O$	2.1	4.99
4	bicarbonate	NH_4HCO_3	.....	11.9	15.8
5	bromide	NH_4Br	.....	60.6	68
6	cadmium sulfate	$(NH_4)_2Cd(SO_4)_2$	$6H_2O$	.....	.....
7	chloride	NH_4Cl	.....	29.4	33.3
8	chloroplatinate	$(NH_4)_2PtCl_6$	.....	.....	0.7
9	chromate	$(NH_4)_2CrO_4$	.....	.....	.....
10	chromium sulfate	$(NH_4)_2Cr_2(SO_4)_4$	$24H_2O$	.....	.....
11	cobaltous sulfate	$(NH_4)_2Co(SO_4)_2$	$6H_2O$	6.0	9.5
12	dichromate	$(NH_4)_2Cr_2O_7$	.....	.....	.....
13	dihydrogen phosphite	$NH_4H_2PO_3$	.....	171	.....
14	ferric sulfate	$(NH_4)_2Fe_2(SO_4)_4$	$24H_2O$	.....	.....
15	ferrous sulfate	$(NH_4)_2Fe(SO_4)_2$	$6H_2O$	12.5	17.2
16	hydrogen phosphate	$(NH_4)_2HPO_4$	.....	.....	.....
17	iodide	NH_4I	.....	154.2	163.2
18	lithium sulfate	NH_4LiSO_4	.....	.....	55.23
19	magnesium phosphate	NH_4MgPO_4	$6H_2O$	0.023	.....
20	manganese phosphate	NH_4MnPO_4	$7H_2O$	.....	.....
21	nitrate	NH_4NO_3	.....	118.3	.....
22	oxalate	$(NH_4)_2C_2O_4$	$1H_2O$	2.2	3.1
23	†perchlorate	NH_4ClO_4†	.....	11.56	.....
24	persulfate	$(NH_4)_2S_2O_8$	.....	58.2	.....
25	selenate	$(NH_4)_2SeO_4$	.....	.....	$1.22^{12°}$
26	sulfate	$(NH_4)_2SO_4$	.....	70.6	73.0
27	thioantimonate	$(NH_4)_3SbS_4$	$4H_2O$	71.2	.....
28	thiocyanate	NH_4CNS	.....	119.8	144
29	vanadate (meta)	NH_4VO_3	.....	.....	.....
30	**Antimonous** chloride	$SbCl_3$	.....	601.6	.....
31	fluoride	SbF_3	.....	384.7	.....
32	sulfide	Sb_2S_3	.....	.....	.....
33	**Arsenic oxide**	As_2O_5	.....	59.5	62.1
34	**Arsenious sulfide**	As_2S_3	.....	5.17×10^{-5} at 18°	
35	**Barium** acetate	$Ba(C_2H_3O_2)_2$	$3H_2O$	59	63
36	acetate	$Ba(C_2H_3O_2)_2$	$1H_2O$	.....	.....
37	bromate	$Ba(BrO_3)_2$	$1H_2O$	0.287	0.441
38	bromide	$BaBr_2$	$2H_2O$	98	101
39	carbonate	$BaCO_3$	.....	.....	$0.0016^{68°}$
40	chlorate	$Ba(ClO_3)_2$	$1H_2O$	20.34	26.95
41	chloride	$BaCl_2$	$2H_2O$	31.6	33.3
42	chromate	$BaCrO_4$	.....	0.0002	0.00028
43	hydroxide	$Ba(OH)_2$	$8H_2O$	1.67	2.48
44	iodate	$Ba(IO_3)_2$	$1H_2O$	0.008	0.014
45	iodide	BaI_2	$6H_2O$	170.2	185.7
46	iodide	BaI_2	$2H_2O$	.....	.....
47	molybdate	$BaMoO_4$	.....	.....	.....
48	nitrate	$Ba(NO_3)_2$	.....	5.0	7.0
49	nitrite	$Ba(NO_2)_2$	$1H_2O$	.....	.....

IN WATER AT VARIOUS TEMPERATURES

solution. Solid Phase gives the hydrated form in equilibrium with the saturated solution.

20°C.	30°C.	40°C.	50°C.	60°C.	70°C.	80°C.	90°C.	100°C.	
69.86[15°]	.....	.....	.....	....	....	....	....	.....	1
36.4	40.4	46.1	52.2	59.2	66.1	73.0	80.8	89.0	2
7.74	10.94	14.88	20.10	26.70	....	....	....	100.7[95°]	3
21	27	.....	.....	....	....	....	....	.....	4
75.5	83.2	91.1	99.2	107.8	116.8	126	135.6	145.6	5
72.3[25°]	.....	.....	.....	....	....	....	....	.....	6
37.2	41.4	45.8	50.4	55.2	60.2	65.6	71.3	77.3	7
.....	.....	.....	.....	....	....	....	....	1.25	8
.....	40.4	.....	.....	....	....	....	....	.....	9
10.78[25°]	.....	.....	.....	....	....	....	....	.....	10
13.0	17.0	22.0	27.0	33.5	40.0	49.0	....	.....	11
.....	47.17	.....	.....	....	....	....	....	.....	12
190[14.5°]	260[31°]	.....	.....	....	....	....	....	.....	13
.....	44.15[25°]	.....	.....	....	....	....	....	.....	14
.....	.....	33	40	....	52	....	....	.....	15
131[15]	.....	.....	.....	....	....	....	....	.....	16
172.3	181.4	190.5	199.6	208.9	218.7	228.8	....	250.3	17
.....	55.93	.....	56.25	....	56.69	....	....	.....	18
0.052	.....	0.036	0.030	0.040	0.016	0.019	....	.....	19
0	.....	0	.....	0	0.005	0.007	....	.....	20
192	241.8	297.0	344.0	421.0	499.0	580.0	740.0	871.0	21
4.4	5.9	8.0	10.3	....	....	....	....	.....	22
20.85	.....	30.58	.....	39.05	....	48.19	....	57.01	23
.....	.....	.....	.....	....	....	....	....	.....	24
.....	.....	.....	.....	....	....	....	....	.....	25
75.4	78.0	81.0	.....	88.0	....	95.3	....	103.3	26
91.2	119.8	.....	.....	....	....	....	....	.....	27
170	207.7	.....	.....	....	....	....	....	.....	28
0.48	0.84	1.32	1.78	....	3.05	....	....	.....	29
931.5	1068.0	1368.0	1917.0	4531.0	....	∞	....	.....	30
444.7	563.6	.....	.....	....	....	....	....	.....	31
0.000175[18°]	.....	.....	.....	....	....	....	....	.....	32
65.8	69.5	71.2	.....	73.0	....	75.1	....	76.7	33
.....	.....	.....	.....	....	....	....	....	.....	34
71	.....	.....	.....	....	....	....	....	.....	35
.....	75	79	77	74	74	....	....	75	36
0.656	0.959	1.33	1.75	2.32	3.01	3.65	4.45	5.71	37
104	109	114	118	123	128	135	....	149	38
0.0022[18°]	0.0024 at 24.2°	.....	.....	....	....	....	....	.....	39
33.80	41.70	49.61	.....	66.81	....	84.84	....	104.9	40
35.7	38.2	40.7	43.6	46.4	49.4	52.4	....	58.8	41
0.00037	0.00046	.....	.....	....	....	....	....	.....	42
3.89	5.59	8.22	13.12	20.94	....	101.4	....	.....	43
0.022	0.031	0.041	0.056	0.074	0.093	0.115	0.141	0.197	44
203.1	219.6	.....	.....	....	....	....	....	.....	45
.....	.....	231.9	.....	247.3	....	261.0	....	271.7	46
0.0058[23°]	.....		.....	....	....	....	....	.....	47
9.2	11.6	14.2	17.1	20.3	....	27.0	....	34.2	48
67.5	.....	.....	.....	....	....	205.8	....	300	49

SOLUBILITIES OF INORGANIC COMPOUNDS

	Substance	Formula	Solid Phase	0°C.	10°C.
1	**Barium** oxalate	BaC_2O_4	.....	.....	0.0016[s°]
2	perchlorate	$Ba(ClO_4)_2$	$3H_2O$	205.8	.....
3	sulfate	$BaSO_4$	.....	1.15×10^{-4}	2.0×10^{-4}
4	**Beryllium** potassium fluoride	$BeF_2.2KF$	.....	.....	.....
5	sodium fluoride	$BeF_2.2NaF$	.....	.....	.....
6	sulfate	$BeSO_4$	$6H_2O$	.....	.....
7	sulfate	$BeSO_4$	$4H_2O$	.....	.....
8	sulfate	$BeSO_4$	$2H_2O$	.....	.....
9	**Bismuth** sulfide	Bi_2S_3	.....	.....	.....
10	**Boric acid**	H_3BO_3	.....	2.66	3.57
11	**Boron oxide**	B_2O_3	.....	1.1	1.5
12	**Bromine**	Br_2	.....	4.22	3.4
13	**Cadmium** bromide	$CdBr_2$	.....	61.08	.....
14	chloride	$CdCl_2$	$4H_2O$	97.59	125.1
15	chloride	$CdCl_2$	$2\frac{1}{2}H_2O$	90.01	.....
16	chloride	$CdCl_2$	$1H_2O$	.....	135.1
17	cyanide	$Cd(CN)_2$	.....	.....	.....
18	hydroxide	$Cd(OH)_2$	.....	.....	.....
19	iodide	CdI_2	.....	79.8	83.2
20	sulfate	$CdSO_4$	.....	76.48	76.00
21	sulfide	CdS	.....	.....	.....
22	**Calcium** acetate	$Ca(C_2H_3O_2)_2$	$2H_2O$	37.4	36.0
23	acetate	$Ca(C_2H_3O_2)_2$	$1H_2O$	.....	.....
24	bicarbonate	$Ca(HCO_3)_2$	.....	16.15	.....
25	bromide	$CaBr_2$	$6H_2O$	125	132
26	bromide	$CaBr_2$	$4H_2O$		.....
27	chloride	$CaCl_2$	$6H_2O$	59.5	65.0
28	chloride	$CaCl_2$	$2H_2O$	.....	.....
29	fluoride	CaF_2	.....	.....	.....
30	hydroxide	$Ca(OH)_2$	.....	0.185	0.176
31	iodate	$Ca(IO_3)_2$	$6H_2O$	0.10	0.17
32	iodate	$Ca(IO_3)_2$	$1H_2O$	.....	.....
33	iodide	CaI_2	.....	181.9	194.1
34	nitrate	$Ca(NO_3)_2$	$4H_2O$	102.0	115.3
35	nitrate	$Ca(NO_3)_2$	$3H_2O$	.....	.....
36	nitrate	$Ca(NO_3)_2$	.....	.....	.....
37	nitrite	$Ca(NO_2)_2$	$4H_2O$	62.07	.....
38	nitrite	$Ca(NO_2)_2$	$2H_2O$	.....	.....
39	oxalate	CaC_2O_4	.....	.....	6.7×10^{-4} at 13°
40	sulfate	$CaSO_4$	$2H_2O$	0.1759	0.1928
41	**Carbon** dioxide, 760 mm	CO_2	.....	0.3346	0.2318
42	monoxide, 760 mm	CO	.....	0.0044	0.0035
43	**Cerous** sulfate	$Ce_2(SO_4)_3$	$9H_2O$	20.75	.....
44	sulfate	$Ce_2(SO_4)_3$	$8H_2O$	18.98	.....
45	sulfate	$Ce_2(SO_4)_3$	$5H_2O$	.....	.....
46	sulfate	$Ce_2(SO_4)_3$	$4H_2O$	.....	.....
47	**Cesium** chlorate	$CsClO_3$	.....	2.46	3.8
48	chloride	CsCl	.....	161.4	174.7
49	fluoride	CsF	$1\frac{1}{2}H_2O$	.....	.....

IN WATER AT VARIOUS TEMPERATURES

20°C.	30°C.	40°C.	50°C.	60°C.	70°C.	80°C.	90°C.	100°C.	
0.0022[18°]	0.0024 at 24.2°	.....	.....	....	....	....	....	.....	1
289.1	.....	358.7	426.3	....	495.2	....	562.3	.....	2
2.4×10^{-4}	2.85×10^{-4}	.....	.....	....	....	....	....	.....	3
2	.....	.....	.....	....	....	....	....	5.2	4
1.4	.....	.....	.....	....	....	....	....	2.9	5
.....	52	.....	60.67	....	....	....	....	.....	6
.....	43.78	46.74	.....	....	62	....	83	100	7
.....	.....	.....	.....	....	....	84.76	98	110	8
1.8×10^{-5} at 18°	.....	.....	.....	....	....	....	....	.....	9
5.04	6.60	8.72	11.54	14.81	18.62	23.75	30.38	40.25	10
2.2	.....	4.0	.....	6.2	....	9.5	....	15.7	11
3.20	3.13	.....	.....	....	....	....	....	.....	12
.....	132.0	154.1	.....	157.1	....	165.2	....	.....	13
.....	.....	.....	.....	....	....	....	....	.....	14
.....	132.1	.....	.....	....	....	....	....	.....	15
134.5	.....	135.3	.....	136.5	....	140.4	....	147.0	16
1.7[15°]	.....	.....	.....	....	....	....	....	.....	17
.....	2.6×10^{-4} at 25°	.....	.....	....	....	....	....	.....	18
86.2	89.7	93.8	97.4	....	....	....	....	127.6	19
76.60	.....	78.54	.....	83.68	....	....	63.13	60.77	20
9×10^{-7} at 18°	.....	.....	.....	....	....	....	....	.....	21
34.7	33.8	33.2	.....	32.7	....	33.5	....	.....	22
.....	.....	.....	.....	....	....	....	31.1	29.7	23
16.60	.....	17.05	.....	17.50	....	17.95	....	18.40	24
143	.....	.....	.....	....	....	....	....	.....	25
.....	.....	213	.....	278	....	295	....	.....	26
74.5	102	.....	.....	....	....	....	....	.....	27
.....	.....	.....	.....	136.8	141.7	147.0	152.7	159	28
0.0016[18°]	0.0017[26°]	.....	.....	....	....	....	....	.....	29
0.165	0.153	0.141	0.128	0.116	0.106	0.094	0.085	0.077	30
.....	0.42	0.61	0.90	1.38	....	....	....	.....	31
.....	.....	0.52	0.59	0.65	....	0.80	....	0.95	32
208.8	222.6	242.5	.....	284.6	....	354.5	....	426.3	33
129.3	152.6	195.9	.....	....	....	....	....	.....	34
.....	.....	237.5	281.5	....	....	....	....	.....	35
.....	.....	.....	.....	....	....	358.7	....	363.6	36
76.68	.....	.....	.....	....	....	....	....	.....	37
.....	.....	.....	.....	132.6	151.9	....	244.8	.....	38
6.8×10^{-4} at 25°	9.5×10^{-4} at 50°	14×10^{-4} at 95°	.....	....	....	....	....	.....	39
.....	0.2090	0.2097	0.2038	....	0.1966	....	.....	0.1619	40
0.1688	0.1257	0.0973	0.0761	0.0576	....	....	....	0	41
0.0028	0.0024	0.0021	0.0018	0.0015	0.0013	0.0010	0.0006	0	42
10.08	6.79	.....	4.674	3.874	....	....	....	.....	43
9.52	.....	5.947	.....	4.04	....	....	....	.....	44
.....	.....	.....	.....	3.247	....	1.204	....	0.46	45
.....	.....	6.056	3.42	2.35	....	1.01	....	0.42	46
6.2	9.5	13.8	19.4	26.2	34.7	45.0	58.0	79.0	47
186.5	197.3	208.0	218.5	229.7	239.5	250.0	260.1	270.5	48
366.5[18°]	.....	.....	.....	....	....	....	....	.....	49

SOLUBILITIES OF INORGANIC COMPOUNDS

	Substance	Formula	Solid Phase	0°C.	10°C.
1	**Cesium** hydroxide	$CsOH$	.....	.....	.....
2	iodate	$CsIO_3$	.....	.....	.....
3	nitrate	$CsNO_3$	.....	9.33	14.9
4	perchlorate	$CsClO_4$	.....	0.8	1.0
5	periodate	$CsIO_4$	.....	.....	2.15[15]
6	sulfate	Cs_2SO_4	.....	167.1	173.1
7	**Chlorine, 760 mm**	Cl_2	.....	1.46	0.980
8	**Chromic anhydride**	CrO_3	.....	164.9	.....
9	**Cobaltous** chloride	$CoCl_2$	$6H_2O$	41.6	46.0
10	chloride	$CoCl_2$	$1H_2O$	.....	.....
11	iodide	CoI_2	$1H_2O$	138.1	159.7
12	nitrate	$Co(NO_3)_2$	$6H_2O$	84.03	.....
13	nitrate	$Co(NO_3)_2$	$3H_2O$	.....	.....
14	sulfate	$CoSO_4$	$7H_2O$	25.55	30.55
15	sulfide	CoS	.....	.....	.....
16	**Cupric** chloride	$CuCl_2$	$2H_2O$	70.7	73.76
17	iodide	CuI_2	.....	.....	.....
18	nitrate	$Cu(NO_3)_2$	$6H_2O$	81.8	95.28
19	nitrate	$Cu(NO_3)_2$	$3H_2O$	.....	.....
20	sulfate	$CuSO_4$	$5H_2O$	14.3	17.4
21	sulfide	CuS	.....	.....	.....
22	**Cuprous chloride**	$CuCl$	.....	.....	.....
23	**Ferric chloride**	$FeCl_3$	.....	74.4	81.9
24	**Ferrous** bromide	$FeBr_2$	$6H_2O$	102.0	.....
25	chloride	$FeCl_2$	$4H_2O$	.....	64.5
26	chloride	$FeCl_2$	.....	.....	.....
27	nitrate	$Fe(NO_3)_2$	$6H_2O$	71.02	.....
28	sulfate	$FeSO_4$	$7H_2O$	15.65	20.51
29	sulfate	$FeSO_4$	$1H_2O$	.....	.....
30	sulfide	FeS	.....	.....	.....
31	**Hydrobromic acid, 760 mm**	HBr	.....	221.2	210.3
32	**Hydrochloric acid, 760 mm**	HCl	.....	82.3	.....
33	**Iodine**	I_2	.....	.....	.....
34	**Lanthanum sulfate**	$La_2(SO_4)_3$	$9H_2O$	3	.....
35	**Lead** acetate	$Pb(C_2H_3O_2)_2$	$3H_2O$	.....	.....
36	bromide	$PbBr_2$	.....	0.4554	.....
37	carbonate	$PbCO_3$	.....	.....	.....
38	chloride	$PbCl_2$	.....	0.6728	.....
39	chromate	$PbCrO_4$	.....	.....	.....
40	fluoride	PbF_2	.....	.....	0.060
41	iodide	PbI_2	.....	0.0442	.....
42	nitrate	$Pb(NO_3)_2$	.....	38.8	48.3
43	sulfate	$PbSO_4$	.....	0.0028	0.0035
44	sulfide	PbS	.....	.....	.....
45	**Lithium** bromide	$LiBr$	$2H_2O$	143	166
46	bromide	$LiBr$	$1H_2O$	.....	.....
47	carbonate	Li_2CO_3	.....	1.54	1.43
48	chloride	$LiCl$	.....	67	72
49	hydroxide	$LiOH$	$1H_2O$	12.7	12.7
50	iodide	LiI	$3H_2O$	151	157
51	iodide	LiI	$1H_2O$	.....	.....
52	nitrate	$LiNO_3$	$3H_2O$	53.4	61.0
53	nitrate	$LiNO_3$	$1\frac{1}{2}H_2O$	.....	.....

IN WATER AT VARIOUS TEMPERATURES

20°C.	30°C.	40°C.	50°C.	60°C.	70°C.	80°C.	90°C.	100°C.	
385.7$^{15°}$	.....	.....	.....	....	....	....	....	.....	1
2.6$^{24°}$	.....	.....	.....	.....	....	....	....	.....	2
23.0	33.9	47.2	64.4	83.8	107.0	134.0	163.0	197.0	3
1.6	2.6	4.0	5.4	7.3	9.8	14.4	20.5	30.0	4
.....	.....	.....	.....	....	....	....	....	.....	5
178.7	184.1	189.9	194.9	199.9	205.0	210.3	214.9	220.3	6
0.716	0.562	0.451	0.386	0.324	0.274	0.219	0.125	0	7
.....	.....	174.0	182.1	....	....	....	217.5	206.8	8
50.4	53.5	.....	.....	....	....	....	....	.....	9
.....	.....	69.5	88.7	90.5	....	98.0	....	104.1	10
187.4	233.3	300.0	376.2	....	....	400.0	....	.....	11
100.0	.....	126.8	.....	....	....	....	....	.....	12
.....	.....	.....	.....	163.2	184.8	212.5	334.9	.....	13
36.21	42.26	48.85	55.2	60.4	65.7	70	....	83	14
3.79×10^{-4} at 18°	.....	.....	.....	....	....	....	....	.....	15
77.0	80.34	83.8	87.44	91.2	....	99.2	....	107.9	16
1.107	.....	.....	.....	....	....	....	....	.....	17
125.1	.....	.....	.....	....	....	....	....	.....	18
.....	.....	159.8	.....	178.8	....	207.8	....	.....	19
20.7	25	28.5	33.3	40	....	55	....	75.4	20
3.3×10^{-5} at 18°	.....	.....	.....	....	....	....	....	.....	21
1.52$^{25°}$	.....	.....	.....	....	....	....	....	.....	22
91.8	.....	.....	315.1	....	....	525.8	....	535.7	23
115.1	122.2	128.3	.....	144	....	159.7	....	177.8	24
.....	73.0	77.3	82.5	88.7	....	100	....	.....	25
.....	.....	.....	.....	....	....	....	105.3	105.8	26
83.8	.....	.....	.....	165.6	....	....	....	.....	27
26.5	32.9	40.2	48.6	....	....	....	....	.....	28
.....	.....	.....	.....	....	50.9	43.6	37.3	.....	29
0.000616$^{18°}$	.....	.....	.....	....	....	....	....	.....	30
198	.....	.....	171.5	....	....	....	....	130	31
.....	67.3	63.3	59.6	56.1	....	....	....	.....	32
0.029	0.04	0.056	0.078	....	....	....	....	.....	33
.....	1.9	.....	1.5	....	....	....	....	0.69	34
.....	55.04$^{25°}$	.....	.....	....	....	....	....	.....	35
0.85	1.15	1.53	1.94	2.36	....	3.34	....	4.75	36
0.00011	.....	.....	.....	....	....	....	....	.....	37
0.99	1.20	1.45	1.70	1.98	....	2.62	....	3.34	38
7×10^{-6}	.....	.....	.....	....	....	....	....	.....	39
0.064	0.068	.....	.....	....	....	....	....	.....	40
0.068	0.090	0.125	0.164	0.197	....	0.302	....	0.436	41
56.5	66	75	85	95	....	115	....	38.8	42
0.0041	0.0049	0.0056	.....	....	....	....	....	.....	43
8.6×10^{-5} at 18°		.....	.....	....	....	....	....	.....	44
177	191	205	.....	....	....	....	....	.....	45
.....	.....	.....	214	224	....	245	....	266	46
1.33	1.25	1.17	1.08	1.01	....	0.85	....	0.72	47
78.5	84.5	90.5	97	103	....	115	....	127.5	48
12.8	12.9	13	13.3	13.8	....	15.3	....	17.5	49
165	171	179	187	202	230	....	....	.....	50
.....	.....	.....	.....	....	....	435	....	481	51
.....	132.6	.....	.....	....	....	....	....	.....	52
.....	.....	.....	156.4	175.3	....	....	....	.....	53

SOLUBILITIES OF INORGANIC COMPOUNDS

	Substance	Formula	Solid Phase	0°C.	10°C.
1	**Lithium** nitrate	$LiNO_3$	.....	.....	.....
2	sulfate	Li_2SO_4	$1H_2O$	35.3	35.0
3	**Magnesium** bromide	$MgBr_2$	$6H_2O$	91.0	94.5
4	chloride	$MgCl_2$	$6H_2O$	52.8	53.5
5	hydroxide	$Mg(OH)_2$	.....	.....	.....
6	iodide	MgI_2	$8H_2O$	120.8	.....
7	nitrate	$Mg(NO_3)_2$	$6H_2O$	66.55	.....
8	sulfate	$MgSO_4$	$7H_2O$	.....	30.9
9	sulfate	$MgSO_4$	$6H_2O$	40.8	42.2
10	sulfate	$MgSO_4$	$1H_2O$	.....	.....
11	**Manganous** bromide	$MnBr_2$	$4H_2O$	127.3	135.9
12	bromide	$MnBr_2$	$2H_2O$	.....	.....
13	chloride	$MnCl_2$	$4H_2O$	63.4	68.1
14	chloride	$MnCl_2$	$2H_2O$	.....	.....
15	nitrate	$Mn(NO_3)_2$	$6H_2O$	101.98	118.0
16	nitrate	$Mn(NO_3)_2$	$3H_2O$	.....	.....
17	sulfate	$MnSO_4$	$7H_2O$	53.23	60.01
18	sulfate	$MnSO_4$	$5H_2O$	.....	59.5
19	sulfate	$MnSO_4$	$4H_2O$	.....	.....
20	sulfate	$MnSO_4$	$1H_2O$	.....	.....
21	sulfide	MnS	.....	.....	.....
22	**Mercuric** bromide	$HgBr_2$	.....	.....	.....
23	chloride	$HgCl_2$	.....	3.6	4.8
24	cyanide	$Hg(CN)_2$	.....	.....	$9.3^{13.5°}$
25	iodide	HgI_2	.....	.....	.....
26	**Mercurous** bromide	HgBr	.....	.....	.....
27	chloride	HgCl	.....	0.00014	.....
28	iodide	HgI	.....	.....	.....
29	**Molybdic oxide**	MoO_3	$2H_2O$	.....	.....
30	**Neodymium sulfate**	$Nd_2(SO_4)_3$	.....	9.5	.....
31	**Nickel** bromide	$NiBr_2$	$6H_2O$	112.8	122.2
32	carbonate	$NiCO_3$	.....	.....	.....
33	chloride	$NiCl_2$	$6H_2O$	53.9	59.5
34	iodide	NiI_2	$6H_2O$	124.2	135.3
35	nitrate	$Ni(NO_3)_2$	$6H_2O$	79.58	.....
36	nitrate	$Ni(NO_3)_2$	$3H_2O$	.....	.....
37	sulfate	$NiSO_4$	$7H_2O$	27.22	32
38	sulfate	$NiSO_4$	$6H_2O$	.....	.....
39	sulfide	NiS	.....	.....	.....
40	**Nitric oxide, 760 mm**	NO	.....	0.00984	0.00757
41	**Nitrous oxide**	N_2O	.....	.....	0.1705
42	**Ozone**	O_3	.....	0.0039	0.0029
43	**Potassium** acetate	$KC_2H_3O_2$	$1\frac{1}{2}H_2O$	216.7	233.9
44	acetate	$KC_2H_3O_2$	$\frac{1}{2}H_2O$	.....	.....
45	alum	$K_2SO_4 \cdot Al_2(SO_4)_3$	$24H_2O$	3.0	4.0
46	bicarbonate	$KHCO_3$	.....	22.4	27.7
47	bisulfate	$KHSO_4$	.....	36.3	.....
48	bitartrate	$KHC_4H_4O_6$	.....	0.32	0.40
49	bromate	$KBrO_3$	.....	3.1	4.8
50	bromide	KBr	.....	53.5	59.5
51	carbonate	K_2CO_3	$2H_2O$	105.5	108
52	chlorate	$KClO_3$	.....	3.3	5
53	chloride	KCl	.....	27.6	31.0
54	chloroplatinate	K_2PtCl_6	.....	0.74	0.90

IN WATER AT VARIOUS TEMPERATURES

20°C.	30°C.	40°C.	50°C.	60°C.	70°C.	80°C.	90°C.	100°C.	
.....	.....	.....	.....	....	194.1	....	....	.....	1
34.2	33.5	32.7	32.5	31.9	....	30.7	....	29.9	2
96.5	99.2	101.6	104.1	107.5	....	113.7	....	120.2	3
54.5	.....	57.5	.....	61.0	....	66.0	....	73.0	4
$0.0009^{18°}$	.....	.....	.....	....	....	....	....	.....	5
139.8	.....	173.2	.....	....	....	....	....	.....	6
.....	.....	84.74	.....	....	....	....	137.0	.....	7
35.5	40.8	45.6	.....	....	....	....	....	.....	8
44.5	45.3	.....	50.4	53.5	59.5	64.2	69.0	74.0	9
.....	.....	.....	.....	....	....	62.9	....	68.3	10
146.9	157.1	169.0	181.7	197.0	212.5	....	....	.....	11
.....	.....	.....	.....	....	....	224.7	225.7	228.0	12
73.9	80.71	88.59	98.15	....	....	....	....	.....	13
.....	.....	.....	.....	108.6	110.6	112.7	114.1	115.3	14
142.7	.....	.....	.....	....	....	....	....	.....	15
.....	206.6	.....	.....	....	....	....	....	.....	16
.....	.....	.....	.....	....	....	....	....	.....	17
62.9	67.76	.....	.....	....	....	....	....	.....	18
64.5	66.44	68.8	72.6	....	....	....	....	.....	19
.....	.....	.....	58.17	55.0	52.0	48.0	42.5	34.0	20
$0.0006^{18°}$	.....	.....	.....	....	....	....	....	.....	21
0.5	.....	.....	.....	....	....	....	....	25	22
6.5	8.3	10.2	.....	16.2	....	30.0	....	61.3	23
.....	.....	.....	.....	....	....	....	....	$53.85^{101.1°}$	24
.....	$0.0059^{25°}$	.....	.....	....	....	....	....	.....	25
3.9×10^{-6} at 25°	.....	.....	.....	....	....	....	....	.....	26
0.0002	.....	0.0007	.....	....	....	....	....	.....	27
2×10^{-8} at 25°	.....	.....	.....	....	....	....	....	.....	28
0.138	0.264	0.476	0.687	1.206	2.055	2.106	....	.....	29
.....	5	.....	3.7	....	....	2.7	....	....	30
130.9	138.1	144.5	150	152.5	....	153.8	....	155.1	31
$0.0092^{25°}$	.....	.....	.....	....	....	....	....	.....	32
64.2	68.9	73.3	78.3	82.2	85.2	....	....	87.6	33
148.1	161.1	173.9	183.0	184.1	185.7	187.4	188.2	.....	34
96.31	.....	122.2	.....	....	....	....	....	.....	35
.....	.....	.....	.....	163.1	169.1	....	235.1	.....	36
.....	42.46	.....	.....	....	....	....	....	.....	37
.....	.....	.....	50.15	54.80	59.44	63.17	....	76.7	38
$0.0003^{18°}$	.....	.....	.....	....	....	....	....	.....	39
0.00618	0.00517	0.00440	0.00376	0.00324	0.00267	0.00199	0.00114	0	40
0.1211	.....	.....	.....	....	....	....	....	.....	41
0.0021	0.0007	0.0004	0.0001	0	....	....	....	.....	42
255.6	283.8	323.3	.....	....	....	....	....	.....	43
.....	.....	.....	337.3	350	364.8	380.1	396.3	.....	44
5.9	8.39	11.70	17.00	24.75	40.0	71.0	109.0	.....	45
33.2	39.1	45.4	.....	60.0	....	....	....	.....	46
51.4	.....	67.3	.....	....	....	....	....	121.6	47
0.53	0.90	1.32	1.83	2.46	....	4.6	....	6.95	48
6.9	9.5	13.2	17.5	22.7	....	34.0	....	50.0	49
65.2	70.6	75.5	80.2	85.5	90.0	95.0	99.2	104.0	50
110.5	113.7	116.9	121.2	126.8	133.1	139.8	147.5	155.7	51
7.4	10.5	14	19.3	24.5	....	38.5	....	57	52
34.0	37.0	40.0	42.6	45.5	48.3	51.1	54.0	56.7	53
1.12	1.41	1.76	2.17	2.64	3.19	3.79	4.45	5.18	54

SOLUBILITIES OF INORGANIC COMPOUNDS

	Substance	Formula	Solid Phase	0°C.	10°C.
1	**Potassium** chromate	K_2CrO_4	.....	58.2	60.0
2	dichromate	$K_2Cr_2O_7$	.....	5	7
3	ferricyanide	$K_3Fe(CN)_6$	.....	31	36
4	hydroxide	KOH	$2H_2O$	97	103
5	hydroxide	KOH	$1H_2O$	.....	.....
6	iodate	KIO_3	.....	4.73	.....
7	iodide	KI	.....	127.5	136
8	nitrate	KNO_3	.....	13.3	20.9
9	nitrite	KNO_2	.....	278.8	.....
10	perchlorate	$KClO_4$	.....	0.75	1.05
11	permanganate	$KMnO_4$	.....	2.83	4.4
12	†persulfate	$K_2S_2O_8$†	†	1.62	2.60
13	sulfate	K_2SO_4	.....	7.35	9.22
14	thiocyanate	KCNS	.....	177.0	.....
15	**Rubidium** chlorate	$RbClO_3$	.....	2.14	.....
16	chloride	RbCl	.....	77	84.4
17	nitrate	$RbNO_3$	.....	19.5	33
18	perchlorate	$RbClO_4$	.....	0.5	0.6
19	sulfate	Rb_2SO_4	.....	36.4	42.6
20	**Selenic** acid	H_2SeO_4	$1H_2O$	426	.....
21	acid	H_2SeO_4	.....	.....	.....
22	**Selenious acid**	H_2SeO_3	.....	90.1	122.2
23	**Silver** acetate	$AgC_2H_3O_2$	.....	0.72	0.88
24	arsenate	Ag_3AsO_4	.....	.....	.....
25	arsenite	Ag_3AsO_3	.....	.....	.....
26	bromide	AgBr	.....	.....	.....
27	carbonate	Ag_2CO_3	.....	.....	.....
28	chloride	AgCl	.....	.....	8.9×10^{-5}
29	chromate	Ag_2CrO_4	.....	0.0014	.....
30	cyanide	AgCN	.....	.....	.....
31	ferricyanide	$Ag_3Fe(CN)_6$	.....	.....	.....
32	iodate	$AgIO_3$	.....	.....	0.003
33	iodide	AgI	.....	.....	.....
34	nitrate	$AgNO_3$	.....	122	170
35	nitrite	$AgNO_2$	.....	0.155	0.220
36	sulfate	Ag_2SO_4	.....	0.573	0.695
37	sulfide	Ag_2S	.....	.....	.....
38	**Sodium** acetate	$NaC_2H_3O_2$	$3H_2O$	36.3	40.8
39	acetate	$NaC_2H_3O_2$	.....	119	121
40	bicarbonate	$NaHCO_3$	.....	6.9	8.15
41	bromate	$NaBrO_3$	.....	27.5	.....
42	bromide	NaBr	$2H_2O$	79.5	.....
43	bromide	NaBr	.....	.....	.....
44	carbonate	Na_2CO_3	$10H_2O$	7	12.5
45	carbonate	Na_2CO_3	$1H_2O$	.....	.....
46	chlorate	$NaClO_3$	.....	79	89
47	chloride	NaCl	.....	35.7	35.8
48	chromate	Na_2CrO_4	$10H_2O$	31.70	50.17
49	chromate	Na_2CrO_4	$4H_2O$	.....	.....
50	chromate	Na_2CrO_4	.....	.....	.....
51	dichromate	$Na_2Cr_2O_7$	$2H_2O$	163.0	.....
52	dichromate	$Na_2Cr_2O_7$	.....	.....	.....
53	dihydrogen phosphate	NaH_2PO_4	$2H_2O$	57.9	69.9
54	dihydrogen phosphate	NaH_2PO_4	$1H_2O$	.....	.....
55	dihydrogen phosphate	NaH_2PO_4	.....	.....	.....
56	ferrocyanide	$Na_4Fe(CN)_6$	.....	.....	.....

IN WATER AT VARIOUS TEMPERATURES

20°C.	30°C.	40°C.	50°C.	60°C.	70°C.	80°C.	90°C.	100°C.	
61.7	63.4	65.2	66.8	68.6	70.4	72.1	73.9	75.6	1
12	20	26	34	43	52	61	70	80	2
43	50	60	.....	66	....	....	....	82.6^{104}	3
112	126	.....	.....	....	....	....	....	.....	4
.....	.....	.....	140	....	....	....	....	178	5
8.13	11.73	12.8	.....	18.5	....	24.8	....	32.2	6
144	152	160	168	176	184	192	200	208	7
31.6	45.8	63.9	85.5	110.0	138	169	202	246	8
298.4	.....	334.9	.....	....	....	....	....	412.8	9
1.80	2.6	4.4	6.5	9	11.8	14.8	18	21.8	10
6.4	9.0	12.56	16.89	22.2	....	....	....	.....	11
4.49	7.19	9.89	.....	....	....	....	....	.....	12
11.11	12.97	14.76	16.50	18.17	19.75	21.4	22.8	24.1	13
217.5	.....	.....	.....	....	....	....	....	.....	14
5.4	8	.....	15.98	....	....	....	....	62.8	15
91.1	97.6	103.5	109.3	115.5	121.4	127.2	133.1	138.9	16
53.3	81.3	116.7	155.6	200	251	309	375	452	17
1.0	1.5	2.3	3.5	4.85	6.72	9.2	12.7	18	18
48.2	53.5	58.5	63.1	67.4	71.4	75.0	78.7	81.8	19
567	.....	.....	.....	....	....	....	....	.....	20
1329	1718	2757	∞	....	....	....	....	.....	21
166.7	235.6	344.4	380.8	383.9	383.9	383.9	385.4	.....	22
1.04	1.21	1.41	1.64	1.89	2.18	2.52	....	.....	23
0.00085	.....	.....	.....	....	....	....	....	.....	24
0.00115	.....	.....	.....	....	....	....	....	.....	25
8.4×10^{-6}	.....	.....	.....	....	....	....	....	.....	26
0.0032	.....	.....	.....	....	....	....	....	0.05	27
1.5×10^{-4}	.....	.....	0.0005	....	....	....	....	0.002	28
.....	0.0036	.....	0.0053	....	0.008	....	....	0.011	29
2.2×10^{-5}	.....	.....	.....	....	....	....	....	.....	30
6.6×10^{-5}	.....	.....	.....	....	....	....	....	.....	31
0.004	.....	.....	.....	0.018	....	....	....	.....	32
.....	3×10^{-7}	.....	.....	3×10^{-6}	....	....	....	.....	33
222	300	376	455	525	....	669	....	952	34
0.340	0.5	0.715	0.995	1.363	....	....	....	.....	35
0.796	0.888	0.979	1.08	1.15	1.22	1.30	1.36	1.41	36
1.4×10^{-5}	.....	.....	.....	....	....	....	....	.....	37
46.5	54.5	65.5	83	139	....	....	....	.....	38
123.5	126	129.5	134	139.5	146	153	161	170	39
9.6	11.1	12.7	14.45	16.4	....	....	....	.....	40
34.5	.....	50.2	.....	62.5	....	75.7	....	90.9	41
90.5	97.6	105.8	116.0	....	....	....	....	.....	42
.....	.....	.....	.....	....	....	118.3	....	121.2	43
21.5	38.8	.....	.....	....	....	....	....	.....	44
.....	50.5	48.5	.....	46.4	....	45.8	....	45.5	45
101	113	126	140	155	172	189	....	230	46
36.0	36.3	36.6	37.0	37.3	37.8	38.4	39.0	39.8	47
88.7	.....	.....	.....	....	....	....	....	.....	48
.....	88.7	95.96	104	114.6	....	....	....	.....	49
.....	.....	.....	.....	....	123.0	124.8	....	125.9	50
177.8	.....	.....	244.8	....	316.7	376.2	....	.....	51
.....	.....	.....	.....	....	....	....	....	426.3	52
85.2	106.5	138.2	.....	....	....	....	....	.....	53
.....	.....	.....	158.6	....	....	....	....	.....	54
.....	.....	.....	.....	179.3	190.3	207.3	225.3	246.6	55
17.9	.....	30	.....	....	....	59	....	63	56

SOLUBILITIES OF INORGANIC COMPOUNDS

	Substance	Formula	Solid Phase	0°C.	10°C.
1	**Sodium** hydrogen arsenate	Na_2HAsO_4	$12H_2O$	7.3	15.5
2	hydrogen phosphate	Na_2HPO_4	$12H_2O$	1.67	3.6
3	hydrogen phosphate	Na_2HPO_4	$7H_2O$	.....	.....
4	hydrogen phosphate	Na_2HPO_4	$2H_2O$	.....	.....
5	hydrogen phosphate	Na_2HPO_4	.....	.....	.....
6	hydroxide	NaOH	$4H_2O$	42	.....
7	hydroxide	NaOH	$3\frac{1}{2}H_2O$	.....	51.5
8	hydroxide	NaOH	$1H_2O$	.....	.....
9	hydroxide	NaOH	.....	.....	.....
10	iodate	$NaIO_3$	.....	2.5	.....
11	iodide	NaI	$2H_2O$	158.7	168.6
12	iodide	NaI	.....	.....	.....
13	nitrate	$NaNO_3$	.....	73	80
14	nitrite	$NaNO_2$	.....	72.1	78.0
15	oxalate	$Na_2C_2O_4$	.....	.....	.....
16	phosphate, tri-	Na_3PO_4	$12H_2O$	1.5	4.1
17	pyrophosphate	$Na_4P_2O_7$	$10H_2O$	3.16	3.95
18	selenate	Na_2SeO_4	$10H_2O$	13.30	.....
19	selenate	Na_2SeO_4	.....	.....	.....
20	sulfate	Na_2SO_4	$10H_2O$	5.0	9.0
21	sulfate	Na_2SO_4	$7H_2O$	19.5	30
22	sulfate	Na_2SO_4	.....	.....	.....
23	sulfide	Na_2S	$9H_2O$	.....	15.42
24	sulfide	Na_2S	$5\frac{1}{2}H_2O$	.....	.....
25	sulfide	Na_2S	$6H_2O$	.....	.....
26	sulfite	Na_2SO_3	$7H_2O$	13.9	20
27	sulfite	Na_2SO_3	.....	.....	.....
28	tetraborate	$Na_2B_4O_7$	$10H_2O$	1.3	1.6
29	tetraborate	$Na_2B_4O_7$	$5H_2O$	.....	.....
30	tungstate	Na_2WO_4	$10H_2O$	57.58	.....
31	tungstate	Na_2WO_4	$2H_2O$	71.61	.....
32	vanadate (meta)	$NaVO_3$	$2H_2O$	.....	.....
33	vanadate (meta)	$NaVO_3$	.....	.....	.....
34	**Stannous** chloride	$SnCl_2$	.....	83.9	.....
35	iodide	SnI_2	.....	.....	.....
36	sulfate	$SnSO_4$	.....	.....	.....
37	**Strontium** acetate	$Sr(C_2H_3O_2)_2$	$4H_2O$	36.9	43.61
38	acetate	$Sr(C_2H_3O_2)_2$	$\frac{1}{2}H_2O$	.....	42.95
39	bromide	$SrBr_2$	$6H_2O$	85.2	93
40	chloride	$SrCl_2$	$6H_2O$	43.5	47.7
41	chloride	$SrCl_2$	$2H_2O$	.....	.....
42	iodide	SrI_2	$6H_2O$	165.3	.....
43	iodide	SrI_2	$2H_2O$	.....	.....
44	nitrate	$Sr(NO_3)_2$	$1H_2O$	52.7	.....
45	nitrate	$Sr(NO_3)_2$	$4H_2O$	40.1	.....
46	nitrate	$Sr(NO_3)_2$	.....	.....	.....
47	oxalate	SrC_2O_4	$1H_2O$	0.0033	0.0044
48	sulfate	$SrSO_4$	.....	0.0113	.....
49	**Sulfur dioxide, 760 mm**	SO_2	.....	22.83	16.21
50	**Telluric** acid	H_2TeO_4	$6H_2O$	16.17	35.52
51	acid	H_2TeO_4	$2H_2O$	.....	33.85
52	**Thallium** bromate	$TlBrO_3$	.....	.....	.....
53	bromide	TlBr	.....	0.024	0.029
54	chlorate	$TlClO_3$	.....	2.8	.....
55	chloride	TlCl	.....	0.21	0.25

IN WATER AT VARIOUS TEMPERATURES

20°C.	30°C.	40°C.	50°C.	60°C.	70°C.	80°C.	90°C.	100°C.	
26.5	37	47	.....	65	....	85	....	.....	1
7.7	20.8	.....	.....	....	....	....	....	.....	2
.....	.....	51.8	.....	....	....	....	....	.....	3
.....	.....	.....	80.2	82.9	88.1	92.4	102.9	.....	4
.....	.....	.....	.....	....	....	....	....	102.2	5
.....	.....	.....	.....	....	....	....	....	.....	6
.....	.....	.....	.....	....	....	....	....	.....	7
109	119	129	145	174	....	....	....	.....	8
.....	.....	.....	.....	....	....	....	313	347	9
9	.....	15	.....	21	....	27	....	34	10
178.7	190.3	205.0	227.8	256.8	....	....	....	.....	11
.....	.....	.....	.....	....	294	296	....	302	12
88	96	104	114	124	....	148	....	180	13
84.5	91.6	98.4	104.1	....	....	132.6	....	163.2	14
3.7	.....	.....	.....	....	....	....	....	6.33	15
11	20	31	43	55	....	81	....	108	16
6.23	9.95	13.50	17.45	21.83	....	30.04	....	40.26	17
.....	78.73	.....	.....	....	....	....	....	.....	18
.....	.....	.....	80.15	....	....	....	....	72.83	19
19.4	40.8	.....	.....	....	....	....	....	.....	20
44	.....	.....	.....	....	....	....	....	.....	21
.....	.....	48.8	46.7	45.3	....	43.7	....	42.5	22
18.8	22.5	28.5	....	....	....	....	....	.....	23
.....	.....	.....	39.82	42.69	45.73	51.40	59.23	.....	24
.....	.....	.....	36.4	39.1	43.31	49.14	57.28	.....	25
26.9	36	.....	.....	....	....	....	....	.....	26
.....	.....	28	28.2	28.8	....	28.3	....	.....	27
2.7	3.9	.....	10.5	20.3	....	....	....	.....	28
.....	.....	.....	.....	....	24.4	31.5	41	52.5	29
.....	.....	.....	.....	....	....	....	....	.....	30
72.4	.....	.....	.....	....	....	91.2	....	97.2	31
$15.3^{25°}$	.....	30.2	.....	68.4	....	....	....	.....	32
$21.10^{25°}$	.....	26.23	.....	32.97	36.9	$38.8^{75°}$	....	.....	33
$269.8^{15°}$	.....	.....	.....	....	....	....	....	.....	34
1.0	1.2	1.4	1.7	2.1	2.5	3.0	3.4	4.0	35
19	.....	.....	.....	....	....	....	....	18	36
.....	.....	.....	.....	....	....	....	....	.....	37
41.6	39.5	.....	37.35	....	36.24	36.10	....	36.4	38
102.4	111.9	123.2	135.8	150	....	181.8	....	222.5	39
52.9	58.7	65.3	72.4	81.8	....	....	....	.....	40
.....	.....	.....	.....	....	85.9	90.5	....	100.8	41
177.8	.....	191.5	.....	217.5	....	270.4	....	.....	42
.....	.....	.....	.....	....	....	....	365.2	383.1	43
64.0	.....	.....	83.8	97.2	....	....	130.4	139	44
70.5	.....	.....	.....	....	....	....	....	.....	45
.....	88.6	90.1	.....	93.8	96	98	100	.....	46
0.0046	0.0057	.....	.....	....	....	....	....	.....	47
0.0114	0.0114	.....	.....	....	....	....	....	.....	48
11.29	7.81	5.41	4.5	....	....	....	....	.....	49
.....	.....	.....	.....	....	....	....	....	.....	50
.....	50.06	57.19	.....	77.52	....	106.4	....	155.3	51
0.346	.....	0.736	.....	....	....	....	....	.....	52
0.042	.....	.....	.....	....	....	....	....	.....	53
3.92	.....	.....	12.67	....	....	36.65	....	57.31	54
0.33	0.42	0.52	0.63	0.8	....	1.2	....	1.8	55

SOLUBILITIES OF INORGANIC COMPOUNDS

	Substance	Formula	Solid Phase	0°C.	10°C.
1	**Thallium** hydroxide	TlOH	.....	25.44	.....
2	iodide	TlI	.....	.....	0.0036
3	nitrate	$TlNO_3$	.....	3.91	6.22
4	perchlorate	$TlClO_4$	.....	6	8.04
5	selenate	Tl_2SeO_4	.....	.....	2.13
6	sulfate	Tl_2SO_4	.....	2.70	3.70
7	sulfide	Tl_2S	.....	.....	.....
8	**Thorium** selenate	$Th(SeO_4)_2$	.....	0.498	.....
9	sulfate	$Th(SO_4)_2$	$9H_2O$	0.74	0.98
10	sulfate	$Th(SO_4)_2$	$8H_2O$	1.0	1.25
11	sulfate	$Th(SO_4)_2$	$6H_2O$	1.50	.....
12	sulfate	$Th(SO_4)_2$	$4H_2O$	.....	.....
13	**Uranyl nitrate**	$UO_2(NO_3)_2$	$6H_2O$	98.0	108.3
14	**Ytterbium sulfate**	$Yb_2(SO_4)_3$	$8H_2O$	44.2	38.4
15	**Zinc** bromide	$ZnBr_2$	$2H_2O$	389.0	.....
16	bromide	$ZnBr_2$	.....	.....	.....
17	chlorate	$ZnClO_3$	$6H_2O$	145.0	152.5
18	chlorate	$ZnClO_3$	$4H_2O$	.....	.....
19	iodide	ZnI_2	$2H_2O$	430.9	457.4
20	iodide	ZnI_2	.....	429.4	.....
21	nitrate	$Zn(NO_3)_2$	$6H_2O$	94.78	.....
22	nitrate	$Zn(NO_3)_2$	$3H_2O$	.....	.....
23	sulfate	$ZnSO_4$	$7H_2O$	41.9	47
24	sulfate	$ZnSO_4$	$6H_2O$	.....	.....
25	sulfate	$ZnSO_4$	$1H_2O$	.....	.....

SOLUBILITY OF CANE SUGAR IN WATER

Temp. °C.	Per cent sugar	Grams of sugar in 100g H_2O
0	64.18	179.2
5	64.87	184.7
10	65.58	190.5
15	66.33	197.0
20	67.09	203.9
25	67.89	211.4
30	68.80	219.5
35	69.55	228.4
40	70.42	238.1
45	71.32	248.7

Temp. °C.	Per cent sugar	Grams of sugar in 100g H_2O
50	72.25	260.4
55	73.20	273.1
60	74.18	287.3
65	75.88	315.0
70	76.22	320.4
75	77.27	339.9
80	78.36	362.1
85	79.46	386.9
90	80.61	415.7
95	81.77	448.5
100	82.97	487.2

IN WATER AT VARIOUS TEMPERATURES

20°C.	30°C.	40°C.	50°C.	60°C.	70°C.	80°C.	90°C.	100°C.	
.....	39.9	49.5	.....	73.8	....	106	126.1	148.3	1
0.006	0.008	0.015	.....	0.035	.....	0.070	....	0.120	2
9.55	14.3	20.9	30.4	46.2	69.5	111.0	200.0	414.0	3
.....	19.72	.....	39.62	....	65.32	81.49	....	166.6	4
2.8	.....	.....	.....	.....	....	8.5	....	10.9	5
4.87	6.16	.....	9.21	10.92	12.74	14.61	16.53	18.45	6
0.0022	.....	.....	.....	....	....	....	....	.....	7
.....	.....	.....	.....	....	....	....	....	1.97	8
1.38	1.995	2.998	5.22	....	....	....	....	.....	9
1.62	.....	.....	.....	....	....	....	....	.....	10
1.90	2.45	.....	.....	6.64	....	....	....	.....	11
.....	.....	4.04	2.54	1.63	1.09	....	....	.....	12
125.5	.....	.....	203	....	....	....	....	.....	13
.....	21.0	.....	....	10.4	7.22	6.92	5.83	4.67	14
446.4	528.1	.....	.....	....	....	....	....	.....	15
.....	.....	591.1	.....	618.4	....	644.6	....	672.2	16
.....	.....	.....	.....	....	....	....	....	.....	17
200.3	209.2	223.2	273.1	....	....	....	....	.....	18
484.8	.....	.....	.....	....	....	....	....	.....	19
.....	.....	445.2	.....	467.2	....	490	....	510.5	20
118.3	.....	.....	.....	....	....	....	....	.....	21
.....	.....	206.9	.....	....	....	....	....	.....	22
54.4	.....	.....	.....	.....	....	....	....	.....	23
.....	.....	70.1	76.8	....	....	....	....	.....	24
.....	.....	.....	.....	....	....	86.6	83.7	80.8	25

SOLUBILITY OF GASES IN WATER

The column headed "α" gives the volume of gas reduced to standard conditions (0°C and 760 mm) dissolved in one volume of water when the pressure of the gas (without the aqueous tension) is 760 mm; this value "α" is the "absorption coefficient." The column headed "l" gives the volume of the gas expressed in cubic centimeters dissolved in one volume of water at a total pressure (partial pressure of the gas plus the aqueous tension at the stated temperature) of 760 mm. The column headed "q" gives the weight of gas in grams dissolved in 100 grams of water at a total pressure (partial pressure of the gas plus the aqueous tension at the stated temperature) of 760 mm.

Temp. Deg. C.	ACETYLENE		AIR*		AMMONIA		BROMINE	
			cc/1000cc	%Oxygen in dissd. air.				
	α	q			α	q	α	q
0	1.73	0.200	29.18	34.91	1176	89.5	60.5	42.9
1	1.68	0.194	28.42	34.87	....	....	....	....
2	1.63	0.188	27.69	34.82	....	....	54.1	38.3
3	1.58	0.182	26.99	34.78	....	....	....	....
4	1.53	0.176	26.32	34.74	1047	79.6	48.3	34.2
5	1.49	0.171	25.68	34.69	....	....	....	....
6	1.45	0.167	25.06	34.65	....	....	43.3	30.6
7	1.41	0.162	24.47	34.60	....	....	....	....
8	1.37	0.157	23.90	34.56	947	72.0	38.9	27.5
9	1.34	0.154	23.36	34.52	....	....	....	....
10	1.31	0.150	22.84	34.47	....	....	35.1	24.8
11	1.27	0.146	22.34	34.43	....	....	....	....
12	1.24	0.142	21.87	34.38	857	65.1	31.5	22.2
13	1.21	0.138	21.41	34.34	837	63.6	....	....
14	1.18	0.135	20.97	34.30	....	....	28.4	20.0
15	1.15	0.131	20.55	34.25	....	....	....	....
16	1.13	0.129	20.14	34.21	775	58.7	25.7	18.0
17	1.10	0.125	19.75	34.17	....	....	....	....
18	1.08	0.123	19.38	34.12	....	....	23.4	16.4
19	1.05	0.119	19.02	34.08	....	....	....	....
20	1.03	0.117	18.68	34.03	702	53.1	21.3	14.9
21	1.01	0.115	18.34	33.99	....	....	....	....
22	0.99	0.112	18.01	33.95	....	....	19.4	13.5
23	0.97	0.110	17.69	33.90	....	....	....	....
24	0.95	0.107	17.38	33.86	639	48.2	17.7	12.3
25	0.93	0.105	17.08	33.82	....	....	....	....
26	0.91	0.102	16.79	33.77	....	....	16.3	11.3
27	0.89	0.100	16.50	33.73	....	....	....	....
28	0.87	0.098	16.21	33.68	586	44.0	15.0	10.3
29	0.85	0.095	15.92	33.64	....	....	....	....
30	0.84	0.094	15.64	33.60	....	....	13.8	9.5
35	....	.....	.....	.....	....	....	....	....
40	....	.....	.....	.....	....	....	9.4	6.3
45	....	.....	.....	.....	....	....	....	....
50	....	.....	.....	.....	....	....	6.5	4.1
60	....	.....	.....	.....	....	....	4.9	2.9
70	....	.....	.....	.....	....	....	3.8	1.9
80	....	.....	.....	.....	....	....	3.0	1.2
90	....	.....	.....	.....	....	....	....	....
100	....	.....	.....	.....	....	....	....	....

* Free from NH_3 and CO_2; total pressure of air + aq. tension is 760 mm.

Temp.	CARBON DIOXIDE		CARBON MONOXIDE		CHLORINE		ETHANE		ETHYLENE		HYDROGEN	
°C.	α	q	α	q	l	q	α	q	α	q	α	q
0	1.713	0.3346	0.03537	0.004397	.....	.....	0.09874	0.01317	0.226	0.0281	0.02148	0.0001922
1	1.646	0.3213	0.03455	0.004293	.....	.....	0.09476	0.01263	0.219	0.0272	0.02126	0.0001901
2	1.584	0.3091	0.03375	0.004191	.....	.....	0.09093	0.01212	0.211	0.0262	0.02105	0.0001881
3	1.527	0.2978	0.03297	0.004092	.....	.....	0.08725	0.01162	0.204	0.0253	0.02084	0.0001862
4	1.473	0.2871	0.03222	0.003996	.....	.....	0.08372	0.01114	0.197	0.0244	0.02064	0.0001843
5	1.424	0.2774	0.03149	0.003903	.....	.....	0.08033	0.01069	0.191	0.0237	0.02044	0.0001824
6	1.377	0.2681	0.03078	0.003813	.....	.....	0.07709	0.01025	0.184	0.0228	0.02025	0.0001806
7	1.331	0.2589	0.03009	0.003725	.....	.....	0.07400	0.00983	0.178	0.0220	0.02007	0.0001789
8	1.282	0.2492	0.02942	0.003640	.....	.....	0.07106	0.00943	0.173	0.0214	0.01989	0.0001772
9	1.237	0.2403	0.02878	0.003559	.....	.....	0.06826	0.00906	0.167	0.0207	0.01972	0.0001756
10	1.194	0.2318	0.02816	0.003479	3.148	0.9972	0.06561	0.00870	0.162	0.0200	0.01955	0.0001740
11	1.154	0.2239	0.02757	0.003405	3.047	0.9654	0.06328	0.00838	0.157	0.0194	0.01940	0.0001725
12	1.117	0.2165	0.02701	0.003332	2.950	0.9346	0.06106	0.00808	0.152	0.0188	0.01925	0.0001710
13	1.083	0.2098	0.02646	0.003261	2.856	0.9050	0.05894	0.00780	0.148	0.0183	0.01911	0.0001696
14	1.050	0.2032	0.02593	0.003194	2.767	0.8768	0.05694	0.00753	0.143	0.0176	0.01897	0.0001682
15	1.019	0.1970	0.02543	0.003130	2.680	0.8495	0.05504	0.00727	0.139	0.0174	0.01883	0.0001668
16	0.985	0.1903	0.02494	0.003066	2.597	0.8232	0.05326	0.00703	0.136	0.0167	0.01869	0.0001654
17	0.956	0.1845	0.02448	0.003007	2.517	0.7979	0.05159	0.00680	0.132	0.0162	0.01856	0.0001641
18	0.928	0.1789	0.02402	0.002947	2.440	0.7738	0.05003	0.00659	0.129	0.0158	0.01844	0.0001628
19	0.902	0.1737	0.02360	0.002891	2.368	0.7510	0.04858	0.00639	0.125	0.0153	0.01831	0.0001616
20	0.878	0.1688	0.02319	0.002838	2.299	0.7293	0.04724	0.00620	0.122	0.0149	0.01819	0.0001603
21	0.854	0.1640	0.02281	0.002789	2.238	0.7100	0.04589	0.00602	0.119	0.0146	0.01805	0.0001588
22	0.829	0.1590	0.02244	0.002739	2.180	0.6918	0.04459	0.00584	0.116	0.0142	0.01792	0.0001575
23	0.804	0.1540	0.02208	0.002691	2.123	0.6739	0.04335	0.00567	0.114	0.0139	0.01779	0.0001561
24	0.781	0.1493	0.02174	0.002646	2.070	0.6572	0.04217	0.00551	0.111	0.0135	0.01766	0.0001548
25	0.759	0.1449	0.02142	0.002603	2.019	0.6413	0.04104	0.00535	0.108	0.0131	0.01754	0.0001535
26	0.738	0.1406	0.02110	0.002560	1.970	0.6259	0.03997	0.00520	0.106	0.0129	0.01742	0.0001522
27	0.718	0.1366	0.02080	0.002519	1.923	0.6112	0.03895	0.00506	0.104	0.0126	0.01731	0.0001509
28	0.699	0.1327	0.02051	0.002479	1.880	0.5975	0.03799	0.00493	0.102	0.0123	0.01720	0.0001496
29	0.682	0.1292	0.02024	0.002442	1.839	0.5847	0.03709	0.00480	0.100	0.0121	0.01709	0.0001484
30	0.665	0.1257	0.01998	0.002405	1.799	0.5723	0.03624	0.00468	0.098	0.0118	0.01699	0.0001474
35	0.592	0.1105	0.01877	0.002231	1.602	0.5104	0.03230	0.00412	.....	.....	0.01666	0.0001425
40	0.530	0.0973	0.01775	0.002075	1.438	0.4590	0.02915	0.00366	.....	.....	0.01644	0.0001384
45	0.479	0.0860	0.01690	0.001933	1.322	0.4228	0.02660	0.00327	.....	.....	0.01624	0.0001341
50	0.436	0.0761	0.01615	0.001797	1.225	0.3925	0.02459	0.00294	.....	.....	0.01608	0.0001287
60	0.359	0.0576	0.01488	0.001522	1.023	0.3295	0.02177	0.00239	.....	.....	0.01600	0.0001178
70	.....	.....	0.01440	0.001276	0.862	0.2793	0.01948	0.00185	.....	.....	0.0160	0.000102
80	.....	.....	0.01430	0.000980	0.683	0.2227	0.01826	0.00134	.....	.....	0.0160	0.000079
90	.....	.....	0.0142	0.00057	0.39	0.127	0.0176	0.0008	.....	.....	0.0160	0.000046
100	.....	.....	0.0141	0.00000	0.00	0.000	0.0172	0.0000	.....	.....	0.0160	0.000000

Temp. °C.	HYDROGEN SULFIDE		METHANE		NITRIC OXIDE		NITROGEN*		OXYGEN		SULFUR DIOXIDE	
	α	q	α	q	α	q	α	q	α	q	l	q
0	4.670	0.7066	0.05563	0.003959	0.07381	0.009833	0.02354	0.002942	0.04889	0.006945	79.789	22.83
1	4.522	0.6839	0.05401	0.003842	0.07184	0.009564	0.02297	0.002869	0.04758	0.006756	77.210	22.09
2	4.379	0.6619	0.05244	0.003728	0.06993	0.009305	0.02241	0.002798	0.04633	0.006574	74.691	21.37
3	4.241	0.6407	0.05093	0.003619	0.06809	0.009057	0.02187	0.002730	0.04512	0.006400	72.230	20.66
4	4.107	0.6201	0.04946	0.003513	0.06632	0.008816	0.02135	0.002663	0.04397	0.006232	69.828	19.98
5	3.977	0.6001	0.04805	0.003410	0.06461	0.008584	0.02086	0.002600	0.04287	0.006072	67.485	19.31
6	3.852	0.5809	0.04669	0.003312	0.06298	0.008361	0.02037	0.002537	0.04180	0.005918	65.200	18.65
7	3.732	0.5624	0.04539	0.003217	0.06140	0.008147	0.01990	0.002477	0.04080	0.005773	62.973	18.02
8	3.616	0.5446	0.04413	0.003127	0.05990	0.007943	0.01945	0.002419	0.03983	0.005632	60.805	17.40
9	3.505	0.5276	0.04292	0.003039	0.05846	0.007747	0.01902	0.002365	0.03891	0.005498	58.697	16.80
10	3.399	0.5112	0.04177	0.002955	0.05709	0.007560	0.01861	0.002312	0.03802	0.005368	56.647	16.21
11	3.300	0.4960	0.04072	0.002879	0.05587	0.007393	0.01823	0.002263	0.03718	0.005246	54.655	15.64
12	3.206	0.4814	0.03970	0.002805	0.05470	0.007233	0.01786	0.002216	0.03637	0.005128	52.723	15.09
13	3.115	0.4674	0.03872	0.002733	0.05357	0.007078	0.01750	0.002170	0.03559	0.005014	50.849	14.56
14	3.028	0.4540	0.03779	0.002665	0.05250	0.006930	0.01717	0.002126	0.03486	0.004906	49.033	14.04
15	2.945	0.4411	0.03690	0.002599	0.05147	0.006788	0.01685	0.002085	0.03415	0.004802	47.276	13.54
16	2.865	0.4287	0.03606	0.002538	0.05049	0.006652	0.01654	0.002045	0.03348	0.004703	45.578	13.05
17	2.789	0.4169	0.03525	0.002478	0.04956	0.006524	0.01625	0.002006	0.03283	0.004606	43.939	12.59
18	2.717	0.4056	0.03448	0.002422	0.04868	0.006400	0.01597	0.001970	0.03220	0.004514	42.360	12.14
19	2.647	0.3948	0.03376	0.002369	0.04785	0.006283	0.01570	0.001935	0.03161	0.004426	40.838	11.70
20	2.582	0.3846	0.03308	0.002319	0.04706	0.006173	0.01545	0.001901	0.03102	0.004339	39.374	11.28
21	2.517	0.3745	0.03243	0.002270	0.04625	0.006059	0.01522	0.001869	0.03044	0.004252	37.970	10.88
22	2.456	0.3648	0.03180	0.002222	0.04545	0.005947	0.01498	0.001838	0.02988	0.004169	36.617	10.50
23	2.396	0.3554	0.03119	0.002177	0.04469	0.005838	0.01475	0.001809	0.02934	0.004087	35.302	10.12
24	2.338	0.3463	0.03061	0.002133	0.04395	0.005733	0.01454	0.001780	0.02881	0.004007	34.026	9.76
25	2.282	0.3375	0.03006	0.002091	0.04323	0.005630	0.01434	0.001751	0.02831	0.003931	32.786	9.41
26	2.229	0.3290	0.02952	0.002050	0.04254	0.005530	0.01413	0.001724	0.02783	0.003857	31.584	9.06
27	2.177	0.3208	0.02901	0.002011	0.04188	0.005435	0.01394	0.001698	0.02736	0.003787	30.422	8.73
28	2.128	0.3130	0.02852	0.001974	0.04124	0.005342	0.01376	0.001672	0.02691	0.003718	29.314	8.42
29	2.081	0.3055	0.02806	0.001938	0.04063	0.005252	0.01358	0.001647	0.02649	0.003651	28.210	8.10
30	2.037	0.2983	0.02762	0.001904	0.04004	0.005165	0.01342	0.001624	0.02608	0.003588	27.161	7.80
35	1.831	0.2648	0.02546	0.001733	0.03734	0.004757	0.01256	0.001501	0.02440	0.003315	22.489	6.47
40	1.660	0.2361	0.02369	0.001586	0.03507	0.004394	0.01184	0.001391	0.02306	0.003082	18.766	5.41
45	1.516	0.2110	0.02238	0.001466	0.03311	0.004059	0.01130	0.001300	0.02187	0.002858	.....	.....
50	1.392	0.1883	0.02134	0.001359	0.03152	0.003758	0.01088	0.001216	0.02090	0.002657	.....	.....
60	1.190	0.1480	0.01954	0.001144	0.02954	0.003237	0.01023	0.001052	0.01946	0.002274	.....	.....
70	1.022	0.1101	0.01825	0.000926	0.02810	0.002668	0.00977	0.000851	0.01833	0.001856	.....	.....
80	0.917	0.0765	0.01770	0.000695	0.02700	0.001984	0.00958	0.000660	0.01761	0.001381	.....	.....
90	0.84	0.041	0.01735	0.00040	0.0265	0.00113	0.0095	0.00038	0.0172	0.00079	.....	.....
100	0.81	0.000	0.0170	0.00000	0.0263	0.00000	0.0095	0.00000	0.0170	0.00000	.....	.....

*Atmospheric Nitrogen containing 98.815% N_2 by volume + 1.185% inert gases.

SOLUBILITY PRODUCT

In a saturated solution of any given salt, the product of the concentrations of the ions which are combining to form the salt, is a constant. If more than one ion of the same kind enters into the formation of one molecule of the compound then the concentration of that ion must be raised to a power equal to the number of such ions entering into one molecule of the compound. The concentrations are expressed as gram molecular concentrations per liter. For example, silver acetate has a solubility of 10.07 grams per liter at 16°C. Its molecular weight is 167 and it is 70.8% ionized. Therefore, its molar concentration would be 10.07/167 and since it is 70.8% ionized, the Ag ion concentration would be $10.07/167 \times 70.8\%$ or 0.0427. Since for each silver ion there is an acetate ion, the acetate ion concentration would be the same as for the silver ion. Hence the solubility product would be $0.0427 \times 0.0427 = 0.00182$ at 16 °C.

Substance	Formula	Temp. °C.	Solubility-Product
Aluminum hydroxide	$Al(OH)_3$	15°	4×10^{-13}
Aluminum hydroxide	$Al(OH)_3$	18°	1.1×10^{-15}
Aluminum hydroxide	$Al(OH)_3$	25°	3.7×10^{-15}
Barium carbonate	$BaCO_3$	16°	7×10^{-9}
Barium carbonate	$BaCO_3$	18°	8.1×10^{-9}
Barium chromate	$BaCrO_4$	18°	1.6×10^{-10}
Barium chromate	$BaCrO_4$	28°	2.4×10^{-10}
Barium fluoride	BaF_2	9.5°	1.6×10^{-6}
Barium fluoride	BaF_2	18°	1.7×10^{-6}
Barium fluoride	BaF_2	25.8°	1.73×10^{-6}
Barium iodate	$Ba(IO_3)_2 \cdot 2H_2O$	10°	8.4×10^{-11}
Barium iodate	$Ba(IO_3)_2 \cdot 2H_2O$	25°	6.5×10^{-10}
Barium oxalate	$BaC_2O_4 \cdot 3\frac{1}{2}H_2O$	18°	1.62×10^{-7}
Barium oxalate	$BaC_2O_4 \cdot 2H_2O$	18°	1.2×10^{-7}
Barium oxalate	$BaC_2O_4 \cdot \frac{1}{2}H_2O$	18°	2.18×10^{-7}
Barium sulfate	$BaSO_4$	18°	0.87×10^{-10}
Barium sulfate	$BaSO_4$	25°	1.08×10^{-10}
Barium sulfate	$BaSO_4$	50°	1.98×10^{-10}
Cadmium oxalate	$CdC_2O_4 \cdot 3H_2O$	18°	1.53×10^{-8}
Cadmium sulfide	CdS	18°	3.6×10^{-29}
Calcium carbonate	$CaCO_3$	15°	0.99×10^{-8}
Calcium carbonate	$CaCO_3$	25°	0.87×10^{-8}
Calcium chromate	$CaCrO_4$	18°	2.3×10^{-2}
Calcium fluoride	CaF_2	18°	3.4×10^{-11}
Calcium fluoride	CaF_2	26°	3.95×10^{-11}
Calcium iodate	$Ca(IO_3)_2 \cdot 6H_2O$	10°	22.2×10^{-8}
Calcium iodate	$Ca(IO_3)_2 \cdot 6H_2O$	18°	64.4×10^{-8}
Calcium oxalate	$CaC_2O_4 \cdot H_2O$	18°	1.78×10^{-9}
Calcium oxalate	$CaC_2O_4 \cdot H_2O$	25°	2.57×10^{-9}
Calcium sulfate	$CaSO_4$	10°	6.1×10^{-5}
Calcium tartrate	$CaC_4H_4O_6 \cdot 2H_2O$	18°	0.77×10^{-6}
Cobalt sulfide	CoS	18°	3×10^{-26}
Cupric iodate	$Cu(IO_3)_2$	25°	1.4×10^{-7}
Cupric oxalate	CuC_2O_4	25°	2.87×10^{-8}
Cupric sulfide	CuS	18°	8.5×10^{-45}
Cuprous bromide	$CuBr$	18°	4.1×10^{-8}
Cuprous chloride	$CuCl$	18°	1.0×10^{-6}
Cuprous iodide	CuI	18°	5.0×10^{-12}
Cuprous sulfide	Cu_2S	16°-18°	2×10^{-47}
Cuprous thiocyanate	$CuSCN$	18°	1.6×10^{-11}
Ferric hydroxide	$Fe(OH)_3$	18°	1.1×10^{-36}
Ferrous hydroxide	$Fe(OH)_2$	18°	1.64×10^{-14}
Ferrous oxalate	FeC_2O_4	25°	2.1×10^{-7}
Ferrous sulfide	FeS	18°	3.7×10^{-19}

SOLUBILITY PRODUCT

Substance	Formula	Temp. °C.	Solubility-Product
Lead carbonate	$PbCO_3$	18°	3.3×10^{-14}
Lead chloride	$PbCl_2$	25.2°	1.0×10^{-4}
Lead chromate	$PbCrO_4$	18°	1.77×10^{-14}
Lead fluoride	PbF_2	9°	2.7×10^{-8}
Lead fluoride	PbF_2	18°	3.2×10^{-8}
Lead fluoride	PbF_2	26.6°	3.7×10^{-8}
Lead iodate	$Pb(IO_3)_2$	9.2°	5.3×10^{-14}
Lead iodate	$Pb(IO_3)_2$	18°	1.2×10^{-13}
Lead iodate	$Pb(IO_3)_2$	25.8°	2.6×10^{-13}
Lead iodide	PbI_2	15°	7.47×10^{-9}
Lead iodide	PbI_2	25°	1.39×10^{-8}
Lead oxalate	PbC_2O_4	18°	2.74×10^{-11}
Lead sulfate	$PbSO_4$	18°	1.06×10^{-8}
Lead sulfide	PbS	18°	3.4×10^{-28}
Lithium carbonate	Li_2CO_3	25°	1.7×10^{-3}
Magnesium ammonium phosphate	$MgNH_4PO_4$	25°	2.5×10^{-13}
Magnesium carbonate	$MgCO_3$	12°	2.6×10^{-5}
Magnesium fluoride	MgF_2	18°	7.1×10^{-9}
Magnesium fluoride	MgF_2	27°	6.4×10^{-9}
Magnesium hydroxide	$Mg(OH)_2$	18°	1.2×10^{-11}
Magnesium oxalate	MgC_2O_4	18°	8.57×10^{-5}
Manganese hydroxide	$Mn(OH)_2$	18°	4×10^{-14}
Manganese sulfide	MnS	18°	1.4×10^{-15}
Mercuric bromide	$HgBr_2$	25°	8×10^{-20}
Mercuric chloride	$HgCl_2$	25°	2.6×10^{-15}
Mercuric iodide	HgI_2	25°	3.2×10^{-29}
Mercuric sulfide	HgS	18°	4×10^{-53} to 2×10^{-49}
Mercurous bromide	$HgBr$	25°	1.3×10^{-21}
Mercurous chloride	$HgCl$	25°	2×10^{-18}
Mercurous iodide	HgI	25°	1.2×10^{-28}
Nickel sulfide	NiS	18°	1.4×10^{-24}
Potassium acid tartrate	$KHC_4H_4O_6$	18°	3.8×10^{-4}
Silver acetate	$AgC_2H_3O_2$	16°	1.82×10^{-3}
Silver bromate	$AgBrO_3$	20°	3.97×10^{-5}
Silver bromate	$AgBrO_3$	25°	5.77×10^{-5}
Silver bromide	$AgBr$	18°	4.1×10^{-13}
Silver bromide	$AgBr$	25°	7.7×10^{-13}
Silver carbonate	Ag_2CO_3	25°	6.15×10^{-12}
Silver chloride	$AgCl$	4.7°	0.21×10^{-10}
Silver chloride	$AgCl$	9.7°	0.37×10^{-10}
Silver chloride	$AgCl$	25°	1.56×10^{-10}
Silver chloride	$AgCl$	50°	13.2×10^{-10}
Silver chloride	$AgCl$	100°	21.5×10^{-10}
Silver chromate	Ag_2CrO_4	14.8°	1.2×10^{-12}
Silver chromate	Ag_2CrO_4	25°	9×10^{-12}
Silver cyanide	$Ag_2(CN)_2$	20°	2.2×10^{-12}
Silver dichromate	$Ag_2Cr_2O_7$	25°	2×10^{-7}
Silver hydroxide	$AgOH$	20°	1.52×10^{-8}
Silver iodate	$AgIO_3$	9.4°	0.92×10^{-8}
Silver iodide	AgI	13°	0.32×10^{-16}
Silver iodide	AgI	25°	1.5×10^{-16}
Silver nitrite	$AgNO_2$	25°	5.86×10^{-4}
Silver oxalate	$Ag_2C_2O_4$	25°	1.3×10^{-11}
Silver sulfide	Ag_2S	18°	1.6×10^{-49}
Silver thiocyanate	$AgSCN$	18°	0.49×10^{-12}

SOLUBILITY PRODUCT

Substance	Formula	Temp. °C.	Solubility-Product
Silver thiocyanate	$AgSCN$	25°	1.16×10^{-12}
Strontium carbonate	$SrCO_3$	25°	1.6×10^{-9}
Strontium fluoride	SrF_2	18°	2.8×10^{-9}
Strontium oxalate	SrC_2O_4	18°	5.61×10^{-8}
Strontium sulfate	$SrSO_4$	2.9°	2.77×10^{-7}
Strontium sulfate	$SrSO_4$	17.4°	2.81×10^{-7}
Thallous bromide	$TlBr$	25°	4×10^{-6}
Thallous chloride	$TlCl$	25°	2.65×10^{-4}
Thallous sulfate	Tl_2SO_4	25°	3.6×10^{-4}
Thallous thiocyanate	$TlSCN$	25°	2.25×10^{-4}
Zinc hydroxide	$Zn(OH)_2$	18°-20°	1.8×10^{-14}
Zinc oxalate	$ZnC_2O_4\cdot2H_2O$	18°	1.35×10^{-9}
Zinc sulfide	ZnS	18°	1.2×10^{-23}

GUM AND

The time for evaporation is based upon the time required to completely evaporate 0.5 cc of solvent on filter paper as compared with the corresponding time for ethyl ether which is given a value of 1.

*indicates that dilution causes cloudiness or precipitation.

† Other grades of shellac are less soluble.

No.	Name of Solvent	Boiling Range °C.	Time for Evaporation	Gum Benzoin (Siam)	Dammar	Elemi
1	Acetone	55-56	2.1	s.	i.	i.
2	Benzene	80-81	3	i.	i.s.	s.
3	Benzine	67-100	3.5	i.	i.s.*	s.*
4	Benzyl alcohol	204-208	1767	s.	s.	s.
5	*n*-Butyl acetate (98%)	121-127	11.8	s.	i.s.*	s.
6	*n*-Butyl acetate (85%)	110-132	12.5	s.	i.s.*	s.
7	*n*-Butyl alcohol	114-118	33	s.	i.	s.
8	*iso*-Butyl alcohol	104-107	24	s.	i.	i.s.
9	*n*-Butyl glycol	164-182	163	s.	i.	s.
10	*n*-Butyl lactate	170-195	443	s.	i.	i.s.
11	Cyclohexanone	150-156	40.4	s.	i.s.	s.
12	Diacetone alcohol	150-165	147	s.	i.	i.
13	Ethyl acetate (98%)	74-77	2.9	s.	i.	i.
14	Ethyl acetylglycolate	181-195	464	s.	i.	i.
15	Ethyl ether	34-35	1	s.	s.*	s.
16	Ethyl glycol	126-138	43	s.	i.	s.
17	Ethyl glycolacetate	149-160	52	s.	i.	s.
18	Ethylene chloride	81-87	4.1	i.s.	i.s.*	i.s.
19	Methyl acetate	56-62	2.2	s.	i.	i.
20	Methyl alcohol	64-65	6.3	s.	i.	i.
21	Methyl cyclohexanone	165-171	47	s.	i.s.	s.
22	Methyl glycol	115-130	34.5	s.	i.	i.
23	Methyl glycolacetate	138-152	35	s.	i.	i.
24	Methylene chloride	40-42	1.8	i.s.	i.	i.s.
25	*n*-Propyl acetate	97-101	6.1	s.	i.	i.
26	*iso*-Propyl acetate	84-93	4.2	s.	i.	i.
27	*iso*-Propyl alcohol	79.5-81.5	21	s.	i.	i.
28	Toluene	109.5-110.5	6.1	i.	i.s.	s.
29	Xylene	137-139	13.5	i.	s.	s.

ORGANIC SOLVENTS ARRANGED BOILING

Name	B. P. Deg. C.
Ethyl ether	34.6
Carbon disulfide	46.3
Acetone	56.5
Methyl acetate	59.5
Chloroform	61.2
Methyl alcohol	64.7
Carbon tetrachloride	76.8
Ethyl acetate	77.1
Ethyl alcohol	78.4
Benzene	79.6
iso-Propyl alcohol	82.5
Ethylene chloride	83.7
iso-Propyl acetate	90
Ethyl propionate	99.1
n-Propyl acetate	101.6

Name	B. P. Deg. C.
iso-Butyl alcohol	108
Toluene	110.8
n-Butyl alcohol	117.4
Ethyl butyrate	121
Ethylene glycol monomethyl ether (methyl cellosolve)	124.5
Diethyl carbonate	126
Butyl acetate	126
Ethylene chlorohydrin	128.8
Ethylene glycol monoethyl ether (cellosolve)	134.8
Ethyl benzene	136.2
n-Amyl alcohol	137.9
m-Xylene	139

RESIN SOLVENTS

s. = soluble in an equal weight of solvent at room or slightly raised temperature; Natural resins, especially gum benzoin, contain more or less insoluble impurities. i. = insoluble; i.s. = partly soluble.

Ester Gum	Gum Mastic	Kauri	Manila Spirit Soluble	Rosin	Rubber	Sandarak	Shellac (bleached)†	No.
s.*	i.	i.s.*	s.	s.	i.	s.	i.	1
s.	s.	i.	i.s.*	s.	s.	i.	i.	2
i.	i.	i.	i.	i.s.*	s.	i.	i.	3
s.	s.	s.	s.	s.	i.	s.	s.	4
s.	s.	s.*	s.*	s.	i.	s.*	i.	5
s.	s.	s.	s.	s.	i.	s.	i.	6
s.*	s.	s.	s.	s.	i.	s.	s.	7
s.*	i.s.*	s.	s.	s.	i.	s.	s.	8
s.	s.	s.	s.	s.	i.	s.	s.	9
s.	i.s.*	s.	s.	s.	i.	s.	s.	10
s.	s.	s.	s.	s.	s.	s.	i.s.	11
i.	s.*	s.*	s.	s.	i.	s.	s.	12
s.	i.s.*	s.*	s.	s.	i.	s.	i.	13
i.	i.	i.	i.	s.	i.	s.*	i.	14
s.*	s.*	i.	s.*	s.	i.s.	s.*	i.	15
s.*	s.*	s.	s.	s.	i.	s.	s.	16
s.*	i.s.*	s.*	s.	s.	i.	s.	i.	17
s.	s.	i.	i.s.*	s.	s.	i.s.*	i.	18
s.*	i.s.*	i.	s.	s.	i.	s.	i.*	19
i.	i.s.*	s.*	s.*	s.	i.	s.*	s.	20
s.	s.	s.*	s.	s.	i.	s.	i.s.	21
i.	i.	s.*	s.	s.	i.	s.	s.	22
s.	i.s.*	s.	s.	s.	i.	s.	i.	23
s.	s.	s.	s.*	s.	s.	s.*	i.	24
s.	s.	s.*	s.	s.	i.	s.*	i.	25
s.	s.	s.*	s.	s.	i.	s.	i.	26
i.	i.s.*	s.*	s.	s.	i.	s.	s.	27
s.	s.	i.	i.s.*	s.	s.	i.	i.	28
s.	s.	i.	i.s.*	s.	s.	i.	i.	29

IN THE ORDER OF THEIR POINTS

Name	B. P. Deg. C.
n-Amyl acetate	148
Acetate of glycol monoethyl ether (cellosolve acetate)	153
Ethyl lactate	155
Cyclohexanone	156
Furfural	161
Diacetone alcohol	166
Butyl cellosolve	170.6
Ethyl acetoacetate	180
Aniline	184.4
Diethyl oxalate	186
n-Butyl lactate	195
Ethylene glycol	197.4
Carbitol	198

Name	B. P. Deg. C.
Benzyl alcohol	205
Nitrobenzene	210.9
Ethyl benzoate	212
n-Butyl stearate	$220\text{-}5^{25\,mm}$
Acetamide	222
Butyl carbitol	222
Diethylene glycol	250
Triphenyl phosphate	$245^{11\,mm}$
Triacetin	259
Diacetin	261
Dimethyl phthalate	282
Diethyl phthalate	298
Dibutyl phthalate	340
Diamyl phthalate	344

DILUTION TABLE

% Before Dilution	% by Volume after Dilution																				% Before Dilution
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95		
10	200.00																				10
15	300.00	150.00																			15
20	400.00	200.00	133.33																		20
25	500.00	250.00	166.67	125.00																	25
30	600.00	300.00	200.00	150.00	120.00																30
35	700.00	350.00	233.33	175.00	140.00	116.67															35
40	800.00	400.00	266.67	200.00	160.00	133.33	114.29														40
45	900.00	450.00	300.00	225.00	180.00	150.00	128.57	112.50													45
50	1000.00	500.00	333.33	250.00	200.00	166.67	142.86	125.00	111.11												50
55	1100.00	550.00	366.67	275.00	220.00	183.33	157.14	137.50	122.22	110.00											55
60	1200.00	600.00	400.00	300.00	240.00	200.00	171.43	150.00	133.33	120.00	109.09										60
65	1300.00	650.00	433.33	325.00	260.00	216.67	185.71	162.50	144.44	130.00	118.18	108.33									65
70	1400.00	700.00	466.67	350.00	280.00	233.33	200.00	175.00	155.56	140.00	127.27	116.67	107.69								70
75	1500.00	750.00	500.00	375.00	300.00	250.00	221.43	187.50	166.67	150.00	136.36	125.00	115.38	107.14							75
80	1600.00	800.00	533.33	400.00	320.00	266.67	228.57	200.00	177.78	160.00	145.45	133.33	123.08	114.29	106.67						80
85	1700.00	850.00	566.67	425.00	340.00	283.33	242.86	212.50	188.89	170.00	154.54	141.67	130.77	121.43	113.33	106.25					85
90	1800.00	900.00	600.00	450.00	360.00	300.00	257.14	225.00	200.00	180.00	163.64	150.00	138.46	128.57	120.00	112.50	105.88				90
95	1900.00	950.00	633.33	475.00	380.00	316.67	271.43	237.50	211.11	190.00	172.73	158.33	146.15	135.71	126.67	118.75	111.76	105.56			95
100	2000.00	1000.00	666.67	500.00	400.00	333.33	285.71	250.00	222.22	200.00	181.82	166.67	153.85	142.86	133.33	125.00	117.65	111.11	105.26		100

The table above shows the volume to which a more concentrated solution must be diluted to obtain the desired more dilute solution. Thus, 100 cc of a solution containing 15% of solute must be diluted to 300 cc to obtain a concentration of 5% and diluted to 150 cc to obtain a concentration of 10%. To prepare 1000 cc of a 5% solution by dilution of a 15% solution: (1000/300) $\times$100 or 333.33 cc of the 15% solution are diluted to 1000 cc.

HYDROMETERS

Various hydrometers and the relation between the various scales.

Alcoholometer. This hydrometer is used in determining the density of aqueous ethyl alcohol solutions; the reading in degrees is numerically the same as the percentage of alcohol by volume. The scale known as *Tralle* gives the precentage by volume. (See also formulas for conversion to percent by weight, percent by volume, and percent proof.) *Wine* and *Must* hydrometer relations are given below.

Ammoniameter. This hydrometer, employed in finding the density of aqueous ammonia solutions, has a scale graduated in equal divisions from 0° to 40°. To convert the reading to specific gravity multiply by 3 and subtract the resulting number from 1000.

Balling Hydrometer. See under **Saccharometer.**

Barkometer or **Barktrometer.** This hydrometer which is used in determining the density of tanning liquors has a scale from 0° to 80° Bk; the number to the right of the decimal point of a specific gravity reading is the corresponding Bk degree; thus, a specific gravity of 1.015 is 15°Bk.

Baumé Hydrometers. For liquids heavier than water.—This hydrometer was originally based on the density of a 10% sodium chloride solution which was given the value of 10° and the density of pure water which was given the value of 0°, the interval between these two values was divided into 10 equal parts. Other reference points have been taken with the result that so much confusion exists that there are about 36 different scales in use, many of which are incorrect. In general a Baumé hydrometer should have inscribed on it the temperature at which it was calibrated and also the temperature of the water used in relating the density to a specific gravity. The following expression gives the relation between the specific gravity and several of the Baumé scales:—

$$\text{Specific gravity} = \frac{m}{m - \text{Baumé}}$$

m = 145 at 60°/60°F (15.56°C) for the American Scale
m = 144 for the old scale used in Holland
m = 146.3 at 15°C for the Gerlach Scale
m = 144.3 at 15°C for the Rational Scale generally used in Germany

See also special table for conversion to density and Twaddell scale.

For liquids lighter than water.—Originally the density of a solution of 1 gram of sodium chloride in 9 grams of water at 12.5°C was given a value of 0°Bé and pure water a value of 10°Bé. The scale between these points was divided into ten equal parts and these divisions were repeated throughout the scale giving a relation which could be expressed by the formula: Specific gravity = 145.88/(135.88+Bé), which is approximately equal to 146/(136+Bé.) Other scales have since come into more general use such as that of the Bu. of Standards in which the specific gravity at 60°/60°F = 140/(130+Bé.) and that of the American Petroleum Institute (A.P.I. Scale) in which the specific gravity at 60°/60°F = 141.5/(131.5+Bé.)

See also special table for conversion to density and Twaddell scale.

Beck's Hydrometer. This hydrometer is graduated to show a reading of 0° in pure water and a reading of 30° in a solution with a specific gravity of 0.850, with equal scale divisions above and below these two points.

Brix Hydrometer. See under Saccharometers.

Cartier's Hydrometer. This hydrometer shows a reading of 22° when immersed in a solution having a density of 22° Baumé but the scale divisions are smaller than on the Baumé hydrometer in the ratio of 16 Cartier to 15 Baumé.

Fatty Oil Hydrometer. The gradu-

ations on this hydrometer are in specific gravity within the range 0.908 to 0.938. The letters on the scale correspond to the specific gravity of the various common oils as follows: *R*, rape; *O*, olive; *A*, almond; *S*, sesame; *HL*, hoof oil; *HP*, hemp; *C*, cotton seed; *L*, linseed. See also Oleometer below.

Lactometers. These hydrometers are used in determining the density of milk. The various scales in common use are the following:

New York Board of Health has a scale graduated into 120 equal parts, 0° being equal to the specific gravity of water and 100° being equal to a specific gravity of 1.029.

Quevenne lactometer is graduated from 15° to 40° corresponding to specific gravities from 1.015 to 1.040.

Soxhlet lactometer has a scale from 25° to 35° corresponding to specific gravities from 1.025 to 1.035 respectively.

Oleometer. A hydrometer for determining the density of vegetable and sperm oils with a scale from 50° to 0° corresponding to specific gravities from 0.870 to 0.970. See also *Fatty Oil* hydrometer above.

Saccharometers. These hydrometers are used in determining the density of sugar solutions. Solutions of the same concentration but of different carbohydrates have very nearly the same specific gravity and in general a concentration of 10 grams of carbohydrate per 100 cc of solution shows a specific gravity of 1.0386. This relation can be expressed as follows:

(a) For concentrations below 12g/100 cc, weight of sugar = density − 1000/3.86

(b) For concentrations above 12g/100 cc, weight of sugar = density − 1000/3.85

The following hydrometers are employed with sugar solutions:

Brix hydrometer is graduated so that the number of degrees is identical with the percentage by weight of cane sugar and is used at the temperature indicated on the hydrometer.

Balling's saccharometer is used in Europe and is practically identical with the Brix hydrometer.

Bates brewers' saccharometer which is used in determining the density of malt worts is graduated so that the divisions express pounds per barrel (32 gallons). The relation between degrees Bates (=b) and degrees Balling (=B) is shown by the following formula: $B = 260b/(360+b)$.

See also below under *Wine and Must*.

Salinometer. This hydrometer, which is used in the pickling and meat packing plants, is graduated to show percentage of saturation of a sodium chloride solution. An aqueous solution is completely saturated when it contains 26.4% pure sodium chloride. The range from 0% to 26.4% is divided into 100 parts, each division therefore representing 1% of saturation. In another type of salinometer, the degrees correspond to percentages of sodium chloride expressed in grams of sodium chloride per 100 cc of water.

Sprayometer (Parrot and Stewart).—This hydrometer which is used in determining the density of *lime sulfur* solutions has two scales; one scale is graduated from 0° to 38° Baumé and the other scale is from 1.000 to 1.350 specific gravity.

Tralle Hydrometer. See *alcoholometer* above.

Twaddell Hydrometer. This hydrometer which is used only for liquids heavier than water, has a scale such that when the reading is multiplied by 5 and added to 1000 the resulting number is the specific gravity with reference to water as 1000. To convert specific gravity at 60°/60°F to Twaddell degrees, take the decimal portion of the specific gravity value and multiply it by 200; thus a specific gravity of $1.032 = 0.032 \times 200 = 6.4°$ Tw. See also special table for conversion to density and Baumé scale.

Wine and Must Hydrometer—This instrument has three scales. One scale shows readings of 0° to 30° Brix for sugar (see Brix hydrometer above); another scale from 0° to 15° Tralle is used for sweet wines to indicate the percentage of alcohol by volume; and a third scale from 0° to 20° Tralle is used for tart wines to indicate the percentage of alcohol by volume.

SPECIFIC GRAVITY CORRECTIONS FOR THE BUOYANT EFFECT OF THE AIR

Determinations made with a pyknometer.

$$D_{vac} = \frac{W_2}{W_1} d - 0.0012 \left(\frac{W_2 d}{W_1} - 1 \right)$$

$$S_{vac} = \frac{W_2}{W_1} - 0.0012 \left(\frac{W_2}{W_1} - 1 \right)$$

Where

D_{vac} = density of the liquid in grams per milliliter at t°C corrected for the buoyant effect of air.

W_1 = weight in air of the water required to fill the pykometer at t°C.

W_2 = weight in air of the liquid required to fill the pyknometer at t°C.

d = density of water in grams per milliliter at t°C.

S_{vac} = specific gravity of the liquid at t°C. referred to water at t°C corrected for the buoyant effect of air.

When the weight of the water is determined at a temperature of t°C, and that of the liquid at a different temperature t', the equations above are modified as follows:

$$D_{vac} = \frac{W_2}{W_1} d - 0.0012 \left(\frac{W_2}{W_1} d - 1 \right) + 0.000026 \, (t' - t^\circ) \left(\frac{W_2}{W_1} d \right)$$

$$S_{vac} = \frac{W_2}{W_1} - 0.0012 \left(\frac{W_2}{W_1} - 1 \right) + 0.000026 \, (t' - t^\circ) \left(\frac{W_2}{W_1} \right)$$

Determinations made with a plummet or sinker.

The equations above may also be used when the density is determined with a plummet or sinker, but in this case

W_1 = weight of the plummet in air minus its weight in water.

W_2 = weight of the plummet in air minus its weight in the liquid.

CONVERSION OF SPECIFIC GRAVITY AT 25°/25° C. TO DENSITY AT ANY TEMPERATURE FROM 0° TO 40° C.

Cf. Dreisbach, *Ind. Eng. Chem., Anal. Ed. 12, 160 (1940).*

Liquids change volume with change in temperature but the amount of this change, β (coefficient of cubical expansion), varies widely with different liquids, and to some extent for the same liquid at different temperatures. See special table, *Coefficients of Cubical Expansion for Various Liquids and Aqueous Solutions.*

The table below, which is calculated from the relationship:

$$F_{\beta t}=\frac{density\ of\ water\ at\ 25°C.\ (=0.99705)}{[1-\beta\ (25-t)]} \quad (1)$$

may be used to find d^t, the density (weight of 1 cc.), of a liquid at any temperature (t) between 0° and 40°C. if the specific gravity at 25°/25°C. (S) and the coefficient of cubical expansion (β) are known. Substitutions are made in the equations:

$$d^t=SF_{\beta t} \quad (2)$$

$$S=\frac{d^t}{F_{\beta t}} \quad (3)$$

TABLE—FACTORS ($F_{\beta t}$)

Density t°C. = Sp. Gr. 25°/25° × $F_{\beta t}$

°C. / *$\beta \times 10^3$	0	5	10	15	20	25	30	35	40
1.3	1.0306	1.0237	1.0169	1.0102	1.0036	0.99705	0.99065	0.9843	0.9780
1.2	1.0279	1.0216	1.0154	1.0092	1.0031	0.99705	0.9911	0.9853	0.9794
1.1	1.0253	1.0195	1.0138	1.0082	1.0026	0.99705	0.9916	0.9963	0.9809
1.0	1.0227	1.0174	1.0123	1.0072	1.0021	0.99705	0.9921	0.9872	0.98234
0.9	1.0200	1.0153	1.0107	1.0060	1.0016	0.99705	0.99262	0.9882	0.9838
0.8	1.0174	1.0133	1.0092	1.0051	1.0011	0.99705	0.9931	0.98918	0.9851
0.7	1.0148	1.0113	1.0077	1.0041	1.0006	0.99705	0.9936	0.99015	0.98672
0.6	1.0122	1.0092	1.0061	1.0031	1.0001	0.99705	0.9941	0.9911	0.9882
0.5	1.0097	1.0072	1.0046	1.0021	0.99958	0.99705	0.9944	0.9921	0.9897
0.4	1.0071	1.0051	1.0031	1.0011	0.99908	0.99705	0.9951	0.9931	0.9911

* β = coefficient of cubical expansion.

EXAMPLES

All examples are based upon an assumed coefficient of cubical expansion, β, of 1.3×10^{-3}.

Example 1. To find the density of a liquid at 20°C., d^{20}, which has a specific gravity (S) of $1.2500^{25°}_{25°}$.

From the table above $F_{\beta t}$ at 20°C. = 1.0036.

$$d^{20}=d^t=SF_{\beta t}=1.2500\times1.0036=1.2545$$

CONVERSIONS OF DENSITY—SPECIFIC GRAVITY

Example 2. To find the density at 20°C. (d^{20}) of a liquid which has a specific gravity of $1.2500^{17.5°}_{4°}$.

Since the density of water at 4°C. is equal to 1, specific gravity at $17°/4° = d^{17} = 1.2500$.

Substitution in equation *3* with $F\beta_t$ at 17°C., by interpolation from the table, equal to 1.00756, gives

$$Sp.\ gr.\ 25°/25° = S = 1.2500 \div 1.00756$$

Substitution of this value for S in equation *2* with $F\beta_t$ at 20°C., from the table, equal to 1.0036, gives

$$d^{20} = d^t = (1.2500 \div 1.00756) \times 1.0036 = 1.2451$$

Example 3. To find the specific gravity at 20°/4°C. of a liquid which has a specific gravity of $1.2500^{25.8°}_{4°}$.

Since the density of water at 4°C. is equal to 1, specific gravity $25°/4° = d^{25} = 1.2500$; and, specific gravity $20°/4° = d^{20}$.

Substitution in equation *3*, with $d^t = 1.2500$; and, with $F\beta_t$ at 25°C., from the table, equal to 0.99705, gives

$$Sp.\ gr.\ 25°/25° = S = 1.2500 \div 0.99705$$

Substitution of this value for S in equation *2*, with $F\beta_t$ at 20°C., from the table, equal to 1.0036, gives

$$Sp.\ gr.\ 20°/4° = d^{20} = (1.2500 \div 0.99705) \times 1.0036 = 1.2582$$

Example 4. To find the density at 25°C. of a liquid which has a specific gravity of $1.2500^{\frac{5}{8}°}_{\frac{5}{8}°}$.

Since the density of water (see special table, *Absolute Density of Water*) at 15°C. = 0.99910,

$$d^{15} = sp.\ gr.\ 15°/15° \times 0.99910 = 1.2500 \times 0.99910$$

Substitution in equation *3*, with $F\beta_t$ at 15°C., from the table, equal to 1.0102, gives

$$Sp.\ gr.\ 25°/25° = S = (1.2500 \times 0.99910) \div 1.0102$$

Substitution of this value for S in equation *2*, with $F\beta_t$ at 25°, from the table, equal to 0.99705, gives

$$d^{25} = d^t = (1.2500 \times 0.99910 \div 1.0102) \times 0.99705 = 1.2326$$

DENSITY OF AQUEOUS SOLUTIONS

The values in the following tables have been computed from the values given under *specific gravity* and *per cent by weight* by means of the following factors:

$$\textbf{Degrees Baumé} = 145 - \frac{145}{\text{Sp. gravity}}$$

Degrees Twaddell = (Sp. gravity -1)$\times 200$
Grams per Liter = Sp. gravity $\times$ per cent by weight $\times$ 10
Pounds per U. S. Gallon = Grams per Liter $\times$ 0.0083454
Pounds per Cubic Foot = Grams per Liter $\times$ 0.06243

See also the tables:—"*Specific Gravity of Aqueous Solutions*", "*Specific Gravity of Alcohol Water Solutions*," and "*Hydrometer Conversion Tables.*"

ACETIC ACID

Density of Aqueous Acetic Acid Solutions at $\frac{20}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $HC_2H_3O_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $HC_2H_3O_2$	Degrees: Baumé	Twaddell
0.9982	.....	.....	.....	0	.....	.....
0.9996	9.996	0.08342	0.6241	1	.....	.....
1.0012	20.02	0.1671	1.250	2	0.2	0.24
1.0025	30.08	0.2510	1.878	3	0.4	0.50
1.0040	40.16	0.3352	2.507	4	0.6	0.80
1.0055	50.28	0.4196	3.139	5	0.8	1.10
1.0069	60.41	0.5042	3.772	6	1.0	1.38
1.0083	70.58	0.5890	4.406	7	1.2	1.66
1.0097	80.78	0.6741	5.043	8	1.4	1.94
1.0111	91.00	0.7594	5.681	9	1.6	2.22
1.0125	101.3	0.8450	6.321	10	1.8	2.50
1.0139	111.5	0.9308	6.963	11	2.0	2.78
1.0154	121.8	1.017	7.607	12	2.2	3.08
1.0168	132.2	1.103	8.252	13	2.4	3.36
1.0182	142.5	1.190	8.899	14	2.6	3.64
1.0195	152.9	1.276	9.547	15	2.8	3.90
1.0209	163.3	1.363	10.20	16	3.0	4.18
1.0223	173.8	1.450	10.85	17	3.2	4.46
1.0236	184.2	1.538	11.50	18	3.3	4.72
1.0250	194.8	1.625	12.16	19	3.5	5.00
1.0263	205.3	1.713	12.81	20	3.7	5.26
1.0276	215.8	1.801	13.47	21	3.9	5.52
1.0288	226.3	1.889	14.13	22	4.1	5.76
1.0301	236.9	1.977	14.79	23	4.2	6.02
1.0313	247.5	2.066	15.45	24	4.4	6.26
1.0326	258.2	2.154	16.12	25	4.6	6.52
1.0338	268.8	2.243	16.78	26	4.7	6.76
1.0349	279.4	2.332	17.44	27	4.9	6.98
1.0361	290.1	2.421	18.11	28	5.1	7.22
1.0372	300.8	2.510	18.78	29	5.2	7.44
1.0384	311.5	2.600	19.45	30	5.4	7.68
1.0395	322.2	2.689	20.12	31	5.5	7.90
1.0406	333.0	2.779	20.79	32	5.7	8.12
1.0417	343.8	2.869	21.46	33	5.8	8.34
1.0428	354.6	2.959	22.13	34	6.0	8.56
1.0438	365.3	3.049	22.81	35	6.1	8.76
1.0449	376.2	3.139	23.48	36	6.2	8.98
1.0459	387.0	3.230	24.16	37	6.4	9.18
1.0469	397.8	3.320	24.84	38	6.5	9.38
1.0479	408.7	3.411	25.51	39	6.6	9.58

ACETIC ACID (Continued)

Specific Gravity	Weight of $HC_2H_3O_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $HC_2H_3O_2$	Degrees: Baumé	Twaddell
1.0488	419.5	3.501	26.19	40	6.8	9.76
1.0498	430.4	3.592	26.87	41	6.9	9.96
1.0507	441.3	3.683	27.55	42	7.0	10.14
1.0516	452.2	3.774	28.23	43	7.1	10.32
1.0525	463.1	3.865	28.91	44	7.2	10.50
1.0534	474.0	3.956	29.59	45	7.4	10.68
1.0542	484.9	4.047	30.27	46	7.5	10.84
1.0551	495.9	4.138	30.96	47	7.6	11.02
1.0559	506.8	4.230	31.64	48	7.7	11.18
1.0567	517.8	4.321	32.33	49	7.8	11.34
1.0575	528.8	4.413	33.01	50	7.9	11.50
1.0582	539.7	4.504	33.69	51	8.0	11.64
1.0590	550.7	4.596	34.38	52	8.1	11.80
1.0597	561.6	4.687	35.06	53	8.2	11.94
1.0604	572.6	4.779	35.75	54	8.3	12.08
1.0611	583.6	4.870	36.43	55	8.4	12.22
1.0618	594.6	4.962	37.12	56	8.4	12.36
1.0624	605.6	5.054	37.81	57	8.5	12.48
1.0631	616.6	5.146	38.49	58	8.6	12.62
1.0637	627.6	5.237	39.18	59	8.7	12.74
1.0642	638.5	5.329	39.86	60	8.8	12.84
1.0648	649.5	5.421	40.55	61	8.8	12.96
1.0653	660.5	5.512	41.23	62	8.9	13.06
1.0658	671.5	5.604	41.92	63	9.0	13.16
1.0662	682.4	5.695	42.60	64	9.0	13.24
1.0666	693.3	5.786	43.28	65	9.1	13.32
1.0671	704.3	5.878	43.97	66	9.1	13.42
1.0675	715.2	5.969	44.65	67	9.2	13.50
1.0678	726.1	6.060	45.33	68	9.2	13.56
1.0682	737.1	6.151	46.01	69	9.3	13.64
1.0685	748.0	6.242	46.69	70	9.3	13.70
1.0687	758.8	6.332	47.37	71	9.3	13.74
1.0690	769.7	6.423	48.05	72	9.4	13.80
1.0693	780.6	6.514	48.73	73	9.4	13.86
1.0694	791.4	6.604	49.40	74	9.4	13.88
1.0696	802.2	6.695	50.08	75	9.4	13.92
1.0698	813.0	6.785	50.76	76	9.5	13.96
1.0699	823.8	6.875	51.43	77	9.5	13.98
1.0700	834.6	6.965	52.10	78	9.5	14.00
1.0700	845.3	7.054	52.77	79	9.5	14.00
1.0700	856.0	7.144	53.44	80	9.5	14.00
1.0699	866.6	7.232	54.10	81	9.5	13.98
1.0698	877.2	7.321	54.77	82	9.5	13.96
1.0696	887.8	7.409	55.42	83	9.4	13.92
1.0693	898.2	7.496	56.08	84	9.4	13.86
1.0689	908.6	7.582	56.72	85	9.4	13.78
1.0685	918.9	7.669	57.37	86	9.3	13.70
1.0680	929.2	7.754	58.01	87	9.2	13.60
1.0675	939.4	7.840	58.65	88	9.2	13.50
1.0668	949.5	7.924	59.27	89	9.1	13.36
1.0661	959.5	8.007	59.90	90	9.0	13.22
1.0652	969.3	8.089	60.52	91	8.9	13.04
1.0643	979.2	8.171	61.13	92	8.8	12.86
1.0632	988.8	8.252	61.73	93	8.6	12.64
1.0619	998.2	8.330	62.32	94	8.5	12.38
1.0605	1007	8.408	62.90	95	8.3	12.10
1.0588	1016	8.483	63.46	96	8.1	11.76
1.0570	1025	8.556	64.01	97	7.8	11.40
1.0549	1034	8.627	64.54	98	7.6	10.98
1.0524	1042	8.695	65.04	99	7.2	10.48
1.0498	1050	8.761	65.54	100	6.9	9.96

ALBUMEN

Density of Aqueous Albumen Solutions at 15.5°C.

Specific Gravity	Weight of Albumen in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Albumen	Degrees: Baumé	Twaddell
1.0026	10.03	0.08367	0.6259	1	0.37	0.52
1.0054	20.11	0.1678	1.255	2	0.77	1.08
1.0078	30.23	0.2523	1.888	3	1.12	1.56
1.0130	50.65	0.4227	3.162	5	1.85	2.60
1.0261	102.6	0.8563	6.406	10	3.66	5.22
1.0384	155.8	1.300	9.724	15	5.32	7.68
1.0515	210.3	1.755	13.13	20	7.06	10.30
1.0644	266.1	2.221	16.61	25	8.72	12.88
1.0780	323.4	2.699	20.19	30	10.42	15.60
1.0919	382.2	3.189	23.86	35	13.12	18.38
1.1058	442.3	3.691	27.61	40	13.78	21.16
1.1204	504.2	4.208	31.48	45	15.48	24.08
1.1352	567.6	4.737	35.44	50	17.16	27.04
1.1511	633.1	5.283	39.52	55	18.90	30.22

ALUMINUM CHLORIDE

Density of Aqueous Aluminum Chloride Solutions at $\frac{18}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $AlCl_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $AlCl_3$	Degrees: Baumé	Twaddell
1.0075	10.08	0.08408	0.6290	1	1.1	1.50
1.0164	20.33	0.1696	1.269	2	2.3	3.28
1.0344	41.38	0.3453	2.583	4	4.8	6.88
1.0526	63.16	0.5271	3.943	6	7.3	10.52
1.0711	85.69	0.7151	5.350	8	9.6	14.22
1.0900	109.0	0.9096	6.805	10	12.0	18.00
1.1093	133.1	1.111	8.310	12	14.3	21.86
1.1290	158.1	1.319	9.868	14	16.6	25.80
1.1491	183.9	1.534	11.48	16	18.8	29.82

Density of Aqueous Aluminum Chloride Solutions at 15°C. Computed from the Values of Gerlach.

Specific Gravity	Weight of Al_2Cl_6 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Al_2Cl_6	Degrees: Baumé	Twaddell
1.0072	10.07	0.08405	0.6288	1	1.0	1.44
1.0144	20.29	0.1693	1.267	2	2.1	2.88
1.0216	30.65	0.2558	1.913	3	3.1	4.32
1.0289	41.16	0.3435	2.569	4	4.1	5.78
1.0360	51.80	0.4323	3.234	5	5.0	7.20
1.0435	62.61	0.5225	3.909	6	6.0	8.70
1.0510	73.57	0.6140	4.593	7	7.0	10.20
1.0585	84.68	0.7067	5.287	8	8.0	11.70
1.0659	95.93	0.8006	5.989	9	9.0	13.18
1.0734	107.3	0.8958	6.701	10	9.9	14.68
1.0812	118.9	0.9925	7.425	11	10.9	16.24
1.0890	130.7	1.091	8.158	12	11.9	17.80
1.0968	142.6	1.190	8.902	13	12.8	19.36
1.1047	154.7	1.291	9.655	14	13.7	20.94
1.1125	166.9	1.393	10.42	15	14.7	22.50

ALUMINUM CHLORIDE (Continued)

Specific Gravity	Weight of Al_2Cl_6 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Al_2Cl_6	Degrees: Baumé	Twaddell
1.1207	179.3	1.496	11.19	16	15.6	24.14
1.1290	191.9	1.602	11.98	17	16.6	25.80
1.1372	204.7	1.708	12.78	18	17.5	27.44
1.1455	217.6	1.816	13.59	19	18.4	29.10
1.1537	230.7	1.926	14.41	20	19.3	30.74
1.1623	244.1	2.037	15.24	21	20.2	32.46
1.1709	257.6	2.150	16.08	22	21.2	34.18
1.1795	271.3	2.264	16.94	23	22.1	35.90
1.1882	285.2	2.380	17.80	24	23.0	37.64
1.1968	299.2	2.497	18.68	25	23.8	39.36
1.2058	313.5	2.616	19.57	26	24.8	41.16
1.2149	328.0	2.737	20.48	27	25.7	42.98
1.2241	342.7	2.860	21.40	28	26.5	44.82
1.2331	357.6	2.984	22.32	29	27.4	46.62
1.2422	372.7	3.110	23.26	30	28.3	48.44
1.2518	388.1	3.238	24.23	31	29.2	50.36
1.2615	403.7	3.369	25.20	32	30.1	52.30
1.2712	419.5	3.501	26.19	33	30.9	54.24
1.2808	435.5	3.634	27.19	34	31.8	56.16
1.2905	451.7	3.769	28.20	35	32.6	58.10
1.3007	468.3	3.908	29.23	36	33.5	60.14
1.3109	485.0	4.048	30.28	37	34.4	62.18
1.3211	502.0	4.190	31.34	38	35.2	64.22
1.3313	519.2	4.333	32.41	39	36.1	66.26
1.3415	536.6	4.478	33.50	40	36.9	68.30
1.3522	554.4	4.627	34.61	41	37.8	70.44

ALUMINUM SULFATE

Density of Aqueous Aluminum Sulfate Solutions at $\frac{15}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $Al_2(SO_4)_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Al_2(SO_4)_3$	Degrees: Baumé	Twaddell
1.0093	10.09	0.08423	0.6301	1	1.3	1.86
1.0195	20.39	0.1702	1.273	2	2.8	3.90
1.0404	41.62	0.3473	2.598	4	5.6	8.08
1.0618	63.71	0.5317	3.977	6	8.4	12.36
1.0837	86.70	0.7235	5.412	8	11.2	16.74
1.1062	110.6	0.9232	6.906	10	13.9	21.24
1.1293	135.5	1.131	8.460	12	16.6	25.86
1.1529	161.4	1.347	10.08	14	19.2	30.58
1.1770	188.3	1.572	11.76	16	21.8	35.40
1.2017	216.3	1.805	13.50	18	24.3	40.34
1.2272	245.4	2.048	15.32	20	26.8	45.44
1.2534	275.7	2.301	17.21	22	29.3	50.68
1.2803	307.3	2.564	19.18	24	31.7	56.06
1.3079	340.1	2.838	21.23	26	34.1	61.58

Specific Gravity	Weight of $Al_2(SO_4)_3 \cdot 18H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds Per Cubic Foot	Per Cent $Al_2(SO_4)_3 \cdot 18H_2O$	Degrees: Baumé	Twaddell
1.0093	19.66	0.1641	1.227	1.948	1.3	1.86
1.0195	39.72	0.3315	2.480	3.896	2.8	3.90
1.0404	81.06	0.6765	5.060	7.791	5.6	8.08

(Completed on following page.)

ALUMINUM SULFATE (Continued)

Specific Gravity	Weight of $Al_2(SO_4)_3 \cdot 18H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Al_2(SO_4)_3 \cdot 18H_2O$	Degrees Baumé	Degrees Twaddell
1.0618	124.1	1.036	7.749	11.69	8.4	12.36
1.0837	168.8	1.409	10.54	15.58	11.2	16.74
1.1062	215.5	1.798	13.45	19.48	13.9	21.24
1.1293	263.9	2.202	16.48	23.37	16.6	25.86
1.1529	314.4	2.624	19.63	27.27	19.2	30.58
1.1770	366.9	3.062	22.90	31.17	21.8	35.40
1.2017	421.3	3.516	26.30	35.06	24.3	40.34
1.2272	478.1	3.990	29.85	38.96	26.8	45.44
1.2534	537.1	4.482	33.53	42.85	29.3	50.68
1.2803	598.5	4.995	37.37	46.75	31.7	56.06
1.3079	662.3	5.527	41.35	50.64	34.1	61.58

AMMONIA

Specific Gravity of Aqueous Ammonia Solutions.

Adopted 1903 as Standard by the Manufacturing Chemists' Association of the United States.

Authority: W. C. Ferguson.

Specific Gravity determinations were made at 60° F., compared with water at 60°F.

From the Specific Gravities the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = \frac{140}{\text{Sp. Gr.}} - 130.$$

* Baumé Hydrometers for use with this table must be graduated by the above formula, which formula should always be printed on the scale.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

Be°	Sp. Gr.	%NH_3	Be°	Sp. Gr.	%NH_3	Be°	Sp. Gr.	%NH_3
10.00	1.0000	.00	16.50	.9556	11.18	23.00	.9150	23.52
10.25	.9982	.40	16.75	.9540	11.64	23.25	.9135	24.01
10.50	.9964	.80	17.00	.9524	12.10	23.50	.9121	24.50
10.75	.9947	1.21	17.25	.9508	12.56	23.75	.9106	24.99
11.00	.9929	1.62	17.50	.9492	13.02	24.00	.9091	25.48
11.25	.9912	2.04	17.75	.9475	13.49	24.25	.9076	25.97
11.50	.9894	2.46	18.00	.9459	13.96	24.50	.9061	26.46
11.75	.9876	2.88	18.25	.9444	14.43	24.75	.9047	26.95
12.00	.9859	3.30	18.50	.9428	14.90	25.00	.9032	27.44
12.25	.9842	3.73	18.75	.9412	15.37	25.25	.9018	27.93
12.50	.9825	4.16	19.00	.9396	15.84	25.50	.9003	28.42
12.75	.9807	4.59	19.25	.9380	16.32	25.75	.8989	28.91
13.00	.9790	5.02	19.50	.9365	16.80	26.00	.8974	29.40
13.25	.9773	5.45	19.75	.9349	17.28	26.25	.8960	29.89
13.50	.9756	5.88	20.00	.9333	17.76	26.50	.8946	30.38
13.75	.9739	6.31	20.25	.9318	18.24	26.75	.8931	30.87
14.00	.9722	6.74	20.50	.9302	18.72	27.00	.8917	31.36
14.25	.9705	7.17	20.75	.9287	19.20	27.25	.8903	31.85
14.50	.9689	7.61	21.00	.9272	19.68	27.50	.8889	32.34
14.75	.9672	8.05	21.25	.9256	20.16	27.75	.8875	32.83
15.00	.9655	8.49	21.50	.9241	20.64	28.00	.8861	33.32
15.25	.9639	8.93	21.75	.9226	21.12	28.25	.8847	33.81
15.50	.9622	9.38	22.00	.9211	21.60	28.50	.8833	34.30
15.75	.9605	9.83	22.25	.9195	22.08	28.75	.8819	34.79
16.00	.9589	10.28	22.50	.9180	22.56	29.00	.8805	35.28
16.25	.9573	10.73	22.75	.9165	23.04			

AMMONIA (Continued)

Allowance For Temperature:

The coefficient of expansion for Ammonia Solutions, varying with the temperature, correction must be applied according to the following table:

Degrees Baumé	Corrections to be added for each degree below 60° F.		Corrections to be subtracted for each degree above 60° F.			
	40° F.	50° F.	70° F.	80° F.	90° F.	100° F.
14°	.015° Bé	.017° Bé	.020° Bé	.022° Bé	.024° Bé	.026° Be
16°	.021° Bé	.023° Bé	.026° Bé	.028° Bé	.030° Bé	.032° Bé
18°	.027° Bé	.029° Bé	.031° Bé	.033° Bé	.035° Bé	.037° Bé
20°	.033° Bé	.036° Bé	.037° Bé	.038° Bé	.040° Bé	.042° Bé
22°	.039° Bé	.042° Bé	.043° Bé	.045° Bé	.047° Bé	
26°	.053° Bé	.057° Bé	.057° Bé	.059° Bé		

AMMONIA

Density of Aqueous Ammonia Solutions at $\frac{20}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of NH_3 in solution expressed in			Per Cent NH_3	Degrees	
	Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot		Baumé	Twaddell
0.9939	9.939	0.08294	0.6205	1	10.9	.....
0.9895	19.79	0.1652	1.235	2	11.5	.....
0.9811	39.24	0.3275	2.450	4	12.7	.....
0.9730	58.38	0.4872	3.645	6	13.9	.....
0.9651	77.21	0.6443	4.820	8	15.1	.....
0.9575	95.75	0.7991	5.978	10	16.2	.....
0.9501	114.0	0.9515	7.118	12	17.3	.....
0.9430	132.0	1.102	8.242	14	18.5	.....
0.9362	149.8	1.250	9.352	16	19.5	.....
0.9295	167.3	1.396	10.45	18	20.6	.....
0.9229	184.6	1.540	11.52	20	21.7	.....
0.9164	201.6	1.682	12.59	22	22.8	.....
0.9101	218.4	1.823	13.64	24	23.8	.....
0.9040	235.0	1.962	14.67	26	24.9	.....
0.8980	251.4	2.098	15.70	28	25.9	.....
0.8920	267.6	2.233	16.71	30	27.0	.....

Determined in Sealed Tubes at $\frac{15^c}{4}$° C.

Specific Gravity	Weight of NH_3 in solution expressed in			Per Cent NH_3	Degrees	
	Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot		Baumé	Twaddell
0.849	382.1	3.188	23.85	45	34.9	.....
0.832	416.0	3.472	25.97	50	38.3	.....
0.815	448.3	3.741	27.98	55	41.8	.....
0.796	477.6	3.986	29.82	60	45.9	.....
0.776	504.4	4.209	31.49	65	50.4	.....
0.755	528.5	4.411	32.99	70	55.4	.....
0.733	549.8	4.588	34.32	75	61.0	.....
0.711	568.8	4.747	35.51	80	66.9	.....
0.688	584.8	4.880	36.51	85	73.5	.....
0.665	598.5	4.995	37.36	90	80.5	.....
0.642	609.9	5.090	38.08	95	88.1	.....
0.618	618.0	5.157	38.58	100	96.5	.....

AMMONIUM CHLORIDE

Density of Aqueous Ammonium Chloride Solutions at $\frac{20}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of NH_4Cl in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent NH_4Cl	Degrees: Baumé	Twaddell
1.0013	10.01	0.08356	0.6251	1	0.2	0.26
1.0045	20.09	0.1677	1.254	2	0.6	0.90
1.0107	40.43	0.3374	2.524	4	1.5	2.14
1.0168	61.01	0.5091	3.809	6	2.4	3.36
1.0227	81.82	0.6828	5.108	8	3.2	4.54
1.0286	102.9	0.8584	6.421	10	4.0	5.72
1.0344	124.1	1.036	7.749	12	4.8	6.88
1.0401	145.6	1.215	9.090	14	5.6	8.02
1.0457	167.3	1.396	10.44	16	6.3	9.14
1.0512	189.2	1.579	11.81	18	7.1	10.24
1.0567	211.3	1.764	13.19	20	7.8	11.34
1.0621	233.7	1.950	14.59	22	8.5	12.42
1.0674	256.2	2.138	15.99	24	9.2	13.48

AMMONIUM NITRATE

Density of Aqueous Ammonium Nitrate Solutions at $\frac{20}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of NH_4NO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent NH_4NO_3	Degrees: Baumé	Twaddell
1.0023	10.02	0.08365	0.6257	1	0.3	0.46
1.0064	20.13	0.1680	1.257	2	0.9	1.28
1.0147	40.59	0.3387	2.534	4	2.1	2.94
1.0230	61.38	0.5122	3.832	6	3.3	4.60
1.0313	82.50	0.6885	5.151	8	4.4	6.26
1.0397	104.0	0.8677	6.491	10	5.5	7.94
1.0482	125.8	1.050	7.853	12	6.7	9.64
1.0567	147.9	1.235	9.236	14	7.8	11.34
1.0653	170.4	1.422	10.64	16	8.9	13.06
1.0740	193.3	1.613	12.07	18	10.0	14.80
1.0828	216.6	1.807	13.52	20	11.1	16.56
1.0916	240.2	2.004	14.99	22	12.2	18.32
1.1005	264.1	2.204	16.49	24	13.2	20.10
1.1095	288.5	2.407	18.01	26	14.3	21.90
1.1186	313.2	2.614	19.55	28	15.4	23.72
1.1277	338.3	2.823	21.12	30	16.4	25.54
1.1512	402.9	3.363	25.15	35	19.0	30.24
1.1754	470.2	3.924	29.35	40	21.6	35.08
1.2003	540.1	4.508	33.72	45	24.2	40.06
1.2258	612.9	5.115	38.26	50	26.7	45.16

AMMONIUM NITRATE

Density of Aqueous Ammonium Nitrate Solutions at 17.5° C. Computed from the Values of Gerlach.

Specific Gravity	Weight of NH_4NO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per cent NH_4NO_3	Degrees: Baumé	Twaddell
1.0042	10.04	0.08380	0.6269	1	0.6	0.84
1.0085	20.17	0.1683	1.259	2	1.2	1.70
1.0127	30.38	0.2535	1.897	3	1.8	2.54
1.0170	40.68	0.3395	2.540	4	2.4	3.40

AMMONIUM NITRATE (Continued)

Specific Gravity	Weight of NH_4NO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent NH_4NO_3	Degrees: Baumé	Twaddell
1.0212	51.06	0.4261	3.188	5	3.0	4.24
1.0255	61.53	0.5135	3.841	6	3.6	5.10
1.0297	72.08	0.6015	4.500	7	4.2	5.94
1.0340	82.72	0.6903	5.164	8	4.8	6.80
1.0382	93.44	0.7798	5.833	9	5.3	7.64
1.0425	104.3	0.8700	6.508	10	5.9	8.50
1.0468	115.1	0.9610	7.189	11	6.5	9.36
1.0512	126.1	1.053	7.875	12	7.1	10.24
1.0555	137.2	1.145	8.566	13	7.6	11.10
1.0599	148.4	1.238	9.264	14	8.2	11.98
1.0642	159.6	1.332	9.966	15	8.8	12.84
1.0686	171.0	1.427	10.67	16	9.3	13.72
1.0729	182.4	1.522	11.39	17	9.9	14.58
1.0773	193.9	1.618	12.11	18	10.4	15.46
1.0816	205.5	1.715	12.83	19	10.9	16.32
1.0860	217.2	1.813	13.56	20	11.5	17.20
1.0905	229.0	1.911	14.30	21	12.0	18.10
1.0950	240.9	2.010	15.04	22	12.6	19.00
1.0995	252.9	2.110	15.79	23	13.1	19.90
1.1040	265.0	2.211	16.54	24	13.7	20.80
1.1085	277.1	2.313	17.30	25	14.2	21.70
1.1130	289.4	2.415	18.07	26	14.7	22.60
1.1175	301.7	2.518	18.84	27	15.2	23.50
1.1220	314.2	2.622	19.61	28	15.8	24.40
1.1265	326.7	2.726	20.39	29	16.3	25.30
1.1310	339.3	2.832	21.18	30	16.8	26.20
1.1358	352.1	2.938	21.98	31	17.3	27.16
1.1406	365.0	3.046	22.79	32	17.9	28.12
1.1454	378.0	3.154	23.60	33	18.4	29.08
1.1502	391.1	3.264	24.41	34	18.9	30.04
1.1550	404.3	3.374	25.24	35	19.5	31.00
1.1598	417.5	3.484	26.07	36	20.0	31.96
1.1646	430.9	3.596	26.90	37	20.5	32.92
1.1694	444.4	3.708	27.74	38	21.0	33.88
1.1743	458.0	3.822	28.59	39	21.5	34.86
1.1790	471.6	3.936	29.44	40	22.0	35.80
1.1841	485.5	4.052	30.31	41	22.5	36.82
1.1892	499.5	4.168	31.18	42	23.1	37.84
1.1942	513.5	4.285	32.06	43	23.6	38.84
1.1994	527.7	4.404	32.95	44	24.1	39.88
1.2045	542.0	4.523	33.84	45	24.6	40.90
1.2096	556.4	4.644	34.74	46	25.1	41.92
1.2147	570.9	4.764	35.64	47	25.6	42.94
1.2198	585.5	4.886	36.55	48	26.1	43.96
1.2249	600.2	5.009	37.47	49	26.6	44.98
1.2300	615.0	5.132	38.39	50	27.1	46.00
1.2353	630.0	5.258	39.33	51	27.6	47.06
1.2407	645.2	5.384	40.28	52	28.1	48.14
1.2460	660.4	5.511	41.23	53	28.6	49.20
1.2514	675.8	5.639	42.19	54	29.1	50.28
1.2567	691.2	5.768	43.15	55	29.6	51.34
1.2621	706.8	5.898	44.12	56	30.1	52.42
1.2674	722.4	6.029	45.10	57	30.6	53.48
1.2728	738.2	6.161	46.09	58	31.1	54.56
1.2781	754.1	6.293	47.08	59	31.6	55.62
1.2835	770.1	6.427	48.08	60	32.0	56.70
1.2888	786.2	6.561	49.08	61	32.5	57.76
1.2942	802.4	6.696	50.09	62	33.0	58.84
1.3005	819.3	6.838	51.15	63	33.5	60.10
1.3059	835.8	6.975	52.18	64	34.0	61.18

AMMONIUM SULFATE

Density of Aqueous Ammonium Sulfate Solutions at $\frac{20°}{4}$ C. Computed from the Values Given in the International Critical Tables.

Specific Gravity	Weight of $(NH_4)_2SO_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $(NH_4)_2SO_4$	Degrees: Baumé	Twaddell
1.0041	10.04	0.08380	0.6269	1	0.6	0.82
1.0101	20.20	0.1686	1.261	2	1.5	2.02
1.0220	40.88	0.3412	2.552	4	3.1	4.40
1.0338	62.03	0.5176	3.872	6	4.7	6.76
1.0456	83.65	0.6981	5.222	8	6.3	9.12
1.0574	105.7	0.8824	6.601	10	7.9	11.48
1.0691	128.3	1.071	8.009	12	9.4	13.82
1.0808	151.3	1.263	9.446	14	10.8	16.16
1.0924	174.8	1.459	10.91	16	12.3	18.48
1.1039	198.7	1.658	12.40	18	13.7	20.78
1.1154	223.1	1.862	13.93	20	15.0	23.08
1.1269	247.9	2.069	15.48	22	16.3	25.38
1.1383	273.2	2.280	17.06	24	17.6	27.66
1.1496	298.9	2.494	18.66	26	18.9	29.92
1.1609	325.1	2.713	20.29	28	20.1	32.18
1.1721	351.6	2.934	21.95	30	21.3	34.42
1.2000	420.0	3.505	26.22	35	24.2	40.00
1.2277	491.1	4.098	30.66	40	26.9	45.54
1.2552	564.8	4.714	35.26	45	29.5	51.04
1.2825	641.3	5.351	40.03	50	31.9	56.50

AMMONIUM SULFATE

Density of Aqueous Ammonium Sulfate Solutions at 19° C. Computed from the Values of Schiff.

Specific Gravity	Weight of $(NH_4)_2SO_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $(NH_4)_2SO_4$	Degrees: Baumé	Twaddell
1.0057	10.06	0.08393	0.6279	1	0.8	1.14
1.0115	20.23	0.1688	1.263	2	1.6	2.30
1.0172	30.52	0.2547	1.905	3	2.5	3.44
1.0230	40.92	0.3415	2.555	4	3.3	4.60
1.0287	51.44	0.4292	3.211	5	4.0	5.74
1.0345	62.07	0.5180	3.875	6	4.8	6.90
1.0403	72.82	0.6077	4.546	7	5.6	8.06
1.0460	83.68	0.6983	5.224	8	6.4	9.20
1.0518	94.66	0.7900	5.910	9	7.1	10.36
1.0575	105.8	0.8825	6.602	10	7.9	11.50
1.0632	117.0	0.9760	7.301	11	8.6	12.64
1.0690	128.3	1.071	8.009	12	9.4	13.80
1.0747	139.7	1.166	8.722	13	10.1	14.94
1.0805	151.3	1.262	9.444	14	10.8	16.10
1.0862	162.9	1.360	10.17	15	11.5	17.24
1.0920	174.7	1.458	10.91	16	12.2	18.40
1.0977	186.6	1.557	11.65	17	12.9	19.54
1.1035	198.6	1.658	12.40	18	13.6	20.70
1.1092	210.7	1.759	13.16	19	14.3	21.84
1.1149	223.0	1.861	13.92	20	14.9	22.98
1.1207	235.3	1.964	14.69	21	15.6	24.14
1.1265	247.8	2.068	15.47	22	16.3	25.30
1.1323	260.4	2.173	16.26	23	16.9	26.46
1.1381	273.1	2.279	17.05	24	17.6	27.62
1.1439	286.0	2.387	17.85	25	18.2	28.78

AMMONIUM SULFATE (Continued)

Specific Gravity	Weight of $(NH_4)_2SO_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $(NH_4)_2SO_4$	Degrees: Baumé	Twaddell
1.1496	298.9	2.494	18.66	26	18.9	29.92
1.1554	312.0	2.603	19.48	27	19.5	31.08
1.1612	325.1	2.713	20.30	28	20.1	32.24
1.1670	338.4	2.824	21.13	29	20.8	33.40
1.1724	351.7	2.935	21.96	30	21.3	34.48
1.1780	365.2	3.048	22.80	31	21.9	35.60
1.1836	378.8	3.161	23.65	32	22.5	36.72
1.1892	392.4	3.275	24.50	33	23.1	37.84
1.1948	406.2	3.390	25.36	34	23.6	38.96
1.2004	420.1	3.506	26.23	35	24.2	40.08
1.2060	434.2	3.623	27.10	36	24.8	41.20
1.2116	448.3	3.741	27.99	37	25.3	42.32
1.2172	462.5	3.860	28.88	38	25.9	43.44
1.2228	476.9	3.980	29.77	39	26.4	44.56
1.2284	491.4	4.101	30.68	40	27.0	45.68
1.2343	506.1	4.223	31.59	41	27.5	46.86
1.2402	520.9	4.347	32.52	42	28.1	48.04
1.2462	535.9	4.472	33.45	43	28.6	49.24
1.2522	551.0	4.598	34.40	44	29.2	50.44
1.2583	566.2	4.725	35.35	45	29.8	51.66
1.2644	581.6	4.854	36.31	46	30.3	52.88
1.2705	597.1	4.983	37.28	47	30.9	54.10
1.2766	612.8	5.114	38.25	48	31.4	55.32
1.2828	628.6	5.246	39.24	49	32.0	56.56
1.2890	644.5	5.379	40.24	50	32.5	57.80

ARSENIC ACID

Density of Aqueous Arsenic Acid Solutions at $\frac{15}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of H_3AsO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent H_3AsO_4	Degrees: Baumé	Twaddell
1.0057	10.06	0.08393	0.6279	1	0.8	1.14
1.0124	20.25	0.1690	1.264	2	1.8	2.48
1.0260	41.04	0.3425	2.562	4	3.7	5.20
1.0398	62.39	0.5207	3.895	6	5.6	7.96
1.0538	84.30	0.7036	5.263	8	7.4	10.76
1.0681	106.8	0.8914	6.668	10	9.3	13.62
1.0826	129.9	1.084	8.110	12	11.1	16.52
1.0975	153.7	1.282	9.592	14	12.9	19.50
1.1128	178.0	1.486	11.12	16	14.7	22.56
1.1285	203.1	1.695	12.68	18	16.5	25.70
1.1447	228.9	1.911	14.29	20	18.3	28.94
1.1614	255.5	2.132	15.95	22	20.2	32.28
1.1785	282.8	2.360	17.66	24	22.0	35.70
1.1961	311.0	2.595	19.41	26	23.8	39.22
1.2143	340.0	2.837	21.23	28	25.6	42.86
1.2331	369.9	3.087	23.09	30	27.4	46.62
1.2829	449.0	3.747	28.03	35	32.0	56.58
1.3370	534.8	4.463	33.39	40	36.6	67.40
1.3959	628.2	5.242	39.22	45	41.1	79.18
1.4602	730.1	6.093	45.58	50	45.7	92.40
1.5304	841.7	7.024	52.55	55	50.3	106.08
1.6070	964.2	8.047	60.20	60	54.8	121.40
1.6904	1099	9.170	68.60	65	59.2	138.08
1.7811	1247	10.40	77.84	70	63.6	156.22

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ARSENIC ACID (Continued)

Specific Gravity	Weight of As_2O_5 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent As_2O_5	Degrees: Baumé	Twaddell
1.0057	8.142	0.06795	0.5083	0.8096	0.8	1.14
1.0124	16.39	0.1368	1.023	1.619	1.8	2.48
1.0260	33.23	0.2773	2.075	3.239	3.7	5.20
1.0398	50.51	0.4216	3.154	4.858	5.6	7.96
1.0538	68.25	0.5696	4.261	6.477	7.4	10.76
1.0681	86.47	0.7217	5.399	8.096	9.3	13.62
1.0826	105.2	0.8778	6.567	9.716	11.1	16.52
1.0975	124.3	1.038	7.763	11.33	12.9	19.50
1.1128	144.1	1.203	8.997	12.95	14.7	22.56
1.1285	164.4	1.372	10.26	14.57	16.5	25.70
1.1447	185.3	1.547	11.57	16.19	18.3	28.94
1.1614	206.8	1.726	12.91	17.81	20.2	32.28
1.1785	229.0	1.911	14.30	19.43	22.0	35.70
1.1961	251.8	2.101	15.72	21.05	23.8	39.22
1.2143	275.3	2.297	17.19	22.67	25.6	42.86
1.2331	299.5	2.500	18.70	24.29	27.4	46.62
1.2829	363.6	3.034	22.70	28.34	32.0	56.58
1.3370	433.1	3.614	27.04	32.39	36.6	67.40
1.3959	508.5	4.244	31.75	36.43	41.1	79.18
1.4602	591.1	4.933	36.90	40.48	45.7	92.40
1.5304	681.5	5.687	42.55	44.53	50.3	106.08
1.6070	780.7	6.515	48.74	48.58	54.8	121.40
1.6904	889.7	7.425	55.54	52.63	59.2	138.08
1.7811	1009	8.423	63.01	56.67	63.6	156.22

BARIUM CHLORIDE

Density of Aqueous Barium Chloride Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $BaCl_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $BaCl_2$	Degrees: Baumé	Twaddell
1.0159	20.32	0.1696	1.268	2	2.3	3.18
1.0341	41.36	0.3452	2.582	4	4.8	6.82
1.0528	63.17	0.5272	3.944	6	7.3	10.56
1.0721	85.77	0.7158	5.354	8	9.8	14.42
1.0921	109.2	0.9114	6.818	10	12.2	18.42
1.1128	133.5	1.114	8.337	12	14.7	22.56
1.1342	158.8	1.325	9.913	14	17.2	26.84
1.1564	185.0	1.544	11.55	16	19.6	31.28
1.1793	212.3	1.772	13.25	18	22.0	35.86
1.2031	240.6	2.008	15.02	20	24.5	40.62
1.2277	270.1	2.254	16.86	22	26.9	45.54
1.2531	300.7	2.510	18.78	24	29.3	50.62
1.2793	332.6	2.776	20.77	26	31.7	55.86

Specific Gravity	Weight of $BaCl_2 \cdot 2H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $BaCl_2 \cdot 2H_2O$	Degrees: Baumé	Twaddell
1.0159	23.83	0.1989	1.488	2.346	2.3	3.18
1.0341	48.52	0.4049	3.029	4.692	4.8	6.82
1.0528	74.10	0.6184	4.626	7.038	7.3	10.56
1.0721	100.6	0.8396	6.281	9.384	9.8	14.42
1.0921	128.1	1.069	7.997	11.73	12.2	18.42
1.1128	156.7	1.308	9.782	14.08	14.7	22.56
1.1342	186.2	1.554	11.63	16.42	17.2	26.84

BARIUM CHLORIDE (Continued)

Specific Gravity	Weight of $BaCl_2 \cdot 2H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $BaCl_2 \cdot 2H_2O$	Degrees: Baumé	Twaddell
1.1564	217.1	1.812	13.56	18.77	19.6	31.28
1.1793	249.0	2.078	15.54	21.11	22.0	35.86
1.2031	282.2	2.355	17.62	23.46	24.5	40.62
1.2277	316.9	2.644	19.78	25.81	26.9	45.54
1.2531	352.7	2.944	22.02	28.15	29.3	50.62
1.2793	390.2	3.256	24.36	30.50	31.7	55.86

CADMIUM NITRATE

Density of Aqueous Cadmium Nitrate Solutions at $\frac{18}{4}^{\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $Cd(NO_3)_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Cd(NO_3)_2$	Degrees: Baumé	Twaddell
1.0154	20.31	0.1695	1.268	2	2.2	3.08
1.0326	41.30	0.3447	2.579	4	4.6	6.52
1.0502	63.01	0.5259	3.934	6	6.9	10.04
1.0683	85.46	0.7132	5.336	8	9.3	13.66
1.0869	108.7	0.9071	6.786	10	11.6	17.38
1.1061	132.7	1.108	8.286	12	13.9	21.22
1.1261	157.7	1.316	9.842	14	16.2	25.22
1.1468	183.5	1.530	11.45	16	18.6	29.36
1.1682	210.3	1.755	13.13	18	20.9	33.64
1.1904	238.1	1.987	14.86	20	23.2	38.08
1.2488	312.2	2.605	19.49	25	28.9	49.76
1.3124	393.7	3.286	24.58	30	34.5	62.48
1.3822	483.8	4.037	30.20	35	40.1	76.44
1.4590	583.6	4.870	36.43	40	45.6	91.80
1.5438	694.7	5.798	43.37	45	51.1	108.76
1.6356	817.8	6.825	51.06	50	56.4	127.12

CALCIUM CHLORIDE

Density of Aqueous Calcium Chloride Solutions at $\frac{20}{4}^{\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $CaCl_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $CaCl_2$	Degrees: Baumé	Twaddell
1.0148	20.30	0.1694	1.267	2	2.1	2.96
1.0316	41.26	0.3444	2.576	4	4.4	6.32
1.0486	62.92	0.5251	3.928	6	6.7	9.72
1.0659	85.27	0.7116	5.324	8	9.0	13.18
1.0835	108.4	0.9042	6.764	10	11.2	16.70
1.1015	132.2	1.103	8.252	12	13.4	20.30
1.1198	156.8	1.308	9.787	14	15.5	23.96
1.1386	182.2	1.520	11.37	16	17.7	27.72
1.1578	208.4	1.739	13.01	18	19.8	31.56
1.1775	235.5	1.965	14.70	20	21.9	35.50
1.2284	307.1	2.563	19.17	25	27.0	45.68
1.2816	384.5	3.209	24.00	30	31.9	56.32
1.3373	468.1	3.906	29.22	35	36.6	67.46
1.3957	558.3	4.659	34.85	40	41.1	79.14

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'CALCIUM CHLORIDE (Continued)

Specific Gravity	Weight of $CaCl_2 \cdot 6H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $CaCl_2 \cdot 6H_2O$	Degrees: Baumé	Twaddell
1.0148	40.06	0.3344	2.501	3.948	2.1	2.96
1.0316	81.46	0.6798	5.085	7.896	4.4	6.32
1.0486	124.2	1.036	7.751	11.84	6.7	9.72
1.0659	168.3	1.405	10.51	15.79	9.0	13.18
1.0835	213.9	1.785	13.35	19.74	11.2	16.70
1.1015	260.9	2.178	16.29	23.69	13.4	20.30
1.1198	309.5	2.583	19.32	27.64	15.5	23.96
1.1386	359.6	3.008	22.45	31.58	17.7	27.72
1.1578	411.4	3.433	25.68	35.53	19.8	31.56
1.1775	465.9	3.888	29.08	39.48	21.9	35.50
1.2284	606.2	5.059	37.85	49.35	27.0	45.68
1.2816	759.0	6.334	47.38	59.22	31.9	56.32
1.3373	923.9	7.711	57.68	69.09	36.6	67.46
1.3957	1102.0	9.197	68.80	78.96	41.1	79.14

CHROMIC ACID

Density of Aqueous Chromic Acid Solutions at $\frac{15}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of CrO_3 in solution expressed in: Grams per Liter	Pounds Per U. S. Gallon	Pounds per Cubic Foot	Per Cent CrO_3	Degrees: Baumé	Twaddell
1.006	10.06	0.08395	0.6280	1	0.9	1.2
1.014	20.28	0.1692	1.266	2	2.0	2.8
1.030	41.20	0.3438	2.572	4	4.2	6.0
1.045	62.70	0.5233	3.914	6	6.2	9.0
1.060	84.80	0.7077	5.294	8	8.2	12.0
1.076	107.6	0.8980	6.717	10	10.2	15.2
1.093	131.2	1.095	8.188	12	12.3	18.6
1.110	155.4	1.297	9.702	14	14.4	22.0
1.127	180.3	1.505	11.26	16	16.3	25.4
1.145	206.1	1.720	12.87	18	18.4	29.0
1.163	232.6	1.941	14.52	20	20.3	32.6
1.181	259.8	2.168	16.22	22	22.2	36.2
1.200	288.0	2.403	17.98	24	24.2	40.0
1.220	317.2	2.647	19.80	26	26.2	44.0
1.240	347.2	2.898	21.68	28	28.1	48.0
1.260	378.0	3.155	23.60	30	29.9	52.0
1.313	459.6	3.835	28.69	35	34.6	62.6
1.371	548.4	4.577	34.24	40	39.2	74.2
1.435	645.8	5.389	40.31	45	44.0	87.0
1.505	752.5	6.280	46.98	50	48.7	101.0
1.581	869.6	7.257	54.29	55	53.3	116.2
1.663	997.8	8.327	62.29	60	57.8	132.6

CHROMIUM SULFATE

Density of Aqueous Chromium Sulfate Solutions at $\frac{15}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $Cr_2(SO_4)_3$ (green) in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Cr_2(SO_4)_3$ (green)	Degrees: Baumé	Twaddell
1.0081	10.08	0.08413	0.6294	1	1.2	1.62
1.0172	20.34	0.1698	1.270	2	2.5	3.44
1.0358	41.43	0.3458	2.587	4	5.0	7.16
1.0551	63.31	0.5283	3.952	6	7.6	11.02
1.0751	86.01	0.7178	5.369	8	10.1	15.02

CHROMIUM SULFATE (Continued)

Specific Gravity	Weight of $Cr_2(SO_4)_3$ (green) in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Cr_2(SO_4)_3$ (green)	Degrees: Baumé	Twaddell
1.0958	109.6	0.9145	6.841	10	12.7	19.16
1.1172	134.1	1.119	8.370	12	15.2	23.44
1.1392	159.5	1.331	9.957	14	17.7	27.84
1.1618	185.9	1.551	11.60	16	20.2	32.36
1.1851	213.3	1.780	13.32	18	22.7	37.02
1.2091	241.8	2.018	15.10	20	25.1	41.82
1.2339	271.5	2.265	16.95	22	27.5	46.78
1.2594	302.3	2.522	18.87	24	29.9	51.88
1.2856	334.3	2.790	20.87	26	32.2	57.12
1.3125	367.5	3.067	22.94	28	34.5	62.50
1.3401	402.0	3.355	25.10	30	36.8	68.02
1.4123	494.3	4.125	30.86	35	42.3	82.46
1.4893	595.7	4.972	37.19	40	47.6	97.86

Specific Gravity	Weight of $Cr_2(SO_4)_3$ (violet) in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Cr_2(SO_4)_3$ (violet)	Degrees: Baumé	Twaddell
1.0091	10.09	0.08421	0.6300	1	1.3	1.82
1.0191	20.38	0.1701	1.272	2	2.7	3.82
1.0395	41.58	0.3470	2.596	4	5.5	7.90
1.0604	63.62	0.5310	3.972	6	8.3	12.08
1.0817	86.54	0.7222	5.403	8	11.0	16.34
1.1034	110.3	0.9208	6.889	10	13.6	20.68
1.1257	135.1	1.127	8.433	12	16.2	25.14
1.1486	160.8	1.342	10.04	14	18.8	29.72
1.1722	187.6	1.565	11.71	16	21.3	34.44
1.1966	215.4	1.797	13.45	18	23.8	39.32
1.2218	244.4	2.039	15.26	20	26.3	44.36
1.2479	274.5	2.291	17.14	22	28.8	49.58
1.2750	306.0	2.554	19.10	24	31.3	55.00
1.3032	338.8	2.828	21.15	26	33.7	60.64
1.3325	373.1	3.114	23.29	28	36.2	66.50

CITRIC ACID

Density of Aqueous Citric Acid Solutions at 15° C. Computed from the Values of Gerlach.

Specific Gravity	Weight of $C_6H_8O_7 \cdot H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $C_6H_8O_7 \cdot H_2O$	Degrees: Baumé	Twaddell
1.0074	20.15	0.1681	1.258	2	1.1	1.48
1.0149	40.60	0.3388	2.534	4	2.1	2.98
1.0227	61.36	0.5121	3.831	6	3.2	4.54
1.0309	82.47	0.6883	5.149	8	4.3	6.18
1.0392	103.9	0.8673	6.488	10	5.5	7.84
1.0470	125.6	1.049	7.844	12	6.5	9.40
1.0549	147.7	1.232	9.220	14	7.6	10.98
1.0632	170.1	1.420	10.62	16	8.6	12.64
1.0718	192.9	1.610	12.04	18	9.7	14.36
1.0805	216.1	1.803	13.49	20	10.8	16.10
1.0889	239.6	1.999	14.96	22	11.8	17.78
1.0972	263.3	2.198	16.44	24	12.8	19.44
1.1060	287.6	2.400	17.95	26	13.9	21.20
1.1152	312.3	2.606	19.49	28	15.0	23.04
1.1244	337.3	2.815	21.06	30	16.0	24.88

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CITRIC ACID (Continued)

Specific Gravity	Weight of $C_6H_8O_7 \cdot H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $C_6H_8O_7 \cdot H_2O$	Degrees: Baumé	Twaddell
1.1332	362.6	3.026	22.64	32	17.1	26.66
1.1422	388.3	3.241	24.24	34	18.1	28.44
1.1515	414.5	3.460	25.88	36	19.1	30.30
1.1612	441.3	3.682	27.55	38	20.1	32.24
1.1709	468.4	3.909	29.24	40	21.2	34.18
1.1814	496.2	4.141	30.98	42	22.3	36.28
1.1899	523.6	4.369	32.69	44	23.1	37.98
1.1998	551.9	4.606	34.46	46	24.2	39.96
1.2103	580.9	4.848	36.27	48	25.2	42.06
1.2204	610.2	5.092	38.09	50	26.2	44.08
1.2307	640.0	5.341	39.95	52	27.2	46.14
1.2410	670.1	5.593	41.84	54	28.2	48.20
1.2514	700.8	5.848	43.75	56	29.1	50.28
1.2627	732.4	6.112	45.72	58	30.2	52.54
1.2738	764.3	6.378	47.71	60	31.2	54.76
1.2849	796.6	6.648	49.73	62	32.2	56.98
1.2960	829.4	6.922	51.78	64	33.1	59.20
1.3071	862.7	7.199	53.86	66	34.1	61.42

COPPER NITRATE

Density of Aqueous Copper Nitrate Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $Cu(NO_3)_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Cu(NO_3)_2$	Degrees: Baumé	Twaddell
1.007	10.07	0.08404	0.6287	1	1.0	1.4
1.015	20.30	0.1694	1.267	2	2.1	3.0
1.032	41.28	0.3445	2.577	4	4.5	6.4
1.050	63.00	0.5258	3.933	6	6.9	10.0
1.069	85.52	0.7137	5.339	8	9.4	13.8
1.088	108.8	0.9080	6.792	10	11.7	17.6
1.107	132.8	1.109	8.293	12	14.0	21.4
1.126	157.6	1.316	9.841	14	16.2	25.2
1.147	183.5	1.532	11.46	16	18.6	29.4
1.168	210.2	1.755	13.13	18	20.9	33.6
1.189	237.8	1.985	14.85	20	23.1	37.8
1.248	312.0	2.604	19.48	25	28.8	49.6

COPPER SULFATE

Density of Aqueous Copper Sulfate Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $CuSO_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $CuSO_4$	Degrees: Baumé	Twaddell
1.009	10.09	0.08421	0.6299	1	1.3	1.8
1.019	20.38	0.1701	1.272	2	2.7	3.8
1.040	41.60	0.3472	2.597	4	5.6	8.0
1.062	63.72	0.5318	3.978	6	8.5	12.4
1.084	86.72	0.7237	5.414	8	11.2	16.8
1.107	110.7	0.9238	6.911	10	14.0	21.4
1.131	135.7	1.133	8.473	12	16.8	26.2
1.154	161.6	1.348	10.09	14	19.4	30.8
1.180	188.8	1.576	11.79	16	22.1	36.0
1.206	217.1	1.812	13.55	18	24.8	41.2

COPPER SULFATE (Continued)

Specific Gravity	Weight of $CuSO_4 \cdot 5H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $CuSO_4 + 5H_2O$	Degrees: Baumé	Twaddell
1.009	15.78	0.1317	0.9852	1.564	1.3	1.8
1.019	31.88	0.2661	1.991	3.129	2.7	3.8
1.040	65.07	0.5431	4.062	6.257	5.6	8.0
1.062	99.68	0.8319	6.223	9.386	8.5	12.4
1.084	135.6	1.132	8.466	12.51	11.2	16.8
1.107	173.1	1.445	10.81	15.64	14.0	21.4
1.131	212.3	1.772	13.25	18.77	16.8	26.2
1.154	252.7	2.109	15.78	21.90	19.4	30.8
1.180	295.3	2.465	18.44	25.03	22.1	36.0
1.206	339.6	2.834	21.20	28.16	24.8	41.2

Density of Aqueous Copper Sulfate Solutions at 18° C. Computed from the Values of Schiff and Gerlach.

Specific Gravity	Weight of $CuSO_4 \cdot 5H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $CuSO_4 \cdot 5H_2O$	Degrees: Baumé	Twaddell
1.0063	10.06	0.08398	0.6282	1	0.9	1.26
1.0126	20.25	0.1690	1.264	2	1.8	2.52
1.0190	30.57	0.2551	1.908	3	2.7	3.80
1.0254	41.02	0.3423	2.561	4	3.6	5.08
1.0319	51.60	0.4306	3.221	5	4.5	6.38
1.0384	62.30	0.5200	3.890	6	5.4	7.68
1.0450	73.15	0.6105	4.567	7	6.2	9.00
1.0516	84.13	0.7021	5.252	8	7.1	10.32
1.0582	95.24	0.7948	5.946	9	8.0	11.64
1.0649	106.5	0.8887	6.648	10	8.8	12.98
1.0716	117.9	0.9837	7.359	11	9.7	14.32
1.0785	129.4	1.080	8.080	12	10.6	15.70
1.0854	141.1	1.178	8.809	13	11.4	17.08
1.0923	152.9	1.276	9.547	14	12.3	18.46
1.0993	164.9	1.376	10.29	15	13.1	19.86
1.1063	177.0	1.477	11.05	16	13.9	21.26
1.1135	189.3	1.580	11.82	17	14.8	22.70
1.1208	201.7	1.684	12.59	18	15.6	24.16
1.1281	214.3	1.789	13.38	19	16.5	25.62
1.1354	227.1	1.895	14.18	20	17.3	27.08
1.1427	240.0	2.003	14.98	21	18.1	28.54
1.1501	253.0	2.112	15.80	22	18.9	30.02
1.1585	266.5	2.224	16.63	23	19.8	31.70
1.1659	279.8	2.335	17.47	24	20.6	33.18
1.1738	293.5	2.449	18.32	25	21.5	34.76
1.1817	307.2	2.564	19.18	26	22.3	36.34
1.1898	321.2	2.681	20.06	27	23.1	37.96
1.1980	335.4	2.799	20.94	28	24.0	39.60
1.2063	349.8	2.919	21.84	29	24.8	41.26
1.2146	364.4	3.041	22.75	30	25.6	42.92

Specific Gravity	Weight of $CuSO_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $CuSO_4$	Degrees: Baumé	Twaddell
1.0063	6.433	0.05369	0.4016	0.6393	0.9	1.26
1.0126	12.95	0.1081	0.8085	1.279	1.8	2.52
1.0190	19.54	0.1631	1.220	1.918	2.7	3.80
1.0254	26.22	0.2188	1.637	2.557	3.6	5.08
1.0319	32.98	0.2752	2.059	3.196	4.5	6.38

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COPPER SULFATE (Continued)

Specific Gravity	Weight of $CuSO_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds Per Cubic Foot	Per Cent $CuSO_4$	Degrees: Baumé	Twaddell
1.0384	39.83	0.3324	2.487	3.836	5.4	7.68
1.0450	46.76	0.3903	2.919	4.475	6.2	9.00
1.0516	53.78	0.4488	3.357	5.114	7.1	10.32
1.0582	60.88	0.5081	3.801	5.753	8.0	11.64
1.0649	68.08	0.5681	4.250	6.393	8.8	12.98
1.0716	75.35	0.6289	4.704	7.032	9.7	14.32
1.0785	82.73	0.6904	5.165	7.671	10.6	15.70
1.0854	90.20	0.7527	5.631	8.310	11.4	17.08
1.0923	97.76	0.8159	6.103	8.950	12.3	18.46
1.0993	105.4	0.8797	6.581	9.589	13.1	19.86
1.1063	113.2	0.9445	7.065	10.23	13.9	21.26
1.1135	121.0	1.010	7.556	10.87	14.8	22.70
1.1208	129.0	1.077	8.054	11.51	15.6	24.16
1.1281	137.1	1.144	8.557	12.15	16.5	25.62
1.1354	145.2	1.212	9.066	12.79	17.3	27.08
1.1427	153.4	1.280	9.574	13.42	18.1	28.54
1.1501	161.7	1.349	10.10	14.06	18.9	30.02
1.1585	170.3	1.421	10.63	14.70	19.8	31.70
1.1659	178.8	1.493	11.17	15.34	20.6	33.18
1.1738	187.6	1.565	11.71	15.98	21.5	34.76
1.1817	196.4	1.639	12.26	16.62	22.3	36.34
1.1898	205.4	1.714	12.82	17.26	23.1	37.96
1.1980	214.4	1.790	13.39	17.90	24.0	39.60
1.2063	223.6	1.866	13.96	18.54	24.8	41.26
1.2146	233.0	1.944	14.54	19.18	25.6	42.92

CUPRIC CHLORIDE

Density of Aqueous Cupric Chloride Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $CuCl_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $CuCl_2$	Degrees: Baumé	Twaddell
1.007	10.07	0.08404	0.6287	1	1.0	1.4
1.017	20.34	0.1697	1.270	2	2.4	3.4
1.036	41.44	0.3458	2.587	4	5.0	7.2
1.056	63.36	0.5288	3.956	6	7.7	11.2
1.075	86.00	0.7177	5.369	8	10.1	15.0
1.096	109.6	0.9147	6.842	10	12.7	19.2
1.117	134.0	1.119	8.368	12	15.2	23.4
1.138	159.3	1.330	9.946	14	17.6	27.6
1.160	185.6	1.549	11.59	16	20.0	32.0
1.182	212.8	1.776	13.28	18	22.3	36.4
1.205	241.0	2.011	15.05	20	24.7	41.0

Density of Aqueous Cupric Chloride Solutions at 17.5° C. Computed from the Values of Franz.

Specific Gravity	Weight of $CuCl_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $CuCl_2$	Degrees: Baumé	Twaddell
1.0091	10.09	0.08421	0.6300	1	1.3	1.82
1.0182	20.36	0.1699	1.271	2	2.6	3.64
1.0273	30.82	0.2572	1.924	3	3.9	5.46
1.0364	41.46	0.3460	2.588	4	5.1	7.28
1.0455	52.28	0.4363	3.264	5	6.3	9.10

CUPRIC CHLORIDE (Continued)

Specific Gravity	Weight of $CuCl_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $CuCl_2$	Degrees: Baumé	Twaddell
1.0548	63.29	0.5282	3.951	6	7.5	10.96
1.0641	74.49	0.6216	4.650	7	8.7	12.82
1.0734	85.87	0.7166	5.361	8	9.9	14.68
1.0827	97.44	0.8132	6.083	9	11.1	16.54
1.0920	109.2	0.9113	6.817	10	12.2	18.40
1.1049	121.5	1.014	7.588	11	13.8	20.98
1.1178	134.1	1.119	8.374	12	15.3	23.56
1.1307	147.0	1.227	9.177	13	16.8	26.14
1.1436	160.1	1.336	9.995	14	18.2	28.72
1.1565	173.5	1.448	10.83	15	19.6	31.30
1.1696	187.1	1.562	11.68	16	21.0	33.92
1.1827	201.1	1.678	12.55	17	22.4	36.54
1.1958	215.2	1.796	13.44	18	23.7	39.16
1.2089	229.7	1.917	14.34	19	25.1	41.78
1.2223	244.5	2.040	15.26	20	26.4	44.46
1.2362	259.6	2.166	16.21	21	27.7	47.24
1.2501	275.0	2.295	17.17	22	29.0	50.02
1.2640	290.7	2.426	18.15	23	30.3	52.80
1.2779	306.7	2.560	19.15	24	31.5	55.58
1.2918	323.0	2.695	20.16	25	32.8	58.36
1.3058	339.5	2.833	21.20	26	34.0	61.16
1.3198	356.3	2.974	22.25	27	35.1	63.96
1.3338	373.5	3.117	23.32	28	36.3	66.76
1.3478	390.9	3.262	24.40	29	37.4	69.56
1.3618	408.5	3.409	25.51	30	38.5	72.36
1.3784	427.3	3.566	26.68	31	39.8	75.68
1.3950	446.4	3.725	27.87	32	41.1	79.00
1.4116	465.8	3.888	29.08	33	42.3	82.32
1.4287	485.8	4.054	30.33	34	43.5	85.74
1.4447	505.6	4.220	31.57	35	44.6	88.94
1.4615	526.1	4.391	32.85	36	45.8	92.30
1.4782	546.9	4.564	34.15	37	46.9	95.64
1.4949	568.1	4.741	35.46	38	48.0	98.98
1.5116	589.5	4.920	36.80	39	49.1	102.32
1.5284	611.4	5.102	38.17	40	50.1	105.68

FERRIC CHLORIDE

Density of Aqueous Ferric Chloride Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $FeCl_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $FeCl_3$	Degrees: Baumé	Twaddell
1.007	10.07	0.08404	0.6287	1	1.0	1.4
1.015	20.30	0.1694	1.267	2	2.1	3.0
1.032	41.28	0.3445	2.577	4	4.5	6.4
1.049	62.94	0.5253	3.929	6	6.8	9.8
1.067	85.36	0.7124	5.329	8	9.1	13.4
1.085	108.5	0.9055	6.774	10	11.4	17.0
1.104	132.5	1.106	8.271	12	13.7	20.8
1.123	157.2	1.312	9.815	14	15.9	24.6
1.142	182.7	1.525	11.41	16	18.0	28.4
1.162	209.2	1.746	13.06	18	20.2	32.4
1.182	236.4	1.973	14.76	20	22.3	36.4
1.234	308.5	2.575	19.26	25	27.5	46.8
1.291	387.3	3.232	24.18	30	32.7	58.2
1.353	473.6	3.952	29.56	35	37.8	70.6
1.418	567.2	4.734	35.41	40	42.7	83.6
1.485	668.3	5.577	41.72	45	47.4	97.0
1.551	775.5	6.472	48.41	50	51.5	110.2

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FERRIC CHLORIDE (Continued)

Density of Aqueous Ferric Chloride Solutions at 17.5° C. Computed from the Values of Franz.

Specific Gravity	Weight of $FeCl_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $FeCl_3$	Degrees: Baumé	Twaddell
1.0073	10.07	0.08406	0.6289	1	1.1	1.46
1.0146	20.29	0.1693	1.267	2	2.1	2.92
1.0219	30.66	0.2558	1.914	3	3.1	4.38
1.0292	41.17	0.3436	2.570	4	4.1	5.84
1.0365	51.83	0.4325	3.235	5	5.1	7.30
1.0439	62.63	0.5227	3.910	6	6.1	8.78
1.0513	73.59	0.6141	4.594	7	7.0	10.26
1.0587	84.70	0.7068	5.288	8	8.0	11.74
1.0661	95.95	0.8007	5.990	9	9.0	13.22
1.0734	107.3	0.8958	6.701	10	9.9	14.68
1.0814	119.0	0.9927	7.426	11	10.9	16.28
1.0894	130.7	1.091	8.161	12	11.9	17.88
1.0974	142.7	1.191	8.906	13	12.9	19.48
1.1054	154.8	1.292	9.661	14	13.8	21.08
1.1134	167.0	1.394	10.43	15	14.8	22.68
1.1215	179.4	1.497	11.20	16	15.7	24.30
1.1297	192.0	1.603	11.99	17	16.6	25.94
1.1378	204.8	1.709	12.79	18	17.6	27.56
1.1458	217.7	1.817	13.59	19	18.4	29.16
1.1542	230.8	1.926	14.41	20	19.4	30.84
1.1644	244.5	2.041	15.27	21	20.5	32.88
1.1746	258.4	2.157	16.13	22	21.6	34.92
1.1848	272.5	2.274	17.01	23	22.6	36.96
1.1950	286.8	2.393	17.90	24	23.7	39.00
1.2052	301.3	2.514	18.81	25	24.7	41.04
1.2155	316.0	2.637	19.73	26	25.7	43.10
1.2258	331.0	2.762	20.66	27	26.7	45.16
1.2365	346.2	2.889	21.61	28	27.7	47.30
1.2464	361.5	3.016	22.57	29	28.7	49.28
1.2568	377.0	3.147	23.54	30	29.6	51.36
1.2673	392.9	3.279	24.53	31	30.6	53.46
1.2778	408.9	3.412	25.53	32	31.5	55.56
1.2883	425.1	3.548	26.54	33	32.5	57.66
1.2988	441.6	3.685	27.57	34	33.4	59.76
1.3093	458.3	3.824	28.61	35	34.3	61.86
1.3199	475.2	3.965	29.66	36	35.1	63.98
1.3305	492.3	4.108	30.73	37	36.0	66.10
1.3411	509.6	4.253	31.82	38	36.9	68.22
1.3517	527.2	4.399	32.91	39	37.7	70.34
1.3622	544.9	4.547	34.02	40	38.6	72.44
1.3746	563.6	4.703	35.18	41	39.5	74.92
1.3870	582.5	4.862	36.37	42	40.5	77.40
1.3994	601.7	5.022	37.57	43	41.4	79.88
1.4118	621.2	5.184	38.78	44	42.3	82.36
1.4242	640.9	5.348	40.01	45	43.2	84.84
1.4367	660.9	5.515	41.26	46	44.1	87.34
1.4492	681.1	5.684	42.52	47	44.9	89.84
1.4617	701.6	5.855	43.80	48	45.8	92.34
1.4742	722.4	6.028	45.10	49	46.6	94.84
1.4867	743.4	6.204	46.41	50	47.5	97.34
1.5010	765.5	6.388	47.79	51	48.4	100.20
1.5153	788.0	6.576	49.19	52	49.3	103.06
1.5296	810.7	6.766	50.61	53	50.2	105.92
1.5439	833.7	6.958	52.05	54	51.1	108.78
1.5582	857.0	7.152	53.50	55	51.9	111.64
1.5729	880.8	7.351	54.99	56	52.8	114.58
1.5876	904.9	7.552	56.49	57	53.7	117.52
1.6023	929.3	7.756	58.02	58	54.5	120.46
1.6170	954.0	7.962	59.56	59	55.3	123.40
1.6317	979.0	8.170	61.12	60	56.1	126.34

FERRIC NITRATE

Density of Aqueous Ferric Nitrate Solutions at $\frac{18}{4}^{\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $Fe(NO_3)_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Fe(NO_3)_3$	Degrees: Baumé	Twaddell
1.0065	10.07	0.08400	0.6284	1	0.9	1.30
1.0144	20.29	0.1693	1.267	2	2.1	2.88
1.0304	41.22	0.3440	2.573	4	4.3	6.08
1.0468	62.81	0.5242	3.921	6	6.5	9.36
1.0636	85.09	0.7101	5.312	8	8.7	12.72
1.0810	108.1	0.9021	6.749	10	10.9	16.20
1.0989	131.9	1.100	8.233	12	13.1	19.78
1.1172	156.4	1.305	9.765	14	15.2	23.44
1.1359	181.7	1.517	11.35	16	17.3	27.18
1.1551	207.9	1.735	12.98	18	19.5	31.02
1.1748	235.0	1.961	14.67	20	21.6	34.96
1.2281	307.0	2.562	19.17	25	26.9	45.62

Density of Aqueous Ferric Nitrate Solutions at 17.5° C. Computed from the Values of Franz.

Specific Gravity	Weight of $Fe(NO_3)_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Fe(NO_3)_3$	Degrees: Baumé	Twaddell
1.0080	10.08	0.08412	0.6293	1	1.2	1.60
1.0160	20.32	0.1696	1.269	2	2.3	3.20
1.0240	30.72	0.2564	1.918	3	3.4	4.80
1.0320	41.28	0.3445	2.577	4	4.5	6.40
1.0398	51.99	0.4339	3.246	5	5.6	7.96
1.0472	62.83	0.5244	3.923	6	6.5	9.44
1.0546	73.82	0.6161	4.609	7	7.5	10.92
1.0620	84.96	0.7090	5.304	8	8.5	12.40
1.0694	96.25	0.8032	6.009	9	9.4	13.88
1.0770	107.7	0.8988	6.724	10	10.4	15.40
1.0852	119.4	0.9962	7.452	11	11.4	17.04
1.0934	131.2	1.095	8.191	12	12.4	18.68
1.1016	143.2	1.195	8.940	13	13.4	20.32
1.1098	155.4	1.297	9.700	14	14.3	21.96
1.1182	167.7	1.400	10.47	15	15.3	23.64
1.1268	180.3	1.505	11.26	16	16.3	25.36
1.1354	193.0	1.611	12.05	17	17.3	27.08
1.1440	205.9	1.718	12.86	18	18.3	28.80
1.1526	219.0	1.828	13.67	19	19.2	30.52
1.1612	232.2	1.938	14.50	20	20.1	32.24
1.1712	246.0	2.053	15.35	21	21.2	34.24
1.1812	259.9	2.169	16.22	22	22.2	36.24
1.1912	274.0	2.286	17.10	23	23.3	38.24
1.2012	288.3	2.406	18.00	24	24.3	40.24
1.2110	302.8	2.527	18.90	25	25.3	42.20
1.2212	317.5	2.650	19.82	26	26.3	44.24
1.2314	332.5	2.775	20.76	27	27.3	46.28
1.2416	347.6	2.901	21.70	28	28.2	48.32
1.2518	363.0	3.030	22.66	29	29.2	50.36
1.2622	378.7	3.160	23.64	30	30.1	52.44
1.2730	394.6	3.293	24.64	31	31.1	54.60
1.2838	410.8	3.428	25.65	32	32.1	56.76
1.2946	427.2	3.565	26.67	33	33.0	58.92
1.3054	443.8	3.704	27.71	34	33.9	61.08
1.3164	460.7	3.845	28.76	35	34.9	63.28

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FERRIC NITRATE (Continued)

Specific Gravity	Weight of $Fe(NO_3)_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Fe(NO_3)_3$	Degrees: Baumé	Twaddell
1.3280	478.1	3.990	29.85	36	35.8	65.60
1.3396	495.7	4.136	30.94	37	36.8	67.92
1.3512	513.5	4.285	32.06	38	37.7	70.24
1.3628	531.5	4.436	33.18	39	38.6	72.56
1.3746	549.8	4.589	34.33	40	39.5	74.92
1.3864	568.4	4.744	35.49	41	40.4	77.28
1.3982	587.2	4.901	36.66	42	41.3	79.64
1.4100	606.3	5.060	37.85	43	42.2	82.00
1.4218	625.6	5.221	39.06	44	43.0	84.36
1.4338	645.2	5.385	40.28	45	43.9	86.76
1.4465	665.4	5.553	41.54	46	44.8	89.30
1.4592	685.8	5.723	42.82	47	45.6	91.84
1.4719	706.5	5.896	44.11	48	46.5	94.38
1.4846	727.5	6.071	45.41	49	47.3	96.92
1.4972	748.6	6.247	46.74	50	48.2	99.44
1.5122	771.2	6.436	48.15	51	49.1	102.44
1.5272	794.1	6.627	49.58	52	50.1	105.44
1.5422	817.4	6.821	51.03	53	51.0	108.44
1.5572	840.9	7.018	52.50	54	51.9	111.44
1.5722	864.7	7.216	53.98	55	52.8	114.44
1.5892	890.0	7.427	55.56	56	53.8	117.84
1.6062	915.5	7.640	57.16	57	54.7	121.24
1.6232	941.5	7.857	58.78	58	55.7	124.64
1.6402	967.7	8.076	60.41	59	56.6	128.04
1.6572	994.3	8.298	62.08	60	57.5	131.44
1.6764	1023	8.534	63.84	61	58.5	135.28
1.6956	1051	8.773	65.63	62	59.5	139.12
1.7148	1080	9.016	67.44	63	60.4	142.96
1.7340	1110	9.261	69.28	64	61.4	146.80
1.7532	1140	9.510	71.14	65	62.3	150.64

FERRIC SULFATE

Density of Aqueous Ferric Sulfate Solutions at $\frac{17.5}{4}^{\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $Fe_2(SO_4)_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Fe_2(SO_4)_3$	Degrees: Baumé	Twaddell
1.007	10.07	0.08404	0.6287	1	1.0	1.4
1.016	20.32	0.1696	1.269	2	2.3	3.2
1.033	41.32	0.3448	2.580	4	4.7	6.6
1.050	63.00	0.5258	3.933	6	6.9	10.0
1.067	85.36	0.7124	5.329	8	9.1	13.4
1.084	108.4	0.9046	6.767	10	11.2	16.8
1.103	132.4	1.105	8.263	12	13.5	20.6
1.122	157.1	1.311	9.807	14	15.8	24.4
1.141	182.6	1.524	11.40	16	17.9	28.2
1.161	209.0	1.744	13.05	18	20.1	32.2
1.181	236.2	1.971	14.75	20	22.2	36.2
1.241	310.3	2.589	19.37	25	28.2	48.2
1.307	392.1	3.272	24.48	30	34.1	61.4
1.376	481.6	4.019	30.07	35	39.6	75.2
1.449	579.6	4.837	36.18	40	44.9	89.8
1.528	687.6	5.738	42.93	45	50.1	105.6
1.613	806.5	6.731	50.35	50	55.1	122.6
1.703	936.7	7.817	58.48	55	59.9	140.6
1.798	1079	9.003	67.35	60	64.4	159.6

FERROUS SULFATE

Density of Aqueous Ferrous Sulfate Solutions at $\frac{18}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $FeSO_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $FeSO_4$	Degrees: Baumé	Twaddell
1.0007	2.001	0.01670	0.1249	0.2	0.1	0.14
1.0028	4.011	0.03348	0.2504	0.4	0.4	0.56
1.0046	6.028	0.05030	0.3763	0.6	0.7	0.92
1.0065	8.052	0.06720	0.5027	0.8	0.9	1.30
1.0085	10.09	0.08416	0.6296	1.0	1.2	1.70
1.0180	20.36	0.1699	1.271	2	2.6	3.60
1.0375	41.50	0.3463	2.591	4	5.2	7.50
1.0575	63.45	0.5295	3.961	6	7.9	11.50
1.0785	86.28	0.7200	5.386	8	10.6	15.70
1.1000	110.0	0.9180	6.867	10	13.2	20.00
1.1220	134.6	1.124	8.406	12	15.8	24.40
1.1445	160.2	1.337	10.00	14	18.3	28.90
1.1675	186.8	1.559	11.66	16	20.8	33.50
1.1905	214.3	1.788	13.38	18	23.2	38.10
1.2135	242.7	2.025	15.15	20	25.5	42.70

Specific Gravity	Weight of $FeSO_4 \cdot 7H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $FeSO_4 \cdot 7H_2O$	Degrees: Baumé	Twaddell
1.0007	3.663	0.03057	0.2287	0.3660	0.1	0.14
1.0028	7.341	0.06127	0.4583	0.7321	0.4	0.56
1.0046	11.03	0.09205	0.6886	1.098	0.7	0.92
1.0065	14.74	0.1230	0.9199	1.464	0.9	1.30
1.0085	18.46	0.1540	1.152	1.830	1.2	1.70
1.0180	37.26	0.3109	2.326	3.660	2.6	3.60
1.0375	75.96	0.6339	4.742	7.321	5.2	7.50
1.0575	116.1	0.9690	7.249	10.98	7.9	11.50
1.0785	157.9	1.318	9.857	14.64	10.6	15.70
1.1000	201.3	1.680	12.57	18.30	13.2	20.00
1.1220	246.4	2.056	15.38	21.96	15.8	24.40
1.1445	293.2	2.447	18.31	25.62	18.3	28.90
1.1675	341.8	2.853	21.34	29.28	20.8	33.50
1.1905	392.2	3.273	24.48	32.94	23.2	38.10
1.2135	444.1	3.707	27.73	36.60	25.5	42.70

FORMIC ACID

Density of Aqueous Formic Acid Solutions at $\frac{20}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of HCO_2H in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent HCO_2H	Degrees: Baumé	Twaddell
0.9982	....	.....	.....	0	....	.....
1.0019	10.02	0.08361	0.6255	1	0.3	0.38
1.0044	20.09	0.1676	1.254	2	0.6	0.88
1.0070	30.21	0.2521	1.886	3	1.0	1.40
1.0093	40.37	0.3369	2.520	4	1.3	1.86
1.0115	50.58	0.4221	3.157	5	1.6	2.30
1.0141	60.85	0.5078	3.799	6	2.0	2.82
1.0170	71.19	0.5941	4.444	7	2.4	3.40
1.0196	81.57	0.6807	5.092	8	2.8	3.92
1.0221	91.99	0.7677	5.743	9	3.1	4.42

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FORMIC ACID (Continued)

Specific Gravity	Weight of HCO_2H in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent HCO_2H	Degrees: Baumé	Twaddell
1.0246	102.5	0.8551	6.397	10	3.5	4.92
1.0271	113.0	0.9429	7.053	11	3.8	5.42
1.0296	123.6	1.031	7.713	12	4.2	5.92
1.0321	134.2	1.120	8.376	13	4.5	6.42
1.0345	144.8	1.209	9.042	14	4.8	6.90
1.0370	156.6	1.298	9.711	15	5.2	7.40
1.0393	166.3	1.388	10.38	16	5.5	7.86
1.0417	177.1	1.478	11.06	17	5.8	8.34
1.0441	187.9	1.568	11.73	18	6.1	8.82
1.0464	198.8	1.659	12.41	19	6.4	9.28
1.0488	209.8	1.751	13.10	20	6.8	9.76
1.0512	220.8	1.842	13.78	21	7.1	10.24
1.0537	231.8	1.935	14.47	22	7.4	10.74
1.0561	242.9	2.027	15.16	23	7.7	11.22
1.0585	254.0	2.120	15.86	24	8.0	11.70
1.0609	265.2	2.213	16.56	25	8.3	12.18
1.0633	276.5	2.307	17.26	26	8.6	12.66
1.0656	287.7	2.401	17.96	27	8.9	13.12
1.0681	299.1	2.496	18.67	28	9.3	13.62
1.0705	310.4	2.591	19.38	29	9.6	14.10
1.0729	321.9	2.686	20.09	30	9.9	14.58
1.0753	333.3	2.782	20.81	31	10.2	15.06
1.0777	344.9	2.878	21.53	32	10.5	15.54
1.0800	356.4	2.974	22.25	33	10.7	16.00
1.0823	368.0	3.071	22.97	34	11.0	16.46
1.0847	379.6	3.168	23.70	35	11.3	16.94
1.0871	391.4	3.266	24.43	36	11.6	17.42
1.0895	403.1	3.364	25.17	37	11.9	17.90
1.0919	414.9	3.463	25.90	38	12.2	18.38
1.0940	426.7	3.561	26.64	39	12.5	18.80
1.0963	438.5	3.660	27.38	40	12.7	19.26
1.0990	450.6	3.760	28.13	41	13.1	19.80
1.1015	462.6	3.861	28.88	42	13.4	20.30
1.1038	474.6	3.961	29.63	43	13.6	20.76
1.1062	486.7	4.062	30.39	44	13.9	21.24
1.1085	498.8	4.163	31.14	45	14.2	21.70
1.1108	511.0	4.264	31.90	46	14.5	22.16
1.1130	523.1	4.366	32.66	47	14.7	22.60
1.1157	535.5	4.469	33.43	48	15.0	23.14
1.1185	548.1	4.574	34.22	49	15.4	23.70
1.1207	560.4	4.676	34.98	50	15.6	24.14
1.1223	572.4	4.777	35.73	51	15.8	24.46
1.1244	584.7	4.879	36.50	52	16.0	24.88
1.1269	597.3	4.984	37.29	53	16.3	25.38
1.1295	609.9	5.090	38.08	54	16.6	25.90
1.1320	622.6	5.196	38.87	55	16.9	26.40
1.1342	635.2	5.301	39.65	56	17.2	26.84
1.1361	647.6	5.404	40.43	57	17.4	27.22
1.1381	660.1	5.509	41.21	58	17.6	27.62
1.1401	672.7	5.614	41.99	59	17.8	28.02
1.1424	685.4	5.720	42.79	60	18.1	28.48
1.1448	698.3	5.828	43.60	61	18.3	28.96
1.1473	711.3	5.936	44.41	62	18.6	29.46
1.1493	724.1	6.043	45.20	63	18.8	29.86
1.1517	737.1	6.151	46.02	64	19.1	30.34
1.1543	750.3	6.262	46.84	65	19.4	30.86
1.1565	763.3	6.370	47.65	66	19.6	31.30
1.1584	776.1	6.477	48.45	67	19.8	31.68
1.1604	789.1	6.585	49.26	68	20.0	32.08
1.1628	802.3	6.696	50.09	69	20.3	32.56

FORMIC ACID (Continued)

Specific Gravity	Weight of HCO_2H in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent HCO_2H	Degrees: Baumé	Twaddell
1.1655	815.9	6.809	50.93	70	20.6	33.10
1.1677	829.1	6.919	51.76	71	20.8	33.54
1.1702	842.5	7.031	52.60	72	21.1	34.04
1.1728	856.1	7.145	53.45	73	21.4	34.56
1.1752	869.6	7.258	54.29	74	21.6	35.04
1.1769	882.7	7.366	55.11	75	21.8	35.38
1.1785	895.7	7.475	55.92	76	22.0	35.70
1.1801	908.7	7.583	56.73	77	22.1	36.02
1.1818	921.8	7.693	57.55	78	22.3	36.36
1.1837	935.1	7.804	58.38	79	22.5	36.74
1.1860	948.8	7.918	59.23	80	22.7	37.20
1.1876	962.0	8.028	60.05	81	22.9	37.52
1.1896	975.5	8.141	60.90	82	23.1	37.92
1.1914	988.9	8.252	61.73	83	23.3	38.28
1.1929	1002	8.362	62.56	84	23.5	38.59
1.1953	1016	8.479	63.43	85	23.7	39.06
1.1976	1030	8.595	64.30	86	23.9	39.52
1.1994	1043	8.708	65.14	87	24.1	39.88
1.2012	1057	8.822	65.99	88	24.3	40.24
1.2028	1070	8.934	66.83	89	24.5	40.56
1.2044	1084	9.046	67.67	90	24.6	40.88
1.2059	1097	9.158	68.51	91	24.8	41.18
1.2078	1111	9.273	69.37	92	25.0	41.56
1.2099	1125	9.390	70.25	93	25.2	41.98
1.2117	1139	9.505	71.11	94	25.3	42.34
1.2140	1153	9.625	72.00	95	25.6	42.80
1.2158	1167	9.741	72.87	96	25.7	43.16
1.2170	1180	9.852	73.70	97	25.9	43.40
1.2183	1194	9.964	74.54	98	26.0	43.66
1.2202	1208	10.08	75.42	99	26.2	44.04
1.2212	1221	10.19	76.24	100	26.3	44.24

GLYCEROL

Density of Aqueous Glycerol Solutions at $\frac{20°}{4°}$ C. Computed from the Values of Bosart and Snoddy. ***Ind. Eng. Chem. 20, 1377 (1928).***

Specific Gravity	Weight of $C_3H_8O_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $C_3H_8O_3$	Degrees: Baume	Twaddell
0.99823	.....	.....	.....	0	...	....
1.00060	10.01	0.08350	0.6247	1	0.1	0.12
1.00300	20.06	0.1674	1.252	2	0.4	0.60
1.00540	30.16	0.2517	1.883	3	0.8	1.08
1.00780	40.31	0.3364	2.516	4	1.1	1.56
1.01015	50.51	0.4215	3.153	5	1.5	2.03
1.01255	60.75	0.5070	3.793	6	1.8	2.51
1.01495	71.05	0.5929	4.436	7	2.1	2.99
1.01730	81.38	0.6792	5.081	8	2.5	3.46
1.01970	91.77	0.7659	5.729	9	2.8	3.94
1.02210	102.2	0.8530	6.381	10	3.1	4.42
1.02455	112.7	0.9406	7.036	11	3.5	4.91
1.02705	123.2	1.028	7.691	12	3.8	5.41
1.02955	133.7	1.116	8.347	13	4.1	5.91
1.03200	144.5	1.206	9.020	14	4.5	6.40

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GLYCEROL (Continued)

Specific Gravity	Weight of $C_3H_8O_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $C_3H_8O_3$	Degrees: Baume	Twaddell
1.03450	155.2	1.295	9.688	15	4.8	6.90
1.03695	165.9	1.385	10.36	16	5.2	7.39
1.03945	176.7	1.475	11.03	17	5.5	7.89
1.04195	187.6	1.565	11.71	18	5.8	8.39
1.04440	198.4	1.656	12.39	19	6.2	8.88
1.04690	209.4	1.748	13.07	20	6.5	9.38
1.04950	220.4	1.839	13.76	21	6.8	9.90
1.05205	231.5	1.932	14.45	22	7.2	10.41
1.05465	242.6	2.025	15.15	23	7.5	10.93
1.05720	253.7	2.117	15.84	24	7.8	11.44
1.05980	265.0	2.212	16.54	25	8.2	11.96
1.06240	276.2	2.305	17.24	26	8.5	12.48
1.06495	287.5	2.399	17.95	27	8.8	12.99
1.06755	298.9	2.494	18.66	28	9.2	13.51
1.07010	310.3	2.590	19.37	29	9.5	14.02
1.07270	321.8	2.686	20.09	30	9.8	14.54
1.07535	333.4	2.782	20.81	31	10.2	15.07
1.07800	345.0	2.879	21.54	32	10.5	15.60
1.08070	356.6	2.976	22.26	33	10.8	16.14
1.08335	368.3	3.074	22.99	34	11.2	16.67
1.08600	380.1	3.172	23.73	35	11.5	17.20
1.08865	391.9	3.271	24.47	36	11.8	17.73
1.09135	403.8	3.370	25.21	37	12.1	18.27
1.09400	415.7	3.469	25.95	38	12.5	18.80
1.09665	427.7	3.569	26.70	39	12.8	19.33
1.09930	439.7	3.669	27.45	40	13.1	19.86
1.10200	451.8	3.770	28.21	41	13.4	20.40
1.10470	464.0	3.872	28.97	42	13.8	20.94
1.10740	476.2	3.974	29.73	43	14.1	21.48
1.11010	488.4	4.076	30.49	44	14.4	22.02
1.11280	500.8	4.179	31.26	45	14.7	22.56
1.11550	513.1	4.282	32.03	46	15.0	23.10
1.11820	525.6	4.386	32.81	47	15.3	23.64
1.12090	538.0	4.490	33.59	48	15.6	24.18
1.12360	550.6	4.595	34.37	49	16.0	24.72
1.12630	563.2	4.700	35.16	50	16.3	25.26
1.12905	575.8	4.805	35.95	51	16.6	25.81
1.13180	588.5	4.911	36.74	52	16.9	26.36
1.13455	601.3	5.018	37.54	53	17.2	26.91
1.13730	614.1	5.125	38.34	54	17.5	27.46
1.14005	627.0	5.233	39.14	55	17.8	28.01
1.14280	640.0	5.341	39.96	56	18.1	28.56
1.14555	653.0	5.450	40.77	57	18.4	29.11
1.14830	665.9	5.557	41.57	58	18.7	29.66
1.15105	679.1	5.667	42.40	59	19.0	30.21
1.15380	692.3	5.778	43.22	60	19.3	30.76
1.15655	705.5	5.887	44.04	61	19.6	31.31
1.15930	718.8	5.999	44.87	62	19.9	31.86
1.16205	732.1	6.110	45.71	63	20.2	32.41
1.16475	745.4	6.221	46.54	64	20.5	32.95
1.16750	758.9	6.333	47.38	65	20.8	33.50
1.17025	772.4	6.446	48.22	66	21.0	34.05
1.17300	785.9	6.559	49.06	67	21.3	34.60
1.17575	800.0	6.676	49.94	68	21.6	35.15
1.17850	813.2	6.786	50.77	69	21.9	35.70
1.18125	826.9	6.901	51.62	70	22.2	36.25
1.18395	840.6	7.015	52.48	71	22.5	36.79
1.18670	854.4	7.130	53.34	72	22.8	37.34
1.18940	868.3	7.246	54.21	73	23.1	37.88
1.19215	882.2	7.362	55.08	74	23.3	38.43

GLYCEROL (Continued)

Specific Gravity	Weight of $C_3H_8O_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $C_3H_8O_3$	Degrees: Baume	Twaddell
1.19485	896.1	7.478	55.93	75	23.6	38.97
1.19760	910.0	7.594	56.81	76	23.9	39.52
1.20030	924.2	7.713	57.70	77	24.2	40.06
1.20305	938.4	7.831	58.58	78	24.4	40.61
1.20575	952.4	7.948	59.46	79	24.7	41.15
1.20850	966.8	8.068	60.36	80	25.0	41.70
1.21115	981.0	8.187	61.24	81	25.2	42.23
1.21380	995.3	8.306	62.14	82	25.5	42.76
1.21650	1010	8.429	63.05	83	25.8	43.30
1.21915	1024	8.543	63.91	84	26.0	43.83
1.22180	1039	8.671	64.86	85	26.3	44.36
1.22445	1053	8.785	65.72	86	26.5	44.89
1.22710	1068	8.913	66.68	87	26.8	45.42
1.22975	1082	9.029	67.54	88	27.1	45.95
1.23245	1097	9.155	68.49	89	27.3	46.49
1.23510	1112	9.280	68.42	90	27.6	47.02
1.23770	1126	9.397	70.30	91	27.8	47.54
1.24035	1141	9.521	71.23	92	28.1	48.07
1.24300	1156	9.646	72.16	93	28.3	48.60
1.24560	1171	9.771	73.09	94	28.6	49.12
1.24825	1186	9.896	74.03	95	28.8	49.65
1.25080	1201	10.02	74.96	96	29.1	50.16
1.25335	1216	10.15	75.90	97	29.3	50.67
1.25590	1231	10.27	76.84	98	29.5	51.18
1.25850	1246	10.40	77.78	99	29.8	51.70
1.26108	1261	10.52	78.72	100	30.0	52.216

HYDROCHLORIC ACID

Specific Gravity of Aqueous Hydrochloric Acid Solutions. Adopted 1903 as Standard by the Manufacturing Chemists' Association of the United States.

Authority: W. C. Ferguson.

Specific Gravity determinations were made at 60° F., compared with water at 60°F.

From the Specific Gravities, the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}$$

* Baumé Hydrometers for use with this table must be graduated by the above formula which formula should always be printed on the scale.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

ALLOWANCE FOR TEMPERATURE:

10 — 15° Be. — 1/40° Be. or .0002 Sp. Gr. for 1° F.
15 — 22° Be. — 1/30° Be. or .0003 Sp. Gr. for 1° F.
22 — 25° Be. — 1/28° Be. or .00035 Sp. Gr. for 1° F.

Be.°	Sp. Gr.	Tw.°	%HCl.	Be.°	Sp. Gr.	Tw.°	%HCl.	Be.°	Sp. Gr.	Tw.°	%HCl.
1.00	1.0069	1.38	1.40	6.50	1.0469	9.38	9.40	9.00	1.0662	13.24	13.26
2.00	1.0140	2.80	2.82	6.75	1.0488	9.76	9.78	9.25	1.0681	13.62	13.65
3.00	1.0211	4.22	4.25	7.00	1.0507	10.14	10.17	9.50	1.0701	14.02	14.04
4.00	1.0284	5.68	5.69	7.25	1.0526	10.52	10.55	9.75	1.0721	14.42	14.43
5.00	1.0357	7.14	7.15	7.50	1.0545	10.90	10.94	10.00	1.0741	14.82	14.83
5.25	1.0375	7.50	7.52	7.75	1.0564	11.28	11.32	10.25	1.0761	15.22	15.22
5.50	1.0394	7.88	7.89	8.00	1.0584	11.68	11.71	10.50	1.0781	15.62	15.62
5.75	1.0413	8.26	8.26	8.25	1.0603	12.06	12.09	10.75	1.0801	16.02	16.01
6.00	1.0432	8.64	8.64	8.50	1.0623	12.46	12.48	11.00	1.0821	16.42	16.41
6.25	1.0450	9.00	9.02	8.75	1.0642	12.84	12.87	11.25	1.0841	16.82	16.81

(Completed on following page.)

HYDROCHLORIC ACID (Continued)

Be.°	Sp. Gr.	Tw.°	%HCl.	Be.°	Sp. Gr.	Tw.°	%HCl.	Be.°	Sp. Gr.	Tw.°	%HCl.
11.50	1.0861	17.22	17.21	18.0	1.1417	28.34	27.92	21.8	1.1770	35.40	34.83
11.75	1.0881	17.62	17.61	18.1	1.1426	28.52	28.09	21.9	1.1779	35.58	35.02
12.00	1.0902	18.04	18.01	18.2	1.1435	28.70	28.26	22.0	1.1789	35.78	35.21
12.25	1.0922	18.44	18.41	18.3	1.1444	28.88	28.44	22.1	1.1798	35.96	35.40
12.50	1.0943	18.86	18.82	18.4	1.1453	29.06	28.61	22.2	1.1808	36.16	35.59
12.75	1.0964	19.28	19.22	18.5	1.1462	29.24	28.78	22.3	1.1817	36.34	35.78
13.00	1.0985	19.70	19.63	18.6	1.1471	29.42	28.95	22.4	1.1827	36.54	35.97
13.25	1.1006	20.12	20.04	18.7	1.1480	29.60	29.13	22.5	1.1836	36.72	36.16
13.50	1.1027	20.54	20.45	18.8	1.1489	29.78	29.30	22.6	1.1846	36.92	36.35
13.75	1.1048	20.96	20.86	18.9	1.1498	29.96	29.48	22.7	1.1856	37.12	36.54
14.00	1.1069	21.38	21.27	19.0	1.1508	30.16	29.65	22.8	1.1866	37.32	36.73
14.25	1.1090	21.80	21.68	19.1	1.1517	30.34	29.83	22.9	1.1875	37.50	36.93
14.50	1.1111	22.22	22.09	19.2	1.1526	30.52	30.00	23.0	1.1885	37.70	37.14
14.75	1.1132	22.64	22.50	19.3	1.1535	30.70	30.18	23.1	1.1895	37.90	37.36
15.00	1.1154	23.08	22.92	19.4	1.1544	30.88	30.35	23.2	1.1904	38.08	37.58
15.25	1.1176	23.52	23.33	19.5	1.1554	31.08	30.53	23.3	1.1914	38.28	37.80
15.50	1.1197	23.94	23.75	19.6	1.1563	31.26	30.71	23.4	1.1924	38.48	38.03
15.75	1.1219	24.38	24.16	19.7	1.1572	31.44	30.90	23.5	1.1934	38.68	38.26
16.0	1.1240	24.80	24.57	19.8	1.1581	31.62	31.08	23.6	1.1944	38.88	38.49
16.1	1.1248	24.96	24.73	19.9	1.1590	31.80	31.27	23.7	1.1953	39.06	38.72
16.2	1.1256	25.12	24.90	20.0	1.1600	32.00	31.45	23.8	1.1963	39.26	38.95
16.3	1.1265	25.30	25.06	20.1	1.1609	32.18	31.64	23.9	1.1973	39.46	39.18
16.4	1.1274	25.48	25.23	20.2	1.1619	32.38	31.82	24.0	1.1983	39.66	39.41
16.5	1.1283	25.66	25.39	20.3	1.1628	32.56	32.01	24.1	1.1993	39.86	39.64
16.6	1.1292	25.84	25.56	20.4	1.1637	32.74	32.19	24.2	1.2003	40.06	39.86
16.7	1.1301	26.02	25.72	20.5	1.1647	32.94	32.38	24.3	1.2013	40.26	40.09
16.8	1.1310	26.20	25.89	20.6	1.1656	33.12	32.56	24.4	1.2023	40.46	40.32
16.9	1.1319	26.38	26.05	20.7	1.1666	33.32	32.75	24.5	1.2033	40.66	40.55
17.0	1.1328	26.56	26.22	20.8	1.1675	33.50	32.93	24.6	1.2043	40.86	40.78
17.1	1.1336	26.72	26.39	20.9	1.1684	33.68	33.12	24.7	1.2053	41.06	41.01
17.2	1.1345	26.90	26.56	21.0	1.1694	33.88	33.31	24.8	1.2063	41.26	41.24
17.3	1.1354	27.08	26.73	21.1	1.1703	34.06	33.50	24.9	1.2073	41.46	41.48
17.4	1.1363	27.26	26.90	21.2	1.1713	34.26	33.69	25.0	1.2083	41.66	41.72
17.5	1.1372	27.44	27.07	21.3	1.1722	34.44	33.88	25.1	1.2093	41.86	41.99
17.6	1.1381	27.62	27.24	21.4	1.1732	34.64	34.07	25.2	1.2103	42.06	42.30
17.7	1.1390	27.80	27.41	21.5	1.1741	34.82	34.26	25.3	1.2114	42.28	42.64
17.8	1.1399	27.98	27.58	21.6	1.1751	35.02	34.45	25.4	1.2124	42.48	43.01
17.9	1.1408	28.16	27.75	21.7	1.1760	35.20	34.64	25.5	1.2134	42.68	43.40

HYDROCHLORIC ACID

Density of Aqueous Hydrochloric Acid Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of HCl in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	*N*	%	Degrees: Baumé	Twaddell
1.0032	10.03	0.08372	0.6263	0.275	1	0.5	0.64
1.0082	20.16	0.1683	1.259	0.553	2	1.2	1.64
1.0181	40.72	0.3399	2.542	1.12	4	2.6	3.62
1.0279	61.67	0.5147	3.850	1.69	6	3.9	5.58
1.0376	83.01	0.6927	5.182	2.28	8	5.3	7.52
1.0474	104.7	0.8741	6.539	2.87	10	6.6	9.48
1.0574	126.9	1.059	7.922	3.48	12	7.9	11.48
1.0675	149.5	1.247	9.330	4.10	14	9.2	13.50
1.0776	172.4	1.439	10.76	4.73	16	10.4	15.52
1.0878	195.8	1.634	12.22	5.37	18	11.7	17.56
1.0980	219.6	1.833	13.71	6.02	20	12.9	19.60
1.1083	243.8	2.035	15.22	6.69	22	14.2	21.66
1.1187	268.5	2.241	16.76	7.36	24	15.4	23.74
1.1290	293.5	2.450	18.33	8.05	26	16.6	25.80
1.1392	319.0	2.662	19.91	8.75	28	17.7	27.84

HYDROCHLORIC ACID (Continued)

Specific Gravity	Weight of HCl in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	N	%	Degrees: Baumé	Twaddell
1.1492	344.8	2.877	21.53	9.46	30	18.8	29.84
1.1593	371.0	3.096	23.16	10.2	32	19.9	31.86
1.1691	397.5	3.317	24.82	10.9	34	21.0	33.82
1.1789	424.4	3.542	26.50	11.6	36	22.0	35.78
1.1885	451.6	3.769	28.20	12.4	38	23.0	37.70
1.1980	479.2	3.999	29.92	13.1	40	24.0	39.60

HYDROCYANIC ACID

Density of Aqueous Hydrocyanic Acid Solutions at $\frac{15°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of HCN in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent HCN	Degrees: Baumé	Twaddell
0.998	9.980	0.08329	0.6231	1	10.3	.....
0.996	19.92	0.1662	1.244	2	10.6	.....
0.993	39.72	0.3315	2.480	4	11.0	.....
0.989	59.34	0.4952	3.705	6	11.4	.....
0.984	78.72	0.6569	4.914	8	12.3	.....
0.978	97.80	0.8162	6.106	10	13.2	.....
0.971	116.5	0.9724	7.274	12	14.2	.....
0.964	135.0	1.126	8.426	14	15.2	.....
0.956	153.0	1.277	9.549	16	16.4	.....

Density of Aqueous Hydrocyanic Acid Solutions at $\frac{20°}{4°}$ C.

Specific Gravity	Weight of HCN in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent HCN	Degrees: Baumé	Twaddell
0.759	607.2	5.067	37.91	80	54.4	.....
0.752	616.6	5.146	38.50	82	56.2	.....
0.745	625.8	5.223	39.07	84	57.9	.....
0.738	634.7	5.297	39.62	86	59.7	.....
0.731	643.3	5.368	40.16	88	61.5	.....
0.724	651.6	5.438	40.68	90	63.4	.....
0.717	659.6	5.505	41.18	92	65.3	.....
0.711	668.3	5.578	41.72	94	66.9	.....
0.704	675.8	5.640	42.19	96	68.9	.....
0.697	683.1	5.700	42.64	98	70.9	.....
0.691	691.0	5.767	43.14	100	72.6	.....

HYDROFLUOSILICIC ACID

Density of Aqueous Hydrofluosilicic Acid Solutions at 17.5° C. Computed from the Values of Stolba.

Specific Gravity	Weight of H_2SiF_6 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent H_2SiF_6	Degrees: Baumé	Twaddell
1.0040	5.020	0.04189	0.3134	0.5	0.6	0.80
1.0080	10.08	0.08412	0.6293	1.0	1.2	1.60
1.0120	15.18	0.1267	0.9477	1.5	1.7	2.40
1.0161	20.32	0.1696	1.269	2.0	2.3	3.22
1.0201	25.50	0.2128	1.592	2.5	2.9	4.02
1.0242	30.73	0.2564	1.918	3.0	3.4	4.84
1.0283	35.99	0.3004	2.247	3.5	4.0	5.66
1.0324	41.30	0.3446	2.578	4.0	4.6	6.48

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HYDROFLUOSILICIC ACID (Continued)

Specific Gravity	Weight of H_2SiF_6 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent H_2SiF_6	Degrees: Baumé	Twaddell
1.0366	46.65	0.3893	2.912	4.5	5.1	7.32
1.0407	52.04	0.4343	3.249	5.0	5.7	8.14
1.0449	57.47	0.4796	3.588	5.5	6.2	8.98
1.0491	62.95	0.5253	3.930	6.0	6.8	9.82
1.0533	68.46	0.5714	4.274	6.5	7.3	11.06
1.0576	74.03	0.6178	4.622	7.0	7.9	11.52
1.0618	79.64	0.6646	4.972	7.5	8.4	12.36
1.0661	85.29	0.7118	5.325	8.0	9.0	13.22
1.0704	90.98	0.7593	5.680	8.5	9.5	14.08
1.0747	96.72	0.8072	6.038	9.0	10.1	14.94
1.0791	102.5	0.8555	6.400	9.5	10.6	15.82
1.0834	108.3	0.9041	6.764	10.0	11.2	16.68
1.0878	114.2	0.9532	7.131	10.5	11.7	17.56
1.0922	120.1	1.003	7.500	11.0	12.2	18.44
1.0966	126.1	1.052	7.873	11.5	12.8	19.32
1.1011	132.1	1.103	8.249	12.0	13.3	20.22
1.1055	138.2	1.153	8.627	12.5	13.8	21.10
1.1100	144.3	1.204	9.009	13.0	14.4	22.00
1.1145	150.5	1.256	9.393	13.5	14.9	22.90
1.1190	156.7	1.307	9.780	14.0	15.4	23.80
1.1236	162.9	1.360	10.17	14.5	16.0	24.72
1.1281	169.2	1.412	10.56	15.0	16.5	25.62
1.1327	175.6	1.465	10.96	15.5	17.0	26.54
1.1373	182.0	1.519	11.36	16.0	17.5	27.46
1.1419	188.4	1.572	11.76	16.5	18.0	28.38
1.1466	194.9	1.627	12.17	17.0	18.5	29.32
1.1512	201.5	1.681	12.58	17.5	19.0	30.24
1.1559	208.1	1.736	12.99	18.0	19.6	31.18
1.1606	214.7	1.792	13.40	18.5	20.1	32.12
1.1653	221.4	1.848	13.82	19.0	20.6	33.06
1.1701	228.2	1.904	14.24	19.5	21.1	34.02
1.1748	235.0	1.961	14.67	20.0	21.6	34.96
1.1796	241.8	2.018	15.10	20.5	22.1	35.92
1.1844	248.7	2.076	15.53	21.0	22.6	36.88
1.1892	255.7	2.134	15.96	21.5	23.1	37.84
1.1941	262.7	2.192	16.40	22.0	23.6	38.82
1.1989	269.8	2.251	16.84	22.5	24.1	39.78
1.2038	276.9	2.311	17.29	23.0	24.6	40.76
1.2087	284.0	2.370	17.73	23.5	25.0	41.74
1.2136	291.3	2.431	18.18	24.0	25.5	42.72
1.2186	298.6	2.492	18.64	24.5	26.0	43.72
1.2235	305.9	2.553	19.10	25.0	26.5	44.70
1.2285	313.3	2.614	19.56	25.5	27.0	45.70
1.2335	320.7	2.676	20.02	26.0	27.5	46.70
1.2385	328.2	2.739	20.49	26.5	27.9	47.70
1.2436	335.8	2.802	20.96	27.0	28.4	48.72
1.2486	343.4	2.866	21.44	27.5	28.9	49.72
1.2537	351.0	2.930	21.92	28.0	29.3	50.74
1.2588	358.8	2.994	22.40	28.5	29.8	51.76
1.2639	366.5	3.059	22.88	29.0	30.3	52.78
1.2691	374.4	3.124	23.37	29.5	30.7	53.82
1.2742	382.3	3.190	23.86	30.0	31.2	54.84
1.2794	390.2	3.257	24.36	30.5	31.7	55.88
1.2846	398.2	3.323	24.86	31.0	32.1	56.92
1.2898	406.3	3.391	25.36	31.5	32.6	57.96
1.2951	414.4	3.459	25.87	32.0	33.0	59.02
1.3003	422.6	3.527	26.38	32.5	33.5	60.06
1.3065	431.1	3.598	26.92	33.0	34.0	61.30
1.3109	439.2	3.665	27.42	33.5	34.4	62.18
1.3162	447.5	3.735	27.94	34.0	34.8	63.24

MAGNESIUM CHLORIDE

Density of Aqueous Magnesium Chloride Solutions at $\frac{20}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $MgCl_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $MgCl_2$	Degrees: Baumé	Twaddell
1.0146	20.29	0.1693	1.267	2	2.1	2.92
1.0311	41.24	0.3442	2.575	4	4.4	6.22
1.0478	62.87	0.5247	3.925	6	6.6	9.56
1.0646	85.17	0.7108	5.317	8	8.8	12.92
1.0816	108.2	0.9026	6.752	10	10.9	16.32
1.0989	131.9	1.100	8.233	12	13.1	19.78
1.1164	156.3	1.304	9.758	14	15.1	23.28
1.1342	181.5	1.514	11.33	16	17.2	26.84
1.1523	207.4	1.731	12.95	18	19.2	30.46
1.1706	234.1	1.954	14.62	20	21.1	34.12
1.2184	304.6	2.542	19.02	25	26.0	43.68
1.2688	380.6	3.177	23.76	30	30.7	53.76

Specific Gravity	Weight of $MgCl_2 \cdot 6H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $MgCl_2 + 6H_2O$	Degrees: Baumé	Twaddell
1.0146	43.32	0.3616	2.705	4.270	2.1	2.92
1.0311	88.07	0.7349	5.498	8.541	4.4	6.22
1.0478	134.2	1.120	8.380	12.81	6.6	9.56
1.0646	181.8	1.517	11.35	17.08	8.8	12.92
1.0816	230.9	1.927	14.42	21.35	10.9	16.32
1.0989	281.5	2.350	17.58	25.62	13.1	19.78
1.1164	333.7	2.785	20.83	29.89	15.1	23.28
1.1342	387.4	3.233	24.19	34.16	17.2	26.84
1.1523	442.8	3.696	27.65	38.43	19.2	30.46
1.1706	499.8	4.171	31.21	42.70	21.1	34.12
1.2184	650.4	5.428	40.60	53.38	26.0	43.68
1.2688	812.7	6.782	50.73	64.05	30.7	53.76

MAGNESIUM CHLORIDE

Density of Aqueous Magnesium Chloride Solutions at 14° C. Computed from the Values of Oudemans.

Specific Gravity	Weight of $MgCl_2 \cdot 6H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $MgCl_2 + 6H_2O$	Degrees: Baumé	Twaddell
1.0033	10.03	0.08373	0.6264	1	0.5	0.66
1.0073	20.15	0.1681	1.258	2	1.1	1.46
1.0113	30.34	0.2532	1.894	3	1.6	2.26
1.0154	40.62	0.3390	2.536	4	2.2	3.08
1.0194	50.97	0.4254	3.182	5	2.8	3.88
1.0234	61.40	0.5124	3.833	6	3.3	4.68
1.0274	71.92	0.6002	4.490	7	3.9	5.48
1.0314	82.51	0.6886	5.151	8	4.4	6.28
1.0355	93.20	0.7777	5.818	9	5.0	7.10
1.0395	104.0	0.8675	6.490	10	5.5	7.90
1.0435	114.8	0.9579	7.166	11	6.0	8.70
1.0476	125.7	1.049	7.848	12	6.6	9.52
1.0517	136.7	1.141	8.535	13	7.1	10.34
1.0558	147.8	1.234	9.228	14	7.7	11.16
1.0599	159.0	1.327	9.925	15	8.2	11.98

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MAGNESIUM CHLORIDE (Continued)

Specific Gravity	Weight of $MgCl_2 \cdot 6H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $MgCl_2 + 6H_2O$	Degrees: Baumé	Twaddell
1.0641	170.3	1.421	10.63	16	8.7	12.82
1.0682	181.6	1.515	11.34	17	9.3	13.64
1.0724	193.0	1.611	12.05	18	9.8	14.48
1.0765	204.5	1.707	12.77	19	10.3	15.30
1.0807	216.1	1.804	13.49	20	10.8	16.14
1.0849	227.8	1.901	14.22	21	11.4	16.98
1.0891	239.6	2.000	14.96	22	11.9	17.82
1.0933	251.5	2.099	15.70	23	12.4	18.66
1.0976	263.4	2.198	16.45	24	12.9	19.52
1.1018	275.5	2.299	17.20	25	13.4	20.36
1.1061	287.6	2.400	17.95	26	13.9	21.22
1.1103	299.8	2.502	18.72	27	14.4	22.06
1.1146	312.1	2.604	19.48	28	14.9	22.92
1.1189	324.5	2.708	20.26	29	15.4	23.78
1.1232	337.0	2.812	21.04	30	15.9	24.64
1.1275	349.5	2.917	21.82	31	16.4	25.50
1.1319	362.2	3.022	22.61	32	16.9	26.38
1.1363	375.0	3.129	23.41	33	17.4	27.26
1.1407	387.8	3.237	24.21	34	17.9	28.14
1.1451	400.8	3.345	25.02	35	18.4	29.02
1.1495	413.8	3.453	25.83	36	18.9	29.90
1.1540	427.0	3.563	26.66	37	19.4	30.80
1.1584	440.2	3.674	27.48	38	19.8	31.68
1.1628	453.5	3.785	28.31	39	20.3	32.56
1.1673	466.9	3.897	29.15	40	20.8	33.46
1.1718	480.4	4.009	29.99	41	21.3	34.36
1.1763	494.0	4.123	30.84	42	21.7	35.26
1.1809	507.8	4.238	31.70	43	22.2	36.18
1.1855	521.6	4.353	32.56	44	22.7	37.10
1.1901	535.5	4.469	33.43	45	23.2	38.02
1.1948	549.6	4.587	34.31	46	23.6	38.96
1.1995	563.8	4.705	35.20	47	24.1	39.90
1.2042	578.0	4.824	36.09	48	24.6	40.84

MAGNESIUM CHLORIDE

Density of Aqueous Magnesium Chloride Solutions at 14° C. Computed from the Values of Oudemans.

Specific Gravity	Weight of $MgCl_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $MgCl_2$	Degrees: Baumé	Twaddell
1.0033	4.699	0.03922	0.2934	0.4684	0.5	0.66
1.0073	9.435	0.07874	0.5891	0.9367	1.1	1.46
1.0113	14.21	0.1186	0.8871	1.405	1.6	2.26
1.0154	19.02	0.1587	1.187	1.873	2.2	3.08
1.0194	23.87	0.1992	1.490	2.342	2.8	3.88
1.0234	28.76	0.2400	1.795	2.810	3.3	4.68
1.0274	33.68	0.2811	2.103	3.278	3.9	5.48
1.0314	38.65	0.3225	2.413	3.747	4.4	6.28
1.0355	43.65	0.3642	2.725	4.215	5.0	7.10
1.0395	48.69	0.4063	3.040	4.684	5.5	7.90
1.0435	53.76	0.4487	3.356	5.152	6.0	8.70
1.0476	58.88	0.4913	3.676	5.620	6.6	9.52
1.0517	64.04	0.5344	3.998	6.089	7.1	10.34
1.0558	69.23	0.5777	4.322	6.557	7.7	11.16
1.0599	74.46	0.6214	4.648	7.025	8.2	11.98

MAGNESIUM CHLORIDE (Continued)

Specific Gravity	Weight of $MgCl_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $MgCl_2$	Degrees: Baumé	Twaddell
1.0641	79.74	0.6655	4.978	7.494	8.7	12.82
1.0682	85.05	0.7098	5.310	7.962	9.3	13.64
1.0724	90.40	0.7545	5.644	8.430	9.8	14.48
1.0765	95.80	0.7995	5.981	8.899	10.3	15.30
1.0807	101.2	0.8448	6.320	9.367	10.8	16.14
1.0849	106.7	0.8905	6.661	9.835	11.4	16.98
1.0891	112.2	0.9362	7.003	10.30	11.9	17.82
1.0933	117.7	0.9827	7.351	10.77	12.4	18.66
1.0976	123.4	1.030	7.702	11.24	12.9	19.52
1.1018	129.0	1.077	8.055	11.71	13.4	20.36
1.1061	134.7	1.124	8.411	12.18	13.9	21.22
1.1103	140.5	1.172	8.768	12.65	14.4	22.06
1.1146	146.1	1.219	9.123	13.11	14.9	22.92
1.1189	151.9	1.268	9.486	13.58	15.4	23.78
1.1232	157.8	1.317	9.852	14.05	15.9	24.64
1.1275	163.7	1.366	10.22	14.52	16.4	25.50
1.1319	169.7	1.416	10.59	14.99	16.9	26.38
1.1363	175.7	1.466	10.97	15.46	17.4	27.26
1.1407	181.6	1.516	11.34	15.92	17.9	28.14
1.1451	187.7	1.566	11.72	16.39	18.4	29.02
1.1495	193.8	1.617	12.10	16.86	18.9	29.90
1.1540	200.0	1.669	12.49	17.33	19.4	30.80
1.1584	206.2	1.721	12.87	17.80	19.8	31.68
1.1628	212.4	1.773	13.26	18.27	20.3	32.56
1.1673	218.6	1.825	13.65	18.73	20.8	33.46
1.1718	225.0	1.878	14.05	19.20	21.3	34.36
1.1763	231.4	1.931	14.44	19.67	21.7	35.26
1.1809	237.8	1.985	14.85	20.14	22.2	36.18
1.1855	244.3	2.039	15.25	20.61	22.7	37.10
1.1901	250.9	2.094	15.66	21.08	23.2	38.02
1.1948	257.4	2.148	16.07	21.54	23.6	38.96
1.1995	264.0	2.203	16.48	22.01	24.1	39.90
1.2042	270.7	2.259	16.90	22.48	24.6	40.84

MAGNESIUM SULFATE

Density of Aqueous Magnesium Sulfate Solutions at $\frac{4}{4}^{0}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $MgSO_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $MgSO_4$	Degrees: Baumé	Twaddell
1.0186	20.37	0.1700	1.272	2	2.6	3.72
1.0392	41.57	0.3469	2.595	4	5.5	7.84
1.0602	63.61	0.5309	3.971	6	8.2	12.04
1.0816	86.53	0.7221	5.402	8	10.9	16.32
1.1034	110.3	0.9208	6.889	10	13.6	20.68
1.1256	135.1	1.127	8.433	12	16.2	25.12
1.1484	160.8	1.342	10.04	14	18.7	29.68
1.1717	187.5	1.565	11.70	16	21.3	34.34
1.1955	215.2	1.796	13.43	18	23.3	39.10
1.2198	244.0	2.036	15.23	20	26.1	43.96
1.2447	273.8	2.285	17.10	22	28.5	48.94
1.2701	304.8	2.544	19.03	24	30.8	54.02
1.2961	337.0	2.812	21.04	26	33.1	59.22

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MAGNESIUM SULFATE (Continued)

Specific Gravity	Weight of $MgSO_4 \cdot 7H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $MgSO_4 + 7H_2O$	Degrees: Baumé	Twaddell
1.0186	41.71	0.3481	2.604	4.095	2.6	3.72
1.0392	85.11	0.7103	5.313	8.190	5.5	7.84
1.0602	130.3	1.087	8.135	12.29	8.2	12.04
1.0816	177.2	1.479	11.06	16.38	10.9	16.32
1.1034	226.0	1.886	14.11	20.48	13.6	20.68
1.1256	276.6	2.308	17.27	24.57	16.2	25.12
1.1484	329.2	2.748	20.55	28.67	18.7	29.68
1.1717	383.8	3.203	23.96	32.76	21.3	34.34
1.1955	440.7	3.677	27.51	36.86	23.3	39.10
1.2198	499.5	4.169	31.18	40.95	26.1	43.96
1.2447	560.7	4.680	35.01	45.05	28.5	48.94
1.2701	624.1	5.209	38.96	49.14	30.8	54.02
1.2961	690.0	5.759	43.08	53.24	33.1	59.22

NICKEL CHLORIDE

Density of Aqueous Nickel Chloride Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $NiCl_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $NiCl_2$	Degrees: Baumé	Twaddell
1.008	10.08	0.08412	0.6293	1	1.2	1.6
1.018	20.36	0.1699	1.271	2	2.6	3.6
1.037	41.48	0.3462	2.590	4	5.2	7.4
1.057	63.42	0.5293	3.959	6	7.8	11.4
1.078	86.24	0.7197	5.384	8	10.5	15.6
1.099	109.9	0.9172	6.861	10	13.1	19.8
1.121	134.5	1.123	8.398	12	15.7	24.2
1.143	160.0	1.335	9.990	14	18.1	28.6
1.167	186.7	1.558	11.66	16	20.8	33.4
1.191	214.4	1.789	13.38	18	23.3	38.2
1.215	243.0	2.028	15.17	20	25.7	43.0
1.280	320.0	2.671	19.98	25	31.7	56.0
1.353	405.9	3.387	25.34	30	37.8	70.6

NICKEL NITRATE

Density of Aqueous Nickel Nitrate Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $Ni(NO_3)_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Ni(NO_3)_2$	Degrees: Baumé	Twaddell
1.007	10.07	0.08404	0.6286	1	1.0	1.4
1.015	20.30	0.1694	1.267	2	2.1	3.0
1.033	41.32	0.3448	2.580	4	4.6	6.6
1.050	63.00	0.5258	3.933	6	6.9	10.0
1.069	85.52	0.7137	5.339	8	9.4	13.8
1.088	108.8	0.9080	6.792	10	11.7	17.6
1.107	132.8	1.109	8.293	12	14.0	21.4
1.127	157.8	1.317	9.850	14	16.3	25.4
1.148	183.7	1.533	11.47	16	18.7	29.6
1.169	210.4	1.756	13.14	18	21.0	33.8
1.191	238.2	1.988	14.87	20	23.3	38.2
1.249	312.3	2.606	19.49	25	28.9	49.8
1.311	393.3	3.282	24.55	30	34.4	62.2
1.377	482.0	4.022	30.09	35	39.7	75.4

NICKEL SULFATE

Density of Aqueous Nickel Sulfate Solutions at 17½° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $NiSO_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $NiSO_4$	Degrees: Baumé	Twaddell
1.009	10.09	0.08421	0.6299	1	1.3	1.8
1.020	20.40	0.1702	1.274	2	2.8	4.0
1.042	41.68	0.3478	2.602	4	5.8	8.4
1.063	63.78	0.5323	3.982	6	8.6	12.6
1.085	86.80	0.7244	5.419	8	11.4	17.0
1.109	110.9	0.9255	6.923	10	14.3	21.8
1.133	136.0	1.135	8.488	12	17.0	26.6
1.158	162.1	1.353	10.12	14	19.8	31.6
1.183	189.3	1.580	11.82	16	22.4	36.6
1.209	217.6	1.816	13.59	18	25.1	41.8

NITRIC ACID

Specific Gravity of Aqueous Nitric Acid Solutions. Adopted 1903 as Standard by the Manufacturing Chemists' Association of the United States. Authority: W. C. Ferguson.

Specific Gravity determinations were made at 60° F., compared with water at 60° F. From the Specific Gravities, the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}$$

Baumé Hydrometers for use with this table must be graduated by the above formula, which formula should always be printed on the scale.

Atomic weight from F. W. Clarke's table of 1901. O = 16.

ALLOWANCE FOR TEMPERATURE:

At 10° — 20° Be. — 1/30° Be. or .00029 Sp. Gr. = 1° F.
20° — 30° Be. — 1/23° Be. or .00044 Sp. Gr. = 1° F.
30° — 40° Be. — 1/20° Be. or .00060 Sp. Gr. = 1° F.
40° — 48.5° Be. — 1/17° Be. or .00084 Sp. Gr. = 1° F.

Be.°	Sp. Gr.	Tw.°	% HNO_3.
10.00	1.0741	14.82	12.86
10.25	1.0761	15.22	13.18
10.50	1.0781	15.62	13.49
10.75	1.0801	16.02	13.81
11.00	1.0821	16.42	14.13
11.25	1.0841	16.82	14.44
11.50	1.0861	17.22	14.76
11.75	1.0881	17.62	15.07
12.00	1.0902	18.04	15.41
12.25	1.0922	18.44	15.72
12.50	1.0943	18.86	16.05
12.75	1.0964	19.28	16.39
13.00	1.0985	19.70	16.72
13.25	1.1006	20.12	17.05
13.50	1.1027	20.54	17.38
13.75	1.1048	20.96	17.71
14.00	1.1069	21.38	18.04
14.25	1.1090	21.80	18.37
14.50	1.1111	22.22	18.70
14.75	1.1132	22.64	19.02
15.00	1.1154	23.08	19.36
15.25	1.1176	23.52	19.70
15.50	1.1197	23.94	20.02
15.75	1.1219	24.38	20.36
16.00	1.1240	24.80	20.69
16.25	1.1262	25.24	21.03
16.50	1.1284	25.68	21.36
16.75	1.1306	26.12	21.70
17.00	1.1328	26.56	22.04
17.25	1.1350	27.00	22.38
17.50	1.1373	27.46	22.74
17.75	1.1395	27.90	23.08
18.00	1.1417	28.34	23.42
18.25	1.1440	28.80	23.77
18.50	1.1462	29.24	24.11
18.75	1.1485	29.70	24.47
19.00	1.1508	30.16	24.82
19.25	1.1531	30.62	25.18
19.50	1.1554	31.08	25.53
19.75	1.1577	31.54	25.88
20.00	1.1600	32.00	26.24
20.25	1.1624	32.48	26.61
20.50	1.1647	32.94	26.96
20.75	1.1671	33.42	27.33
21.00	1.1694	33.88	27.67
21.25	1.1718	34.36	28.02
21.50	1.1741	34.82	28.36
21.75	1.1765	35.30	28.72
22.00	1.1789	35.78	29.07
22.25	1.1813	36.26	29.43
22.50	1.1837	36.74	29.78
22.75	1.1861	37.22	30.14
23.00	1.1885	37.70	30.49
23.25	1.1910	38.20	30.86
23.50	1.1934	38.68	31.21
23.75	1.1959	39.18	31.58
24.00	1.1983	39.66	31.94
24.25	1.2008	40.16	32.31
24.50	1.2033	40.66	32.68
24.75	1.2058	41.16	33.05
25.00	1.2083	41.66	33.42
25.25	1.2109	42.18	33.80
25.50	1.2134	42.68	34.17
25.75	1.2160	43.20	34.56
26.00	1.2185	43.70	34.94
26.25	1.2211	44.22	35.33
26.50	1.2236	44.72	35.70
26.75	1.2262	45.24	36.09
27.00	1.2288	45.76	36.48
27.25	1.2314	46.28	36.87
27.50	1.2340	46.80	37.26
27.75	1.2367	47.34	37.67
28.00	1.2393	47.86	38.06
28.25	1.2420	48.40	38.46
28.50	1.2446	48.92	38.85

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NITRIC ACID (Continued)

Be.°	Sp. Gr.	Tw.°	% HNO_3.
28.75	1.2473	49.46	39.25
29.00	1.2500	50.00	39.66
29.25	1.2527	50.54	40.06
29.50	1.2554	51.08	40.47
29.75	1.2582	51.64	40.89
30.00	1.2609	52.18	41.30
30.25	1.2637	52.74	41.72
30.50	1.2664	53.28	42.14
30.75	1.2692	53.84	42.58
31.00	1.2719	54.38	43.00
31.25	1.2747	54.94	43.44
31.50	1.2775	55.50	43.89
31.75	1.2804	56.08	44.34
32.00	1.2832	56.64	44.78
32.25	1.2861	57.22	45.24
32.50	1.2889	57.78	45.68
32.75	1.2918	58.36	46.14
33.00	1.2946	58.92	46.58
33.25	1.2975	59.50	47.04
33.50	1.3004	60.08	47.49
33.75	1.3034	60.68	47.95
34.00	1.3063	61.26	48.42
34.25	1.3093	61.86	48.90
34.50	1.3122	62.44	49.35
34.75	1.3152	63.04	49.83
35.00	1.3182	63.64	50.32
35.25	1.3212	64.24	50.81
35.50	1.3242	64.84	51.30
35.75	1.3273	65.46	51.80
36.00	1.3303	66.06	52.30
36.25	1.3334	66.68	52.81
36.50	1.3364	67.28	53.32
36.75	1.3395	67.90	53.84
37.00	1.3426	68.52	54.36
37.25	1.3457	69.14	54.89
37.50	1.3488	69.76	55.43
37.75	1.3520	70.40	55.97
38.00	1.3551	71.02	56.52
38.25	1.3583	71.66	57.08
38.50	1.3615	72.30	57.65
38.75	1.3647	72.94	58.23
39.00	1.3679	73.58	58.82
39.25	1.3712	74.24	59.43
39.50	1.3744	74.88	60.06
39.75	1.3777	75.54	60.71
40.00	1.3810	76.20	61.38
40.25	1.3843	76.86	62.07
40.50	1.3876	77.52	62.77
40.75	1.3909	78.18	63.48
41.00	1.3942	78.84	64.20
41.25	1.3976	79.52	64.93
41.50	1.4010	80.20	65.67
41.75	1.4044	80.88	66.42
42.00	1.4078	81.56	67.18
42.25	1.4112	82.24	67.95
42.50	1.4146	82.92	68.73
42.75	1.4181	83.62	69.52
43.00	1.4216	84.32	70.33
43.25	1.4251	85.02	71.15
43.50	1.4286	85.72	71.98
43.75	1.4321	86.42	72.82
44.00	1.4356	87.12	73.67
44.25	1.4392	87.84	74.53
44.50	1.4428	88.56	75.40
44.75	1.4464	89.28	76.28
45.00	1.4500	90.00	77.17
45.25	1.4536	90.72	78.07
45.50	1.4573	91.46	79.03
45.75	1.4610	92.20	80.04
46.00	1.4646	92.92	81.08
46.25	1.4684	93.68	82.18
46.50	1.4721	94.42	83.33
46.75	1.4758	95.16	84.48
47.00	1.4796	95.92	85.70
47.25	1.4834	96.68	86.98
47.50	1.4872	97.44	88.32
47.75	1.4910	98.20	89.76
48.00	1.4948	98.96	91.35
48.25.	1.4987	99.74	93.13
48.50	1.5026	100.52	95.11

NITRIC ACID

Density of Aqueous Nitric Acid Solutions at $\frac{20}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of HNO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	N	%	Degrees Baumé	Degrees Twaddell
1.0036	10.04	0.08375	0.6265	0.159	1	0.5	0.72
1.0091	20.18	0.1684	1.260	0.320	2	1.3	1.82
1.0146	30.44	0.2540	1.900	0.483	3	2.1	2.92
1.0201	40.80	0.3405	2.547	0.647	4	2.9	4.02
1.0256	51.28	0.4280	3.201	0.814	5	3.6	5.12
1.0312	61.87	0.5163	3.863	0.982	6	4.4	6.24
1.0369	72.58	0.6057	4.531	1.15	7	5.2	7.38
1.0427	83.42	0.6961	5.208	1.32	8	5.9	8.54
1.0485	94.37	0.7875	5.891	1.50	9	6.7	9.70
1.0543	105.4	0.8799	6.582	1.67	10	7.5	10.86
1.0602	116.6	0.9733	7.281	1.85	11	8.2	12.04
1.0661	127.9	1.068	7.987	2.03	12	9.0	13.22
1.0721	139.4	1.163	8.701	2.21	13	9.8	14.42
1.0781	150.9	1.260	9.423	2.39	14	10.5	15.62
1.0842	162.6	1.357	10.15	2.58	15	11.3	16.84
1.0903	174.4	1.456	10.89	2.77	16	12.0	18.06
1.0964	186.4	1.555	11.64	2.96	17	12.8	19.28
1.1026	198.5	1.656	12.39	3.15	18	13.5	20.52
1.1088	210.7	1.758	13.15	3.34	19	14.2	21.76
1.1150	223.0	1.861	13.92	3.54	20	15.0	23.00
1.1213	235.5	1.965	14.70	3.74	21	15.7	24.26
1.1276	248.1	2.070	15.49	3.94	22	16.4	25.52
1.1340	260.8	2.177	16.28	4.13	23	17.1	26.80
1.1404	273.7	2.284	17.09	4.34	24	17.9	28.08
1.1469	286.7	2.393	17.90	4.55	25	18.6	29.38

NITRIC ACID (Continued)

Specific Gravity	Weight of HNO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	*N*	%	Degrees: Baumé	Twaddell
1.1534	299.9	2.503	18.72	4.76	26	19.4	30.68
1.1600	313.2	2.614	19.55	4.97	27	20.0	32.00
1.1666	326.6	2.726	20.39	5.18	28	20.7	33.32
1.1733	340.3	2.840	21.24	5.40	29	21.4	34.66
1.1800	354.0	2.954	22.10	5.62	30	22.1	36.00
1.1867	367.9	3.070	22.97	5.84	31	22.8	37.34
1.1934	381.9	3.187	23.84	6.06	32	23.5	38.68
1.2002	396.1	3.305	24.73	6.29	33	24.2	40.04
1.2071	410.4	3.425	25.62	6.51	34	24.9	41.42
1.2140	424.9	3.546	26.53	6.74	35	25.6	42.80
1.2205	439.4	3.667	27.43	6.97	36	26.2	44.10
1.2270	454.0	3.789	28.34	7.20	37	26.8	45.40
1.2335	468.7	3.912	29.26	7.44	38	27.5	46.70
1.2399	483.6	4.036	30.19	7.67	39	28.1	47.98
1.2463	498.5	4.160	31.12	7.91	40	28.7	49.26
1.2527	513.6	4.286	32.06	8.15	41	29.3	50.54
1.2591	528.8	4.413	33.01	8.39	42	29.8	51.82
1.2655	544.2	4.541	33.97	8.64	43	30.4	53.10
1.2719	559.6	4.670	34.94	8.88	44	31.0	54.38
1.2783	575.2	4.801	35.91	9.13	45	31.6	55.66
1.2847	591.0	4.932	36.89	9.38	46	32.1	56.94
1.2911	606.8	5.064	37.88	9.63	47	32.7	58.22
1.2975	622.8	5.198	38.88	9.88	48	33.2	59.50
1.3040	639.0	5.332	39.89	10.1	49	33.8	60.80
1.3100	655.0	5.466	40.89	10.4	50	34.3	62.00
1.3160	671.2	5.601	41.90	10.7	51	34.8	63.20
1.3219	687.4	5.737	42.91	10.9	52	35.3	64.38
1.3278	703.7	5.873	43.93	11.1	53	35.8	65.56
1.3336	720 1	6.010	44.96	11.4	54	36.3	66.72
1.3393	736.6	6.147	45.99	11.7	55	36.7	67.86
1.3449	753.1	6.285	47.02	12.0	56	37.2	68.98
1.3505	769.8	6.424	48.06	12.2	57	37.6	70.10
1.3560	786.5	6.563	49.10	12.5	58	38.1	71.20
1.3614	803.2	6.703	50.15	12.7	59	38.5	72.28
1.3667	820.0	6.843	51.19	13.0	60	38.9	73.34
1.3719	836.9	6.984	52.25	13.3	61	39.3	74.38
1.3769	853.7	7.124	53.30	13.5	62	39.7	75.38
1.3818	870.5	7.265	54.35	13.8	63	40.1	76.36
1.3866	887.4	7.406	55.40	14.1	64	40.4	77.32
1.3913	904.3	7.547	56.46	14.4	65	40.8	78.26
1.3959	921.3	7.689	57.52	14.6	66	41.1	79.18
1.4004	938.3	7.830	58.58	14.9	67	41.5	80.08
1.4048	955.3	7.972	59.64	15.2	68	41.8	80.96
1.4091	972.3	8.114	60.70	15.4	69	42.1	81.82
1.4134	989.4	8.257	61.77	15.7	70	42.4	82.68
1.4176	1006	8.400	62.84	16.0	71	42.7	83.52
1.4218	1024	8.543	63.91	16.3	72	43.0	84.36
1.4258	1041	8.686	64.98	16.5	73	43.3	85.16
1.4298	1058	8.830	66.05	16.8	74	43.6	85.96
1.4337	1075	8.974	67.13	17.1	75	43.9	86.74
1.4375	1093	9.117	68.20	17.3	76	44.1	87.50
1.4413	1110	9.262	69.28	17.6	77	44.4	88.26
1.4450	1127	9.406	70.36	17.9	78	44.7	89.00
1.4486	1144	9.550	71.44	18.2	79	44.9	89.72
1.4521	1162	9.695	72.52	18.4	80	45.1	90.42
1.4555	1179	9.839	73.60	18.7	81	45.4	91.10
1.4589	1196	9.984	74.69	19.0	82	45.6	91.78
1.4622	1214	10.13	75.77	19.3	83	45.8	92.44
1.4655	1231	10.27	76.85	19.5	84	46.1	93.10
1.4686	1248	10.42	77.93	19.8	85	46.3	93.72

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NITRIC ACID (Continued)

Specific Gravity	Weight of HNO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	N	%	Degrees: Baumé	Twaddell
1.4716	1266	10.56	79.01	20.1	86	46.5	94.32
1.4745	1283	10.71	80.09	20.4	87	46.7	94.90
1.4773	1300	10.85	81.16	20.6	88	46.8	95.46
1.4800	1317	10.99	82.23	20.9	89	47.0	96.00
1.4826	1334	11.14	83.30	21.2	90	47.2	96.52
1.4850	1351	11.28	84.36	21.4	91	47.4	97.00
1.4873	1368	11.42	85.42	21.7	92	47.5	97.46
1.4892	1385	11.56	86.46	22.0	93	47.6	97.84
1.4912	1402	11.70	87.51	22.3	94	47.8	98.24
1.4932	1419	11.84	88.56	22.5	95	47.9	98.64
1.4952	1435	11.98	89.61	22.8	96	48.0	99.04
1.4974	1452	12.12	90.68	23.0	97	48.2	99.48
1.5008	1471	12.27	91.82	23.3	98	48.4	100.16
1.5056	1491	12.44	93.05	23.7	99	48.7	101.12
1.5129	1513	12.63	94.45	24.0	100	49.2	102.58

OXALIC ACID

Density of Aqueous Oxalic Acid Solutions at 17.5° C. Computed from the Values of Gerlach.

Specific Gravity	Weight of $H_2C_2O_4 \cdot 2H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $H_2C_2O_4 + 2H_2O$	Degrees: Baumé	Twaddell
1.0035	10.04	0.08375	0.6265	1	0.5	0.70
1.0070	20.14	0.1681	1.257	2	1.0	1.40
1.0105	30.32	0.2530	1.893	3	1.5	2.10
1.0140	40.56	0.3385	2.532	4	2.0	2.80
1.0175	50.88	0.4246	3.176	5	2.5	3.50
1.0210	61.26	0.5112	3.824	6	3.0	4.20
1.0245	71.72	0.5985	4.477	7	3.5	4.90
1.0280	82.24	0.6863	5.134	8	4.0	5.60
1.0315	92.84	0.7747	5.796	9	4.4	6.30
1.0350	103.5	0.8637	6.462	10	4.9	7.00
1.0385	114.2	0.9533	7.132	11	5.4	7.70
1.0420	125.0	1.044	7.806	12	5.8	8.40
1.0455	135.9	1.134	8.485	13	6.3	9.10

Specific Gravity	Weight of $H_2C_2O_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $H_2C_2O_4$	Degrees: Baumé	Twaddell
1.0035	7.166	0.05980	0.4474	0.7141	0.5	0.70
1.0070	14.38	0.1200	0.8977	1.428	1.0	1.40
1.0105	21.64	0.1806	1.351	2.142	1.5	2.10
1.0140	28.97	0.2418	1.809	2.857	2.0	2.80
1.0175	36.33	0.3032	2.268	3.571	2.5	3.50
1.0210	43.75	0.3651	2.731	4.285	3.0	4.20
1.0245	51.21	0.4274	3.197	4.999	3.5	4.90
1.0280	58.73	0.4901	3.666	5.713	4.0	5.60
1.0315	66.29	0.5533	4.139	6.427	4.4	6.30
1.0350	73.91	0.6168	4.614	7.141	4.9	7.00
1.0385	81.58	0.6809	5.093	7.856	5.4	7.70
1.0420	89.30	0.7452	5.575	8.570	5.8	8.40
1.0455	97.06	0.8100	6.060	9.284	6.3	9.10

PHOSPHORIC ACID

Density of Aqueous Phosphoric Acid Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of H_3PO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent H_3PO_4	Degrees: Baumé	Twaddell
1.0038	10.04	0.08377	0.6267	1	0.6	0.76
1.0092	20.18	0.1684	1.260	2	1.3	1.84
1.0200	40.80	0.3405	2.547	4	2.8	4.00
1.0309	61.85	0.5162	3.862	6	4.3	6.18
1.0420	83.36	0.6957	5.204	8	5.8	8.40
1.0532	105.3	0.8789	6.575	10	7.3	10.64
1.0647	127.8	1.066	7.976	12	8.8	12.94
1.0764	150.7	1.258	9.408	14	10.3	15.28
1.0884	174.1	1.453	10.87	16	11.8	17.68
1.1008	198.1	1.654	12.37	18	13.3	20.16
1.1134	222.7	1.858	13.90	20	14.8	22.68
1.1263	247.8	2.068	15.47	22	16.3	25.26
1.1395	273.5	2.282	17.07	24	17.8	27.90
1.1529	299.8	2.502	18.71	26	19.2	30.58
1.1665	326.6	2.726	20.39	28	20.7	33.30
1.1805	354.2	2.956	22.11	30	22.2	36.10
1.216	425.6	3.552	26.57	35	25.8	43.2
1.254	501.6	4.186	31.31	40	29.4	50.8
1.293	581.9	4.856	36.32	45	32.9	58.6
1.335	667.5	5.571	41.67	50	36.4	67.0
1.379	758.5	6.330	47.35	55	39.9	75.8
1.426	855.6	7.140	53.42	60	43.3	85.2
1.475	958.8	8.001	59.85	65	46.7	95.0
1.526	1068	8.915	66.69	70	50.0	105.2
1.579	1184	9.883	73.93	75	53.2	115.8
1.633	1306	10.90	81.56	80	56.2	126.6
1.689	1436	11.98	89.63	85	59.2	137.8
1.746	1571	13.11	98.10	90	62.0	149.2
1.770	1628	13.59	101.7	92	63.1	154.0
1.794	1686	14.07	105.3	94	64.2	158.8
1.819	1746	14.57	109.0	96	65.3	163.8
1.844	1807	15.08	112.8	98	66.4	168.8
1.870	1870	15.61	116.7	100	67.5	174.0

PHOSPHORIC ACID

Density of Aqueous Phosphoric Acid Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of P_2O_5 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent P_2O_5	Degrees: Baumé	Twaddell
1.0038	7.272	0.06068	0.4540	0.7244	0.6	0.76
1.0092	14.62	0.1220	0.9129	1.449	1.3	1.84
1.0200	29.56	0.2467	1.845	2.898	2.8	4.00
1.0309	44.80	0.3739	2.797	4.346	4.3	6.18
1.0420	60.38	0.5039	3.770	5.795	5.8	8.40
1.0532	76.29	0.6367	4.763	7.244	7.3	10.64
1.0647	92.55	0.7724	5.778	8.693	8.8	12.94
1.0764	109.1	0.9109	6.814	10.14	10.3	15.28
1.0884	126.1	1.053	7.875	11.59	11.8	17.68
1.1008	143.5	1.198	8.961	13.04	13.3	20.16
1.1134	161.3	1.346	10.07	14.49	14.8	22.68
1.1263	179.5	1.498	11.21	15.94	16.3	25.26
1.1395	198.2	1.654	12.37	17.39	17.8	27.90
1.1529	217.1	1.812	13.55	18.83	19.2	30.58
1.1665	236.6	1.974	14.77	20.28	20.7	33.30

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PHOSPHORIC ACID (Continued)

Specific Gravity	Weight of P_2O_5 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent P_2O_5	Degrees: Baumé	Twaddell
1.1805	256.5	2.141	16.01	21.73	22.2	36.10
1.216	308.3	2.573	19.24	25.35	25.8	43.2
1.254	363.4	3.033	22.69	28.98	29.4	50.8
1.293	421.5	3.518	26.32	32.60	32.9	58.6
1.335	483.5	4.035	30.19	36.22	36.4	67.0
1.379	549.4	4.585	34.30	39.84	39.9	75.8
1.426	619.7	5.172	38.69	43.46	43.3	85.2
1.475	694.6	5.797	43.36	47.09	46.7	95.0
1.526	773.8	6.458	48.31	50.71	50.0	105.2
1.579	857.9	7.159	53.56	54.33	53.2	115.8
1.633	946.3	7.897	59.08	57.95	56.2	126.6
1.689	1040	8.679	64.92	61.57	59.2	137.8
1.746	1138	9.500	71.07	65.20	62.0	149.2
1.770	1180	9.844	73.64	66.64	63.1	154.0
1.794	1222	10.19	76.26	68.09	64.2	158.8
1.819	1265	10.56	78.97	69.54	65.3	163.8
1.844	1309	10.92	81.72	70.99	66.4	168.8
1.870	1355	11.30	84.57	72.44	67.5	174.0

POTASSIUM BROMIDE

Density of Aqueous Potassium Bromide Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of KBr in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent KBr	Degrees: Baumé	Twaddell
1.0054	10.05	0.08390	0.6277	1	0.8	1.08
1.0127	20.25	0.1690	1.264	2	1.8	2.54
1.0275	41.10	0.3430	2.566	4	3.9	5.50
1.0426	62.56	0.5221	3.905	6	5.9	8.52
1.0581	84.65	0.7064	5.285	8	8.0	11.62
1.0740	107.4	0.8963	6.705	10	10.0	14.80
1.0903	130.8	1.092	8.168	12	12.0	18.06
1.1070	155.0	1.293	9.675	14	14.0	21.40
1.1242	179.9	1.501	11.23	16	16.0	24.84
1.1419	205.5	1.715	12.83	18	18.0	28.38
1.1601	232.0	1.936	14.49	20	20.0	32.02
1.1788	259.3	2.164	16.19	22	22.0	35.76
1.1980	287.5	2.399	17.95	24	24.0	39.60
1.2178	316.6	2.642	19.77	26	25.9	43.56
1.2383	346.7	2.894	21.65	28	27.9	47.66
1.2593	377.8	3.153	23.59	30	29.9	51.86
1.3147	460.1	3.840	28.73	35	34.7	62.94
1.3746	549.8	4.589	34.33	40	39.5	74.92

POTASSIUM CARBONATE

Density of Aqueous Potassium Carbonate Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of K_2CO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent K_2CO_3	Degrees: Baumé	Twaddell
1.0072	10.07	0.08405	0.6288	1	1.0	1.44
1.0163	20.33	0.1696	1.269	2	2.3	3.26
1.0345	41.38	0.3453	2.583	4	4.8	6.90
1.0529	63.17	0.5272	3.944	6	7.3	10.58
1.0715	85.72	0.7154	5.351	8	9.7	14.30

POTASSIUM CARBONATE (Continued)

Specific Gravity	Weight of K_2CO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent K_2CO_3	Degrees: Baumé	Twaddell
1.0904	109.0	0.9100	6.807	10	12.0	18.08
1.1096	133.2	1.111	8.313	12	14.3	21.92
1.1291	158.1	1.319	9.869	14	16.6	25.82
1.1490	183.8	1.534	11.48	16	18.8	29.80
1.1692	210.5	1.756	13.14	18	21.0	33.84
1.1898	238.0	1.986	14.86	20	23.1	37.96
1.2107	266.4	2.223	16.63	22	25.2	42.14
1.2320	295.7	2.468	18.46	24	27.3	46.40
1.2536	325.9	2.720	20.35	26	29.3	50.72
1.2756	357.2	2.981	22.30	28	31.3	55.12
1.2979	389.4	3.249	24.31	30	33.3	59.58
1.3548	474.2	3.957	29.60	35	38.0	70.96
1.4141	565.6	4.720	35.31	40	42.5	82.82
1.4759	664.2	5.543	41.46	45	46.8	95.18
1.5404	770.2	6.428	48.08	50	50.9	108.08

POTASSIUM CHLORIDE

Density of Aqueous Potassium Chloride Solutions at $\frac{20}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of KCl in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent KCl	Degrees: Baumé	Twaddell
1.0046	10.05	0.08384	0.6272	1	0.7	0.92
1.0110	20.22	0.1687	1.262	2	1.6	2.20
1.0239	40.96	0.3418	2.557	4	3.4	4.78
1.0369	62.21	0.5192	3.884	6	5.2	7.38
1.0500	84.00	0.7010	5.244	8	6.9	10.00
1.0633	106.3	0.8874	6.638	10	8.6	12.66
1.0768	129.2	1.078	8.067	12	10.3	15.36
1.0905	152.7	1.274	9.531	14	12.0	18.10
1.1043	176.7	1.475	11.03	16	13.7	20.86
1.1185	201.3	1.680	12.57	18	15.4	23.70
1.1328	226.6	1.891	14.14	20	17.0	26.56
1.1474	252.4	2.107	15.76	22	18.6	29.48
1.1623	279.0	2.328	17.41	24	20.2	32.46

POTASSIUM CHROMATE

Density of Aqueous Potassium Chromate Solutions at $\frac{18}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of K_2CrO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent K_2CrO_4	Degrees: Baumé	Twaddell
1.0066	10.07	0.08400	0.6284	1	1.0	1.32
1.0147	20.29	0.1694	1.267	2	2.1	2.94
1.0311	41.24	0.3442	2.575	4	4.4	6.22
1.0477	62.86	0.5246	3.924	6	6.6	9.54
1.0647	85.18	0.7108	5.318	8	8.8	12.94
1.0821	108.2	0.9031	6.756	10	11.0	16.42
1.0999	132.0	1.101	8.240	12	13.2	19.98
1.1181	156.5	1.306	9.772	14	15.3	23.62
1.1366	181.9	1.518	11.35	16	17.4	27.32
1.1555	208.0	1.736	12.98	18	19.5	31.10

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POTASSIUM CHROMATE (Continued)

Specific Gravity	Weight of K_2CrO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent K_2CrO_4	Degrees: Baumé	Twaddell
1.1748	235.0	1.961	14.67	20	21.6	34.96
1.1945	262.8	2.193	16.41	22	23.6	38.90
1.2147	291.5	2.433	18.20	24	25.6	42.94
1.2354	321.2	2.681	20.05	26	27.6	47.08
1.2566	351.8	2.936	21.97	28	29.6	51.32
1.2784	383.5	3.201	23.94	30	31.6	55.68

Density of Aqueous Potassium Chromate Solutions at 19.5° C. Computed from the Values of Schiff.

Specific Gravity	Weight of K_2CrO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent K_2CrO_4	Degrees: Baumé	Twaddell
1.0080	10.08	0.08412	0.6293	1	1.2	1.60
1.0161	20.32	0.1696	1.269	2	2.3	3.22
1.0243	30.73	0.2564	1.918	3	3.4	4.86
1.0325	41.30	0.3447	2.578	4	4.6	6.50
1.0408	52.04	0.4343	3.249	5	5.7	8.16
1.0492	62.95	0.5254	3.930	6	6.8	9.84
1.0576	74.03	0.6178	4.622	7	7.9	11.52
1.0663	85.30	0.7119	5.326	8	9.0	13.26
1.0750	96.75	0.8074	6.040	9	10.1	15.00
1.0837	108.4	0.9044	6.766	10	11.2	16.74
1.0925	120.2	1.003	7.503	11	12.3	18.50
1.1014	132.2	1.103	8.251	12	13.4	20.28
1.1104	144.4	1.205	9.012	13	14.4	22.08
1.1195	156.7	1.308	9.785	14	15.5	23.90
1.1287	169.3	1.413	10.57	15	16.5	25.74
1.1380	182.1	1.520	11.37	16	17.6	27.60
1.1474	195.1	1.628	12.18	17	18.6	29.48
1.1570	208.3	1.738	13.00	18	19.7	31.40
1.1667	221.7	1.850	13.84	19	20.7	33.34
1.1765	235.3	1.964	14.69	20	21.8	35.30
1.1864	249.1	2.079	15.55	21	22.8	37.28
1.1964	263.2	2.197	16.43	22	23.8	39.28
1.2066	277.5	2.316	17.33	23	24.8	41.32
1.2169	292.1	2.437	18.23	24	25.8	43.38
1.2274	306.9	2.561	19.16	25	26.9	45.48
1.2379	321.9	2.686	20.09	26	27.9	47.58
1.2485	337.1	2.813	21.04	27	28.9	49.70
1.2592	352.6	2.942	22.01	28	29.8	51.84
1.2700	368.3	3.074	22.99	29	30.8	54.00
1.2808	384.2	3.207	23.99	30	31.8	56.16
1.2921	400.6	3.343	25.01	31	32.8	58.42
1.3035	417.1	3.481	26.04	32	33.8	60.70
1.3151	434.0	3.622	27.09	33	34.7	63.02
1.3268	451.1	3.765	28.16	34	35.7	65.36
1.3386	468.5	3.910	29.25	35	36.7	67.72
1.3505	486.2	4.057	30.35	36	37.6	70.10
1.3625	504.1	4.207	31.47	37	38.6	72.50
1.3746	522.3	4.359	32.61	38	39.5	74.92
1.3868	540.9	4.514	33.77	39	40.4	77.36
1.3991	559.6	4.670	34.94	40	41.4	79.82

POTASSIUM CHROME ALUM (GREEN)

Density of Aqueous Potassium Chrome Alum Solutions at $\frac{15}{4}^{\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $K_2Cr_2(SO_4)_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $K_2Cr_2(SO_4)_4$	Degrees: Baumé	Twaddell
1.007	10.07	0.08404	0.6287	1	1.0	1.4
1.016	20.32	0.1696	1.269	2	2.3	3.2
1.034	41.36	0.3452	2.582	4	4.8	6.8
1.052	63.12	0.5268	3.941	6	7.2	10.4
1.070	85.60	0.7144	5.344	8	9.5	14.0
1.089	108.9	0.9088	6.799	10	11.9	17.8
1.109	133.1	1.111	8.308	12	14.3	21.8
1.129	158.1	1.319	9.868	14	16.6	25.8
1.150	184.0	1.536	11.49	16	18.9	30.0
1.171	210.8	1.759	13.16	18	21.2	34.2
1.193	238.6	1.991	14.90	20	23.5	38.6
1.216	267.5	2.233	16.70	22	25.8	43.2
1.239	297.4	2.482	18.56	24	28.0	47.8
1.263	328.4	2.740	20.50	26	30.2	52.6
1.289	360.9	3.012	22.53	28	32.5	57.8
1.315	394.5	3.292	24.63	30	34.7	63.0
1.383	484.1	4.040	30.22	35	40.2	76.6
1.456	582.4	4.860	36.36	40	45.4	91.2
1.533	689.9	5.757	43.07	45	50.4	106.6
1.615	807.5	6.739	50.41	50	55.2	123.0

Specific Gravity	Weight of $K_2Cr_2(SO_4)_4 \cdot 24H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $K_2Cr_2(SO_4)_4 + 24H_2O$	Degrees: Baumé	Twaddell
1.007	17.76	0.1482	1.109	1.763	1.0	1.4
1.016	35.83	0.2991	2.237	3.527	2.3	3.2
1.034	72.93	0.6086	4.553	7.053	4.8	6.8
1.052	111.3	0.9289	6.949	10.58	7.2	10.4
1.070	151.0	1.260	9.425	14.11	9.5	14.0
1.089	192.0	1.602	11.99	17.63	11.9	17.8
1.109	234.7	1.958	14.65	21.16	14.3	21.8
1.129	278.8	2.326	17.40	24.69	16.6	25.8
1.150	324.4	2.707	20.25	28.21	18.9	30.0
1.171	371.7	3.102	23.20	31.74	21.2	34.2
1.193	420.8	3.512	26.27	35.27	23.5	38.6
1.216	471.7	3.936	29.45	38.79	25.8	43.2
1.239	524.3	4.376	32.73	42.32	28.0	47.8
1.263	579.1	4.833	36.15	45.85	30.2	52.6
1.289	636.4	5.311	39.73	49.37	32.5	57.8
1.315	695.6	5.805	43.43	52.90	34.7	63.0
1.383	853.6	7.124	53.29	61.72	40.2	76.6
1.456	1026.9	8.570	64.11	70.53	45.4	91.2
1.533	1216.4	10.15	75.94	79.35	50.4	106.6
1.615	1423.9	11.88	88.90	88.17	55.2	123.0

POTASSIUM DICHROMATE

Density of Aqueous Potassium Dichromate Solutions at $\frac{20}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $K_2Cr_2O_7$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $K_2Cr_2O_7$	Degrees: Baumé	Twaddell
1.0052	10.05	0.08389	0.6275	1	0.8	1.04
1.0122	20.24	0.1689	1.264	2	1.7	2.44
1.0264	41.06	0.3426	2.563	4	3.7	5.28
1.0408	62.45	0.5212	3.899	6	5.7	8.16
1.0554	84.43	0.7046	5.271	8	7.6	11.08
1.0703	107.0	0.8932	6.682	10	9.5	14.06

POTASSIUM HYDROXIDE

Density of Aqueous Potassium Hydroxide Solutions at $\frac{15}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of KOH in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent KOH	Degrees: Baumé	Twaddell
1.0083	10.08	0.08415	0.6295	1	1.2	1.66
1.0175	20.35	0.1698	1.270	2	2.5	3.50
1.0267	30.80	0.2570	1.923	3	3.8	5.34
1.0359	41.44	0.3458	2.587	4	5.0	7.18
1.0452	52.26	0.4361	3.263	5	6.3	9.04
1.0544	63.26	0.5280	3.950	6	7.5	10.88
1.0637	74.46	0.6214	4.648	7	8.7	12.74
1.0730	85.84	0.7164	5.359	8	9.9	14.60
1.0824	97.42	0.8130	6.082	9	11.0	16.48
1.0918	109.2	0.9112	6.816	10	12.2	18.36
1.1013	121.1	1.011	7.563	11	13.3	20.26
1.1108	133.3	1.112	8.322	12	14.5	22.16
1.1203	145.6	1.215	9.092	13	15.6	24.06
1.1299	158.2	1.320	9.874	14	16.7	25.98
1.1396	170.9	1.427	10.67	15	17.8	27.92
1.1493	183.9	1.535	11.48	16	18.8	29.86
1.1590	197.0	1.644	12.30	17	19.9	31.80
1.1688	210.4	1.756	13.13	18	20.9	33.76
1.1786	223.9	1.869	13.98	19	22.0	35.72
1.1884	237.7	1.984	14.84	20	23.0	37.68
1.1984	251.7	2.100	15.71	21	24.0	39.68
1.2083	265.8	2.218	16.60	22	25.0	41.66
1.2184	280.2	2.339	17.49	23	26.0	43.68
1.2285	294.8	2.461	18.41	24	27.0	45.70
1.2387	309.7	2.584	19.33	25	27.9	47.74
1.2489	324.7	2.710	20.27	26	28.9	49.78
1.2592	340.0	2.837	21.23	27	29.8	51.84
1.2695	355.5	2.966	22.19	28	30.8	53.90
1.2800	371.2	3.098	23.17	29	31.7	56.00
1.2905	387.2	3.231	24.17	30	32.6	58.10
1.3010	403.3	3.366	25.18	31	33.6	60.20
1.3117	419.7	3.503	26.20	32	34.5	62.34
1.3224	436.4	3.642	27.24	33	35.4	64.48
1.3331	453.3	3.783	28.30	34	36.2	66.62
1.3440	470.4	3.926	29.37	35	37.1	68.80
1.3549	487.8	4.071	30.45	36	38.0	70.98
1.3659	505.4	4.218	31.55	37	38.8	73.18
1.3769	523.2	4.366	32.66	38	39.7	75.38
1.3879	541.3	4.517	33.79	39	40.5	77.58
1.3991	559.6	4.670	34.94	40	41.4	79.82

POTASSIUM HYDROXIDE (Continued)

Specific Gravity	Weight of KOH in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent KOH	Degrees: Baumé	Twaddell
1.4103	578.2	4.826	36.10	41	42.2	82.06
1.4215	597.0	4.982	37.27	42	43.0	84.30
1.4329	616.1	5.142	38.47	43	43.8	86.58
1.4443	635.5	5.303	39.67	44	44.6	88.86
1.4558	655.1	5.467	40.90	45	45.4	91.16
1.4673	675.0	5.633	42.14	46	46.2	93.46
1.4790	695.1	5.801	43.40	47	47.0	95.80
1.4907	715.5	5.971	44.67	48	47.7	98.14
1.5025	736.2	6.144	45.96	49	48.5	100.50
1.5143	757.2	6.319	47.27	50	49.2	102.86
1.5262	778.4	6.496	48.59	51	50.0	105.24
1.5382	799.9	6.675	49.94	52	50.7	107.64

POTASSIUM IODIDE

Density of Aqueous Potassium Iodide Solutions at $\frac{20^\circ}{4^\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of KI in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent KI	Degrees: Baumé	Twaddell
1.0055	10.06	0.08391	0.6277	1	0.8	1.10
1.0130	20.26	0.1691	1.265	2	1.9	2.60
1.0281	41.12	0.3432	2.567	4	4.0	5.62
1.0437	62.62	0.5226	3.909	6	6.1	8.74
1.0597	84.78	0.7075	5.293	8	8.2	11.94
1.0761	107.6	0.8980	6.718	10	10.3	15.22
1.0930	131.2	1.095	8.188	12	12.3	18.60
1.1104	155.5	1.297	9.705	14	14.4	22.08
1.1284	180.5	1.507	11.27	16	16.5	25.68
1.1469	206.4	1.723	12.89	18	18.6	29.38
1.1660	233.2	1.946	14.56	20	20.6	33.20
1.1857	260.9	2.177	16.29	22	23.7	37.14
1.2060	289.4	2.415	18.07	24	24.8	41.20
1.2270	319.0	2.662	19.92	26	26.8	45.40
1.2487	349.6	2.918	21.83	28	28.9	49.74
1.2712	381.4	3.183	23.81	30	30.9	54.24
1.3308	465.8	3.887	29.08	35	36.0	66.16
1.3959	558.4	4.660	34.86	40	41.1	79.18
1.4672	660.2	5.510	41.22	45	46.2	93.44
1.5458	772.9	6.450	48.25	50	51.2	109.16
1.6327	898.0	7.494	56.06	55	56.2	126.54

POTASSIUM NITRATE

Density of Aqueous Potassium Nitrate Solutions at $\frac{20^\circ}{4^\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of KNO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent KNO_3	Degrees: Baumé	Twaddell
1.0045	10.05	0.08383	0.6271	1	0.6	0.90
1.0108	20.22	0.1687	1.262	2	1.5	2.16
1.0234	40.94	0.3416	2.556	4	3.3	4.68
1.0363	62.18	0.5189	3.882	6	5.1	7.26
1.0494	83.95	0.7006	5.241	8	6.8	9.88

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POTASSIUM NITRATE (Continued)

Specific Gravity	Weight of KNO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent KNO_3	Degrees: Baumé	Twaddell
1.0627	106.3	0.8869	6.634	10	8.6	12.54
1.0762	129.1	1.078	8.062	12	10.3	15.24
1.0899	153.6	1.273	9.526	14	12.0	17.98
1.1039	176.6	1.474	11.03	16	13.7	20.78
1.1181	201.3	1.680	12.56	18	15.3	23.62
1.1326	226.5	1.890	14.14	20	17.0	26.52
1.1473	252.4	2.106	15.76	22	18.6	29.46
1.1623	279.0	2.328	17.41	24	20.2	32.46

POTASSIUM SULFATE

Density of Aqueous Potassium Sulfate Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of K_2SO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent K_2SO_4	Degrees: Baumé	Twaddell
1.0063	10.06	0.08398	0.6282	1	0.9	1.26
1.0145	20.29	0.1693	1.267	2	2.1	2.90
1.0310	41.24	0.3442	2.575	4	4.4	6.20
1.0477	62.86	0.5246	3.924	6	6.6	9.54
1.0646	85.17	0.7108	5.317	8	8.8	12.92
1.0817	108.17	0.9027	6.753	10	11.0	16.34

POTASSIUM TARTRATE

Density of Aqueous Potassium Tartrate Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $K_2C_4H_4O_6$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $K_2C_4H_4O_6$	Degrees: Baumé	Twaddell
1.0048	10.05	0.08385	0.6273	1	0.7	0.96
1.0114	20.23	0.1688	1.263	2	1.6	2.28
1.0248	40.99	0.3421	2.559	4	3.5	4.96
1.0383	62.30	0.5199	3.889	6	5.4	7.66
1.0519	84.15	0.7023	5.254	8	7.2	10.38
1.0657	106.6	0.8894	6.653	10	8.9	13.14
1.0798	129.6	1.081	8.089	12	10.7	15.96
1.0941	153.2	1.278	9.563	14	12.5	18.82
1.1087	177.4	1.480	11.07	16	14.2	21.74
1.1236	202.2	1.688	12.63	18	16.0	24.72
1.1387	227.7	1.901	14.22	20	17.7	27.74
1.1540	253.9	2.119	15.85	22	19.4	30.80
1.1696	280.7	2.343	17.52	24	21.0	33.92
1.1855	308.2	2.572	19.24	26	22.7	37.10
1.2017	336.5	2.808	21.01	28	24.3	40.34
1.2181	365.4	3.050	22.81	30	26.0	43.62
1.2606	441.2	3.682	27.54	35	30.0	52.12
1.3051	522.0	4.357	32.59	40	33.9	61.02
1.3516	608.2	5.076	37.97	45	37.7	70.32
1.4001	700.1	5.842	43.70	50	41.4	80.02

POTASSIUM TARTRATE (Continued)

Specific Gravity	Weight of $K_2C_4H_4O_6 \cdot \frac{1}{2}H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $K_2C_4H_4O_6 + \frac{1}{2}H_2O$	Degrees: Baumé	Twaddell
1.0048	10.45	0.08719	0.6523	1.040	0.7	0.96
1.0114	21.03	0.1755	1.313	2.080	1.6	2.28
1.0248	42.62	0.3557	2.661	4.159	3.5	4.96
1.0383	64.78	0.5406	4.044	6.239	5.4	7.66
1.0519	87.50	0.7303	5.463	8.319	7.2	10.38
1.0657	110.8	0.9248	6.918	10.40	8.9	13.14
1.0798	134.7	1.124	8.412	12.48	10.7	15.96
1.0941	159.3	1.329	9.944	14.56	12.5	18.82
1.1087	184.5	1.539	11.52	16.64	14.2	21.74
1.1236	210.3	1.755	13.13	18.72	16.0	24.72
1.1387	236.8	1.976	14.78	20.80	17.7	27.74
1.1540	264.0	2.203	16.48	22.88	19.4	30.80
1.1696	291.9	2.436	18.22	24.96	21.0	33.92
1.1855	320.5	2.675	20.01	27.04	22.7	37.10
1.2017	349.9	2.920	21.84	29.12	24.3	40.34
1.2181	380.0	3.171	23.72	31.19	26.0	43.62
1.2606	458.8	3.829	28.64	36.39	30.0	52.12
1.3051	542.8	4.530	33.89	41.59	33.9	61.02
1.3516	632.4	5.278	39.48	46.79	37.7	70.32
1.4001	727.9	6.075	45.44	51.99	41.4	80.02

SODIUM ACETATE

Density of Aqueous Sodium Acetate Solutions at $\frac{20^\circ}{4^\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $NaC_2H_3O_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $NaC_2H_3O_2$	Degrees: Baumé	Twaddell
1.0033	10.03	0.08373	0.6264	1	0.5	0.66
1.0084	20.17	0.1683	1.259	2	1.2	1.68
1.0186	40.74	0.3400	2.544	4	2.6	3.72
1.0289	61.73	0.5152	3.854	6	4.1	5.78
1.0392	83.14	0.6938	5.190	8	5.5	7.84
1.0495	105.0	0.8758	6.552	10	6.8	9.90
1.0598	127.2	1.061	7.940	12	8.2	11.96
1.0702	149.8	1.250	9.354	14	9.5	14.04
1.0807	172.9	1.443	10.79	16	10.8	16.14
1.0913	196.4	1.639	12.26	18	12.1	18.26
1.1021	220.4	1.839	13.76	20	13.4	20.42
1.1130	244.9	2.043	15.29	22	14.7	22.60
1.1240	269.8	2.251	16.84	24	16.0	24.80
1.1351	295.1	2.463	18.42	26	17.3	27.02
1.1462	320.9	2.678	20.04	28	18.5	29.24

SODIUM ARSENATE

Density of Aqueous Di-sodium Arsenate Solutions at $\frac{14^\circ}{4^\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of Na_2HAsO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Na_2HAsO_4	Degrees: Baumé	Twaddell
1.0083	10.08	0.08415	0.6295	1	1.2	1.66
1.0175	20.35	0.1698	1.270	2	2.5	3.50
1.0365	41.46	0.3460	2.588	4	5.1	7.30
1.0563	63.38	0.5289	3.957	6	7.7	11.26
1.0768	86.14	0.7189	5.378	8	10.3	15.36

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SODIUM ARSENATE (Continued)

Specific Gravity	Weight of Na_2HAsO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Na_2HAsO_4	Degrees: Baumé	Twaddell
1.0980	109.8	0.9163	6.855	10	12.9	19.60
1.1197	134.4	1.121	8.388	12	15.5	23.94
1.1419	159.9	1.334	9.980	14	18.0	28.38
1.1645	186.3	1.555	11.63	16	20.5	32.90

Specific Gravity	Weight of $Na_2HAsO_4 \cdot 12H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2HAsO_4 + 12H_2O$	Degrees: Baumé	Twaddell
1.0083	21.81	0.1820	1.361	2.163	1.2	1.66
1.0175	44.01	0.3673	2.748	4.325	2.5	3.50
1.0365	89.67	0.7483	5.598	8.651	5.1	7.30
1.0563	137.1	1.144	8.557	12.98	7.7	11.26
1.0768	186.3	1.555	11.63	17.30	10.3	15.36
1.0980	237.5	1.982	14.83	21.63	12.9	19.60
1.1197	290.6	2.425	18.14	25.95	15.5	23.94
1.1419	345.7	2.885	21.58	30.28	18.0	28.38
1.1645	403.0	3.363	25.16	34.60	20.5	32.90

SODIUM ARSENATE

Density of Aqueous Di-sodium Arsenate Solutions at 14° C. Computed from the Values of Schiff.

Specific Gravity	Weight of $Na_2HAsO_4 \cdot 12H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2HAsO_4 + 12H_2O$	Degrees: Baumé	Twaddell
1.0042	10.04	0.08380	0.6269	1	0.6	0.84
1.0084	20.17	0.1683	1.259	2	1.2	1.68
1.0126	30.38	0.2535	1.896	3	1.8	2.52
1.0168	40.67	0.3394	2.539	4	2.4	3.36
1.0212	51.06	0.4261	3.188	5	3.0	4.24
1.0256	61.54	0.5135	3.842	6	3.6	5.12
1.0300	72.10	0.6017	4.501	7	4.2	6.00
1.0344	82.75	0.6906	5.166	8	4.8	6.88
1.0389	93.50	0.7803	5.837	9	5.4	7.78
1.0434	104.3	0.8708	6.514	10	6.0	8.68
1.0479	115.3	0.9620	7.196	11	6.6	9.58
1.0525	126.3	1.054	7.885	12	7.2	10.50
1.0571	137.4	1.147	8.579	13	7.8	11.42
1.0618	148.7	1.241	9.280	14	8.4	12.36
1.0665	160.0	1.335	9.987	15	9.0	13.30
1.0712	171.4	1.430	10.70	16	9.6	14.24
1.0759	182.9	1.526	11.42	17	10.2	15.18
1.0807	194.5	1.623	12.14	18	10.8	16.14
1.0855	206.2	1.721	12.88	19	11.4	17.10
1.0904	218.1	1.820	13.61	20	12.0	18.08
1.0953	230.0	1.920	14.36	21	12.6	19.06
1.1002	242.0	2.020	15.11	22	13.2	20.04
1.1052	254.2	2.121	15.87	23	13.8	21.04
1.1102	266.4	2.224	16.63	24	14.4	22.04
1.1153	278.8	2.327	17.41	25	15.0	23.06

SODIUM ARSENATE (Continued)

Specific Gravity	Weight of $Na_2HAsO_4 \cdot 12 H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2HAsO_4 + 12H_2O$	Degrees: Baumé	Twaddell
1.1204	291.3	2.431	18.19	26	15.6	24.08
1.1255	303.9	2.536	18.97	27	16.2	25.10
1.1306	316.6	2.642	19.76	28	16.8	26.12
1.1358	329.4	2.749	20.56	29	17.3	27.16
1.1410	342.3	2.857	21.37	30	17.9	28.20
1.1463	355.4	2.966	22.18	31	18.5	29.26
1.1516	368.5	3.075	23.01	32	19.1	30.32
1.1569	381.8	3.186	23.83	33	19.7	31.38
1.1623	395.2	3.298	24.67	34	20.2	32.46
1.1677	408.7	3.411	25.51	35	20.8	33.54
1.1731	422.3	3.524	26.37	36	21.4	34.62
1.1786	436.1	3.639	27.22	37	22.0	35.72
1.1838	449.8	3.754	28.08	38	22.5	36.76
1.1896	464.0	3.872	28.96	39	23.1	37.92
1.1952	478.1	3.990	29.85	40	23.7	39.04

SODIUM ARSENATE

Density of Aqueous Tri-sodium Arsenate Solutions at $\frac{17}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of Na_3AsO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Na_3AsO_4	Degrees: Baumé	Twaddell
1.0097	10.10	0.08426	0.6304	1	1.4	1.94
1.0207	20.41	0.1704	1.274	2	2.9	4.14
1.0431	41.72	0.3482	2.605	4	6.0	8.62
1.0659	63.95	0.5337	3.993	6	9.0	13.18
1.0892	87.14	0.7272	5.440	8	11.9	17.84
1.1130	111.3	0.9288	6.948	10	14.7	22.60
1.1373	136.5	1.1389	8.520	12	17.5	27.46

Specific Gravity	Weight of $Na_3AsO_4 \cdot 12H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_3AsO_4 + 12H_2O$	Degrees: Baumé	Twaddell
1.0097	20.60	0.1719	1.286	2.040	1.4	1.94
1.0207	41.64	0.3475	2.600	4.080	2.9	4.14
1.0431	85.11	0.7103	5.313	8.159	6.0	8.62
1.0659	130.5	1.089	8.144	12.24	9.0	13.18
1.0892	177.7	1.483	11.10	16.32	11.9	17.84
1.1130	227.0	1.895	14.17	20.40	14.7	22.60
1.1373	278.4	2.323	17.38	24.48	17.5	27.46

Density of Aqueous Tri-sodium Arsenate Solutions at 17° C. Computed from the Values of Schiff.

Specific Gravity	Weight of $Na_3AsO_4 \cdot 12H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	PerCent $Na_3AsO_4 + 12H_2O$	Degrees: Baumé	Twaddell
1.0053	10.05	0.08390	0.6276	1	0.8	1.06
1.0107	20.21	0.1687	1.262	2	1.5	2.14
1.0161	30.48	0.2544	1.903	3	2.3	3.22
1.0215	40.86	0.3410	2.551	4	3.1	4.30
1.0270	51.35	0.4285	3.206	5	3.8	5.40

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SODIUM ARSENATE (Continued)

Specific Gravity	Weight of $Na_3AsO_4 \cdot 12\,H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_3AsO_4 + 12H_2O$	Degrees: Baumé	Twaddell
1.0325	61.95	0.5170	3.868	6	4.6	6.50
1.0380	72.66	0.6064	4.536	7	5.3	7.60
1.0435	83.48	0.6967	5.212	8	6.0	8.70
1.0491	94.42	0.7880	5.895	9	6.8	9.82
1.0547	105.5	0.8802	6.584	10	7.5	10.94
1.0603	116.6	0.9733	7.281	11	8.3	12.06
1.0659	127.9	1.067	7.985	12	9.0	13.18
1.0716	139.3	1.163	8.697	13	9.7	14.32
1.0773	150.8	1.259	9.416	14	10.4	15.46
1.0830	162.5	1.356	10.14	15	11.1	16.60
1.0887	174.2	1.454	10.87	16	11.8	17.74
1.0945	186.1	1.553	11.62	17	12.5	18.90
1.1003	198.1	1.653	12.36	18	13.2	20.06
1.1061	210.2	1.754	13.12	19	13.9	21.22
1.1120	222.4	1.856	13.88	20	14.6	22.40
1.1179	234.8	1.959	14.66	21	15.3	23.58
1.1238	247.2	2.063	15.43	22	16.0	24.78

SODIUM BROMIDE

Density of Aqueous Sodium Bromide Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of NaBr in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent NaBr	Degrees: Baumé	Twaddell
1.0060	10.06	0.08395	0.6280	1	0.9	1.20
1.0139	20.28	0.1692	1.266	2	2.0	2.78
1.0298	41.19	0.3438	2.572	4	4.2	5.96
1.0462	62.77	0.5239	3.919	6	6.4	9.24
1.0631	85.05	0.7098	5.310	8	8.6	12.62
1.0803	108.0	0.9016	6.744	10	10.8	16.06
1.0981	131.8	1.100	8.227	12	13.0	19.62
1.1164	156.3	1.304	9.758	14	15.1	23.28
1.1352	181.6	1.516	11.34	16	17.3	27.04
1.1546	207.8	1.734	12.97	18	19.4	30.92
1.1745	234.9	1.960	14.66	20	21.5	34.90
1.1951	262.9	2.194	16.41	22	23.7	39.02
1.2163	291.9	2.436	18.22	24	25.8	43.26
1.2382	321.9	2.687	20.10	26	27.9	47.64
1.2608	353.0	2.946	22.04	28	30.0	52.16
1.2841	385.2	3.215	24.05	30	32.1	56.82
1.3462	471.2	3.932	29.42	35	37.3	69.24
1.4138	565.5	4.719	35.31	40	42.4	82.76

SODIUM CARBONATE

Density of Aqueous Sodium Carbonate Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of Na_2CO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Na_2CO_3	Degrees: Baumé	Twaddell
1.0086	10.09	0.08417	0.6297	1	1.2	1.72
1.0190	20.38	0.1701	1.272	2	2.7	3.80

SODIUM CARBONATE (Continued)

Specific Gravity	Weight of Na_2CO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Na_2CO_3	Degrees: Baumé	Twaddell
1.0398	41.59	0.3471	2.597	4	5.6	7.96
1.0606	63.64	0.5311	3.973	6	8.3	12.12
1.0816	86.53	0.7221	5.402	8	10.9	16.32
1.1029	110.3	0.9204	6.885	10	13.5	20.58
1.1244	134.9	1.126	8.424	12	16.0	24.88
1.1463	160.5	1.339	10.02	14	18.5	29.26

Specific Gravity	Weight of $Na_2CO_3 \cdot 10H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2CO_3 + 10H_2O$	Degrees: Baumé	Twaddell
1.0086	27.23	0.2272	1.700	2.700	1.2	1.72
1.0190	55.02	0.4592	3.435	5.400	2.7	3.80
1.0398	112.3	0.9371	7.010	10.80	5.6	7.96
1.0606	171.8	1.434	10.73	16.20	8.3	12.12
1.0816	233.6	1.950	14.58	21.60	10.9	16.32
1.1029	297.8	2.485	18.59	27.00	13.5	20.58
1.1244	364.3	3.040	22.74	32.40	16.0	24.88
1.1463	433.3	3.616	27.05	37.80	18.5	29.26

SODIUM CHLORIDE

Density of Aqueous Sodium Chloride Solutions at $\frac{20^\circ}{4^\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of NaCl in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent NaCl	Degrees: Baumé	Twaddell
1.0053	10.05	0.08390	0.6276	1	0.8	1.06
1.0125	20.25	0.1690	1.264	2	1.8	2.50
1.0268	41.07	0.3428	2.564	4	3.8	5.36
1.0413	62.48	0.5214	3.901	6	5.8	8.26
1.0559	84.47	0.7050	5.274	8	7.7	11.18
1.0707	107.1	0.8935	6.684	10	9.6	14.14
1.0857	130.3	1.087	8.134	12	11.5	17.14
1.1009	154.1	1.286	9.622	14	13.3	20.18
1.1162	178.6	1.490	11.15	16	15.1	23.24
1.1319	203.7	1.700	12.72	18	16.9	26.38
1.1478	229.6	1.916	14.33	20	18.7	29.56
1.1640	256.1	2.137	15.99	22	20.4	32.80
1.1804	283.3	2.364	17.69	24	22.2	36.08
1.1972	311.3	2.598	19.43	26	23.9	39.44

SODIUM CHROMATE

Density of Aqueous Sodium Chromate Solutions at $\frac{18^\circ}{4^\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of Na_2CrO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Na_2CrO_4	Degrees: Baumé	Twaddell
1.0074	10.07	0.08407	0.6289	1	1.1	1.48
1.0163	20.33	0.1696	1.269	2	2.3	3.26
1.0344	41.38	0.3453	2.583	4	4.8	6.88
1.0529	63.17	0.5272	3.944	6	7.3	10.58
1.0718	85.74	0.7156	5.353	8	9.7	14.36

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SODIUM CHROMATE (Continued)

Specific Gravity	Weight of Na_2CrO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Na_2CrO_4	Degrees: Baumé	Twaddell
1.0912	109.1	0.9107	6.812	10	12.1	18.24
1.1110	133.3	1.113	8.323	12	14.5	22.20
1.1312	158.4	1.322	9.887	14	16.8	26.24
1.1518	184.3	1.538	11.51	16	19.1	30.36
1.1728	211.1	1.762	13.18	18	21.4	34.56
1.1942	238.8	1.993	14.91	20	23.6	38.84
1.2160	267.5	2.233	16.70	22	25.8	43.20
1.2383	297.2	2.480	18.55	24	27.9	47.66
1.2611	327.9	2.736	20.47	26	30.0	52.22

SODIUM DICHROMATE

Density of Aqueous Sodium Dichromate Solutions at $\frac{15^\circ}{4^\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $Na_2Cr_2O_7$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2Cr_2O_7$	Degrees: Baumé	Twaddell
1.006	10.06	0.08395	0.6280	1	0.9	1.2
1.013	20.26	0.1691	1.265	2	1.9	2.6
1.027	41.08	0.3428	2.565	4	3.8	5.4
1.041	62.46	0.5213	3.899	6	5.7	8.2
1.056	84.48	0.7050	5.274	8	7.7	11.2
1.070	107.0	0.8930	6.680	10	9.5	14.0
1.084	130.1	1.086	8.121	12	11.2	16.8
1.098	153.7	1.283	9.597	14	12.9	19.6
1.112	177.9	1.485	11.11	16	14.6	22.4
1.126	202.7	1.691	12.65	18	16.2	25.2
1.140	228.0	1.903	14.23	20	17.8	28.0
1.153	253.7	2.117	15.84	22	19.2	30.6
1.166	279.8	2.335	17.47	24	20.6	33.2
1.179	306.5	2.558	19.14	26	22.0	35.8
1.193	334.0	2.788	20.85	28	23.5	38.6
1.207	362.1	3.022	22.61	30	24.9	41.4
1.244	435.4	3.634	27.18	35	28.4	48.8
1.279	511.6	4.270	31.94	40	31.6	55.8
1.312	590.4	4.927	36.86	45	34.5	62.4
1.342	671.0	5.600	41.89	50	37.0	68.4

SODIUM HYDROXIDE

Density of Aqueous Sodium Hydroxide Solutions at $\frac{20^\circ}{4^\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of NaOH in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent NaOH	Degrees: Baumé	Twaddell
1.0095	10.10	0.08425	0.6302	1	1.4	1.90
1.0207	20.41	0.1704	1.274	2	2.9	4.14
1.0318	30.95	0.2583	1.932	3	4.5	6.36
1.0428	41.71	0.3481	2.604	4	6.0	8.56
1.0538	52.69	0.4397	3.289	5	7.4	10.76
1.0648	63.89	0.5332	3.989	6	8.8	12.96
1.0758	75.31	0.6285	4.701	7	10.2	15.16
1.0869	86.95	0.7256	5.428	8	11.6	17.38

SODIUM HYDROXIDE (Continued)

Specific Gravity	Weight of NaOH in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent NaOH	Degrees: Baumé	Twaddell
1.0979	98.81	0.8246	6.169	9	12.9	19.58
1.1089	110.9	0.9254	6.923	10	14.2	21.78
1.1309	135.7	1.133	8.472	12	16.8	26.18
1.1530	161.4	1.347	10.08	14	19.2	30.60
1.1751	188.0	1.569	11.74	16	21.6	35.02
1.1972	215.5	1.798	13.45	18	23.9	39.44
1.2191	243.8	2.035	15.22	20	26.1	43.82
1.2411	273.0	2.279	17.05	22	28.2	48.22
1.2629	303.1	2.529	18.92	24	30.2	52.58
1.2848	334.0	2.788	20.85	26	32.1	56.96
1.3064	365.8	3.053	22.84	28	34.0	61.28
1.3279	398.4	3.325	24.87	30	35.8	65.58
1.3490	431.7	3.603	26.95	32	37.5	69.80
1.3696	465.7	3.886	29.07	34	39.1	73.92
1.3900	500.4	4.176	31.24	36	40.7	78.00
1.4101	535.8	4.472	33.45	38	42.2	82.02
1.4300	572.0	4.774	35.71	40	43.6	86.00
1.4494	608.7	5.080	38.00	42	45.0	89.88
1.4685	646.1	5.392	40.34	44	46.3	93.70
1.4873	684.2	5.710	42.71	46	47.5	97.46
1.5065	723.1	6.035	45.14	48	48.8	101.30
1.5253	762.7	6.365	47.61	50	49.9	105.06

SODIUM NITRATE

Density of Aqueous Sodium Nitrate Solutions at $\frac{20}{4}^{\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $NaNO_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $NaNO_3$	Degrees: Baumé	Twaddell
1.0049	10.05	0.08386	0.6274	1	0.7	0.98
1.0117	20.23	0.1689	1.263	2	1.7	2.34
1.0254	41.02	0.3423	2.561	4	3.6	5.08
1.0392	62.35	0.5204	3.893	6	5.5	7.84
1.0532	84.26	0.7032	5.260	8	7.3	10.64
1.0674	106.7	0.8908	6.664	10	9.2	13.48
1.0819	129.8	1.083	8.105	12	11.0	16.38
1.0967	153.5	1.281	9.585	14	12.8	19.34
1.1118	177.9	1.485	11.11	16	14.6	22.36
1.1272	202.9	1.693	12.67	18	16.4	25.44
1.1429	228.6	1.908	14.27	20	18.1	28.58
1.1589	255.0	2.128	15.92	22	19.9	31.78
1.1752	282.0	2.354	17.61	24	21.6	35.04
1.1917	309.8	2.586	19.34	26	23.3	38.34
1.2085	338.4	2.824	21.13	28	25.0	41.70
1.2256	367.7	3.068	22.95	30	26.7	45.12
1.2701	444.5	3.710	27.75	35	30.8	54.02
1.3175	527.0	4.398	32.90	40	34.9	63.50
1.3683	615.7	5.139	38.44	45	39.0	73.66

SODIUM NITRITE

Density of Aqueous Sodium Nitrite Solutions at $\frac{15}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $NaNO_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $NaNO_2$	Degrees: Baumé	Twaddell
1.0058	10.06	0.08394	0.6279	1	0.8	1.16
1.0125	20.25	0.1690	1.264	2	1.8	2.50
1.0260	41.04	0.3425	2.562	4	3.7	5.20
1.0397	62.38	0.5206	3.894	6	5.5	7.94
1.0535	84.28	0.7034	5.261	8	7.4	10.70
1.0675	106.8	0.8909	6.664	10	9.2	13.50
1.0816	129.8	1.083	8.103	12	10.9	16.32
1.0959	153.4	1.280	9.578	14	12.7	19.18
1.1103	177.6	1.483	11.09	16	14.4	22.06
1.1248	202.5	1.690	12.64	18	16.1	24.96
1.1394	227.9	1.902	14.23	20	17.7	27.88

SODIUM POTASSIUM TARTRATE—Rochelle Salt

Density of Aqueous Sodium Potassium Tartrate Solutions at $\frac{20}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $NaKC_4H_4O_6$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $NaKC_4H_4O_6$	Degrees: Baumé	Twaddell
1.0049	10.05	0.08386	0.6274	1	0.7	0.98
1.0116	20.23	0.1688	1.263	2	1.7	2.32
1.0252	41.01	0.3422	2.560	4	3.6	5.04
1.0390	62.34	0.5203	3.892	6	5.4	7.80
1.0530	84.24	0.7030	5.259	8	7.3	10.60
1.0673	106.7	0.8907	6.663	10	9.1	13.46
1.0818	129.8	1.083	8.104	12	11.0	16.36
1.0965	153.5	1.281	9.584	14	12.8	19.30
1.1114	177.8	1.484	11.10	16	14.5	22.28
1.1265	202.8	1.692	12.66	18	16.3	25.30
1.1419	228.4	1.906	14.26	20	18.0	28.38
1.1576	254.7	2.125	15.90	22	19.7	31.52
1.1735	281.6	2.350	17.58	24	21.4	34.70
1.1896	309.3	2.581	19.31	26	23.1	37.92
1.2059	337.7	2.818	21.08	28	24.8	41.18
1.2225	366.8	3.061	22.90	30	26.4	44.50
1.2394	396.6	3.310	24.76	32	28.0	47.88
1.2566	427.2	3.566	26.67	34	29.6	51.32
1.2742	458.7	3.828	28.64	36	31.2	54.84

Specific Gravity	Weight of $NaKC_4H_4O_6 \cdot 4H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $NaKC_4H_4O_6 + 4H_2O$	Degrees: Baumé	Twaddell
1.0049	13.50	0.1126	0.8425	1.343	0.7	0.98
1.0116	27.17	0.2267	1.696	2.686	1.7	2.32
1.0252	55.07	0.4596	3.438	5.372	3.6	5.04
1.0390	83.72	0.6987	5.227	8.058	5.4	7.80
1.0530	113.1	0.9441	7.063	10.74	7.3	10.60
1.0673	143.3	1.196	8.948	13.43	9.1	13.46
1.0818	174.3	1.455	10.88	16.12	11.0	16.36
1.0965	206.2	1.720	12.87	18.80	12.8	19.30

SODIUM POTASSIUM TARTRATE—Rochelle Salt (Continued)

Specific Gravity	Weight of $NaKC_4H_4O_6 \cdot 4H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $NaKC_4H_4O_6 + 4H_2O$	Degrees: Baumé	Twaddell
1.1114	238.8	1.993	14.91	21.49	14.5	22.28
1.1265	272.3	2.272	17.00	24.17	16.3	25.30
1.1419	306.7	2.560	19.15	26.86	18.0	28.38
1.1576	342.0	2.854	21.35	29.54	19.7	31.52
1.1735	378.2	3.156	23.61	32.23	21.4	34.70
1.1896	415.4	3.466	25.93	34.92	23.1	37.92
1.2059	453.4	3.784	28.31	37.60	24.8	41.18
1.2225	492.5	4.110	30.75	40.29	26.4	44.50
1.2394	532.6	4.445	33.25	42.97	28.0	47.88
1.2566	573.8	4.788	35.82	45.66	29.6	51.32
1.2742	616.0	5.141	38.46	48.35	31.2	54.84

SODIUM SILICATE

Density of Aqueous Sodium Silicate Solutions at $\frac{20^\circ}{4^\circ}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $Na_2O + 3.9SiO_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2O + 3.9SiO_2$	Degrees: Baumé	Twaddell
1.006	10.06	0.08395	0.6280	1	0.9	1.2
1.014	20.28	0.1692	1.266	2	2.0	2.8
1.030	41.20	0.3438	2.572	4	4.2	6.0
1.046	62.76	0.5238	3.918	6	6.4	9.2
1.063	85.04	0.7097	5.309	8	8.6	12.6
1.080	108.0	0.9013	6.742	10	10.7	16.0
1.098	131.8	1.100	8.226	12	12.9	19.6
1.116	156.2	1.304	9.754	14	14.6	23.2
1.134	181.4	1.514	11.33	16	17.1	26.8
1.153	207.5	1.732	12.96	18	19.2	30.6
1.172	234.4	1.956	14.63	20	21.3	34.4
1.191	262.0	2.187	16.36	22	23.3	38.2
1.211	290.6	2.426	18.14	24	25.3	42.2
1.232	320.3	2.673	20.00	26	27.3	46.4
1.253	350.8	2.928	21.90	28	29.3	50.6
1.275	382.5	3.192	23.88	30	31.3	55.0
1.298	415.4	3.466	25.93	32	33.3	59.6

Specific Gravity	Weight of $Na_2O + 3.36SiO_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2O + 3.36SiO_2$	Degrees: Baumé	Twaddell
1.006	10.06	0.08395	0.6280	1	0.9	1.2
1.014	20.28	0.1692	1.266	2	2.0	2.8
1.030	41.20	0.3438	2.572	4	4.2	6.0
1.047	62.82	0.5243	3.922	6	6.5	9.4
1.065	85.20	0.7110	5.319	8	8.9	13.0
1.083	108.3	0.9038	6.761	10	11.1	16.6
1.101	132.1	1.103	8.248	12	13.3	20.2
1.120	156.8	1.309	9.789	14	15.5	24.0
1.139	182.2	1.521	11.38	16	17.7	27.8
1.159	208.6	1.741	13.02	18	19.9	31.8

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SODIUM SILICATE (Continued)

Specific Gravity	Weight of $Na_2O+3.36SiO_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2O+3.36SiO_2$	Degrees: Baumé	Twaddell
1.179	235.8	1.968	14.72	20	22.0	35.8
1.200	264.0	2.203	16.48	22	24.2	40.0
1.222	293.3	2.448	18.31	24	26.3	44.4
1.244	323.4	2.699	20.19	26	28.4	48.8
1.267	354.8	2.961	22.15	28	30.6	53.4
1.290	387.0	3.230	24.16	30	32.6	58.0
1.314	420.5	3.509	26.25	32	34.7	62.8
1.339	455.3	3.799	28.42	34	36.7	67.8
1.365	491.4	4.101	30.68	36	38.8	73.0
1.393	529.3	4.418	33.05	38	40.9	78.6

Specific Gravity	Weight of $Na_2O+2.40SiO_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2O+2.40SiO_2$	Degrees: Baumé	Twaddell
1.007	10.07	0.08404	0.6287	1	1.0	1.4
1.016	20.32	0.1696	1.269	2	2.3	3.2
1.034	41.36	0.3452	2.582	4	4.8	6.8
1.052	63.12	0.5268	3.941	6	7.2	10.4
1.071	85.68	0.7150	5.349	8	9.6	14.2
1.090	109.0	0.9096	6.805	10	12.0	18.0
1.110	133.2	1.112	8.316	12	14.4	22.0
1.130	158.2	1.320	9.876	14	16.7	26.0
1.151	184.2	1.537	11.50	16	19.0	30.2

Specific Gravity	Weight of $Na_2O+2.44SiO_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2O+2.44SiO_2$	Degrees: Baumé	Twaddell
1.285	359.8	3.003	22.46	28	32.2	57.0
1.309	392.7	3.277	24.52	30	34.2	61.8
1.334	426.9	3.562	26.65	32	36.3	66.8
1.360	462.4	3.859	28.87	34	38.4	72.0
1.387	499.3	4.167	31.17	36	40.5	77.4
1.415	537.7	4.487	33.57	38	42.5	83.0
1.445	578.0	4.824	36.08	40	44.7	89.0

Specific Gravity	Weight of $Na_2O+2.06SiO_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2O+2.06SiO_2$	Degrees: Baumé	Twaddell
1.007	10.07	0.08404	0.6287	1	1.0	1.4
1.016	20.32	0.1696	1.269	2	2.3	3.2
1.035	41.40	0.3455	2.585	4	4.9	7.0
1.054	63.24	0.5278	3.948	6	7.4	10.8
1.073	85.84	0.7164	5.359	8	9.9	14.6
1.093	109.3	0.9122	6.824	10	12.3	18.6
1.113	133.6	1.115	8.338	12	14.7	22.6
1.134	158.8	1.325	9.911	14	17.1	26.8
1.156	185.0	1.544	11.55	16	19.6	31.2
1.178	212.0	1.770	13.24	18	21.9	35.6
1.200	240.0	2.003	14.98	20	24.2	40.0
1.223	269.1	2.245	16.80	22	26.4	44.6
1.247	299.3	2.498	18.68	24	28.7	49.4

SODIUM SILICATE (Continued)

Specific Gravity	Weight of $Na_2O+2.06SiO_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2O+2.06SiO_2$	Degrees: Baumé	Twaddell
1.271	330.5	2.758	20.63	26	30.9	54.2
1.296	362.9	3.028	22.65	28	33.1	59.2
1.321	396.3	3.307	24.74	30	35.2	64.2
1.346	430.7	3.595	26.89	32	37.3	69.2
1.371	466.1	3.890	29.10	34	39.2	74.2
1.397	502.9	4.197	31.40	36	41.2	79.4
1.423	540.7	4.513	33.76	38	43.1	84.6
1.450	580.0	4.840	36.21	40	45.0	90.0
1.520	684.0	5.708	42.70	45	49.6	104.0
1.594	797.0	6.651	49.76	50	54.0	118.8
1.673	920.2	7.679	57.44	55	58.3	134.6

Specific Gravity	Weight of $Na_2O+1.69SiO_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2O+1.69SiO_2$	Degrees: Baumé	Twaddell
1.007	10.07	0.08404	0.6287	1	1.0	1.4
1.017	20.34	0.1697	1.270	2	2.4	3.4
1.036	41.44	0.3458	2.587	4	5.0	7.2
1.056	63.36	0.5288	3.956	6	7.7	11.2
1.077	86.16	0.7190	5.379	8	10.4	15.4
1.098	109.8	0.9163	6.855	10	12.9	19.6
1.119	134.3	1.121	8.383	12	15.4	23.8
1.141	159.7	1.333	9.973	14	17.9	28.2
1.163	186.1	1.553	11.62	16	20.3	32.6
1.186	213.5	1.782	13.33	18	22.7	37.2
1.210	242.0	2.020	15.11	20	25.2	42.0
1.234	271.5	2.266	16.95	22	27.5	46.8
1.259	302.2	2.522	18.86	24	29.8	51.8
1.284	333.8	2.786	20.84	26	32.1	56.8
1.310	366.8	3.061	22.90	28	34.3	62.0
1.337	401.1	3.347	25.04	30	36.6	67.4
1.365	436.8	3.645	27.27	32	38.8	73.0
1.394	474.0	3.955	29.59	34	41.0	78.8
1.424	512.6	4.278	32.00	36	43.2	84.8
1.456	553.3	4.617	34.54	38	45.4	91.2

SODIUM SULFATE

Density of Aqueous Sodium Sulfate Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of Na_2SO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Na_2SO_4	Degrees: Baumé	Twaddell
1.0073	10.07	0.08406	0.6289	1	1.1	1.46
1.0164	20.33	0.1696	1.269	2	2.3	3.28
1.0348	41.39	0.3454	2.584	4	4.9	6.96
1.0535	63.21	0.5275	3.946	6	7.4	10.70
1.0724	85.79	0.7160	5.356	8	9.8	14.48
1.0915	109.2	0.9109	6.814	10	12.2	18.30
1.1109	133.3	1.113	8.322	12	14.5	22.18
1.1306	158.3	1.321	9.882	14	16.8	26.12
1.1506	184.1	1.536	11.49	16	19.0	30.12
1.1709	210.8	1.759	13.16	18	21.2	34.18
1.1915	238.3	1.989	14.88	20	23.3	38.30
1.2124	266.7	2.226	16.65	22	25.4	42.48
1.2336	296.1	2.471	18.48	24	27.5	46.72

(Continued on following page.)

SODIUM SULFATE (Continued)

Specific Gravity	Weight of $Na_2SO_4 \cdot 10H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2SO_4 + 10H_2O$	Degrees: Baumé	Twaddell
1.0073	22.85	0.1907	1.426	2.268	1.1	1.46
1.0164	46.11	0.3848	2.879	4.537	2.3	3.28
1.0348	93.89	0.7835	5.861	9.073	4.9	6.96
1.0535	143.4	1.197	8.951	13.61	7.4	10.70
1.0724	194.6	1.624	12.15	18.15	9.8	14.48
1.0915	247.6	2.066	15.46	22.68	12.2	18.30
1.1109	302.4	2.523	18.88	27.22	14.5	22.18
1.1306	359.0	2.996	22.41	31.76	16.8	26.12
1.1506	417.6	3.485	26.07	36.29	19.0	30.12
1.1709	478.1	3.990	29.85	40.83	21.2	34.18
1.1915	540.5	4.511	33.75	45.37	23.3	38.30
1.2124	605.0	5.049	37.77	49.90	25.4	42.48
1.2336	671.6	5.604	41.93	54.44	27.5	46.72

Density of Aqueous Sodium Sulfate Solutions at 15° C. Computed from the Values of Gerlach.

Specific Gravity	Weight of $Na_2SO_4 \cdot 10H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2SO_4 + 10H_2O$	Degrees: Baumé	Twaddell
1.004	10.04	0.08379	0.6268	1	0.6	0.8
1.008	20.16	0.1682	1.259	2	1.2	1.6
1.013	30.39	0.2536	1.897	3	1.9	2.6
1.016	40.64	0.3392	2.537	4	2.3	3.2
1.020	51.00	0.4256	3.184	5	2.8	4.0
1.024	61.44	0.5127	3.836	6	3.4	4.8
1.028	71.96	0.6005	4.492	7	4.0	5.6
1.032	82.56	0.6890	5.154	8	4.5	6.4
1.036	93.24	0.7781	5.821	9	5.0	7.2
1.040	104.0	0.8679	6.493	10	5.6	8.0
1.044	114.8	0.9584	7.169	11	6.1	8.8
1.047	125.6	1.049	7.844	12	6.5	9.4
1.052	136.8	1.141	8.538	13	7.2	10.4
1.056	147.8	1.234	9.230	14	7.7	11.2
1.060	159.0	1.327	9.926	15	8.2	12.0
1.064	170.2	1.421	10.63	16	8.7	12.8
1.069	181.7	1.517	11.35	17	9.4	13.8
1.073	193.1	1.612	12.06	18	9.9	14.6
1.077	204.6	1.708	12.78	19	10.4	15.4
1.082	216.4	1.806	13.51	20	11.0	16.4
1.086	228.1	1.903	14.24	21	11.5	17.2
1.090	239.8	2.001	14.97	22	12.0	18.0
1.094	251.6	2.100	15.71	23	12.5	18.8
1.098	263.5	2.199	16.45	24	12.9	19.6
1.103	275.8	2.301	17.22	25	13.5	20.6
1.107	287.8	2.402	17.97	26	14.0	21.4
1.111	300.0	2.503	18.73	27	14.5	22.2
1.116	312.5	2.608	19.51	28	15.1	23.2
1.120	324.8	2.711	20.28	29	15.5	24.0
1.125	337.5	2.817	21.07	30	16.1	25.0

SODIUM SULFATE (Continued)

Specific Gravity	Weight of Na_2SO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Na_2SO_4	Degrees: Baumé	Twaddell
1.004	4.426	0.03694	0.2763	0.4409	0.6	0.8
1.008	8.888	0.07417	0.5549	0.8817	1.2	1.6
1.013	13.40	0.1118	0.8364	1.323	1.9	2.6
1.016	17.92	0.1495	1.119	1.763	2.3	3.2
1.020	22.48	0.1876	1.404	2.204	2.8	4.0
1.024	27.09	0.2261	1.691	2.645	3.4	4.8
1.028	31.73	0.2648	1.981	3.086	4.0	5.6
1.032	36.40	0.3038	2.272	3.527	4.5	6.4
1.036	41.11	0.3431	2.566	3.968	5.0	7.2
1.040	45.85	0.3826	2.862	4.409	5.6	8.0
1.044	50.63	0.4225	3.161	4.850	6.1	8.8
1.047	55.39	0.4623	3.458	5.290	6.5	9.4
1.052	60.29	0.5032	3.764	5.731	7.2	10.4
1.056	65.18	0.5439	4.069	6.172	7.7	11.2
1.060	70.10	0.5850	4.376	6.613	8.2	12.0
1.064	75.05	0.6264	4.686	7.054	8.7	12.8
1.069	80.12	0.6686	5.002	7.495	9.4	13.8
1.073	85.15	0.7106	5.316	7.936	9.9	14.6
1.077	90.22	0.7529	5.632	8.377	10.4	15.4
1.082	95.40	0.7962	5.956	8.817	11.0	16.4
1.086	100.5	0.8391	6.277	9.258	11.5	17.2
1.090	105.7	0.8823	6.600	9.699	12.0	18.0
1.094	110.9	0.9258	6.925	10.14	12.5	18.8
1.098	116.2	0.9696	7.253	10.58	12.9	19.6
1.103	121.6	1.015	7.590	11.02	13.5	20.6
1.107	126.9	1.059	7.922	11.46	14.0	21.4
1.111	132.2	1.104	8.256	11.90	14.5	22.2
1.116	137.8	1.150	8.601	12.34	15.1	23.2
1.120	143.2	1.195	8.940	12.79	15.5	24.0
1.125	148.8	1.242	9.289	13.23	16.1	25.0

SODIUM SULFIDE

Density of Aqueous Sodium Sulfide Solutions at $\frac{18°}{4°}$ C. Computed from Vlaues Given in the International Critical Tables.

Specific Gravity	Weight of Na_2S in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Na_2S	Degrees: Baumé	Twaddell
1.0098	10.10	0.08427	0.6304	1	1.4	1.96
1.0211	20.42	0.1704	1.275	2	3.0	4.22
1.0440	41.76	0.3485	2.607	4	6.1	8.80
1.0672	64.03	0.5344	3.998	6	9.1	13.44
1.0907	87.26	0.7282	5.447	8	12.1	18.14
1.1146	111.5	0.9302	6.958	10	14.9	22.92
1.1388	136.7	1.140	8.531	12	17.7	27.76
1.1634	162.9	1.359	10.17	14	20.4	32.68
1.1885	190.2	1.587	11.87	16	23.0	37.70
1.2140	218.5	1.824	13.64	18	25.6	42.80

SODIUM ACID SULFITE

Density of Aqueous Sodium Acid Sulfite Solutions at 15° C.

Specific Gravity	Weight of $NaHSO_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $NaHSO_3$	Degrees: Baumé	Twaddell
1.008	16.13	0.1346	1.007	1.6	1.2	1.6
1.022	21.46	0.1791	1.340	2.1	3.1	4.4
1.038	37.37	0.3119	2.333	3.6	5.3	7.6
1.052	53.65	0.4477	3.349	5.1	7.2	10.4
1.068	69.42	0.5793	4.334	6.5	9.2	13.6
1.084	86.72	0.7237	5.414	8.0	11.2	16.8
1.100	104.5	0.8721	6.524	9.5	13.2	20.0
1.116	125.0	1.043	7.803	11.2	15.1	23.2
1.134	145.2	1.211	9.062	12.8	17.1	26.8
1.152	168.2	1.404	10.50	14.6	19.1	30.4
1.171	193.2	1.612	12.06	16.5	21.2	34.2
1.190	220.2	1.837	13.74	18.5	23.2	38.0
1.210	252.9	2.110	15.79	20.9	25.2	42.0
1.231	289.3	2.414	18.06	23.5	27.2	46.2
1.252	324.3	2.706	20.24	25.9	29.2	50.4
1.275	368.5	3.075	23.00	28.9	31.3	55.0
1.298	411.5	3.434	25.69	31.7	33.3	59.6
1.321	458.4	3.825	28.62	34.7	35.2	64.2
1.345	511.1	4.265	31.91	38.0	37.2	69.0

Specific Gravity	Weight of SO_2 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent SO_2	Degrees: Baumé	Twaddell
1.008	9.928	0.08286	0.6198	0.9850	1.2	1.6
1.022	13.21	0.1103	0.8248	1.293	3.1	4.4
1.038	22.44	0.1873	1.401	2.162	5.3	7.6
1.052	33.03	0.2756	2.062	3.140	7.2	10.4
1.068	42.74	0.3566	2.668	4.001	9.2	13.6
1.084	53.39	0.4455	3.333	4.925	11.2	16.8
1.100	64.33	0.5369	4.016	5.848	13.2	20.0
1.116	76.95	0.6421	4.804	6.895	15.1	23.2
1.134	89.36	0.7457	5.579	7.880	17.1	26.8
1.152	103.5	0.8641	6.464	8.988	19.1	30.4
1.171	118.9	0.9926	7.426	10.16	21.2	34.2
1.190	135.5	1.131	8.461	11.39	23.2	38.0
1.210	155.7	1.299	9.719	12.87	25.2	42.0
1.231	178.1	1.486	11.12	14.47	27.2	46.2
1.252	199.6	1.666	12.46	15.94	29.2	50.4
1.275	226.8	1.893	14.16	17.79	31.3	55.0
1.298	253.3	2.114	15.81	19.51	33.3	59.6
1.321	282.2	2.355	17.62	21.36	35.2	64.2
1.345	314.6	2.626	19.64	23.39	37.2	69.0

SODIUM SULFITE

Density of Aqueous Sodium Sulfite Solutions at $\frac{18°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of Na_2SO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Na_2SO_3	Degrees: Baumé	Twaddell
1.0078	10.08	0.08410	0.6292	1	1.1	1.56
1.0172	20.34	0.1698	1.270	2	2.5	3.44
1.0363	41.45	0.3459	2.588	4	5.1	7.26
1.0556	63.34	0.5286	3.954	6	7.6	11.12

SODIUM SULFITE (Continued)

Specific Gravity	Weight of Na_2SO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent Na_2SO_3	Degrees: Baumé	Twaddell
1.0751	86.01	0.7178	5.369	8	10.1	15.02
1.0948	109.5	0.9137	6.835	10	12.6	18.96
1.1146	133.8	1.116	8.350	12	14.9	22.92
1.1346	158.8	1.326	9.917	14	17.2	26.92
1.1549	184.8	1.542	11.54	16	19.4	30.98
1.1755	211.6	1.766	13.21	18	21.7	35.10

SODIUM TARTRATE

Density of Aqueous Sodium Tartrate Solutions at $\frac{20}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $Na_2C_4H_4O_6$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2C_4H_4O_6$	Degrees: Baumé	Twaddell
1.0052	10.05	0.08389	0.6275	1	0.8	1.04
1.0123	20.25	0.1690	1.264	2	1.8	2.46
1.0266	41.06	0.3427	2.564	4	3.8	5.32
1.0410	62.46	0.5213	3.899	6	5.7	8.20
1.0555	84.44	0.7047	5.272	8	7.6	11.10
1.0702	107.0	0.8931	6.681	10	9.5	14.04
1.0851	130.2	1.087	8.129	12	11.4	17.02
1.1002	154.0	1.285	9.616	14	13.2	20.04
1.1156	178.5	1.490	11.14	16	15.0	23.12
1.1313	203.6	1.699	12.71	18	16.8	26.26
1.1471	229.4	1.915	14.32	20	18.6	29.42
1.1633	255.9	2.136	15.98	22	20.4	32.66
1.1797	283.1	2.363	17.68	24	22.1	35.94
1.1963	311.0	2.596	19.42	26	23.8	39.26
1.2132	339.7	2.835	21.21	28	25.5	42.64

Specific Gravity	Weight of $Na_2C_4H_4O_6 \cdot 2H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2C_4H_4O_6 + 2H_2O$	Degrees: Baumé	Twaddell
1.0052	11.92	0.09947	0.7441	1.186	0.8	1.04
1.0123	24.01	0.2003	1.499	2.371	1.8	2.46
1.0266	48.69	0.4063	3.040	4.743	3.8	5.32
1.0410	74.06	0.6180	4.623	7.114	5.7	8.20
1.0555	100.1	0.8355	6.250	9.486	7.6	11.10
1.0702	126.9	1.059	7.922	11.86	9.5	14.04
1.0851	154.4	1.288	9.639	14.23	11.4	17.02
1.1002	182.6	1.524	11.40	16.60	13.2	20.04
1.1156	211.6	1.766	13.21	18.97	15.0	23.12
1.1313	241.4	2.015	15.07	21.34	16.8	26.26
1.1471	272.0	2.270	16.98	23.71	18.6	29.42
1.1633	303.4	2.532	18.94	26.09	20.4	32.66
1.1797	335.7	2.802	20.96	28.46	22.1	35.94
1.1963	368.8	3.078	23.02	30.83	23.8	39.26
1.2132	402.8	3.361	25.15	33.20	25.5	42.64

SODIUM THIOSULFATE

Density of Aqueous Sodium Thiosulfate Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $Na_2S_2O_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2S_2O_3$	Degrees: Baumé	Twaddell
1.0065	10.07	0.08400	0.6284	1	0.9	1.30
1.0148	20.30	0.1694	1.267	2	2.1	2.96
1.0315	41.26	0.3443	2.576	4	4.4	6.30
1.0483	62.90	0.5249	3.927	6	6.7	9.66
1.0654	85.23	0.7113	5.321	8	8.9	13.08
1.0827	108.3	0.9036	6.759	10	11.1	16.54
1.1003	132.0	1.102	8.243	12	13.2	20.06
1.1182	156.5	1.306	9.773	14	15.3	23.64
1.1365	181.8	1.518	11.35	16	17.4	27.30
1.1551	207.9	1.735	12.98	18	19.5	31.02
1.1740	234.8	1.959	14.66	20	21.5	34.80
1.1932	262.5	2.191	16.39	22	23.5	38.64
1.2128	291.1	2.429	18.17	24	25.4	42.56
1.2328	320.5	2.675	20.01	26	27.4	46.56
1.2532	350.9	2.928	21.91	28	29.3	50.64
1.2739	382.2	3.189	23.86	30	31.2	54.78
1.3273	464.6	3.877	29.00	35	35.8	65.46
1.3827	553.1	4.616	34.53	40	40.1	76.54

Specific Gravity	Weight of $Na_2S_2O_3 \cdot 5H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2S_2O_3 + 5H_2O$	Degrees: Baumé	Twaddell
1.0065	15.80	0.1318	0.9863	1.570	0.9	1.30
1.0148	31.86	0.2659	1.989	3.139	2.1	2.96
1.0315	64.77	0.5405	4.043	6 279	4.4	6.30
1.0483	98.73	0.8239	6.164	9.418	6.7	9.66
1.0654	133.8	1.117	8.352	12.56	8.9	13.08
1.0827	170.0	1.418	10.61	15.70	11.1	16.54
1.1003	207.3	1.730	12.94	18.84	13.2	20.06
1.1182	245.7	2.051	15.34	21.98	15.3	23.64
1.1365	285.4	2.382	17.82	25.12	17.4	27.30
1.1551	326.4	2.724	20.38	28.25	19.5	31.02
1.1740	368.6	3.076	23.01	31.39	21.5	34.80
1.1932	412.1	3.439	25.72	34.53	23.5	38.64
1.2128	456.9	3.813	28.52	37.67	25.4	42.56
1.2328	503.1	4.199	31.41	40.81	27.4	46.56
1.2532	550.8	4.597	34.39	43.95	29.3	50.64
1.2739	599.9	5.006	37.45	47.09	31.2	54.78
1.3273	729.2	6.086	45.52	54.94	35.8	65.46
1.3827	868.2	7.245	54.20	62.79	40.1	76.54

Density of Aqueous Sodium Thiosulfate Solutions at 19° C. Computed from the Values of Schiff.

Specific Gravity	Weight of $Na_2S_2O_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2S_2O_3$	Degrees: Baumé	Twaddell
1.0052	6.404	0.05344	0.3998	0.6371	0.8	1.04
1.0105	12.87	0.1074	0.8038	1.274	1.5	2.10
1.0158	19.41	0.1620	1.212	1.911	2.3	3.16
1.0211	26.02	0.2171	1.624	2.548	3.0	4.22
1.0264	32.69	0.2728	2.041	3.185	3.7	5.28

SODIUM THIOSULFATE (Continued)

Specific Gravity	Weight of $Na_2S_2O_3$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2S_2O_3$	Degrees: Baumé	Twaddell
1.0317	39.44	0.3291	2.462	3.822	4.5	6.34
1.0370	46.24	0.3859	2.887	4.459	5.2	7.40
1.0423	53.12	0.4433	3.316	5.096	5.9	8.46
1.0476	60.06	0.5013	3.750	5.734	6.6	9.52
1.0529	67.08	0.5598	4.188	6.371	7.3	10.58
1.0584	74.17	0.6190	4.630	7.008	8.0	11.68
1.0639	81.33	0.6787	5.078	7.645	8.7	12.78
1.0695	88.57	0.7392	5.530	8.282	9.4	13.90
1.0751	95.89	0.8002	5.986	8.919	10.1	15.02
1.0807	103.3	0.8618	6.447	9.556	10.8	16.14
1.0863	110.7	0.9241	6.913	10.19	11.5	17.26
1.0919	118.3	0.9869	7.383	10.83	12.2	18.38
1.0975	125.9	1.050	7.857	11.47	12.9	19.50
1.1031	133.5	1.114	8.336	12.10	13.6	20.62
1.1087	141.3	1.179	8.819	12.74	14.2	21.74
1.1145	149.1	1.244	9.308	13.38	14.9	22.90
1.1204	157.0	1.310	9.803	14.02	15.6	24.08
1.1263	165.0	1.377	10.30	14.65	16.3	25.26
1.1322	173.1	1.445	10.81	15.29	16.9	26.44
1.1381	181.3	1.513	11.32	15.93	17.6	27.62
1.1440	189.5	1.581	11.83	16.56	18.3	28.80
1.1499	197.8	1.651	12.35	17.20	18.9	29.98
1.1558	206.2	1.721	12.87	17.84	19.5	31.16
1.1617	214.6	1.791	13.40	18.47	20.2	32.34
1.1676	223.1	1.862	13.93	19.11	20.8	33.52
1.1738	231.8	1.935	14.47	19.75	21.5	34.76
1.1800	240.6	2.008	15.02	20.39	22.1	36.00
1.1862	249.4	2.081	15.57	21.02	22.8	37.24
1.1924	258.3	2.155	16.12	21.66	23.4	38.48
1.1986	267.3	2.230	16.68	22.30	24.0	39.72
1.2048	276.3	2.306	17.25	22.93	24.7	40.96
1.2110	285.4	2.382	17.82	23.57	25.3	42.20
1.2172	294.7	2.459	18.40	24.21	25.9	43.44
1.2234	304.0	2.537	18.98	24.85	26.5	44.68
1.2297	313.4	2.615	19.56	25.48	27.1	45.94
1.2362	322.9	2.695	20.16	26.12	27.7	47.24
1.2427	332.5	2.775	20.76	26.76	28.3	48.54
1.2492	342.2	2.856	21.36	27.39	28.9	49.84
1.2558	352.0	2.938	21.98	28.03	29.5	51.16
1.2624	361.9	3.020	22.59	28.67	30.1	52.48
1.2690	371.9	3.103	23.22	29.30	30.7	53.80
1.2756	381.9	3.187	23.84	29.94	31.3	55.12
1.2822	392.1	3.272	24.48	30.58	31.9	56.44
1.2888	402.3	3.357	25.12	31.22	32.5	57.76
1.2954	412.6	3.444	25.76	31.85	33.1	59.08

Density of Aqueous Sodium Thiosulfate Solutions at 19° C. Computed from the Values of Schiff.

Specific Gravity	Weight of $Na_2S_2O_3 \cdot 5H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2S_2O_3 + 5H_2O$	Degrees: Baumé	Twaddell
1.0052	10.05	0.08389	0.6275	1	0.8	1.04
1.0105	20.21	0.1687	1.262	2	1.5	2.10
1.0158	30.47	0.2543	1.902	3	2.3	3.16
1.0211	40.84	0.3409	2.550	4	3.0	4.22

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SODIUM THIOSULFATE (Continued)

Specific Gravity	Weight of $Na_2S_2O_3 \cdot 5H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Na_2S_2O_3 + 5H_2O$	Degrees: Baume	Twaddell
1.0264	51.32	0.4283	3.204	5	3.7	5.28
1.0317	61.90	0.5166	3.865	6	4.5	6.34
1.0370	72.59	0.6058	4.532	7	5.2	7.40
1.0423	83.38	0.6959	5.206	8	5.9	8.46
1.0476	94.28	0.7868	5.886	9	6.6	9.52
1.0529	105.3	0.8787	6.573	10	7.3	10.58
1.0584	116.4	0.9716	7.268	11	8.0	11.68
1.0639	127.7	1.065	7.970	12	8.7	12.78
1.0695	139.0	1.160	8.680	13	9.4	13.90
1.0751	150.5	1.256	9.397	14	10.1	15.02
1.0807	162.1	1.353	10.12	15	10.8	16.14
1.0863	173.8	1.450	10.85	16	11.5	17.26
1.0919	185.6	1.549	11.59	17	12.2	18.38
1.0975	197.6	1.649	12.33	18	12.9	19.50
1.1031	209.6	1.749	13.08	19	13.6	20.62
1.1087	221.7	1.851	13.84	20	14.2	21.74
1.1145	234.0	1.953	14.61	21	14.9	22.90
1.1204	246.5	2.057	15.39	22	15.6	24.08
1.1263	259.0	2.162	16.17	23	16.3	25.26
1.1322	271.7	2.268	16.96	24	16.9	26.44
1.1381	284.5	2.374	17.76	25	17.6	27.62
1.1440	297.4	2.482	18.57	26	18.3	28.80
1.1499	310.5	2.591	19.38	27	18.9	29.98
1.1558	323.6	2.701	20.20	28	19.5	31.16
1.1617	336.9	2.812	21.03	29	20.2	32.34
1.1676	350.3	2.923	21.87	30	20.8	33.52
1.1738	363.9	3.037	22.72	31	21.5	34.76
1.1800	377.6	3.151	23.57	32	22.1	36.00
1.1862	391.4	3.267	24.44	33	22.8	37.24
1.1924	405.4	3.383	25.31	34	23.4	38.48
1.1986	419.5	3.501	26.19	35	24.0	39.72
1.2048	433.7	3.620	27.08	36	24.7	40.96
1.2110	448.1	3.739	27.97	37	25.3	42.20
1.2172	462.5	3.860	28.88	38	25.9	43.44
1.2234	477.1	3.982	29.79	39	26.5	44.68
1.2297	491.9	4.105	30.71	40	27.1	45.94
1.2362	506.8	4.230	31.64	41	27.7	47.24
1.2427	521.9	4.356	32.58	42	28.3	48.54
1.2492	537.2	4.483	33.53	43	28.9	49.84
1.2558	552.6	4.611	34.50	44	29.5	51.16
1.2624	568.1	4.741	35.47	45	30.1	52.48
1.2690	583.7	4.872	36.44	46	30.7	53.80
1.2756	599.5	5.003	37.43	47	31.3	55.12
1.2822	615.5	5.136	38.42	48	31.9	56.44
1.2888	631.5	5.270	39.43	49	32.5	57.76
1.2954	647.7	5.405	40.44	50	33.1	59.08

STANNIC CHLORIDE

Density of Aqueous Stannic Chloride Solutions at $\frac{15}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $SnCl_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $SnCl_4$	Degrees: Baumé	Twaddell
1.007	10.07	0.08404	0.6287	1	1.0	1.4
1.015	20.30	0.1694	1.267	2	2.1	3.0
1.031	41.24	0.3442	2.575	4	4.4	6.2
1.047	62.82	0.5243	3.922	6	6.5	9.4
1.064	85.12	0.7104	5.314	8	8.7	12.8
1.081	108.1	0.9021	6.749	10	10.9	16.2
1.099	131.9	1.101	8.233	12	13.1	19.8
1.117	156.4	1.305	9.763	14	15.2	23.4
1.135	181.6	1.516	11.34	16	17.2	27.0
1.154	207.7	1.734	12.97	18	19.4	30.8
1.173	234.6	1.958	14.65	20	21.4	34.6
1.192	262.2	2.188	16.37	22	23.4	38.4
1.212	290.9	2.428	18.16	24	25.4	42.4
1.233	320.6	2.675	20.01	26	27.4	46.6
1.255	351.4	2.933	21.94	28	29.5	51.0
1.278	383.4	3.200	23.94	30	31.5	55.6
1.337	468.0	3.905	29.21	35	36.6	67.4
1.403	561.2	4.683	35.04	40	41.7	80.6
1.475	663.8	5.539	41.44	45	46.7	95.0
1.555	777.5	6.489	48.54	50	51.8	111.0
1.644	904.2	7.546	56.45	55	56.8	128.8
1.742	1045	8.723	65.25	60	61.8	148.4
1.851	1203	10.04	75.11	65	66.7	170.2
1.971	1380	11.51	86.13	70	71.4	194.2

Specific Gravity	Weight of $SnCl_4 \cdot 5H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $SnCl_4 + 5H_2O$	Degrees: Baumé	Twaddell
1.007	13.55	0.1131	0.8460	1.346	1.0	1.4
1.015	27.32	0.2280	1.706	2.692	2.1	3.0
1.031	55.50	0.4632	3.465	5.383	4.4	6.2
1.047	84.54	0.7055	5.278	8.075	6.5	9.4
1.064	114.6	0.9560	7.151	10.77	8.7	12.8
1.081	145.5	1.214	9.082	13.46	10.9	16.2
1.099	177.5	1.481	11.08	16.15	13.1	19.8
1.117	210.4	1.756	13.14	18.84	15.2	23.4
1.135	244.4	2.040	15.26	21.53	17.2	27.0
1.154	279.5	2.333	17.45	24.22	19.4	30.8
1.173	315.7	2.635	19.71	26.92	21.4	34.6
1.192	352.9	2.945	22.03	29.61	23.4	38.4
1.212	391.5	3.267	24.44	32.30	25.4	42.4
1.233	431.4	3.600	26.93	34.99	27.4	46.6
1.255	472.9	3.947	29.52	37.68	29.5	51.0
1.278	516.0	4.306	32.21	40.37	31.5	55.6
1.337	629.7	5.255	39.31	47.10	36.6	67.4
1.403	755.2	6.303	47.15	53.83	41.7	80.6
1.475	893.2	7.454	55.77	60.56	46.7	95.0
1.555	1046	8.732	65.32	67.29	51.8	111.0
1.644	1217	10.15	75.97	74.02	56.8	128.8
1.742	1407	11.74	87.81	80.75	61.8	148.4
1.851	1619	13.51	101.1	87.47	66.7	170.2
1.971	1857	15.50	115.9	94.20	71.4	194.2

STANNOUS CHLORIDE

Density of Aqueous Stannous Chloride Solutions at $\frac{15}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $SnCl_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $SnCl_2$	Degrees: Baumé	Twaddell
1.0068	10.07	0.08402	0.6285	1	1.0	1.36
1.0146	20.29	0.1693	1.267	2	2.1	2.92
1.0306	41.22	0.3440	2.574	4	4.3	6.12
1.0470	62.82	0.5243	3.922	6	6.5	9.40
1.0638	85.10	0.7102	5.313	8	8.7	12.76
1.0810	108.1	0.9021	6.749	10	10.9	16.20
1.0986	131.8	1.100	8.230	12	13.0	19.72
1.1167	156.3	1.305	9.760	14	15.2	23.34
1.1353	181.6	1.516	11.34	16	17.3	27.06
1.1545	207.8	1.734	12.97	18	19.4	30.90
1.1743	234.9	1.960	14.66	20	21.5	34.86
1.1948	262.9	2.194	16.41	22	23.6	38.96
1.2159	291.8	2.435	18.22	24	25.8	43.18
1.2377	321.8	2.686	20.09	26	27.8	47.54
1.2603	352.9	2.945	22.03	28	29.9	52.06
1.2837	385.1	3.214	24.04	30	32.0	56.74
1.3461	471.1	3.932	29.41	35	37.3	69.22
1.4145	565.8	4.722	35.32	40	42.5	82.90
1.4897	670.4	5.594	41.85	45	47.7	97.94
1.5729	786.5	6.563	49.10	50	52.8	114.58
1.6656	916.1	7.645	57.19	55	57.9	133.12
1.7695	1062	8.860	66.28	60	63.1	153.90
1.8865	1226	10.23	76.55	65	68.1	177.30

Specific Gravity	Weight of $SnCl_2 \cdot 2H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $SnCl_4 + 2H_2O$	Degrees: Baumé	Twaddell
1.0068	11.98	0.09999	0.7480	1.190	1.0	1.36
1.0146	24.15	0.2015	1.508	2.380	2.1	2.92
1.0306	49.06	0.4094	3.063	4.760	4.3	6.12
1.0470	74.76	0.6239	4.667	7.140	6.5	9.40
1.0638	101.3	0.8452	6.323	9.521	8.7	12.76
1.0810	128.6	1.074	8.031	11.90	10.9	16.20
1.0986	156.9	1.309	9.795	14.28	13.0	19.72
1.1167	186.1	1.553	11.62	16.66	15.2	23.34
1.1353	216.2	1.804	13.50	19.04	17.3	27.06
1.1545	247.3	2.064	15.44	21.42	19.4	30.90
1.1743	279.5	2.333	17.45	23.80	21.5	34.86
1.1948	312.8	2.611	19.53	26.18	23.6	38.96
1.2159	347.3	2.898	21.68	28.56	25.8	43.18
1.2377	383.0	3.196	23.91	30.94	27.8	47.54
1.2603	420.0	3.505	26.22	33.32	29.9	52.06
1.2837	458.3	3.825	28.61	35.70	32.0	56.74
1.3461	560.7	4.679	35.00	41.65	37.3	69.22
1.4145	673.3	5.619	42.04	47.60	42.5	82.90
1.4897	797.8	6.658	49.81	53.55	47.7	97.94
1.5729	935.9	7.811	58.43	59.50	52.8	114.58
1.6656	1090	9.098	68.06	65.45	57.9	133.12
1.7695	1263	10.54	78.88	71.40	63.1	153.90
1.8865	1459	12.18	91.10	77.35	68.1	177.30

SUCROSE

Density of Aqueous Sucrose Solutions at $\frac{20°}{4°}$ C. Computed from the Values of Plato.

Specific Gravity	Weight of $C_{12}H_{22}O_{11}$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $C_{12}H_{22}O_{11}$	Degrees: Baumé	Twaddell
0.9982	.....	.....	.....	0	.....	.....
1.0021	10.02	0.08363	0.6256	1	0.3	0.42
1.0060	20.12	0.1679	1.256	2	0.9	1.20
1.0099	30.30	0.2528	1.891	3	1.4	1.98
1.0139	40.56	0.3385	2.532	4	2.0	2.78
1.0179	50.90	0.4247	3.177	5	2.5	3.58
1.0219	61.31	0.5117	3.828	6	3.1	4.38
1.0259	71.81	0.5993	4.483	7	3.7	5.18
1.0299	82.39	0.6876	5.144	8	4.2	5.98
1.0340	93.06	0.7766	5.810	9	4.8	6.80
1.0381	103.8	0.8663	6.481	10	5.3	7.62
1.0423	114.7	0.9568	7.158	11	5.9	8.46
1.0465	125.6	1.048	7.840	12	6.4	9.30
1.0507	136.6	1.140	8.527	13	7.0	10.14
1.0549	147.7	1.232	9.220	14	7.6	10.98
1.0592	158.9	1.326	9.919	15	8.1	11.84
1.0635	170.2	1.420	10.62	16	8.7	12.70
1.0678	181.5	1.515	11.33	17	9.2	13.56
1.0721	193.0	1.610	12.05	18	9.7	14.42
1.0765	204.5	1.707	12.77	19	10.3	15.30
1.0810	216.2	1.804	13.50	20	10.9	16.20
1.0854	227.9	1.902	14.23	21	11.4	17.08
1.0899	239.8	2.001	14.97	22	12.0	17.98
1.0944	251.7	2.101	15.71	23	12.5	18.88
1.0990	263.8	2.201	16.47	24	13.1	19.80
1.1036	275.9	2.302	17.22	25	13.6	20.72
1.1082	288.1	2.405	17.99	26	14.2	21.64
1.1128	300.5	2.507	18.76	27	14.7	22.56
1.1175	312.9	2.611	19.53	28	15.2	23.50
1.1222	325.4	2.716	20.32	29	15.8	24.44
1.1270	338.1	2.822	21.11	30	16.3	25.40
1.1318	350.9	2.928	21.90	31	16.9	26.36
1.1366	363.7	3.035	22.71	32	17.4	27.32
1.1415	376.7	3.144	23.52	33	18.0	28.30
1.1463	389.7	3.253	24.33	34	18.5	29.26
1.1513	403.0	3.363	25.16	35	19.1	30.26
1.1562	416.2	3.474	25.99	36	19.6	31.24
1.1612	429.6	3.586	26.82	37	20.1	32.24
1.1663	443.2	3.699	27.67	38	20.7	33.26
1.1713	456.8	3.812	28.52	39	21.2	34.26
1.1764	470.6	3.927	29.38	40	21.7	35.28
1.1816	484.5	4.043	30.24	41	22.3	36.32
1.1868	498.5	4.160	31.12	42	22.8	37.36
1.1920	512.6	4.278	32.00	43	23.4	38.40
1.1972	526.8	4.396	32.89	44	23.9	39.44
1.2025	541.1	4.516	33.78	45	24.4	40.50
1.2079	555.6	4.637	34.69	46	25.0	41.58
1.2132	570.2	4.759	35.60	47	25.5	42.64
1.2186	584.9	4.881	36.52	48	26.0	43.72
1.2241	599.8	5.006	37.45	49	26.5	44.82
1.2296	614.8	5.131	38.38	50	27.1	45.92
1.2351	629.9	5.257	39.32	51	27.6	47.02
1.2406	645.1	5.384	40.27	52	28.1	48.12
1.2462	660.5	5.512	41.23	53	28.6	49.24
1.2519	676.0	5.642	42.20	54	29.2	50.38
1.2575	691.6	5.772	43.18	55	29.7	51.50

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SUCROSE (Continued)

Specific Gravity	Weight of $C_{12}H_{22}O_{11}$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $C_{12}H_{22}O_{11}$	Degrees: Baumé	Twaddell
1.2632	707.4	5.903	44.16	56	30.2	52.64
1.2690	723.3	6.036	45.16	57	30.7	53.80
1.2748	739.4	6.170	46.16	58	31.3	54.96
1.2806	755.6	6.305	47.17	59	31.8	56.12
1.2865	771.9	6.442	48.19	60	32.3	57.30
1.2924	788.4	6.579	49.22	61	32.8	58.48
1.2983	804.9	6.718	50.25	62	33.3	59.66
1.3043	821.7	6.857	51.30	63	33.8	60.86
1.3103	838.6	6.998	52.35	64	34.3	62.06
1.3163	855.6	7.140	53.41	65	34.8	63.26
1.3224	872.8	7.284	54.49	66	35.3	64.48
1.3286	890.2	7.429	55.57	67	35.9	65.72
1.3347	907.6	7.574	56.66	68	36.4	66.94
1.3409	925.2	7.721	57.76	69	36.9	68.18
1.3472	943.0	7.870	58.87	70	37.4	69.44
1.3535	961.0	8.020	59.99	71	37.9	70.70
1.3598	979.1	8.171	61.12	72	38.4	71.96
1.3661	997.3	8.322	62.26	73	38.9	73.22
1.3725	1016	8.476	63.41	74	39.4	74.50
1.3790	1034	8.631	64.57	75	39.9	75.80
1.3854	1053	8.787	65.73	76	40.3	77.08
1.3920	1072	8.945	66.91	77	40.8	78.40
1.3985	1091	9.103	68.10	78	41.3	79.70
1.4051	1110	9.264	69.30	79	41.8	81.02
1.4117	1129	9.425	70.51	80	42.3	82.34
1.4184	1149	9.588	71.73	81	42.8	83.68
1.4251	1169	9.752	72.95	82	43.2	85.02
1.4318	1188	9.918	74.19	83	43.7	86.36
1.4386	1208	10.08	75.44	84	44.2	87.72
1.4454	1229	10.25	76.70	85	44.7	89.08
1.4522	1249	10.42	77.97	86	45.1	90.44
1.4591	1269	10.59	79.25	87	45.6	91.82
1.4660	1290	10.77	80.54	88	46.1	93.20
1.4730	1311	10.94	81.84	89	46.6	94.60
1.4800	1332	11.12	83.16	90	47.0	96.00
1.4870	1353	11.29	84.48	91	47.5	97.40
1.4941	1375	11.47	85.81	92	48.0	98.82
1.5012	1396	11.65	87.16	93	48.4	100.24
1.5083	1418	11.83	88.51	94	48.9	101.66
1.5155	1440	12.02	89.88	95	49.3	103.10
1.5227	1462	12.20	91.26	96	49.8	104.54
1.5299	1484	12.38	92.65	97	50.2	105.98
1.5372	1506	12.57	94.05	98	50.7	107.44
1.5445	1529	12.76	95.46	99	51.1	108.90
1.5518	1552	12.95	96.88	100	51.6	110.36

SULFURIC ACID

Specific Gravity of Aqueous Sulfuric Acid Solutions Adopted 1904 as Standard by the Manufacturing Chemists' Association of the United States.

Authorities: W. C. Ferguson; H. P. Talbot.

Specific Gravity determinations were made at 60° F., compared with water at 60°F.

From the Specific Gravities, the corresponding degrees Baumé were calculated by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}$$

SULFURIC ACID (Continued)

Baumé Hydrometers for use with this table must be graduated by the above formula, which formula should always be printed on the scale.

66° Baumé = Sp. Gr. 1.8354.

1 cu. ft. water at 60° F. weighs 62.37 lbs. avoirdupois.

Atomic weights from F. W. Clarke's table of 1901. O = 16.

H_2SO_4 = 100 per cent

	H_2SO_4	O. V.	60°
O. V.	93.19	100.00	119.98
60°	77.67	83.35	100.00
50°	62.18	66.72	80.06

Acids stronger than 66° Bé should have their percentage compositions determined by chemical analysis.

* Calculated from Pickering's results, Journal of London Chemical Society, vol. 57, p. 363.

Be°	Sp. Gr.	Tw.°	Per Cent H_2SO_4	Weight of 1 cu.ft. in lbs. Av.	Per Cent O. V.	Pounds O. V. in 1 cu. ft.	*Freezing (Melting) Point
0	1.0000	0.0	0.00	62.37	0.00	0.00	32.0° F.
1	1.0069	1.4	1.02	62.80	1.09	0.68	31.2° F.
2	1.0140	2.8	2.08	63.24	2.23	1.41	30.5° F.
3	1.0211	4.2	3.13	63.69	3.36	2.14	29.8° F.
4	1.0284	5.7	4.21	64.14	4.52	2.90	28.9° F.
5	1.0357	7.1	5.28	64.60	5.67	3.66	28.1° F.
6	1.0432	8.6	6.37	65.06	6.84	4.45	27.2° F.
7	1.0507	10.1	7.45	65.53	7.99	5.24	26.3° F.
8	1.0584	11.7	8.55	66.01	9.17	6.06	25.1° F.
9	1.0662	13.2	9.66	66.50	10.37	6.89	24.0° F.
10	1.0741	14.8	10.77	66.99	11.56	7.74	22.8° F.
11	1.0821	16.4	11.89	67.49	12.76	8.61	21.5° F.
12	1.0902	18.0	13.01	68.00	13.96	9.49	20.0° F.
13	1.0985	19.7	14.13	68.51	15.16	10.39	18.3° F.
14	1.1069	21.4	15.25	69.04	16.36	11.30	16.6° F.
15	1.1154	23.1	16.38	69.57	17.58	12.23	14.7° F.
16	1.1240	24.8	17.53	70.10	18.81	13.19	12.6° F.
17	1.1328	26.6	18.71	70.65	20.08	14.18	10.2° F.
18	1.1417	28.3	19.89	71.21	21.34	15.20	7.7° F.
19	1.1508	30.2	21.07	71.78	22.61	16.23	4.8° F.
20	1.1600	32.0	22.25	72.35	23.87	17.27	+ 1.6° F.
21	1.1694	33.9	23.43	72.94	25.14	18.34	— 1.8° F.
22	1.1789	35.8	24.61	73.53	26.41	19.42	— 6.0° F.
23	1.1885	37.7	25.81	74.13	27.69	20.53	—11 ° F.
24	1.1983	39.7	27.03	74.74	29.00	21.68	—16 ° F.
25	1.2083	41.7	28.28	75.36	30.34	22.87	—23 ° F.
26	1.2185	43.7	29.53	76.00	31.69	24.08	—30 ° F.
27	1.2288	45.8	30.79	76.64	33.04	25.32	—39 ° F.
28	1.2393	47.9	32.05	77.30	34.39	26.58	—49 ° F.
29	1.2500	50.0	33.33	77.96	35.76	27.88	—61 ° F.
30	1.2609	52.2	34.63	78.64	37.16	29.22	—74 ° F.
31	1.2719	54.4	35.93	79.33	38.55	30.58	—82 ° F.
32	1.2832	56.6	37.26	80.03	39.98	32.00	—96 ° F.
33	1.2946	58.9	38.58	80.74	41.40	33.42	—97 ° F.
34	1.3063	61.3	39.92	81.47	42.83	34.90	—91 ° F.
35	1.3182	63.6	41.27	82.22	44.28	36.41	—81 ° F.
36	1.3303	66.1	42.63	82.97	45.74	37.95	—70 ° F.
37	1.3426	68.5	43.99	83.74	47.20	39.53	—60 ° F.
38	1.3551	71.0	45.35	84.52	48.66	41.13	—53 ° F.
39	1.3679	73.6	46.72	85.32	50.13	42.77	—47 ° F.
40	1.3810	76.2	48.10	86.13	51.61	44.45	—41 ° F.
41	1.3942	78.8	49.47	86.96	53.08	46.16	—35 ° F.
42	1.4078	81.6	50.87	87.80	54.58	47.92	—31 ° F.
43	1.4216	84.3	52.26	88.67	56.07	49.72	—27 ° F.
44	1.4356	87.1	53.66	89.54	57.58	51.56	—23 ° F.

(Continued on following page.)

SULFURIC ACID (Continued)

Be°	Sp. Gr.	Tw.°	Per Cent H_2SO_4	Weight of 1 cu.ft. in lbs. Av.	Per Cent O. V.	Pounds O. V. in 1 cu. ft.	*Freezing (Melting) Point
45	1.4500	90.0	55.07	90.44	59.09	53.44	—20 ° F.
46	1.4646	92.9	56.48	91.35	60.60	55.36	—14 ° F.
47	1.4796	95.9	57.90	92.28	62.13	57.33	—15 ° F.
48	1.4948	99.0	59.32	93.23	63.65	59.34	—18 ° F.
49	1.5104	102.1	60.75	94.20	65.18	61.40	—22 ° F.
50	1.5263	105.3	62.18	95.20	66.72	63.52	—27 ° F.
51	1.5426	108.5	63.66	96.21	68.31	65.72	—33 ° F.
52	1.5591	111.8	65.13	97.24	69.89	67.96	—39 ° F.
53	1.5761	115.2	66.63	98.30	71.50	70.28	—49 ° F.
54	1.5934	118.7	68.13	99.38	73.11	72.66	—59 ° F.
55	1.6111	122.2	69.65	100.48	74.74	75.10	.. }
56	1.6292	125.8	71.17	101.61	76.37	77.60	.. } Below
57	1.6477	129.5	72.75	102.77	78.07	80.23	.. } —40
58	1.6667	133.3	74.36	103.95	79.79	82.95	.. }
59	1.6860	137.2	75.99	105.16	81.54	85.75	— 7 }
60	1.7059	141.2	77.67	106.40	83.35	88.68	+12.6° F.
61	1.7262	145.2	79.43	107.66	85.23	91.76	27.3° F.
62	1.7470	149.4	81.30	108.96	87.24	95.06	39.1° F.
63	1.7683	153.7	83.34	110.29	89.43	98.63	46.1° F.
64	1.7901	158.0	85.66	111.65	91.92	102.63	46.4° F.
64¼	1.7957	159.1	86.33	112.00	92.64	103.75	43.6° F.
64½	1.8012	160.2	87.04	112.34	93.40	104.93	41.1° F.
64¾	1.8068	161.4	87.81	112.69	94.23	106.19	37.9° F.
65	1.8125	162.5	88.65	113.05	95.13	107.54	33.1° F.
65¼	1.8182	163.6	89.55	113.40	96.10	108.97	24.6° F.
65½	1.8239	164.8	90.60	113.76	97.22	110.60	13.4° F.
65¾	1.8297	165.9	91.80	114.12	98.51	112.42	— 1 ° F.
66	1.8354	167.1	93.19	114.47	100.00	114.47	—29 ° F.

APPROXIMATE BOILING POINTS

50° Bé, 295° F.
60° Bé, 386° F.
61° Bé, 400° F.
62° Bé, 415° F.
63° Bé, 432° F.
64° Bé, 451° F.
65° Bé, 485° F.
66° Bé, 538° F.

FIXED POINTS

Sp. Gr.	Per Cent H_2SO_4	Sp. Gr.	Per Cent H_2SO_4
1.0000	.00	1.5281	62.34
1.0048	.71	1.5440	63.79
1.0347	5.14	1.5748	66.51
1.0649	9.48	1.6272	71.00
1.0992	14.22	1.6679	74.46
1.1353	19.04	1.7044	77.54
1.1736	23.94	1.7258	79.40
1.2105	28.55	1.7472	81.32
1.2513	33.49	1.7700	83.47
1.2951	38.64	1.7959	86.36
1.3441	44.15	1.8117	88.53
1.3947	49.52	1.8194	89.75
1.4307	53.17	1.8275	91.32
1.4667	56.68	1.8354	93.19
1.4822	58.14		

ALLOWANCE FOR TEMPERATURE

At 10° Bé, .029° Bé or .00023 Sp. Gr.= 1° F.
At 20° Bé, .036° Bé or .00034 Sp. Gr.= 1° F.
At 30° Bé, .035° Bé or .00039 Sp. Gr.= 1° F.
At 40° Bé, .031° Bé or .00041 Sp. Gr.= 1° F.
At 50° Bé, .028° Bé or .00045 Sp. Gr.= 1° F.
At 60° Bé, .026° Bé or .00053 Sp. Gr.= 1° F.
At 63° Bé. .026° Bé or .00057 Sp. Gr.= 1° F.
At 66° Bé, .0235°Bé or .00054 Sp. Gr.= 1° F.

Per Cent 60°	Pounds 60° in 1 cu. ft.	Per Cent 50°	Pounds 50° in 1 cu. ft.
61.93	53.34	77.36	66.63
63.69	55.39	79.56	69.19
65.50	57.50	81.81	71.83
67.28	59.66	84.05	74.53
69.09	61.86	86.30	77.27
70.90	64.12	88.56	80.10
72.72	66.43	90.83	82.98
74.55	68.79	93.12	85.93
76.37	71.20	95.40	88.94
78.22	73.68	97.70	92.03
80.06	76.21	100.00	95.20
81.96	78.85	102.38	98.50
83.86	81.54	104.74	101.85
85.79	84.33	107.15	105.33
87.72	87.17	109.57	108.89
89.67	90.10	112.01	112.55
91.63	93.11	114.46	116.30
93.67	96.26	117.00	120.24
95.74	99.52	119.59	124.31
97.84	102.89	122.21	128.52
100.00	106.40	124.91	132.91
102.27	110.10	127.74	137.52
104.67	114.05	130.75	142.47
107.30	118.34	134.03	147.82
110.29	123.14	137.76	153.81
111.15	124.49	138.84	155.50
112.06	125.89	139.98	157.25
113.05	127.40	141.22	159.14
114.14	129.03	142.57	161.17
115.30	130.75	144.02	163.32
116.65	132.70	145.71	165.76
118.19	134.88	147.63	168.48
119.98	137.34	149.87	171.56

SULFURIC ACID

Density of Aqueous Sulfuric Acid Solutions at $\frac{20°}{4°}$ C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of H_2SO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	*N*	%	Degrees: Baumé	Twaddell
1.0051	10.05	0.08388	0.6275	0.205	1	0.7	1.02
1.0118	20.24	0.1689	1.263	0.413	2	1.7	2.36
1.0184	30.55	0.2550	1.907	0.623	3	2.6	3.68
1.0250	41.00	0.3422	2.560	0.836	4	3.5	5.00
1.0317	51.59	0.4305	3.220	1.05	5	4.5	6.34
1.0385	62.31	0.5200	3.890	1.27	6	5.4	7.70
1.0453	73.17	0.6106	4.568	1.49	7	6.3	9.06
1.0522	84.18	0.7025	5.255	1.72	8	7.2	10.44
1.0591	95.32	0.7955	5.951	1.94	9	8.1	11.82
1.0661	106.6	0.8897	6.656	2.17	10	9.0	13.22
1.0731	118.0	0.9851	7.369	2.41	11	9.9	14.62
1.0802	129.6	1.082	8.092	2.64	12	10.8	16.04
1.0874	141.4	1.180	8.825	2.88	13	11.7	17.48
1.0947	153.3	1.279	9.568	3.13	14	12.5	18.94
1.1020	165.3	1.379	10.32	3.37	15	13.4	20.40
1.1094	177.5	1.481	11.08	3.62	16	14.3	21.88
1.1168	189.9	1.584	11.85	3.87	17	15.2	23.36
1.1243	202.4	1.689	12.63	4.13	18	16.0	24.86
1.1318	215.0	1.795	13.43	4.38	19	16.9	26.36
1.1394	227.9	1.902	14.23	4.65	20	17.7	27.88
1.1471	240.9	2.010	15.04	4.91	21	18.6	29.42
1.1548	254.1	2.120	15.86	5.18	22	19.4	30.96
1.1626	267.4	2.232	16.69	5.45	23	20.3	32.52
1.1704	280.9	2.344	17.54	5.73	24	21.1	34.08
1.1783	294.6	2.458	18.39	6.01	25	21.9	35.66
1.1862	308.4	2.574	19.25	6.29	26	22.8	37.24
1.1942	322.4	2.691	20.13	6.57	27	23.6	38.84
1.2023	336.6	2.809	21.02	6.86	28	24.4	40.46
1.2104	351.0	2.929	21.91	7.16	29	25.2	42.08
1.2185	365.6	3.051	22.82	7.46	30	26.0	43.70
1.2267	380.3	3.174	23.74	7.76	31	26.8	45.34
1.2349	395.2	3.298	24.67	8.06	32	27.6	46.98
1.2432	410.3	3.424	25.61	8.37	33	28.4	48.64
1.2515	425.5	3.551	26.56	8.68	34	29.1	50.30
1.2599	441.0	3.680	27.53	8.99	35	29.9	51.98
1.2684	456.6	3.811	28.51	9.31	36	30.7	53.68
1.2769	472.5	3.943	29.50	9.64	37	31.4	55.38
1.2855	488.5	4.077	30.50	9.96	38	32.2	57.10
1.2941	504.7	4.212	31.51	10.3	39	33.0	58.82
1.3028	521.1	4.349	32.53	10.6	40	33.7	60.56
1.3116	537.8	4.488	33.57	11.0	41	34.5	62.32
1.3205	554.6	4.628	34.62	11.3	42	35.2	64.10
1.3294	571.6	4.771	35.69	11.7	43	35.9	65.88
1.3384	588.9	4.915	36.76	12.0	44	36.7	67.68
1.3476	606.4	5.061	37.86	12.4	45	37.4	69.52
1.3569	624.2	5.209	38.97	12.7	46	38.1	71.38
1.3663	642.2	5.359	40.09	13.1	47	38.9	73.26
1.3758	660.4	5.511	41.23	13.5	48	39.6	75.16
1.3854	678.8	5.665	42.38	13.8	49	40.3	77.08
1.3951	697.6	5.821	43.55	14.2	50	41.1	79.02
1.4049	716.5	5.979	44.73	14.6	51	41.8	80.98
1.4148	735.7	6.140	45.93	15.0	52	42.5	82.96
1.4248	755.1	6.302	47.14	15.4	53	43.2	84.96
1.4350	774.9	6.467	48.38	15.8	54	44.0	87.00
1.4453	794.9	6.634	49.63	16.2	55	44.7	89.06

(Completed on following page.)

SULFURIC ACID (Continued)

Specific Gravity	Weight of H_2SO_4 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	*N*	%	Degrees: Baumé	Twaddell
1.4557	815.2	6.803	50.89	16.6	56	45.4	91.14
1.4662	835.7	6.975	52.17	17.0	57	46.1	93.24
1.4768	856.5	7.148	53.47	17.5	58	46.8	95.36
1.4875	877.6	7.324	54.79	17.9	59	47.5	97.50
1.4983	899.0	7.502	56.12	18.3	60	48.2	99.66
1.5091	920.6	7.682	57.47	18.8	61	48.9	101.82
1.5200	942.4	7.865	58.83	19.2	62	49.6	104.00
1.5310	964.5	8.049	60.22	19.7	63	50.3	106.20
1.5421	986.9	8.236	61.61	20.1	64	51.0	108.42
1.5533	1010	8.426	63.03	20.6	65	51.7	110.66
1.5646	1033	8.618	64.47	21.1	66	52.3	112.92
1.5760	1056	8.812	65.92	21.5	67	53.0	115.20
1.5874	1079	9.008	67.39	22.0	68	53.7	117.48
1.5989	1103	9.207	68.88	22.5	69	54.3	119.78
1.6105	1127	9.408	70.38	23.0	70	55.0	122.10
1.6221	1152	9.611	71.90	23.5	71	55.6	124.42
1.6338	1176	9.817	73.44	24.0	72	56.3	126.76
1.6456	1201	10.03	75.00	24.5	73	56.9	129.12
1.6574	1226	10.24	76.57	25.0	74	57.5	131.48
1.6692	1252	10.45	78.16	25.5	75	58.1	133.84
1.6810	1278	10.66	79.76	26.1	76	58.7	136.20
1.6927	1303	10.88	81.37	26.6	77	59.3	138.54
1.7043	1329	11.09	82.99	27.1	78	59.9	140.86
1.7158	1355	11.31	84.62	27.6	79	60.5	143.16
1.7272	1382	11.53	86.26	28.2	80	61.1	145.44
1.7383	1408	11.75	87.90	28.7	81	61.6	147.66
1.7491	1434	11.97	89.54	29.2	82	62.1	149.82
1.7594	1460	12.19	91.17	29.8	83	62.6	151.88
1.7693	1486	12.40	92.78	30.3	84	63.0	153.86
1.7786	1512	12.62	94.38	30.8	85	63.5	155.72
1.7872	1537	12.83	95.95	31.3	86	63.9	157.44
1.7951	1562	13.03	97.50	31.9	87	64.2	159.02
1.8022	1586	13.24	99.01	32.3	88	64.5	160.44
1.8087	1610	13.43	100.5	32.8	89	64.8	161.74
1.8144	1633	13.63	101.9	33.3	90	65.1	162.88
1.8195	1656	13.82	103.4	33.8	91	65.3	163.90
1.8240	1678	14.00	104.8	34.2	92	65.5	164.80
1.8279	1700	14.19	106.1	34.7	93	65.7	165.58
1.8312	1721	14.37	107.5	35.1	94	65.8	166.24
1.8337	1742	14.54	108.8	35.5	95	65.9	166.74
1.8355	1762	14.71	110.0	35.9	96	66.0	167.10
1.8364	1781	14.87	111.2	36.3	97	66.0	167.28
1.8361	1799	15.02	112.3	36.7	98	66.0	167.22
1.8342	1816	15.15	113.4	37.0	99	65.9	166.84
1.8305	1831	15.28	114.3	37.3	100	65.8	166.10

SULFURIC ACID, as SO_3 (Continued)

Specific Gravity	Weight of SO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent SO_3	Degrees: Baumé	Twaddell
1.0250	33.47	0.2793	2.089	3.265	3.5	5.00
1.0317	42.11	0.3514	2.629	4.082	4.5	6.34
1.0385	50.86	0.4245	3.175	4.898	5.4	7.70
1.0453	59.73	0.4985	3.729	5.714	6.3	9.06
1.0522	68.71	0.5734	4.290	6.530	7.2	10.44
1.0591	77.81	0.6494	4.858	7.347	8.1	11.82
1.0661	87.03	0.7263	5.433	8.163	9.0	13.22
1.0731	96.36	0.8041	6.016	8.979	9.9	14.62
1.0802	105.8	0.8831	6.606	9.796	10.8	16.04
1.0874	115.4	0.9630	7.204	10.61	11.7	17.48
1.0947	125.1	1.044	7.810	11.43	12.5	18.94
1.1020	134.9	1.126	8.424	12.24	13.4	20.40
1.1094	144.9	1.209	9.046	13.06	14.3	21.88
1.1168	155.0	1.293	9.676	13.88	15.2	23.36
1.1243	165.2	1.379	10.31	14.69	16.0	24.86
1.1318	175.5	1.465	10.96	15.51	16.9	26.36
1.1394	186.0	1.552	11.61	16.33	17.7	27.88
1.1471	196.6	1.641	12.28	17.14	18.6	29.42
1.1548	207.4	1.731	12.95	17.96	19.4	30.96
1.1626	218.3	1.822	13.63	18.78	20.3	32.52
1.1704	229.3	1.914	14.32	19.59	21.1	34.08
1.1783	240.5	2.007	15.01	20.41	21.9	35.66
1.1862	251.8	2.101	15.72	21.22	22.8	37.24
1.1942	263.2	2.197	16.43	22.04	23.6	38.84
1.2023	274.8	2.293	17.16	22.86	24.4	40.46
1.2104	286.5	2.391	17.89	23.67	25.2	42.08
1.2185	298.4	2.490	18.63	24.49	26.0	43.70
1.2267	310.4	2.591	19.38	25.31	26.8	45.34
1.2349	322.6	2.692	20.14	26.12	27.6	46.98
1.2432	334.9	2.795	20.91	26.94	28.4	48.64
1.2515	347.3	2.899	21.68	27.75	29.1	50.30
1.2599	360.0	3.004	22.47	28.57	29.9	51.98
1.2684	372.7	3.111	23.27	29.39	30.7	53.68
1.2769	385.7	3.219	24.08	30.20	31.4	55.38
1.2855	398.8	3.328	24.89	31.02	32.2	57.10
1.2941	412.0	3.438	25.72	31.84	33.0	58.82
1.3028	425.4	3.550	26.56	32.65	33.7	60.56
1.3116	439.0	3.663	27.41	33.47	34.5	62.32
1.3205	452.7	3.778	28.26	34.29	35.2	64.10
1.3294	466.6	3.894	29.13	35.10	35.9	65.88
1.3384	480.7	4.012	30.01	35.92	36.7	67.68
1.3476	495.0	4.131	30.90	36.73	37.4	69.52
1.3569	509.5	4.252	31.81	37.55	38.1	71.38
1.3663	524.2	4.375	32.73	38.37	38.9	73.26
1.3758	539.1	4.499	33.65	39.18	39.6	75.16
1.3854	554.1	4.625	34.60	40.00	40.3	77.08
1.3951	569.4	4.752	35.55	40.82	41.1	79.02
1.4049	584.9	4.881	36.51	41.63	41.8	80.98
1.4148	600.6	5.012	37.49	42.45	42.5	82.96
1.4248	616.4	5.144	38.48	43.26	43.2	84.96
1.4350	632.6	5.279	39.49	44.08	44.0	87.00
1.4453	648.9	5.415	40.51	44.90	44.7	89.06
1.4557	665.4	5.553	41.54	45.71	45.4	91.14
1.4662	682.2	5.693	42.59	46.53	46.1	93.24
1.4768	699.2	5.835	43.65	47.35	46.8	95.36
1.4875	716.4	5.979	44.73	48.16	47.5	97.50
1.4983	733.8	6.124	45.81	48.98	48.2	99.66
1.5091	751.5	6.271	46.91	49.80	48.9	101.82
1.5200	769.3	6.420	48.03	50.61	49.6	104.00

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SULFURIC ACID, as SO_3 (Continued)

Specific Gravity	Weight of SO_3 in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent SO_3	Degrees: Baumé	Twaddell
1.5310	787.4	6.571	49.15	51.43	50.3	106.20
1.5421	805.7	6.723	50.30	52.24	51.0	108.42
1.5533	824.2	6.878	51.45	53.06	51.7	110.66
1.5646	843.0	7.035	52.63	53.88	52.3	112.92
1.5760	862.0	7.193	53.81	54.69	53.0	115.20
1.5874	881.2	7.354	55.01	55.51	53.7	117.48
1.5989	900.6	7.516	56.22	56.33	54.3	119.78
1.6105	920.3	7.680	57.45	57.14	55.0	122.10
1.6221	940.1	7.846	58.69	57.96	55.6	124.42
1.6338	960.3	8.014	59.95	58.77	56.3	126.76
1.6456	980.6	8.184	61.22	59.59	56.9	129.12
1.6574	1001	8.355	62.50	60.41	57.5	131.48
1.6692	1022	8.528	63.80	61.22	58.1	133.84
1.6810	1043	8.703	65.11	62.04	58.7	136.20
1.6927	1064	8.879	66.42	62.86	59.3	138.54
1.7043	1085	9.056	67.75	63.67	59.9	140.86
1.7158	1106	9.234	69.08	64.49	60.5	143.16
1.7272	1128	9.413	70.42	65.30	61.1	145.44
1.7383	1149	9.592	71.76	66.12	61.6	147.66
1.7491	1171	9.771	73.09	66.94	62.1	149.82
1.7594	1192	9.948	74.42	67.75	62.6	151.88
1.7693	1213	10.12	75.74	68.57	63.0	153.86
1.7786	1234	10.30	77.05	69.39	63.5	155.72
1.7872	1255	10.47	78.33	70.20	63.9	157.44
1.7951	1275	10.64	79.59	71.02	64.2	159.02
1.8022	1295	10.80	80.82	71.84	64.5	160.44
1.8087	1314	10.97	82.04	72.65	64.8	161.74
1.8144	1333	11.12	83.22	73.47	65.1	162.88
1.8195	1352	11.28	84.38	74.28	65.3	163.90
1.8240	1370	11.43	85.52	75.10	65.5	164.80
1.8279	1388	11.58	86.63	75.92	65.7	165.58
1.8312	1405	11.73	87.72	76.73	65.8	166.24
1.8337	1422	11.87	88.78	77.55	65.9	166.74
1.8355	1438	12.00	89.80	78.37	66.0	167.10
1.8364	1454	12.14	90.78	79.18	66.0	167.28
1.8361	1469	12.26	91.70	80.00	66.0	167.22
1.8342	1482	12.37	92.54	80.81	65.9	166.84
1.8305	1494	12.47	93.29	81.63	65.8	166.10

TANNIC ACID

Density of Aqueous Tannic Acid Solutions at 15° C. Computed from the Values of Trammer.

Specific Gravity	Weight of $C_{14}H_{10}O_9$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $C_{14}H_{10}O_9$	Degrees: Baumé	Twaddell
1.0040	10.04	0.08379	0.6268	1.0	0.6	0.80
1.0044	11.05	0.09220	0.6898	1.1	0.6	0.88
1.0048	12.06	0.1006	0.7528	1.2	0.7	0.96
1.0052	13.07	0.1091	0.8158	1.3	0.8	1.04
1.0056	14.08	0.1175	0.8789	1.4	0.8	1.12
1.0060	15.09	0.1259	0.9421	1.5	0.9	1.20
1.0064	16.10	0.1344	1.005	1.6	0.9	1.28
1.0068	17.12	0.1428	1.069	1.7	1.0	1.36
1.0072	18.13	0.1513	1.132	1.8	1.0	1.44
1.0076	19.14	0.1598	1.195	1.9	1.1	1.52

TANNIC ACID (Continued)

Specific Gravity	Weight of $C_{14}H_{10}O_9$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $C_{14}H_{10}O_9$	Degrees: Baumé	Twaddell
1.0080	20.16	0.1682	1.259	2.0	1.2	1.60
1.0084	21.18	0.1767	1.322	2.1	1.2	1.68
1.0088	22.19	0.1852	1.386	2.2	1.3	1.76
1.0092	23.21	0.1937	1.449	2.3	1.3	1.84
1.0096	24.23	0.2022	1.513	2.4	1.4	1.92
1.0100	25.25	0.2107	1.576	2.5	1.4	2.00
1.0104	26.27	0.2192	1.640	2.6	1.5	2.08
1.0108	27.29	0.2278	1.704	2.7	1.5	2.16
1.0112	28.31	0.2363	1.768	2.8	1.6	2.24
1.0116	29.34	0.2448	1.831	2.9	1.7	2.32
1.0120	30.36	0.2534	1.895	3.0	1.7	2.40
1.0124	31.38	0.2619	1.959	3.1	1.8	2.48
1.0128	32.41	0.2705	2.023	3.2	1.8	2.56
1.0132	33.44	0.2790	2.087	3.3	1.9	2.64
1.0136	34.46	0.2876	2.151	3.4	1.9	2.72
1.0140	35.49	0.2962	2.216	3.5	2.0	2.80
1.0144	36.52	0.3048	2.280	3.6	2.1	2.88
1.0148	37.55	0.3133	2.344	3.7	2.1	2.96
1.0152	38.58	0.3219	2.408	3.8	2.2	3.04
1.0156	39.61	0.3305	2.473	3.9	2.2	3.12
1.0160	40.64	0.3392	2.537	4.0	2.3	3.20
1.0164	41.67	0.3478	2.602	4.1	2.3	3.28
1.0168	42.71	0.3564	2.666	4.2	2.4	3.36
1.0172	43.74	0.3650	2.731	4.3	2.5	3.44
1.0176	44.77	0.3737	2.795	4.4	2.5	3.52
1.0180	45.81	0.3823	2.860	4.5	2.6	3.60
1.0184	46.85	0.3910	2.925	4.6	2.6	3.68
1.0188	47.88	0.3996	2.989	4.7	2.7	3.76
1.0192	48.92	0.4083	3.054	4.8	2.7	3.84
1.0196	49.96	0.4169	3.119	4.9	2.8	3.92
1.0200	51.00	0.4256	3.184	5.0	2.8	4.00
1.0401	104.0	0.8680	6.493	10.0	5.6	8.02

TARTARIC ACID

Density of Aqueous Tartaric Acid Solutions at 15° C. Computed from the Values of Gerlach.

Specific Gravity	Weight of $H_2C_4H_4O_6$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $H_2C_4H_4O_6$	Degrees: Baumé	Twaddell
1.0045	10.05	0.08383	0.6271	1	0.6	0.90
1.0090	20.18	0.1684	1.260	2	1.3	1.80
1.0179	40.72	0.3398	2.542	4	2.6	3.58
1.0273	61.64	0.5144	3.848	6	3.9	5.46
1.0371	82.97	0.6924	5.180	8	5.2	7.42
1.0469	104.7	0.8737	6.536	10	6.5	9.38
1.0565	126.8	1.058	7.915	12	7.8	11.30
1.0661	149.3	1.246	9.318	14	9.0	13.22
1.0761	172.2	1.437	10.75	16	10.3	15.22
1.0865	195.6	1.632	12.21	18	11.5	17.30
1.0969	219.4	1.831	13.70	20	12.8	19.38
1.1072	243.6	2.033	15.21	22	14.0	21.44
1.1175	268.2	2.238	16.74	24	15.2	23.50
1.1282	293.3	2.448	18.31	26	16.5	25.64
1.1393	319.0	2.662	19.92	28	17.7	27.86

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TARTARIC ACID (Continued)

Specific Gravity	Weight of $H_2C_4H_4O_6$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $H_2C_4H_4O_6$	Degrees: Baumé	Twaddell
1.1505	345.2	2.880	21.55	30	19.0	30.10
1.1615	371.7	3.102	23.20	32	20.2	32.30
1.1726	398.7	3.327	24.89	34	21.3	34.52
1.1840	426.2	3.557	26.61	36	22.5	36.80
1.1959	454.4	3.793	28.37	38	23.8	39.18
1.2078	483.1	4.032	30.16	40	25.0	41.56
1.2198	512.3	4.275	31.98	42	26.1	43.96
1.2317	541.9	4.523	33.83	44	27.3	46.34
1.2441	572.3	4.776	35.73	46	28.5	48.82
1.2568	603.3	5.034	37.66	48	29.6	51.36
1.2696	634.8	5.298	39.63	50	30.8	53.92
1.2828	667.1	5.567	41.64	52	32.0	56.56
1.2961	699.9	5.841	43.69	54	33.1	59.22
1.3093	733.2	6.119	45.77	56	34.3	61.86

ZINC CHLORIDE

Specific Gravity of Aqueous Zinc Chloride Solutions Adopted 1922 as Standard by the Manufacturing Chemists' Association of the United States.

Authorities: W. H. Whitney, E. H. Hartle, C. H. Sakryd.

Checked by: L. C. Drefahl, R. M. Meiklejohn, R. O. Fernandez.

Specific gravity determinations were made at 60° F., compared with water at 60° F., on solutions of Zinc Chloride made from chemically pure zinc and Hydrochloric Acid, these solutions exhibiting a neutral reaction to methyl orange when diluted below 5° Bé with water.

The corresponding degrees Baumé were calculated from the Specific Gravities by the following formula:

$$\text{Baumé} = 145 - \frac{145}{\text{Sp. Gr.}}$$

Baumé Hydrometers for use with this table must be graduated by the above formula, which formula should always be printed on the scale.

1 cubic foot of water weighs 62.37 lbs. avoirdupois.

Atomic weights used: F. W. Clarke's table of 1912. O = 16.

*The percentage composition on all fixed points were determined by actual chemical analysis both Zinc and Chlorine being determined.

Bé°	Sp. Gr.	% $ZnCl_2$	Weight of 1 cu.ft. in lbs.	Lbs. $ZnCl_2$ in 1 cu.ft.	% 50% $ZnCl_2$	Lbs. 50% $ZnCl_2$ in 1 cu. ft.
0	1.0000	0	62.37	0	0	0
1	1.0069	.76	62.80	.4773	1.52	.9546
2	1.0140	1.53	63.24	.9676	3.06	1.9352
3	1.0211	2.29	63.69	1.4585	4.58	2.9170
4	1.0284	3.05	64.14	1.9563	6.10	3.9126
5	1.0357	3.81	64.60	2.4613	7.62	4.9226
6	1.0432	4.63	65.06	3.0123	9.26	6.0246
7	1.0507	5.45	65.53	3.5714	10.90	7.1428
8	1.0584	6.27	66.01	4.1388	12.54	8.2776
9	1.0662	7.09	66.50	4.7149	14.18	9.4298

ZINC CHLORIDE (Continued)

Bé°	Sp. Gr.	% $ZnCl_2$	Weight of 1 cu.ft. in lbs.	Lbs. $ZnCl_2$ in 1 cu. ft.	% 50% $ZnCl_2$	Lbs. 50% $ZnCl_2$ in 1 cu. ft.
10	1.0741	7.91	66.99	5.2989	15.82	10.5978
11	1.0821	8.78	67.49	5.9256	17.56	11.8512
12	1.0902	9.65	68.00	6.5620	19.30	13.1240
13	1.0985	10.52	68.51	7.2073	21.04	14.4146
14	1.1069	11.39	69.04	7.8637	22.78	15.7274
15	1.1154	12.26	69.57	8.5293	24.52	17.0586
16	1.1240	13.21	70.10	9.2602	26.42	18.5204
17	1.1328	14.15	70.65	9.9970	28.30	19.9940
18	1.1417	15.10	71.21	10.7527	30.20	21.5054
19	1.1508	16.04	71.78	11.5135	32.08	23.0270
20	1.1600	16.98	72.35	12.2850	33.96	24.5700
21	1.1694	17.96	72.94	13.1000	35.92	26.2000
22	1.1789	18.94	73.53	13.9266	37.88	27.8532
23	1.1885	19.92	74.13	14.7667	39.84	29.5334
24	1.1983	20.90	74.74	15.6207	41.80	31.2414
25	1.2083	21.88	75.36	16.4888	43.76	32.9776
26	1.2185	22.88	76.00	17.3888	45.76	34.7776
27	1.2288	23.88	76.64	18.3016	47.76	36.6032
28	1.2393	24.89	77.30	19.2400	49.78	38.4800
29	1.2500	25.89	77.96	20.1838	51.78	40.3676
30	1.2609	26.90	78.64	21.1542	53.80	42.3084
31	1.2719	27.91	79.33	22.1410	55.82	44.2820
32	1.2832	28.91	80.03	23.1367	57.82	46.2734
33	1.2946	29.92	80.74	24.1574	59.84	48.3148
34	1.3063	30.93	81.47	25.1987	61.86	50.3974
35	1.3182	31.93	82.22	26.2528	63.86	52.5056
36	1.3303	32.94	82.97	27.3303	65.88	54.6606
37	1.3426	33.95	83.74	28.4297	67.90	56.8594
38	1.3551	34.96	84.52	29.5482	69.92	59.0964
39	1.3679	35.97	85.32	30.6896	71.94	61.3792
40	1.3810	36.98	86.13	31.8509	73.96	63.7018
41	1.3942	38.02	86.96	33.0622	76.04	66.1244
42	1.4078	39.05	87.80	34.2859	78.10	68.5718
43	1.4216	40.09	88.67	35.5478	80.18	71.0956
44	1.4356	41.12	89.54	36.8188	82.24	73.6376
45	1.4500	42.16	90.44	38.1295	84.32	76.2590
46	1.4646	43.21	91.35	39.4723	86.42	78.9446
47	1.4796	44.26	92.28	40.8431	88.52	81.6862
48	1.4948	45.32	93.23	42.2518	90.64	84.5036
49	1.5104	46.37	94.20	43.6805	92.74	87.3610
50	1.5263	47.43	95.20	45.1534	94.86	90.3068
51	1.5426	48.48	96.21	46.6426	96.96	93.2852
52	1.5591	49.54	97.24	48.1727	99.08	96.3454
53	1.5761	50.60	98.30	49.7398	101.20	99.4796
54	1.5934	51.66	99.38	51.3397	103.32	102.6794
55	1.6111	52.72	100.48	52.9731	105.44	105.9462
56	1.6292	53.80	101.61	54.6662	107.60	109.3324
57	1.6477	54.88	102.77	56.4002	109.76	112.8004
58	1.6667	55.97	103.95	58.1808	111.94	116.3616
59	1.6860	57.06	105.16	60.0043	114.12	120.0086
60	1.7059	58.15	106.40	61.8716	116.30	123.7432
61	1.7262	59.23	107.66	63.7670	118.46	127.5340
62	1.7470	60.30	108.96	65.7029	120.60	131.4058
63	1.7683	61.37	110.29	67.6850	122.74	135.3700
64	1.7901	62.44	111.65	69.7143	124.88	139.4286
65	1.8125	63.52	113.05	71.8094	127.04	143.6188
66	1.8354	64.68	114.47	74.0392	129.36	148.0784
67	1.8590	65.85	115.95	76.3531	131.70	152.7062
68	1.8831	67.02	117.45	78.7150	134.04	157.4300
69	1.9079	68.19	119.00	81.1461	136.38	162.2922
70	1.9333	69.36	120.58	83.6343	138.72	167.2586

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ZINC CHLORIDE (Continued)

APPROXIMATE ALLOWANCE FOR TEMPERATURE	*FIXED POINTS		
	Bé°	Sp. Gr.	Per Cent $ZnCl_2$
	5.08	1.0363	3.88
	10.16	1.0754	8.05
	15.35	1.1184	12.59
	20.35	1.1633	17.32
	25.14	1.1707	22.02
	30.00	1.2609	26.90
	35.07	1.3190	32.00
	40.15	1.3829	37.14
	44.99	1.4499	42.15
	50.14	1.5285	47.58
	55.05	1.6120	52.77
	60.13	1.7085	58.29
	65.11	1.8150	63.65
	70.05	1.9345	69.42

At 5° Bé = 0.024° Bé
At 10° Bé = 0.029° Bé
At 15° Bé = 0.029° Bé
At 20° Bé = 0.033° Bé
At 25° Bé = 0.033° Bé
At 30° Bé = 0.033° Bé
At 35° Bé = 0.033° Bé
At 40° Bé = 0.033° Bé
At 45° Bé = 0.033° Bé
At 50° Bé = 0.030° Bé
At 55° Bé = 0.028° Bé
At 60° Bé = 0.027° Bé
At 65° Bé = 0.027° Bé
At 70° Bé = 0.024° Bé

} For each 1° Fahrenheit

ZINC CHLORIDE

Density of Aqueous Zinc Chloride Solutions at $\frac{20}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $ZnCl_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $ZnCl_2$	Degrees: Baumé	Twaddell
1.0167	20.33	0.1697	1.269	2	2.4	3.34
1.0350	41.40	0.3455	2.585	4	4.9	7.00
1.0532	63.19	0.5274	3.945	6	7.3	10.64
1.0715	85.72	0.7154	5.351	8	9.7	14.30
1.0819	108.2	0.9029	6.754	10	11.0	16.38
1.1085	133.0	1.110	8.304	12	14.2	21.70
1.1275	157.9	1.317	9.855	14	16.4	25.50
1.1468	183.5	1.531	11.46	16	18.6	29.36
1.1665	210.0	1.752	13.11	18	20.7	33.30
1.1866	237.3	1.981	14.82	20	22.8	37.32
1.2380	309.5	2.583	19.32	25	27.9	47.60
1.2928	387.8	3.237	24.21	30	32.8	58.56
1.3522	473.3	3.950	29.55	35	37.8	70.44
1.4173	566.9	4.731	35.39	40	42.7	83.46
1.4890	670.1	5.592	41.83	45	47.6	97.80
1.5681	784.1	6.543	48.95	50	52.5	113.62
1.655	910.3	7.596	56.83	55	57.4	131.0
1.749	1049	8.758	65.51	60	62.1	149.8
1.851	1203	10.04	75.11	65	66.7	170.2
1.962	1373	11.46	85.74	70	71.1	192.4

ZINC NITRATE

Density of Aqueous Zinc Nitrate Solutions at $\frac{18}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $Zn(NO_3)_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Zn(NO_3)_2$	Degrees: Baumé	Twaddell
1.0154	20.31	0.1695	1.268	2	2.2	3.08
1.0322	41.29	0.3446	2.578	4	4.5	6.44
1.0496	62.98	0.5256	3.932	6	6.9	9.92
1.0675	85.40	0.7127	5.332	8	9.2	13.50
1.0859	108.6	0.9062	6.779	10	11.5	17.18

ZINC NITRATE (Continued)

Specific Gravity	Weight of $Zn(NO_3)_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Zn(NO_3)_2$	Degrees: Baumé	Twaddell
1.1048	132.6	1.106	8.277	12	13.8	20.96
1.1244	157.4	1.314	9.827	14	16.0	24.88
1.1445	183.1	1.528	11.43	16	18.3	28.90
1.1652	209.7	1.750	13.09	18	20.6	33.04
1.1865	237.3	1.980	14.81	20	22.8	37.30
1.2427	310.7	2.593	19.40	25	28.3	48.54
1.3029	390.9	3.262	24.40	30	33.7	60.58
1.3678	478.7	3.995	29.89	35	39.0	73.56
1.4378	575.1	4.800	35.90	40	44.2	87.56
1.5134	681.0	5.683	42.52	45	49.2	102.68
1.5944	797.2	6.653	49.77	50	54.1	118.88

Density of Aqueous Zinc Nitrate Solutions at 17.5° C. Computed from the Values of Franz.

Specific Gravity	Weight of $Zn(NO_3)_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Zn(NO_3)_2$	Degrees: Baumé	Twaddell
1.0099	10.10	0.08428	0.6305	1	1.4	1.98
1.0198	20.40	0.1702	1.273	2	2.8	3.96
1.0297	30.89	0.2578	1.929	3	4.2	5.94
1.0396	41.58	0.3470	2.596	4	5.5	7.92
1.0496	52.48	0.4380	3.276	5	6.9	9.92
1.0590	63.54	0.5303	3.967	6	8.1	11.80
1.0684	74.79	0.6241	4.669	7	9.3	13.68
1.0778	86.22	0.7196	5.383	8	10.5	15.56
1.0872	97.85	0.8166	6.109	9	11.6	17.44
1.0968	109.7	0.9153	6.847	10	12.8	19.36
1.1070	121.8	1.016	7.602	11	14.0	21.40
1.1172	134.1	1.119	8.370	12	15.2	23.44
1.1274	146.6	1.223	9.150	13	16.4	25.48
1.1376	159.3	1.329	9.943	14	17.5	27.52
1.1476	172.1	1.437	10.75	15	18.6	29.52
1.1586	185.4	1.547	11.57	16	19.9	31.72
1.1696	198.8	1.659	12.41	17	21.0	33.92
1.1806	212.5	1.773	13.27	18	22.2	36.12
1.1916	226.4	1.889	14.13	19	23.3	38.32
1.2024	240.5	2.007	15.01	20	24.4	40.48
1.2147	255.1	2.129	15.93	21	25.6	42.94
1.2270	269.9	2.253	16.85	22	26.8	45.40
1.2393	285.0	2.379	17.79	23	28.0	47.86
1.2516	300.4	2.507	18.75	24	29.1	50.32
1.2640	316.0	2.637	19.73	25	30.3	52.80
1.2766	331.9	2.770	20.72	26	31.4	55.32
1.2892	348.1	2.905	21.73	27	32.5	57.84
1.3018	364.5	3.042	22.76	28	33.6	60.36
1.3144	381.2	3.181	23.80	29	34.7	62.88
1.3268	398.0	3.322	24.85	30	35.7	65.36
1.3396	415.3	3.466	25.93	31	36.8	67.92
1.3524	432.8	3.612	27.02	32	37.8	70.48
1.3652	450.5	3.760	28.13	33	38.8	73.04
1.3780	468.5	3.910	29.25	34	39.8	75.60
1.3906	486.7	4.062	30.39	35	40.7	78.1
1.4039	505.4	4.218	31.55	36	41.7	80.78
1.4172	524.4	4.376	32.74	37	42.7	83.44
1.4305	543.6	4.536	33.94	38	43.6	86.10
1.4438	563.1	4.699	35.15	39	44.6	88.76
1.4572	582.9	4.864	36.39	40	45.5	91.44

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ZINC NITRATE (Continued)

Specific Gravity	Weight of $Zn(NO_3)_2$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $Zn(NO_3)_2$	Degrees: Baumé	Twaddell
1.4707	603.0	5.032	37.64	41	46.4	94.14
1.4844	623.4	5.203	38.92	42	47.3	96.88
1.4981	644.2	5.376	40.22	43	48.2	99.62
1.5118	665.2	5.551	41.53	44	49.1	102.36
1.5258	686.6	5.730	42.87	45	50.0	105.16
1.5403	708.5	5.913	44.23	46	50.9	108.06
1.5548	730.8	6.098	45.62	47	51.7	110.96
1.5693	753.3	6.286	47.03	48	52.6	113.86
1.5838	776.1	6.477	48.45	49	53.4	116.76
1.5984	799.2	6.670	49.89	50	54.3	119.68

ZINC SULFATE

Density of Aqueous Zinc Sulfate Solutions at $\frac{20}{4}$° C. Computed from Values Given in the International Critical Tables.

Specific Gravity	Weight of $ZnSO_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $ZnSO_4$	Degrees: Baumé	Twaddell
1.0190	20.38	0.1701	1.272	2	2.7	3.80
1.0403	41.61	0.3473	2.598	4	5.6	8.06
1.0620	63.72	0.5318	3.978	6	8.5	12.40
1.0842	86.74	0.7238	5.415	8	11.3	16.84
1.1071	110.7	0.9239	6.912	10	14.0	21.42
1.1308	135.7	1.132	8.472	12	16.8	26.16
1.1553	161.7	1.350	10.10	14	19.5	31.06
1.1806	188.9	1.576	11.79	16	22.2	36.12

Specific Gravity	Weight of $ZnSO_4 \cdot 7H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $ZnSO_4 + 7H_2O$	Degrees: Baumé	Twaddell
1.0190	36.30	0.3029	2.266	3.562	2.7	3.80
1.0403	74.12	0.6185	4.627	7.125	5.6	8.06
1.0620	113.5	0.9472	7.086	10.69	8.5	12.40
1.0842	154.5	1.289	9.645	14.25	11.3	16.84
1.1071	197.2	1.646	12.31	17.81	14.0	21.42
1.1308	241.7	2.017	15.09	21.37	16.8	26.16
1.1533	287.6	2.400	17.95	24.94	19.5	31.06
1.1806	336.5	2.808	21.00	28.50	22.2	36.12

Density of Aqueous Zinc Sulfate Solutions at 15° C. Computed from the Values of Gerlach.

Specific Gravity	Weight of $ZnSO_4 \cdot 7H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $ZnSO_4 + 7H_2O$	Degrees: Baumé	Twaddell
1.006	10.06	0.08395	0.6280	1	0.9	1.2
1.013	20.26	0.1691	1.265	2	1.9	2.6
1.019	30.57	0.2551	1.908	3	2.7	3.8
1.024	40.96	0.3418	2.557	4	3.4	4.8
1.029	51.45	0.4294	3.212	5	4.1	5.8
1.035	62.10	0.5182	3.877	6	4.9	7.0
1.041	72.87	0.6081	4.549	7	5.7	8.2
1.047	83.76	0.6990	5.229	8	6.5	9.4
1.053	94.77	0.7909	5.916	9	7.3	10.6
1.059	105.9	0.8838	6.611	10	8.1	11.8

ZINC SULFATE (Continued)

Specific Gravity	Weight of $ZnSO_4 \cdot 7H_2O$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $ZnSO_4 + 7H_2O$	Degrees: Baumé	Twaddell
1.066	117.3	0.9786	7.321	11	9.0	13.2
1.073	128.8	1.075	8.038	12	9.9	14.6
1.079	140.3	1.171	8.757	13	10.6	15.8
1.085	151.9	1.268	9.483	14	11.4	17.0
1.091	163.7	1.366	10.22	15	12.1	18.2
1.097	175.5	1.465	10.96	16	12.8	19.4
1.103	187.5	1.565	11.71	17	13.5	20.6
1.110	199.8	1.667	12.47	18	14.4	22.0
1.116	212.0	1.770	13.24	19	15.1	23.2
1.124	224.8	1.876	14.03	20	16.0	24.8
1.130	237.3	1.980	14.81	21	16.7	26.0
1.137	250.1	2.088	15.62	22	17.5	27.4
1.143	262.9	2.194	16.41	23	18.1	28.6
1.150	276.0	2.303	17.23	24	18.9	30.0
1.157	289.3	2.414	18.06	25	19.7	31.4
1.164	302.6	2.526	18.89	26	20.4	32.8
1.171	316.2	2.639	19.74	27	21.2	34.2
1.179	330.1	2.755	20.61	28	22.0	35.8
1.185	343.7	2.868	21.45	29	22.6	37.0
1.193	357.9	2.987	22.34	30	23.5	38.6
1.200	372.0	3.104	23.22	31	24.2	40.0
1.209	386.9	3.229	24.15	32	25.1	41.8
1.216	401.3	3.349	25.05	33	25.8	43.2
1.224	416.2	3.473	25.98	34	26.5	44.8
1.231	430.9	3.596	26.90	35	27.2	46.2
1.240	446.4	3.725	27.87	36	28.1	48.0
1.246	461.0	3.847	28.78	37	28.6	49.2
1.255	476.9	3.980	29.77	38	29.5	51.0
1.263	492.6	4.111	30.75	39	30.2	52.6
1.271	508.4	4.243	31.74	40	30.9	54.2
1.280	524.8	4.380	32.76	41	31.7	56.0
1.288	541.0	4.515	33.77	42	32.4	57.6
1.295	556.9	4.647	34.76	43	33.0	59.0
1.304	573.8	4.788	35.82	44	33.8	60.8
1.310	589.5	4.920	36.80	45	34.3	62.0
1.320	607.2	5.067	37.91	46	35.2	64.0
1.330	625.1	5.217	39.02	47	36.0	66.0
1.337	641.8	5.356	40.07	48	36.6	67.4
1.346	659.5	5.504	41.18	49	37.3	69.2
1.353	676.5	5.646	42.23	50	37.8	70.6
1.362	694.6	5.797	43.37	51	38.5	72.4
1.370	712.4	5.945	44.48	52	39.2	74.0
1.380	731.4	6.104	45.66	53	39.9	76.0
1.390	750.6	6.264	46.86	54	40.7	78.0
1.399	769.5	6.421	48.04	55	41.4	79.8
1.406	787.4	6.571	49.15	56	41.9	81.2
1.416	807.1	6.736	50.39	57	42.6	83.2
1.425	826.5	6.897	51.60	58	43.2	85.0
1.435	846.7	7.066	52.86	59	44.0	87.0
1.445	867.0	7.235	54.13	60	44.7	89.0

Specific Gravity	Weight of $ZnSO_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $ZnSO_4$	Degrees: Baumé	Twaddell
1.006	5.648	0.04713	0.3526	0.5614	0.9	1.2
1.013	11.37	0.09493	0.7101	1.123	1.9	2.6
1.019	17.16	0.1432	1.071	1.684	2.7	3.8
1.024	23.00	0.1919	1.436	2.246	3.4	4.8

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ZINC SULFATE (Continued)

Specific Gravity	Weight of $ZnSO_4$ in solution expressed in: Grams per Liter	Pounds per U. S. Gallon	Pounds per Cubic Foot	Per Cent $ZnSO_4$	Degrees: Baumé	Twaddell
1.029	28.89	0.2411	1.803	2.807	4.1	5.8
1.035	34.86	0.2910	2.177	3.369	4.9	7.0
1.041	40.91	0.3414	2.554	3.930	5.7	8.2
1.047	47.03	0.3924	2.936	4.491	6.5	9.4
1.053	53.21	0.4440	3.322	5.053	7.3	10.6
1.059	59.46	0.4962	3.712	5.614	8.1	11.8
1.066	65.83	0.5494	4.110	6.176	9.0	13.2
1.073	72.29	0.6033	4.513	6.737	9.9	14.6
1.079	78.75	0.6572	4.916	7.299	10.6	15.8
1.085	85.28	0.7117	5.324	7.860	11.4	17.0
1.091	91.88	0.7668	5.736	8.421	12.1	18.2
1.097	98.54	0.8224	6.152	8.983	12.8	19.4
1.103	105.3	0.8786	6.572	9.544	13.5	20.6
1.110	112.2	0.9361	7.003	10.11	14.4	22.0
1.116	119.0	0.9935	7.432	10.67	15.1	23.2
1.124	126.2	1.053	7.879	11.23	16.0	24.8
1.130	133.2	1.112	8.317	11.79	16.7	26.0
1.137	140.4	1.172	8.767	12.35	17.5	27.4
1.143	147.6	1.232	9.214	12.91	18.1	28.6
1.150	155.0	1.293	9.674	13.47	18.9	30.0
1.157	162.4	1.355	10.14	14.04	19.7	31.4
1.164	169.9	1.418	10.61	14.60	20.4	32.8
1.171	177.5	1.481	11.08	15.16	21.2	34.2
1.179	185.3	1.547	11.57	15.72	22.0	35.8
1.185	192.9	1.610	12.04	16.28	22.6	37.0
1.193	200.9	1.677	12.54	16.84	23.5	38.6
1.200	208.9	1.743	13.04	17.40	24.2	40.0
1.209	217.2	1.813	13.56	17.97	25.1	41.8
1.216	225.3	1.880	14.06	18.53	25.8	43.2
1.224	233.6	1.950	14.59	19.09	26.5	44.8
1.231	241.9	2.019	15.10	19.65	27.2	46.2
1.240	250.6	2.092	15.65	20.21	28.1	48.0
1.246	258.8	2.160	16.16	20.77	28.6	49.2
1.255	267.7	2.234	16.72	21.33	29.5	51.0
1.263	276.5	2.308	17.26	21.90	30.2	52.6
1.271	285.4	2.382	17.82	22.46	30.9	54.2
1.280	294.6	2.459	18.39	23.02	31.7	56.0
1.288	303.7	2.535	18.96	23.58	32.4	57.6
1.295	312.6	2.609	19.52	24.14	33.0	59.0
1.304	322.1	2.688	20.11	24.70	33.8	60.8
1.310	331.0	2.762	20.66	25.26	34.3	62.0
1.320	340.9	2.845	21.28	25.83	35.2	64.0
1.330	350.9	2.929	21.91	26.39	36.0	66.0
1.337	360.3	3.007	22.49	26.95	36.6	67.4
1.346	370.3	3.090	23.12	27.51	37.3	69.2
1.353	379.8	3.170	23.71	28.07	37.8	70.6
1.362	390.0	3.255	24.35	28.63	38.5	72.4
1.370	400.0	3.338	24.97	29.19	39.2	74.0
1.380	410.6	3.427	25.64	29.76	39.9	76.0
1.390	421.4	3.517	26.31	30.32	40.7	78.0
1.399	432.0	3.605	26.97	30.88	41.4	79.8
1.406	442.0	3.689	27.60	31.44	41.9	81.2
1.416	453.1	3.782	28.29	32.00	42.6	83.2
1.425	464.0	3.872	28.97	32.56	43.2	85.0
1.435	475.3	3.967	29.68	33.12	44.0	87.0
1.445	486.8	4.062	30.39	33.69	44.7	89.0

SPECIFIC GRAVITY OF AUQEOUS SOLUTIONS

% by weight	AgF $d\frac{18°}{4°}$C.	$AgNO_3$ $d\frac{20°}{4°}$C.	$Al(NO_3)_3$ $d\frac{18°}{4°}$C.	$AuCl_3$ $d\frac{15°}{4°}$C.	$Ba(C_2H_3O_2)_2$ $d\frac{18°}{4°}$C.	$BaBr_2$ $d\frac{20°}{4°}$C.	BaI_2 $d\frac{20°}{4°}$C.	$Ba(NO_3)_2$ $d\frac{18°}{4°}$C.	$Be(NO_3)_2$ $d\frac{18°}{4°}$C.	$CaBr_2$ $d\frac{20°}{4°}$C.	$Ca(C_2H_3O_2)_2$ $d\frac{18°}{4°}$C.
1	1.0088	1.0070	1.0065	1.0060	1.0059	.....	.....	.....	.....	.....	1.0043
2	1.0191	1.0154	1.0144	1.0132	1.0133	1.0156	1.0154	1.0151	1.0108	1.0152	1.0100
3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	1.0399	1.0327	1.0305	1.0281	1.0282	1.0335	1.0331	1.0320	1.0233	1.0326	1.0215
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	1.0613	1.0506	1.0469	1.0434	1.0433	1.0519	1.0513	1.0494	1.0361	1.0504	1.0331
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	1.0838	1.0690	1.0638	1.0591	1.0587	1.0710	1.0701	1.0674	1.0491	1.0688	1.0447
9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	1.1071	1.0882	1.0811	1.0750	1.0745	1.0907	1.0896	.....	1.0624	1.0877	1.0563
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	1.1316	1.1080	1.0989	.....	1.0908	1.1111	1.1099	.....	1.0761	1.1071	1.0679
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	1.1572	1.1284	1.1171	.....	1.1075	1.1323	1.1308	.....	1.0902	1.1272	1.0795
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	1.1837	1.1495	1.1357	.....	1.1246	1.1543	1.1525	.....	1.1046	1.1480	1.0912
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	1.2110	1.1715	1.1549	.....	1.1421	1.1770	1.1750	.....	1.1193	1.1696	1.1029
19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	1.2394	1.1942	1.1745	.....	1.1599	1.2006	1.1984	.....	1.1344	1.1919	1.1146
21	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	.....	.....	1.1946	.....	1.1782	.....	.....	.....	1.1499	.....	1.1263
23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	.....	.....	1.2153	.....	1.1970	.....	.....	.....	1.1657	.....	.....
25	1.3146	1.2545	.....	.....	.....	1.2634	1.2610	.....	.....	1.2499	.....
30	1.40	1.3205	1.2805	.....	1.2554	1.3325	1.3289	.....	.....	1.3125	.....
35	1.48	1.3931	.....	.....	1.3069	1.4087	1.404	.....	.....	1.381	.....
40	1.58	1.4743	.....	.....	1.3608	1.4926	1.490	.....	.....	1.457	.....
45	1.70	1.565	.....	.....	.....	.....	1.587	.....	.....	1.541	.....
50	1.85	1.668	.....	.....	.....	.....	1.698	.....	.....	1.635	.....
60	2.26	1.916	.....	.....	.....	.....	1.970	.....	.....	.....	.....
70	.....	2.2333	.....	.....	.....	.....	.....	.....	.....	.....	.....
80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS

% by weight	CaI_2 $d\frac{20°}{4°}$ C.	$Ca(NO_3)_2$ $d\frac{18°}{4°}$ C.	$CdBr_2$ $d\frac{20°}{4°}$ C.	$CdCl_2$ $d\frac{20°}{4°}$ C.	CdI_2 $d\frac{20°}{4°}$ C.	$CdSO_4$ $d\frac{18°}{4°}$ C.	$Ce_2(SO_4)_3$ $d\frac{15°}{4°}$ C.	$CoCl_2$ $d\frac{20°}{4°}$ C.	$Co(NO_3)_2$ $d\frac{20°}{4°}$ C.	$CrBr_3$ $d\frac{18°}{4°}$ C.	$CrCl_3$-violet $d\frac{18°}{4°}$ C.
1	.....	.....	.....	.....	.....	1.0086	1.0090	1.0073	1.0064	1.0074	1.0076
2	1.0150	1.0137	1.0158	1.0159	1.0153	1.0182	1.0190	1.0165	1.0145	1.0162	1.0166
3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	1.0323	1.0291	1.0339	1.0339	1.0328	1.0383	1.0395	1.0350	1.0315	1.0344	1.0349
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	1.0500	1.0448	1.0524	1.0524	1.0507	1.0590	1.0606	1.0538	1.0485	1.0532	1.0535
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	1.0683	1.0608	1.0714	1.0715	1.0690	1.0803	1.0823	1.0735	1.0660	1.0726	1.0724
9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	1.0873	1.0771	1.0910	1.0912	1.0879	1.1023	1.1047	1.0940	1.084	1.0926	1.0917
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	1.1069	1.0937	1.1112	1.1115	1.1075	1.1250	1.1279	1.1150	1.103	1.1132	1.1114
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	1.1273	1.1106	1.1322	1.1324	1.1278	1.1485	1.1520	1.1365	1.122	1.1345	1.1316
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	1.1485	1.1279	1.1540	1.1540	1.1489	1.1729	1.1770	1.1585	1.142	1.1565	.....
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	1.1703	1.1455	1.1766	1.1762	1.1709	1.1982	1.2030	1.1815	1.163	1.1794	.....
19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	1.1928	1.1636	1.2000	1.1992	1.1937	1.2243	1.2300	1.2050	1.184	1.2031	.....
21	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	.....	.....	.....	.....	.....	.....	1.2582	.....	.....	1.2277	.....
23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	.....	.....	.....	.....	.....	.....	1.2876	.....	.....	1.2532	.....
25	1.2530	1.2106	1.2605	1.2604	1.2546	1.2940	.....	.....	1.239	.....	.....
30	1.3195	1.260	1.3286	1.3273	1.3219	1.3714	.....	.....	1.299	1.3355	.....
35	1.3928	1.311	1.4049	1.4010	1.3967	1.4551	.....	.....	.....	.....	.....
40	1.4734	1.365	1.4902	1.4833	1.4801	1.5470	.....	.....	.....	.....	.....
45	.....	1.422	.....	1.5748	1.5726	.....	.....	.....	.....	.....	.....
50	.....	.....	.....	1.6762	.....	.....	.....	.....	.....	.....	.....
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS

% by weight	$CrCl_3$-green $d\frac{18°}{4°}$C.	CsBr $d\frac{20°}{4°}$C.	CsCl $d\frac{20°}{4°}$C.	CsI $d\frac{20°}{4°}$C.	$CsNO_3$ $d\frac{20°}{4°}$C.	Cs_2SO_4 $d\frac{20°}{4°}$C.	$FeSO_4 \cdot (NH_4)_2SO_4$ $d\frac{25°}{4°}$C.	$Fe_2(SO_4)_3 \cdot (NH_4)_2SO_4$ $d\frac{15°}{4°}$C.	HBr $d\frac{20°}{4°}$C.	$HClO_3$ $d\frac{18°}{4°}$C.	$HClO_4$ $d\frac{15°}{4°}$C.
1	1.0071	1.00612	1.00593	1.00608	1.00566	1.0061	1.005	1.0072	1.0053	1.0044	1.0050
2	1.0157	1.01412	1.01374	1.01402	1.01319	1.0144	1.013	1.0157	1.0124	1.0103	1.0109
3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	1.0332	1.03048	1.02969	1.03029	1.02859	1.0316	1.029	1.0324	1.0269	1.0222	1.0228
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	1.0510	1.04734	1.04609	1.04707	1.04443	1.0494	1.045	1.0498	1.0417	1.0344	1.0348
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	1.0691	1.06472	1.06297	1.06438	1.06072	1.0676	1.062	1.0675	1.0568	1.0468	1.0471
9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	1.0876	1.08265	1.08036	1.08225	1.07745	1.0870	1.080	1.0856	1.0723	1.0594	1.0597
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	1.1065	1.10116	1.09828	1.10071	1.09463	1.1071	1.098	1.1038	1.0883	1.0723	1.0726
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	.....	1.12029	1.11676	1.11979	1.11227	1.1275	1.116	1.1224	1.1048	1.0856	1.0859
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	.....	1.14007	1.13582	1.13953	.....	1.1484	.....	1.1412	1.1219	1.0991	1.0995
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	.....	1.16053	1.15549	1.15996	.....	1.1696	.....	1.1609	1.1396	1.1130	1.1135
19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	1.18170	1.17580	1.18112	.....	1.1913	.....	1.1809	1.1579	1.1273	1.1279
21	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	.....	1.20362	1.19679	1.20305	.....	1.2137	.....	.....	1.1767	1.1419	1.1428
23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	.....	1.22634	1.21849	1.22580	.....	1.2375	.....	.....	1.1961	1.1568	1.1581
25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
30	.....	1.29973	1.28817	1.29944	.....	.....	.....	.....	1.2580	.....	1.2067
35	.....	1.36764	1.35218	1.36776	.....	.....	.....	.....	1.3150	.....	.....
40	.....	1.44275	1.42245	1.44354	.....	.....	.....	1.3799	1.3772	.....	1.2991
45	.....	1.52626	1.49993	1.52803	.....	.....	.....	.....	1.4446	.....	1.3521
50	.....	1.61970	1.58575	1.62278	.....	.....	.....	.....	1.5173	.....	1.4103
60	.....	.....	1.78859	.....	.....	.....	.....	.....	1.6787	.....	1.5389
70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.6736
80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS

% by weight	HF $d\frac{20°}{4°}$ C.	HI $d\frac{20°}{4°}$ C.	HIO_3 $d\frac{18°}{4°}$ C.	HIO_4 $d\frac{17°}{4°}$ C.	H_2O_2 $d\frac{18°}{4°}$ C.	H_2SeO_4 $d\frac{20°}{4°}$ C.	$HgCl_2$ $d\frac{20°}{4°}$ C.	$KC_2H_3O_2$ $d\frac{18°}{4°}$ C.	$KBrO_3$ $d\frac{20°}{4°}$ C.	KCNS $d\frac{18°}{4°}$ C.	$KClO_3$ $d\frac{20°}{4°}$ C.
1	.....	1.0054	1.0071	1.0076	1.0022	1.0059	1.0065	1.0038	1.0056	1.0035	1.0045
2	.....	1.0127	1.0157	1.0165	1.0058	1.0136	1.0150	1.0089	1.0131	1.0085	1.0109
3	.....	.....	.....	.....	.....	.....	1.0236	.....	1.0206	.....	1.0174
4	.....	1.0277	1.0334	1.0349	1.0131	1.0291	1.0323	1.0191	1.0282	1.0186	1.0241
5	1.017	.....	.....	.....	.....	.....	1.0411	.....	1.0359	.....	.....
6	.....	1.0431	1.0517	1.0539	1.0204	1.0447	.....	1.0293	.....	1.0288	.....
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	.....	1.0589	1.0706	1.0737	1.0277	1.0605	.....	1.0395	.....	1.0391	.....
9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	1.035	1.0751	1.0900	1.0944	1.0351	1.0766	.....	1.0497	.....	1.0495	.....
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	.....	1.0918	1.1100	1.1161	1.0425	1.0931	.....	1.0599	.....	1.0601	.....
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	.....	1.1091	1.1306	1.1388	1.0499	1.1101	.....	1.0703	.....	1.0708	.....
15	1.053	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	.....	1.1270	1.1519	1.1623	1.0574	1.1276	.....	1.0808	.....	1.0817	.....
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	.....	1.1456	1.1740	1.1865	1.0649	1.1455	.....	1.0914	.....	1.0927	.....
19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	1.070	1.1649	1.1969	1.2116	1.0725	1.1639	.....	1.1022	.....	1.1039	.....
21	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	.....	1.1850	1.2206	1.2376	1.0802	1.1829	.....	1.1131	.....	1.1152	.....
23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	.....	1.2059	1.2450	1.2647	1.0880	1.2026	.....	1.1241	.....	1.1266	.....
25	1.086	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
30	1.101	1.2737	1.3218	1.3545	1.1122	1.2653	.....	1.1579	.....	1.1618	.....
35	1.116	1.3357	1.3900	.....	1.1327	.....	.....	1.1868	.....	1.1899	.....
40	1.130	1.4029	1.4640	.....	1.1536	1.3819	.....	1.2162	.....	1.2200	.....
45	1.143	1.4755	.....	.....	1.1749	.....	.....	1.2460	.....	1.2517	.....
50	1.155	.....	.....	.....	1.1966	1.5186	.....	1.2761	.....	1.2849	.....
60	.....	.....	.....	.....	1.2416	1.6850	.....	1.3372	.....	1.3554	.....
70	.....	.....	.....	.....	1.2897	1.8870	.....	.....	.....	1.4307	.....
80	.....	.....	.....	.....	1.3406	2.1220	.....	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS

% by weight	KF $d\frac{18°}{4°}$C.	$KHSO_4$ $d\frac{20°}{4°}$C.	$K_3Fe(CN)_6$ $d\frac{20°}{4°}$C.	$K_4Fe(CN)_6$ $d\frac{20°}{4°}$C.	KIO_3 $d\frac{20°}{4°}$C.	KN_3 $d\frac{20°}{4°}$C.	$La(NO_3)_3$ $d\frac{18°}{4°}$C.	LiBr $d\frac{20°}{4°}$C.	LiCl $d\frac{20°}{4°}$C.	LiI $d\frac{20°}{4°}$C.	$LiNO_3$ $d\frac{20°}{4°}$C.
1	1.0072	1.0051	1.0034	1.0051	1.0068	1.0037	1.0076	1.0055	1.0041	1.0056	1.00409
2	1.0159	1.0120	1.0090	1.0119	1.0155	1.0093	1.0167	1.0128	1.0099	1.0131	1.01002
3	.....	.....	.....	.....	1.0243	.....	.....	.....	.....	.....	.....
4	1.0334	1.0260	1.0201	1.0256	.....	1.0206	1.0353	1.0277	1.0215	1.0284	1.02198
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	1.0512	1.0403	1.0314	1.0395	.....	1.0319	1.0545	1.0429	1.0330	1.0442	1.03413
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	1.0693	1.0549	1.0427	1.0536	.....	1.0434	1.0742	1.0585	1.0444	1.0604	1.04647
9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	1.0877	1.0698	1.0542	1.0678	.....	1.0550	1.0945	1.0746	1.0559	1.0771	1.05903
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	1.1064	1.0850	1.0656	1.0823	.....	1.0669	1.1153	1.0910	1.0675	1.0943	1.07181
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	1.1254	1.1004	1.0774	1.0971	.....	1.0790	1.1368	1.1079	1.0792	1.1120	1.08482
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	1.1448	1.1161	1.0890	1.1120	.....	1.0913	1.1589	1.1253	1.0910	1.1303	1.09807
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	1.1646	.....	1.1010	.....	.....	1.1036	1.1817	1.1432	1.1029	1.1492	1.11159
19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	1.1847	.....	1.1130	.....	.....	1.1161	1.2052	1.1616	1.1150	1.1688	1.12539
21	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	1.2052	.....	.....	.....	.....	1.1288	1.2295	1.1806	1.1274	1.1890	1.13948
23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	1.2260	.....	.....	.....	.....	1.1417	1.2547	1.2002	1.1399	1.2099	1.15387
25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
30	.....	.....	.....	.....	.....	1.1809	1.3360	1.2629	1.1791	1.2772	1.19879
35	.....	.....	.....	.....	.....	.....	.....	1.3204	.....	1.3393	1.2392
40	.....	.....	.....	.....	.....	.....	.....	1.3836	.....	1.4078	1.2837
45	.....	.....	.....	.....	.....	.....	.....	1.4535	.....	1.4840	.....
50	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.5692	.....
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.7748	.....
70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS

% by weight	LiOH $d\frac{20°}{4°}$ C.	Li_2SO_4 $d\frac{20°}{4°}$ C.	$MgBr_2$ $d\frac{20°}{4°}$ C.	MgI_2 $d\frac{20°}{4°}$ C.	$Mg(NO_3)_2$ $d\frac{20°}{4°}$ C.	$MnBr_2$ $d\frac{18°}{4°}$ C.	$MnCl_2$ $d\frac{18°}{4°}$ C.	$Mn(NO_3)_2$ $d\frac{18°}{4°}$ C.	$MnSO_4$ $d\frac{20°}{4°}$ C.	N_2H_4 $d\frac{15°}{4°}$ C.	NH_4Br $d\frac{25°}{4°}$ C.
1	1.0102	1.0068	.....	.....	.....	1.0071	1.0069	1.0063	1.0080	1.0002	1.0027
2	1.0217	1.0155	1.0151	1.0149	1.0132	1.0157	1.0153	1.0140	1.0178	1.0013	1.0084
3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	1.0437	1.0329	1.0324	1.0321	1.0285	1.0332	1.0324	1.0298	1.0378	1.0034	1.0198
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	1.0650	1.0505	1.0501	1.0498	1.0441	1.0511	1.0498	1.0459	1.0583	1.0056	1.0314
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	1.0862	1.0684	1.0683	1.0680	1.0600	1.0695	1.0676	1.0624	1.0794	1.0077	1.0432
9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	1.1074	1.0863	1.0871	1.0869	1.0762	1.0886	1.0859	1.0794	1.1012	1.0099	1.0552
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	.....	1.1044	1.1065	1.1065	1.0928	1.1083	1.1046	1.0969	1.1236	1.0121	1.0674
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	.....	1.1228	1.1265	1.1268	1.1098	1.1287	1.1238	1.1149	1.1467	1.0143	1.0799
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	.....	1.1411	1.1471	1.1478	1.1272	1.1498	1.1435	1.1333	1.1705	1.0164	1.0927
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	.....	1.1599	1.1683	1.1695	1.1449	1.1716	1.1638	1.1522	1.1950	1.0186	1.1058
19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	.....	1.1789	1.1903	1.1920	1.1630	1.1942	1.1846	1.1717	.....	1.0207	1.1191
21	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	.....	1.1984	.....	.....	1.1815	1.2176	1.2061	1.1918	.....	1.0228	1.1327
23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	.....	1.2182	.....	.....	1.2004	1.2419	1.2283	1.2125	.....	1.0248	1.1466
25	.....	.....	1.2482	1.2519	.....	.....	.....	.....	.....	.....	.....
30	.....	.....	1.3110	1.3180	.....	1.3206	1.2988	1.2781	.....	1.0305	1.1901
35	.....	.....	1.379	1.3914	.....	.....	.....	1.3367	.....	1.035	.....
40	.....	.....	1.452	1.4730	.....	.....	.....	1.3993	.....	1.038	1.2702
45	.....	.....	1.532	.....	.....	.....	.....	1.4662	.....	1.042	.....
50	.....	.....	.....	.....	.....	.....	.....	1.5378	.....	1.044	.....
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.047	.....
70	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.046	.....
80	.....	.....	.....	.....	.....	.....	.....	.....	.....	1.040	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS

% by weight	$NH_4C_2H_3O_2$ $d\frac{25°}{4°}$C.	$(NH_4)_2CO_3$ $d\frac{15°}{4°}$C.	NH_4F $d\frac{18°}{4°}$C.	NH_4I $d\frac{18°}{4°}$C.	NH_2OH $d\frac{20°}{4°}$C.	$NaBrO_3$ $d\frac{18°}{4°}$C.	$NaClO_4$ $d\frac{18°}{4°}$C.	$NaHCO_3$ $d\frac{18°}{4°}$C.	NaN_3 $d\frac{20°}{4°}$C.	Na_2S $d\frac{18°}{4°}$C.
1	0.9992	1.0026	1.0034	1.0050	1.0002	1.0064	1.0051	1.0059	1.0040	1.0098
2	1.0013	1.0061	1.0085	1.0114	1.0023	1.0143	1.0116	1.0132	1.010	1.0211
3	.....	.....	.....	.....	.....	.....	.....	1.0206	.....	.....
4	1.0055	1.0130	1.0178	1.0244	1.0065	1.0305	1.0247	1.0280	1.022	1.0440
5	.....	.....	.....	.....	.....	.....	.....	1.0354	.....	.....
6	1.0096	1.0199	1.0265	1.0377	1.0107	1.0471	1.0381	1.0429	1.034	1.0672
7	.....	.....	.....	.....	.....	.....	.....	1.0505	.....	.....
8	1.0136	1.0267	1.0346	1.0513	1.0149	1.0641	1.0517	1.0581	1.047	1.0907
9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	1.0176	1.0335	1.0420	1.0652	1.0192	1.0816	1.0656	.....	1.059	1.1146
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	1.0216	1.0403	1.0487	1.0795	1.0235	1.0996	1.0798	.....	1.072	1.1388
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	1.0255	1.0471	1.0547	1.0942	1.0278	1.1182	1.0943	.....	1.085	1.1634
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	1.0294	1.0539	.....	1.1093	1.0322	1.1373	1.1090	.....	1.099	1.1885
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	1.0331	1.0607	.....	1.1248	1.0366	1.1569	1.1241	.....	1.112	1.2140
19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	1.0368	1.0675	.....	1.1407	1.0410	1.1771	1.1396	.....	1.126	.....
21	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	1.0404	1.0742	.....	1.1570	1.0454	1.1979	1.1554	.....	1.140	.....
23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	1.0439	1.0808	.....	1.1737	1.0499	1.2193	1.1717	.....	1.155	.....
25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
30	1.0540	1.1006	.....	1.2265	1.0637	1.3565	1.2227	.....	1.202	.....
35	1.0618	1.1157	.....	1.2745	1.0755	.....	.....	.....	.....	.....
40	1.0691	1.1294	.....	1.3264	1.0875	.....	.....	.....	.....	.....
45	1.0760	1.1417	.....	1.3823	1.0997	.....	.....	.....	.....	.....
50	.....	.....	.....	.....	1.1122	.....	.....	.....	.....	.....
60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS

% by weight	Na_2WO_4 $d\frac{20°}{4°}$C.	$NiBr_2$ $d\frac{18°}{4°}$C.	$Ni(NO_3)_2$ $d\frac{18°}{4°}$C.	$Pb(C_2H_3O_2)_2$ $d\frac{18°}{4°}$C.	$Pb(NO_3)_2$ $d\frac{18°}{4°}$C.	RbBr $d\frac{20°}{4°}$C.	RbCl $d\frac{20°}{4°}$C.	RbI $d\frac{20°}{4°}$C.	$RbNO_3$ $d\frac{20°}{4°}$C.	Rb_2SO_4 $d\frac{20°}{4°}$C.
1	1.0074	1.0078	1.0070	1.0061	1.0074	1.00593	1.00561	1.00591	1.0053	1.0066
2	1.0166	1.0170	1.0155	1.0137	1.0163	1.01372	1.01307	1.01370	1.0125	1.0150
3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	1.0354	1.0359	1.0330	1.0290	1.0344	1.02965	1.02825	1.02963	1.0272	1.0322
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	1.0546	1.0555	1.0508	1.0446	1.0529	1.04604	1.04379	1.04604	1.0422	1.0499
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	1.0742	1.0758	1.0693	1.0605	1.0720	1.06291	1.05971	1.06296	1.0575	1.0680
9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	1.0944	1.0969	1.0882	1.0768	1.0918	1.08028	1.07604	1.08041	1.0731	1.0864
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	1.1154	1.1188	1.1076	1.0936	1.1123	1.09817	1.09281	1.09842	1.0892	1.1052
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	1.1372	1.1414	1.1277	1.1109	1.1336	1.11661	1.11004	1.11701	1.1057	1.1246
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	1.1598	1.1648	1.1484	1.1283	1.1557	1.13563	1.12775	1.13621	1.1227	1.1446
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	1.1833	1.1889	1.1696	1.1473	1.1789	1.15526	1.14596	1.15605	1.1401	1.1652
19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	1.2076	1.2140	1.1914	1.1663	1.2030	1.17554	1.16469	1.17657	1.1580	1.1864
21	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	1.2328	.....	.....	1.1860	1.2277	1.19650	1.18396	1.19781	1.1763	1.2083
23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	1.2590	.....	.....	1.2063	1.2529	1.21817	1.20379	1.21980	1.1952	1.2309
25	.....	1.2615	1.2493	.....	.....	.....	.....	.....	.....	.....
30	1.3444	.....	1.3114	1.2711	1.3289	1.28784	1.26691	1.29061	1.2552	1.3028
35	.....	.....	1.3777	1.3304	.....	1.35191	1.32407	1.35598	.....	.....
40	1.5156	.....	.....	1.3994	.....	1.42233	1.38599	1.42806	.....	.....
45	.....	.....	.....	.....	.....	1.50010	1.45330	1.50792	.....	.....
50	.....	.....	.....	.....	.....	1.58639	1.52675	1.59691	.....	.....
60	.....	.....	.....	.....	.....	.....	.....	1.80924	.....	.....
70	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

SPECIFIC GRAVITY OF AQUEOUS SOLUTIONS

% by weight	$Sa(NO_3)_3$ $d\frac{18°}{4°}$C.	SO_2 $d\frac{15.5°}{4°}$C.	$SrBr_2$ $d\frac{20°}{4°}$C.	$SrCl_2$ $d\frac{20°}{4°}$C.	SrI_2 $d\frac{20°}{4°}$C.	$Sr(NO_3)_2$ $d\frac{20°}{4°}$C.	$UO_2(NO_3)_2$ $d\frac{17°}{4°}$C.	WO_3 $d\frac{17.5°}{4°}$C.	$ZnBr_2$ $d\frac{20°}{4°}$C.	ZnI_2 $d\frac{20°}{4°}$C.
1	1.0061	1.0040	.....	.....	.....	.....	1.008	1.0078	.....	.....
2	1.0136	1.0091	1.0157	1.0161	1.0154	1.015	1.017	1.0170	1.0167	1.016
3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	1.0289	1.0191	1.0337	1.0344	1.0331	1.031	1.036	1.0357	1.0354	1.034
5	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	1.0445	1.0292	1.0522	1.0532	1.0513	1.048	1.054	1.0550	1.0544	1.053
7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
8	1.0604	1.0393	1.0712	1.0726	1.0701	1.065	1.072	1.075	1.0738	1.072
9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	1.0766	1.0493	1.0907	1.0925	1.0896	1.083	1.091	1.096	1.0935	1.091
11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	1.0931	.....	1.1109	1.1130	1.1099	1.101	1.110	1.118	1.1135	1.111
13	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	1.1099	.....	1.1317	1.1341	1.1308	1.119	1.129	1.141	1.1338	1.131
15	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	1.1271	.....	1.1532	1.1558	1.1526	1.138	1.149	1.166	1.1544	1.152
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	1.1447	.....	1.1757	1.1781	1.1753	1.158	1.171	1.191	1.1753	1.174
19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	1.1628	.....	1.1992	1.2010	1.1990	1.179	1.194	1.217	1.1965	1.197
21	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
22	1.1814	.....	.....	.....	.....	.....	1.218	1.244	.....	.....
23	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
24	1.2005	.....	.....	.....	.....	.....	1.243	1.272	.....	.....
25	.....	.....	1.2620	1.2600	1.2608	1.233	.....	.....	1.2543	1.258
30	.....	.....	1.3300	1.3250	1.3295	1.290	1.322	1.363	1.3170	1.325
35	.....	.....	1.4050	1.3960	1.4058	1.352	.....	.....	1.3859	1.398
40	.....	.....	1.4890	.....	1.4904	1.419	1.466	1.546	1.4620	1.478
45	.....	.....	1.5830	.....	1.5844	.....	.....	.....	1.5470	1.566
50	.....	.....	1.6860	.....	.....	.....	1.649	.....	1.6430	1.663
60	.....	.....	.....	.....	.....	.....	.....	.....	1.8690	1.893
70	.....	.....	.....	.....	.....	.....	.....	.....	.....	2.202
80	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

ETHYL ALCOHOL

Specific gravity of aqueous solutions of ethyl alcohol at $\frac{15.56°}{15.56°}$ C. To convert to specific gravity at $\frac{15.56°}{4°}$ C, multiply the specific gravities as given in the table by 0.99908.

(U. S. Dept. of Agriculture.)

Specific gravity $\frac{15.56°}{15.56°}$C.	% Alcohol by volume	% Alcohol by weight	Grams Alcohol per 100 cc
1.00000	0.00	0.00	0.00
0.99984	0.10	0.08	0.08
0.99968	0.20	0.16	0.16
0.99953	0.30	0.24	0.24
0.99937	0.40	0.32	0.32
0.99923	0.50	0.40	0.40
0.99907	0.60	0.48	0.48
0.99892	0.70	0.56	0.56
0.99877	0.80	0.64	0.64
0.99861	0.90	0.71	0.71
0.99849	1.00	0.79	0.79
0.99834	1.10	0.87	0.87
0.99819	1.20	0.95	0.95
0.99805	1.30	1.03	1.03
0.99790	1.40	1.11	1.11
0.99775	1.50	1.19	1.19
0.99760	1.60	1.27	1.27
0.99745	1.70	1.35	1.35
0.99731	1.80	1.43	1.43
0.99716	1.90	1.51	1.51
0.99701	2.00	1.59	1.59
0.99687	2.10	1.67	1.66
0.99672	2.20	1.75	1.74
0.99658	2.30	1.83	1.82
0.99643	2.40	1.91	1.90
0.99629	2.50	1.99	1.98
0.99615	2.60	2.07	2.06
0.99600	2.70	2.15	2.14
0.99586	2.80	2.23	2.22
0.99571	2.90	2.31	2.30
0.99557	3.00	2.39	2.38
0.99543	3.10	2.47	2.46
0.99529	3.20	2.55	2.54
0.99515	3.30	2.64	2.62
0.99501	3.40	2.72	2.70
0.99487	3.50	2.80	2.78
0.99473	3.60	2.88	2.86
0.99459	3.70	2.96	2.94
0.99445	3.80	3.04	3.02
0.99431	3.90	3.12	3.10
0.99417	4.00	3.20	3.18
0.99403	4.10	3.28	3.26
0.99390	4.20	3.36	3.34
0.99376	4.30	3.44	3.42
0.99363	4.40	3.52	3.50
0.99349	4.50	3.60	3.58
0.99335	4.60	3.68	3.66
0.99322	4.70	3.76	3.74
0.99308	4.80	3.84	3.81
0.99295	4.90	3.92	3.89
0.99281	5.00	4.00	3.97
0.99268	5.10	4.08	4.05
0.99255	5.20	4.16	4.13
0.99241	5.30	4.24	4.21
0.99228	5.40	4.32	4.29
0.99215	5.50	4.40	4.37
0.99202	5.60	4.48	4.44
0.99189	5.70	4.56	4.52
0.99175	5.80	4.64	4.60
0.99162	5.90	4.72	4.68
0.99149	6.00	4.80	4.76
0.99136	6.10	4.88	4.84
0.99123	6.20	4.96	4.92
0.99111	6.30	5.05	5.00
0.99098	6.40	5.13	5.08
0.99085	6.50	5.21	5.16
0.99072	6.60	5.29	5.24
0.99059	6.70	5.37	5.32
0.99047	6.80	5.45	5.40
0.99034	6.90	5.53	5.48
0.99021	7.00	5.61	5.56
0.99009	7.10	5.69	5.64
0.98996	7.20	5.77	5.72
0.98984	7.30	5.86	5.80
0.98971	7.40	5.94	5.88
0.98959	7.50	6.02	5.96
0.98947	7.60	6.10	6.04
0.98934	7.70	6.18	6.11
0.98922	7.80	6.26	6.19
0.98909	7.90	6.34	6.27
0.98897	8.00	6.42	6.35
0.98885	8.10	6.50	6.43
0.98873	8.20	6.58	6.51
0.98861	8.30	6.67	6.59
0.98849	8.40	6.75	6.67
0.98837	8.50	6 83	6.75
0.98825	8.60	6.91	6 83
0.98813	8.70	6.99	6.91
0.98801	8.80	7.07	6.99
0.98789	8.90	7.15	7.07
0.98777	9.00	7.23	7.14
0.98765	9.10	7.31	7.22
0.98754	9.20	7.39	7.30
0.98742	9.30	7.48	7.38
0.98730	9.40	7.56	7.46
0.98719	9.50	7.64	7.54
0.98707	9.60	7.72	7.62
0.98695	9.70	7.80	7.70
0.98683	9.80	7.88	7.78
0.98672	9.90	7.96	7.85
0.98660	10.00	8.04	7.93
0.98649	10.10	8.12	8.01
0.98637	10.20	8.20	8.09
0.98626	10.30	8.29	8.17
0.98614	10.40	8.37	8.25
0.98603	10.50	8.45	8.33
0.98592	10.60	8.53	8.41
0.98580	10.70	8.61	8.49
0.98569	10.80	8.70	8.57
0.98557	10.90	8.78	8.65

AQUEOUS ETHYL ALCOHOL AT $\frac{15.56°}{15.56°}$ C. (Continued)

Specific gravity $\frac{15.56°C.}{15.56°C.}$	% Alcohol by volume	% Alcohol by weight	Grams alcohol per 100 cc
0.98546	11.00	8.86	8.73
0.98535	11.10	8.94	8.81
0.98524	11.20	9.02	8.89
0.98513	11.30	9.11	8.97
0.98502	11.40	9.19	9.05
0.98491	11.50	9.27	9.13
0.98479	11.60	9.35	9.21
0.98468	11.70	9.43	9.29
0.98457	11.80	9.51	9.36
0.98446	11.90	9.59	9.44
0.98435	12.00	9.67	9.52
0.98424	12.10	9.75	9.60
0.98413	12.20	9.83	9.68
0.98402	12.30	9.92	9.76
0.98391	12.40	10.00	9.84
0.98381	12.50	10.08	9.92
0.98370	12.60	10.16	10.00
0.98359	12.70	10.24	10.07
0.98348	12.80	10.33	10.15
0.98337	12.90	10.41	10.23
0.98326	13.00	10.49	10.31
0.98315	13.10	10.57	10.39
0.98305	13.20	10.65	10.47
0.98294	13.30	10.74	10.55
0.98283	13.40	10.82	10.63
0.98273	13.50	10.90	10.71
0.98262	13.60	10.98	10.79
0.98251	13.70	11.06	10.87
0.98240	13.80	11.15	10.95
0.98230	13.90	11.23	11.03
0.98219	14.00	11.31	11.11
0.98209	14.10	11.39	11.19
0.98198	14.20	11.47	11.27
0.98188	14.30	11.56	11.35
0.98177	14.40	11.64	11.43
0.98167	14.50	11.72	11.51
0.98156	14.60	11.80	11.59
0.98146	14.70	11.88	11.67
0.98135	14.80	11.97	11.75
0.98125	14.90	12.05	11.82
0.98114	15.00	12.13	11.90
0.98104	15.10	12.21	11.98
0.98093	15.20	12.29	12.06
0.98083	15.30	12.38	12.14
0.98073	15.40	12.46	12.22
0.98063	15.50	12.54	12.30
0.98052	15.60	12.62	12.37
0.98042	15.70	12.70	12.45
0.98032	15.80	12.79	12.53
0.98021	15.90	12.87	12.61
0.98011	16.00	12.95	12.69
0.98001	16.10	13.03	12.77
0.97991	16.20	13.12	12.85
0.97980	16.30	13.20	12.93
0.97970	16.40	13.29	13.01
0.97960	16.50	13.37	13.09
0.97950	16.60	13.45	13.17
0.97940	16.70	13.53	13.25
0.97929	16.80	13.62	13.33
0.97917	16.90	13.70	13.41
0.97909	17.00	13.78	13.49
0.97899	17.10	13.86	13.57
0.97889	17.20	13.94	13.65
0.97879	17.30	14.03	13.73
0.97869	17.40	14.11	13.81
0.97859	17.50	14.19	13.89
0.97848	17.60	14.27	13.96
0.97838	17.70	14.35	14.04
0.97828	17.80	14.44	14.12
0.97818	17.90	14.52	14.20
0.97808	18.00	14.60	14.28
0.97798	18.10	14.68	14.36
0.97788	18.20	14.77	14.44
0.97778	18.30	14.85	14.52
0.97768	18.40	14.94	14.60
0.97758	18.50	15.02	14.68
0.97748	18.60	15.10	14.76
0.97738	18.70	15.18	14.84
0.97728	18.80	15.27	14.92
0.97718	18.90	15.38	15.00
0.97708	19.00	15.43	15.08
0.97698	19.10	15.51	15.15
0.97688	19.20	15.59	15.23
0.97678	19.30	15.68	15.31
0.97668	19.40	15.76	15.39
0.97658	19.50	15.84	15.47
0.97648	19.60	15.93	15.55
0.97638	19.70	16.01	15.63
0.97628	19.80	16.09	15.71
0.97618	19.90	16.18	15.79
0.97608	20.00	16.26	15.87
0.97598	20.10	16.34	15.95
0.97588	20.20	16.42	16.03
0.97578	20.30	16.51	16.10
0.97568	20.40	16.59	16.18
0.97558	20.50	16.67	16.26
0.97547	20.60	16.75	16.34
0.97537	20.70	16.84	16.42
0.97527	20.80	16.92	16.50
0.97517	20.90	17.01	16.58
0.97507	21.00	17.09	16.66
0.97497	21.10	17.17	16.74
0.97487	21.20	17.26	16.82
0.97477	21.30	17.34	16.90
0.97467	21.40	17.43	16.98
0.97457	21.50	17.51	17.06
0.97446	21.60	17.59	17.14
0.97436	21.70	17.67	17.22
0.97426	21.80	17.76	17.30
0.97416	21.90	17.84	17.38
0.97406	22.00	17.92	17.46
0.97396	22.10	18.00	17.54
0.97386	22.20	18.09	17.62
0.97375	22.30	18.17	17.70
0.97365	22.40	18.26	17.78
0.97355	22.50	18.34	17.86
0.97345	22.60	18.42	17.94
0.97335	22.70	18.51	18.02
0.97324	22.80	18.59	18.10
0.97314	22.90	18.68	18.18

(Continued on following page.)

AQUEOUS ETHYL ALCOHOL AT $\frac{15.56°}{15.56°}$ C. (Continued)

Specific gravity $\frac{15.56°C.}{15.56°C.}$	% Alcohol by volume	% Alcohol by weight	Grams alcohol per 100 cc
0.97304	23.00	18.76	18.26
0.97294	23.10	18.84	18.33
0.97283	23.20	18.92	18.41
0.97273	23.30	19.01	18.49
0.97263	23.40	19.09	18.57
0.97253	23.50	19.17	18.65
0.97242	23.60	19.25	18.73
0.97232	23.70	19.34	18.18
0.97222	23.80	19.42	18.88
0.97211	23.90	19.51	18.96
0.97201	24.00	19.59	19.04
0.97191	24.10	19.67	19.12
0.97180	24.20	19.76	19.20
0.97170	24.30	19.84	19.28
0.97159	24.40	19.93	19.36
0.97149	24.50	20.01	19.44
0.97139	24.60	20.09	19.52
0.97128	24.70	20.18	19.60
0.97118	24.80	20.26	19.68
0.97107	24.90	20.35	19.76
0.97097	25.00	20.43	19.84
0.97086	25.10	20.51	19.92
0.97076	25.20	20.60	20.00
0.97065	25.30	20.68	20.08
0.97055	25.40	20.77	20.16
0.97044	25.50	20.85	20.24
0.97033	25.60	20.93	20.32
0.97023	25.70	21.02	20.40
0.97012	25.80	21.10	20.47
0.97001	25.90	21.19	20.55
0.96991	26.00	21.27	20.63
0.96980	26.10	21.35	20.71
0.96969	26.20	21.44	20.79
0.96959	26.30	21.52	20.87
0.96949	26.40	21.61	20.95
0.96937	26.50	21.69	21.03
0.96926	26.60	21.77	21.11
0.96915	26.70	21.86	21.19
0.96905	26.80	21.94	21.27
0.96894	26.90	22.03	21.35
0.96883	27.00	22.11	21.43
0.96872	27.10	22.20	21.51
0.96861	27.20	22.28	21.59
0.96850	27.30	22.37	21.67
0.96839	27.40	22.45	21.75
0.96828	27.50	22.54	21.83
0.96816	27.60	22.62	21.90
0.96805	27.70	22.71	21.98
0.96794	27.80	22.79	22.06
0.96783	27.90	22.88	22.14
0.96772	28.00	22.96	22.22
0.96761	28.10	23.04	22.30
0.96749	28.20	23.13	22.38
0.96738	28.30	23.21	22.45
0.96726	28.40	23.30	22.53
0.96715	28.50	23.38	22.61
0.96704	28.60	23.47	22.69
0.96692	28.70	23.55	22.77
0.96681	28.80	23.64	22.85
0.96669	28.90	23.72	22.93

Specific gravity $\frac{15.56°C.}{15.56°C.}$	% Alcohol by volume	% Alcohol by weight	Grams alcohol per 100 cc
0.96658	29.00	23.81	23.01
0.96646	29.10	23.89	23.09
0.96635	29.20	23.98	23.17
0.96623	29.30	24.06	23.25
0.96611	29.40	24.15	23.33
0.96600	29.50	24.23	23.41
0.96587	29.60	24.32	23.49
0.96576	29.70	24.40	23.57
0.96564	29.80	24.49	23.65
0.96553	29.90	24.57	23.73
0.96541	30.00	24.66	23.81
0.96529	30.10	24.74	23.89
0.96517	30.20	24.83	23.97
0.96505	30.30	24.91	24.04
0.96493	30.40	25.00	24.12
0.96481	30.50	25.08	24.20
0.96469	30.60	25.17	24.28
0.96457	30.70	25.25	24.36
0.96445	30.80	25.34	24.44
0.96433	30.90	25.42	24.52
0.96421	31.00	25.51	24.60
0.96409	31.10	25.60	24.68
0.96396	31.20	25.68	24.76
0.96384	31.30	25.77	24.84
0.96372	31.40	25.85	24.92
0.96360	31.50	25.94	25.00
0.96347	31.60	26.03	25.08
0.96335	31.70	26.11	25.16
0.96323	31.80	26.20	25.24
0.96310	31.90	26.28	25.32
0.96298	32.00	26.37	25.40
0.96285	32.10	26.46	25.48
0.96273	32.20	26.54	25.56
0.96260	32.30	26.63	25.64
0.96248	32.40	26.71	25.71
0.96235	32.50	26.80	25.79
0.96222	32.60	26.89	25.87
0.96210	32.70	26.97	25.95
0.96197	32.80	27.06	26.03
0.96185	32.90	27.14	26.11
0.96172	33.00	27.23	26.19
0.96159	33.10	27.32	26.27
0.96146	33.20	27.40	26.35
0.96133	33.30	27.49	26.43
0.96120	33.40	27.57	26.51
0.96108	33.50	27.66	26.59
0.96095	33.60	27.75	26.67
0.96082	33.70	27.83	26.75
0.96069	33.80	27.92	26.82
0.96056	33.90	28.00	26.90
0.96043	34.00	28.09	26.98
0.96030	34.10	28.18	27.06
0.96016	34.20	28.26	27.14
0.96003	34.30	28.35	27.22
0.95990	34.40	28.43	27.30
0.95977	34.50	28.52	27.38
0.95963	34.60	28.61	27.46
0.95950	34.70	28.70	27.54
0.95937	34.80	28.78	27.62
0.95923	34.90	28.87	27.70

AQUEOUS ETHYL ALCOHOL AT $\frac{15.56°}{15.56°}$ C. (Continued)

Specific gravity $\frac{15.56°}{15.56°}$C.	% Alcohol by volume	% Alcohol by weight	Grams alcohol per 100 cc
0.95910	35.00	28.96	27.78
0.95896	35.10	29.05	27.86
0.95883	35.20	29.13	27.94
0.95869	35.30	29.22	28.02
0.95855	35.40	29.30	28.09
0.95842	35.50	29.38	28.17
0.95828	35.60	29.48	28.25
0.95814	35.70	29.57	28.33
0.95800	35.80	29.65	28.41
0.95787	35.90	29.74	28.49
0.95773	36.00	29.83	28.57
0.95759	36.10	29.92	28.65
0.95745	36.20	30.00	28.73
0.95731	36.30	30.09	28.81
0.95717	36.40	30.17	28.88
0.95703	36.50	30.26	28.96
0.95688	36.60	30.35	29.04
0.95674	36.70	30.44	29.12
0.95660	36.80	30.52	29.20
0.95646	36.90	30.61	29.29
0.95632	37.00	30.70	29.36
0.95618	37.10	30.79	29.44
0.95603	37.20	30.88	29.52
0.95589	37.30	30.96	29.60
0.95574	37.40	31.05	29.68
0.95560	37.50	31.14	29.76
0.95545	37.60	31.23	29.84
0.95531	37.70	31.32	29.92
0.95516	37.80	31.40	30.00
0.95502	37.90	31.49	30.08
0.95487	38.00	31.58	30.16
0.95472	38.10	31.67	30.24
0.95457	38.20	31.76	30.32
0.95442	38.30	31.85	30.40
0.95427	38.40	31.94	30.48
0.95413	38.50	32.03	30.56
0.95398	38.60	32.12	30.64
0.95383	38.70	32.20	30.72
0.95368	38.80	32.29	30.79
0.95353	38.90	32.37	30.87
0.95338	39.00	32.46	30.95
0.95323	39.10	32.55	31.03
0.95307	39.20	32.64	31.11
0.95292	39.30	32.72	31.18
0.95277	39.40	32.81	31.26
0.95262	39.50	32.90	31.34
0.95246	39.60	32.99	31.42
0.95231	39.70	33.08	31.50
0.95216	39.80	33.17	31.58
0.95200	39.90	33.27	31.66
0.95185	40.00	33.35	31.74
0.95169	40.10	33.44	31.82
0.95154	40.20	33.53	31.90
0.95138	40.30	33.61	31.98
0.95122	40.40	33.70	32.06
0.95107	40.50	33.79	32.14
0.95091	40.60	33.88	32.22
0.95075	40.70	33.97	32.30
0.95059	40.80	34.06	32.38
0.95044	40.90	34.15	32.46

Specific gravity $\frac{15.56°}{15.56°}$C.	% Alcohol by volume	% Alcohol by weight	Grams alcohol per 100 cc
0.95028	41.00	34.24	32.54
0.95012	41.10	34.33	32.62
0.94996	41.20	34.42	32.70
0.94980	41.30	34.50	32.78
0.94964	41.40	34.59	32.86
0.94948	41.50	34.68	32.93
0.94932	41.60	34.77	33.01
0.94916	41.70	34.86	33.09
0.94900	41.80	34.95	33.17
0.94884	41.90	35.04	33.25
0.94868	42.00	35.13	33.33
0.94852	42.10	35.22	33.41
0.94835	42.20	35.31	33.49
0.94810	42.30	35.40	33.57
0.94802	42.40	35.49	33.65
0.94786	42.50	35.58	33.73
0.94770	42.60	35.67	33.81
0.94753	42.70	35.76	33.89
0.94737	42.80	35.85	33.97
0.94720	42.90	35.94	34.04
0.94704	43.00	36.03	34.12
0.94687	43.10	36.12	34.20
0.94670	43.20	36.21	34.28
0.94654	43.30	36.30	34.36
0.94637	43.40	36.39	34.44
0.94620	43.50	36.48	34.52
0.94603	43.60	36.57	34.60
0.94586	43.70	36.66	34.68
0.94570	43.80	36.75	34.76
0.94553	43.90	36.84	34.84
0.94536	44.00	36.93	34.91
0.94519	44.10	37.02	34.99
0.94502	44.20	37.11	35.07
0.94484	44.30	37.21	35.15
0.94467	44.40	37.30	35.23
0.94450	44.50	37.39	35.31
0.94433	44.60	37.48	35.39
0.94416	44.70	37.57	35.47
0.94398	44.80	37.66	35.55
0.94381	44.90	37.76	35.63
0.94364	45.00	37.84	35.71
0.94346	45.10	37.93	35.79
0.94329	45.20	38.02	35.87
0.94311	45.30	38.12	35.95
0.94294	45.40	38.21	36.03
0.94276	45.50	38.30	36.11
0.94258	45.60	38.39	36.19
0.94241	45.70	38.48	36.26
0.94223	45.80	38.57	36.34
0.94206	45.90	38.66	36.42
0.94188	46.00	38.75	36.50
0.94170	46.10	38.84	36.58
0.94152	46.20	38.93	36.66
0.94134	46.30	39.03	36.74
0.94116	46.40	39.12	36.82
0.94098	46.50	39.21	36.90
0.94080	46.60	39.30	36.98
0.94062	46.70	39.39	37.06
0.94044	46.80	39.49	37.13
0.94026	46.90	39.58	37.21

(Continued on following page.)

AQUEOUS ETHYL ALCOHOL AT $\frac{15.56°}{15.56°}$ C. (Continued)

Specific gravity $\frac{15.56°}{15.56°}$C.	% Alcohol by volume	% Alcohol by weight	Grams alcohol per 100 cc
0.94008	47.00	39.67	37.29
0.93990	47.10	39.76	37.37
0.93971	47.20	39.85	37.45
0.93953	47.30	39.95	37.53
0.93934	47.40	40.04	37.61
0.93916	47.50	40.13	37.69
0.93898	47.60	40.22	37.77
0.93879	47.70	40.32	37.85
0.93861	47.80	40.41	37.93
0.93842	47.90	40.51	38.01
0.93824	48.00	40.60	38.09
0.93805	48.10	40.69	38.17
0.93786	48.20	40.78	38.25
0.93768	48.30	40.88	38.33
0.93749	48.40	40.97	38.41
0.93730	48.50	41.06	38.49
0.93711	48.60	41.15	38.57
0.93692	48.70	41.24	38.65
0.93679	48.80	41.34	38.72
0.93655	48.90	41.43	38.80
0.93636	49.00	41.52	38.88
0.93617	49.10	41.61	38.96
0.93598	49.20	41.71	39.04
0.93578	49.30	41.80	39.12
0.93559	49.40	41.90	39.20
0.93540	49.50	41.99	39.28
0.93521	49.60	42.08	39.36
0.93502	49.70	42.18	39.44
0.93482	49.80	42.27	39.52
0.93463	49.90	42.37	39.60
0.9344	50.00	.....	.....
0.9325	51.00	.....	.....
0.9305	52.00	.....	.....
0.9285	53.00	.....	.....
0.9264	54.00	.....	.....
0.9244	55.00	.....	.....
0.9222	56.00	.....	.....
0.9201	57.00	.....	.....
0.9180	58.00	.....	.....
0.9158	59.00	.....	.....

Specific gravity $\frac{15.56°}{15.56°}$C.	% Alcohol by volume	% Alcohol by weight	Grams alcohol per 100 cc
0.9136	60.00	.....	.....
0.9113	61.00	.....	.....
0.9091	62.00	.....	.....
0.9068	63.00	.....	.....
0.9044	64.00	.....	.....
0.9021	65.00	.....	.....
0.8997	66.00	.....	.....
0.8974	67.00	.....	.....
0.8949	68.00	.....	.....
0.8925	69.00	.....	.....
0.8900	70.00	.....	.....
0.8876	71.00	.....	.....
0.8850	72.00	.....	.....
0.8825	73.00	.....	.....
0.8799	74.00	.....	.....
0.8773	75.00	.....	.....
0.8747	76.00	.....	.....
0.8721	77.00	.....	.....
0.8694	78.00	.....	.....
0.8667	79.00	.....	.....
0.8639	80.00	.....	.....
0.8611	81.00	.....	.....
0.8583	82.00	.....	.....
0.8554	83.00	.....	.....
0.8525	84.00	.....	.....
0.8496	85.00	.....	.....
0.8465	86.00	.....	.....
0.8435	87.00	.....	.....
0.8404	88.00	.....	.....
0.8372	89.00	.....	.....
0.8339	90.00	.....	.....
0.8306	91.00	.....	.....
0.8272	92.00	.....	.....
0.8236	93.00	.....	.....
0.8199	94.00	.....	.....
0.8161	95.00	.....	.....
0.8121	96.00	.....	.....
0.8079	97.00	.....	.....
0.8035	98.00	.....	.....
0.7989	99.00	.....	.....
0.7939	100.00	.....	.....

ETHYL ALCOHOL

The table below gives values for the density of aqueous alcohol solutions at $\frac{20°}{4°}$ C. $d\frac{20°}{4°}$ = g/ml *in vacuo*

% Alcohol by weight	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
0	0.99823	804	785	766	748	729	710	692	673	655
1	636	618	599	581	562	544	525	507	489	471
2	453	435	417	399	381	363	345	327	310	292
3	275	257	240	222	205	188	171	154	137	120
4	103	087	070	053	037	020	003	*987	*971	*954
5	0.98938	922	906	890	874	859	843	827	811	796
6	780	765	749	734	718	703	688	673	658	642
7	627	612	597	582	567	553	538	523	508	493
8	478	463	449	434	419	404	389	374	360	345
9	331	316	301	287	273	258	244	229	215	201
10	187	172	158	144	130	117	103	089	075	061

AQUEOUS ETHYL ALCOHOL AT $\frac{20°}{4°}$ C. (Continued)

% Alcohol by weight	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
11	0.98047	033	019	006	*992	*978	*964	*951	*937	*923
12	0.97910	896	883	869	855	842	828	815	801	788
13	775	761	748	735	722	709	696	683	670	657
14	643	630	617	604	591	578	565	552	539	526
15	514	501	488	475	462	450	438	425	412	400
16	0.97387	374	361	349	336	323	310	297	284	272
17	259	246	233	220	207	194	181	168	155	142
18	129	116	103	089	076	063	050	037	024	010
19	0.96997	984	971	957	944	931	917	904	891	877
20	864	850	837	823	810	796	783	769	756	742
21	0.96729	716	702	688	675	661	647	634	620	606
22	592	578	564	551	537	523	509	495	481	467
23	453	439	425	411	396	382	368	354	340	326
24	312	297	283	269	254	240	225	211	196	182
25	168	153	139	124	109	094	080	065	050	035
26	0.96020	005	*990	*975	*959	*944	*929	*914	*898	*883
27	0.95867	851	836	820	805	789	773	757	742	726
28	710	694	678	662	646	630	613	597	581	565
29	548	532	516	499	483	466	450	433	416	400
30	382	365	349	332	315	298	281	264	247	230
31	0.95212	195	178	161	143	126	108	091	074	056
32	038	020	003	*985	*967	*950	*932	*914	*896	*878
33	0.94860	842	824	806	788	770	752	734	715	697
34	679	660	642	624	605	587	568	550	531	512
35	494	475	456	438	419	400	382	363	344	325
36	0.94306	287	268	249	230	211	192	172	153	134
37	114	095	075	056	036	017	*997	*978	*958	*939
38	0.93919	899	879	859	840	820	800	780	760	740
39	720	700	680	660	640	620	599	579	559	539
40	518	498	478	458	437	417	396	376	356	335
41	0.93314	294	273	253	232	212	191	170	149	129
42	107	086	065	044	023	002	*981	*960	*939	*918
43	0.92897	876	855	834	812	791	770	749	728	707
44	685	664	642	621	600	579	557	536	515	493
45	472	450	429	408	386	365	343	322	300	279
46	0.92257	236	214	193	171	150	128	106	085	063
47	041	019	*997	*976	*954	*932	*910	*889	*867	*845
48	0.91823	801	780	758	736	714	692	670	648	626
49	604	582	560	538	516	494	472	450	428	406
50	384	361	339	317	295	272	250	228	206	183
51	0.91160	138	116	093	071	049	026	004	*981	*959
52	0.90936	914	891	869	846	824	801	779	756	734
53	711	689	666	644	621	598	576	553	531	508
54	485	463	440	417	395	372	349	327	304	281
55	258	236	213	190	167	145	122	099	076	054
56	0.90031	008	*985	*962	*939	*917	*894	*871	*848	*825
57	0.89803	780	757	734	711	688	665	643	620	597
58	574	551	528	505	482	459	436	413	390	367
59	344	321	298	275	252	229	206	183	160	137
60	113	090	067	044	021	*998	*975	*951	*928	*905
61	0.88882	859	836	812	789	766	743	720	696	673
62	650	626	603	580	557	533	510	487	463	440
63	417	393	370	347	323	300	277	253	230	206
64	183	160	136	113	089	063	042	019	*995	*972
65	0.87948	925	901	878	854	831	807	784	760	737
66	0.87713	689	666	642	619	595	572	548	524	501
67	477	454	430	406	383	359	336	312	288	265
68	241	218	194	170	147	123	099	075	052	028
69	004	*981	*957	*933	*909	*885	*862	*838	*814	*790
70	0.86766	742	718	694	671	647	623	599	575	551
71	527	503	479	455	431	407	383	359	335	311

(*Continued on following page.*)

AQUEOUS ETHYL ALCOHOL AT $\frac{20°}{4°}$ C. (Continued)

% Alcohol by weight	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
72	0.86287	263	239	215	191	167	143	119	095	071
73	047	022	*998	*974	*950	*926	*902	*878	*854	*830
74	0.85806	781	757	733	709	685	661	636	612	588
75	564	540	515	491	467	443	419	394	370	346
76	322	297	273	249	225	200	176	152	128	103
77	0.85079	055	031	006	*982	*958	*933	*909	*884	*860
78	0.84835	811	787	762	738	713	689	664	640	615
79	590	566	541	517	492	467	443	418	393	369
80	344	319	294	270	245	220	196	171	146	121
81	096	072	047	022	*997	*972	*947	*923	*898	*873
82	0.83848	823	798	773	748	723	698	674	649	624
83	599	574	549	523	498	473	448	423	398	373
84	348	323	297	272	247	222	196	171	146	120
85	095	070	044	019	*994	*968	*943	*917	*892	*866
86	0.82840	815	789	763	738	712	686	660	635	609
87	0.82583	557	531	505	479	453	427	401	375	349
88	323	297	271	245	219	193	167	140	114	088
89	062	035	009	*983	*956	*930	*903	*877	*850	*824
90	0.81797	770	744	717	690	664	637	610	583	556
91	529	502	475	448	421	394	366	339	312	285
92	0.81257	230	203	175	148	120	093	066	038	010
93	0.80983	955	928	900	872	844	817	789	761	733
94	705	677	649	621	593	565	537	509	480	452
95	424	395	367	338	310	281	253	224	195	166
96	138	109	080	051	022	*993	*963	*934	*905	*875
97	0.79846	816	787	757	727	698	668	638	608	578
98	547	517	487	456	426	396	365	335	305	274
99	243	213	182	151	120	089	059	028	*997	*966
100	0.78934									

ETHYL ALCOHOL

The table below gives the values for $d_{4°}^{t°}$ = g/ml *in vacuo*.
Osborne-McKelvy-Bearce, *Bull. Bu. Stand.*, Vol 9, p. 424 (1913)

% Alcohol by weight	$d\frac{10°}{4°}$ C	$d\frac{20°}{4°}$ C	$d\frac{25°}{4°}$ C	$d\frac{30°}{4°}$ C
0	0.99973	0.99823	0.99708	0.99568
1	0.99785	0.99636	0.99520	0.99379
2	0.99602	0.99453	0.99336	0.99194
3	0.99426	0.99275	0.99157	0.99014
4	0.99258	0.99103	0.98984	0.98839
5	0.99098	0.98938	0.98817	0.98670
6	0.98946	0.98780	0.98656	0.98507
7	0.98801	0.98627	0.98500	0.98347
8	0.98660	0.98478	0.98346	0.98189
9	0.98524	0.98331	0.98193	0.98031
10	0.98393	0.98187	0.98043	0.97875
11	0.98267	0.98047	0.97897	0.97723
12	0.98145	0.97910	0.97753	0.97573
13	0.98026	0.97775	0.97611	0.97424
14	0.97911	0.97643	0.97472	0.97278
15	0.97800	0.97514	0.97334	0.97133
16	0.97692	0.97387	0.97199	0.96990
17	0.97583	0.97259	0.97062	0.96844
18	0.97473	0.97129	0.96923	0.96697
19	0.97363	0.96997	0.96782	0.96547
20	0.97252	0.96864	0.96639	0.96395
21	0.97139	0.96729	0.96495	0.96242

ETHYL ALCOHOL (Continued)

% Alcohol by weight	$d\frac{10°}{4°}C$	$d\frac{20°}{4°}C$	$d\frac{25°}{4°}C$	$d\frac{30°}{4°}C$
22	0.97024	0.96592	0.96348	0.96087
23	0.96907	0.96453	0.96199	0.95929
24	0.96787	0.96312	0.96048	0.95769
25	0.96665	0.96168	0.95895	0.95607
26	0.96539	0.96020	0.95738	0.95442
27	0.96406	0.95867	0.95576	0.95272
28	0.96268	0.95710	0.95410	0.95098
29	0.96125	0.95548	0.95241	0.94922
30	0.95977	0.95382	0.95067	0.94741
31	0.95823	0.95212	0.94890	0.94557
32	0.95665	0.95038	0.94709	0.94370
33	0.95502	0.94860	0.94525	0.94180
34	0.95334	0.94679	0.94337	0.93986
35	0.95162	0.94494	0.94146	0.93790
36	0.94986	0.94306	0.93952	0.93591
37	0.94805	0.94114	0.93756	0.93390
38	0.94620	0.93919	0.93556	0.93186
39	0.94431	0.93720	0.93353	0.92979
40	0.94238	0.93518	0.93148	0.92770
41	0.94042	0.93314	0.92940	0.92558
42	0.93842	0.93107	0.92729	0.92344
43	0.93639	0.92897	0.92516	0.92128
44	0.93433	0.92685	0.92301	0.91910
45	0.93226	0.92472	0.92085	0.91692
46	0.93017	0.92257	0.91868	0.91472
47	0.92806	0.92041	0.91649	0.91250
48	0.92593	0.91823	0.91429	0.91028
49	0.92379	0.91604	0.91208	0.90805
50	0.92162	0.91384	0.90985	0.90580
51	0.91943	0.91160	0.90760	0.90353
52	0.91723	0.90936	0.90534	0.90125
53	0.91502	0.90711	0.90307	0.89896
54	0.91279	0.90485	0.90079	0.89667
55	0.91055	0.90258	0.89850	0.89437
56	0.90831	0.90031	0.89621	0.89206
57	0.90607	0.89803	0.89392	0.88975
58	0.90381	0.89574	0.89162	0.88744
59	0.90154	0.89344	0.88931	0.88512
60	0.89927	0.89113	0.88699	0.88278
61	0.89698	0.88882	0.88466	0.88044
62	0.89468	0.88650	0.88233	0.87809
63	0.89237	0.88417	0.87998	0.87574
64	0.89006	0.88183	0.87763	0.87337
65	0.88774	0.87948	0.87527	0.87100
66	0.88541	0.87713	0.87291	0.86863
67	0.88308	0.87477	0.87054	0.86625
68	0.88074	0.87241	0.86817	0.86387
69	0.87839	0.87004	0.86579	0.86148
70	0.87602	0.86766	0.86340	0.85908
71	0.87365	0.86527	0.86100	0.85667
72	0.87127	0.86287	0.85859	0.85426
73	0.86888	0.86047	0.85618	0.85184
74	0.86648	0.85806	0.85376	0.84941
75	0.86408	0.85564	0.85134	0.84698
76	0.86168	0.85322	0.84891	0.84455
77	0.85927	0.85079	0.84647	0.84211
78	0.85685	0.84835	0.84403	0.83966
79	0.85442	0.84590	0.84158	0.83720
80	0.85197	0.84344	0.83911	0.83473
81	0.84950	0.84096	0.83664	0.83224
82	0.84702	0.83848	0.83416	0.82974

(Continued on following page.)

ETHYL ALCOHOL (Continued)

% Alcohol by weight	$d\frac{10°}{4°}C$	$d\frac{20°}{4°}C$	$d\frac{25°}{4°}C$	$d\frac{30°}{4°}C$
83	0.84453	0.83599	0.83164	0.82724
84	0.84203	0.83348	0.82913	0.82473
85	0.83951	0.83095	0.82660	0.82220
86	0.83697	0.82840	0.82405	0.81965
87	0.83441	0.82583	0.82148	0.81708
88	0.83181	0.82323	0.81888	0.81448
89	0.82919	0.82062	0.81626	0.81186
90	0.82654	0.81797	0.81362	0.80922
91	0.82386	0.81529	0.81094	0.80655
92	0.82114	0.81257	0.80823	0.80384
93	0.81839	0.80983	0.80549	0.80111
94	0.81561	0.80705	0.80272	0.79835
95	0.81278	0.80424	0.79991	0.79555
96	0.80991	0.80138	0.79706	0.79271
97	0.80698	0.79846	0.79415	0.78981
98	0.80399	0.79547	0.79117	0.78684
99	0.80094	0.79243	0.78814	0.78382
100	0.79784	0.78934	0.78506	0.78075

ETHYL ALCOHOL

Specific gravity of aqueous solutions of ethyl alcohol at $\frac{20°}{20°}$ C and at $\frac{25°}{25°}$ C.

% Alcohol by weight	Specific gravity $\frac{20°}{20°}C$	Specific gravity $\frac{25°}{25°}C$
0	1.00000	1.00000
1	0.99813	0.99811
2	0.99629	0.99627
3	0.99451	0.99447
4	0.99279	0.99274
5	0.99113	0.99106
6	0.98955	0.98945
7	0.98802	0.98788
8	0.98653	0.98634
9	0.98505	0.98481
10	0.98361	0.98330
11	0.98221	0.98184
12	0.98084	0.98039
13	0.97948	0.97897
14	0.97816	0.97757
15	0.97687	0.97619
16	0.97560	0.97484
17	0.97431	0.97346
18	0.97301	0.97207
19	0.97169	0.97065
20	0.97036	0.96922
21	0.96901	0.96778
22	0.96763	0.96630
23	0.96624	0.96481
24	0.96483	0.96329
25	0.96339	0.96176
26	0.96190	0.96018
27	0.96037	0.95856
28	0.95880	0.95689
29	0.95717	0.95520
30	0.95551	0.95345
31	0.95381	0.95168

% Alcohol by weight	Specific gravity $\frac{20°}{20°}C$	Specific gravity $\frac{25°}{25°}C$
32	0.95207	0.94986
33	0.95028	0.94802
34	0.94847	0.94613
35	0.94662	0.94422
36	0.94473	0.94227
37	0.94281	0.94031
38	0.94086	0.93830
39	0.93886	0.93626
40	0.93684	0.93421
41	0.93479	0.93212
42	0.93272	0.93001
43	0.93062	0.92787
44	0.92849	0.92571
45	0.92636	0.92355
46	0.92421	0.92137
47	0.92204	0.91917
48	0.91986	0.91697
49	0.91766	0.91475
50	0.91546	0.91251
51	0.91322	0.91026
52	0.91097	0.90799
53	0.90872	0.90571
54	0.90645	0.90343
55	0.90418	0.90113
56	0.90191	0.89883
57	0.89962	0.89654
58	0.89733	0.89423
59	0.89502	0.89191
60	0.89271	0.88959
61	0.89040	0.88725
62	0.88807	0.88491
63	0.88574	0.88256

ETHYL ALCOHOL (Continued)

% Alcohol by weight	Specific gravity 20°/20°C	Specific gravity 25°/25°C
64	0.88339	0.88020
65	0.88104	0.87783
66	0.87869	0.87547
67	0.87632	0.87309
68	0.87396	0.87071
69	0.87158	0.86833
70	0.86920	0.86593
71	0.86680	0.86352
72	0.86440	0.86110
73	0.86200	0.85869
74	0.85958	0.85626
75	0.85716	0.85383
76	0.85473	0.85140
77	0.85230	0.84895
78	0.84985	0.84650
79	0.84740	0.84404
80	0.84494	0.84157
81	0.84245	0.83909
82	0.83997	0.83659

% Alcohol by weight	Specific gravity 20°/20°C	Specific Gravity 25°/25°C
83	0.83747	0.83408
84	0.83496	0.83156
85	0.83242	0.82902
86	0.82987	0.82646
87	0.82729	0.82389
88	0.82469	0.82128
89	0.82207	0.81865
90	0.81942	0.81600
91	0.81674	0.81331
92	0.81401	0.81060
93	0.81127	0.80785
94	0.80848	0.80507
95	0.80567	0.80225
96	0.80280	0.79939
97	0.79988	0.79648
98	0.79688	0.79349
99	0.79383	0.79045
100	0.79074	0.78736

DENSITY OF ETHYL ALCOHOL

This table gives the weight in grams of one cubic centimeter of ethyl alcohol as computed from Mendelejeff's formula.

Temp. °C.	Density
0	0.80625
1	0.80541
2	0.80457
3	0.80374
4	0.80290
5	0.80207
6	0.80123
7	0.80039
8	0.79956
9	0.79872
10	0.79788
11	0.79704
12	0.79620
13	0.79535
14	0.79451
15	0.79367
16	0.79283
17	0.79198
18	0.79114
19	0.79029

Temp. °C.	Density
20	0.78945
21	0.78860
22	0.78775
23	0.78691
24	0.78606
25	0.78522
26	0.78437
27	0.78352
28	0.78267
29	0.78182
30	0.78097
31	0.78012
32	0.77927
33	0.77841
34	0.77756
35	0.77671
36	0.77585
37	0.77500
38	0.77414
39	0.77329

METHYL ALCOHOL

Specific gravity of aqueous solutions of methyl alcohol at $\frac{15.6°}{15.6°}$ C. To convert to specific gravity at $\frac{15.4°}{4°}$ C, multiply the specific gravities as given in the table by 0.99908.

[Arkiv. Kemi Min. Geol. [2] 27, 32 (Stockholm.)]

Specific gravity $\frac{15.6°}{15.6°}$ C.	% Alcohol by weight	% Alcohol by volume
1.0000	0.00	0.00
0.9999	0.06	0.07
0.9998	0.11	0.13
0.9997	0.17	0.20
0.9996	0.22	0.27
0.9995	0.28	0.33
0.9994	0.33	0.40
0.9993	0.39	0.47
0.9992	0.44	0.53
0.9991	0.50	0.60
0.9990	0.55	0.67
0.9989	0.61	0.73
0.9988	0.66	0.80
0.9987	0.72	0.86
0.9986	0.77	0.93
0.9985	0.83	1.00
0.9984	0.88	1.06
0.9983	0.94	1.13
0.9982	0.99	1.20
0.9981	1.05	1.26
0.9980	1.10	1.33
0.9979	1.15	1.40
0.9978	1.20	1.47
0.9977	1.26	1.54
0.9976	1.31	1.62
0.9975	1.36	1.69
0.9974	1.41	1.76
0.9973	1.46	1.83
0.9972	1.52	1.90
0.9971	1.57	1.97
0.9970	1.62	2.05
0.9969	1.67	2.12
0.9968	1.72	2.19
0.9967	1.78	2.26
0.9966	1.83	2.33
0.9965	1.88	2.40
0.9964	1.93	2.47
0.9963	1.98	2.55
0.9962	2.04	2.62
0.9961	2.09	2.69
0.9960	2.14	2.76
0.9959	2.20	2.83
0.9958	2.26	2.90
0.9957	2.31	2.98
0.9956	2.37	3.05
0.9955	2.43	3.12
0.9954	2.49	3.19
0.9953	2.55	3.26
0.9952	2.60	3.34
0.9951	2.66	3.41
0.9950	2.72	3.48
0.9949	2.78	3.55
0.9948	2.84	3.62
0.9947	2.89	3.70
0.9946	2.95	3.77
0.9945	3.01	3.84
0.9944	3.07	3.91
0.9943	3.13	3.98
0.9942	3.18	4.06
0.9941	3.24	4.13
0.9940	3.30	4.20
0.9939	3.36	4.27
0.9938	3.42	4.35
0.9937	3.48	4.42
0.9936	3.53	4.49
0.9935	3.59	4.57
0.9934	3.65	4.64
0.9933	3.71	4.71
0.9932	3.77	4.79
0.9931	3.83	4.86
0.9930	3.89	4.94
0.9929	3.94	5.01
0.9928	4.00	5.08
0.9927	4.06	5.16
0.9926	4.12	5.23
0.9925	4.18	5.30
0.9924	4.24	5.38
0.9923	4.29	5.45
0.9922	4.35	5.52
0.9921	4.41	5.60
0.9920	4.47	5.67
0.9919	4.53	5.74
0.9918	4.60	5.82
0.9917	4.66	5.89
0.9916	4.72	5.96
0.9915	4.78	6.04
0.9914	4.85	6.11
0.9913	4.91	6.18
0.9912	4.97	6.25
0.9911	5.03	6.33
0.9910	5.10	6.40
0.9909	5.16	6.47
0.9908	5.22	6.55
0.9907	5.28	6.62
0.9906	5.35	6.69
0.9905	5.41	6.77
0.9904	5.47	6.84
0.9903	5.53	6.91
0.9902	5.60	6.98
0.9901	5.66	7.06
0.9900	5.72	7.13
0.9899	5.78	7.21
0.9898	5.85	7.28
0.9897	5.91	7.36
0.9896	5.97	7.44
0.9895	6.04	7.52
0.9894	6.10	7.59
0.9893	6.16	7.67
0.9892	6.23	7.75
0.9891	6.29	7.82
0.9890	6.36	7.90
0.9889	6.42	7.98

Specific gravity $\frac{15.6°}{15.5°}$ C.	% Alcohol by weight	% Alcohol by volume
0.9888	6.48	8.05
0.9887	6.55	8.13
0.9886	6.61	8.21
0.9885	6.67	8.29
0.9884	6.74	8.36
0.9883	6.80	8.44
0.9882	6.86	8.52
0.9881	6.93	8.59
0.9880	6.99	8.67
0.9879	7.06	8.75
0.9878	7.12	8.83
0.9877	7.19	8.90
0.9876	7.25	8.98
0.9875	7.32	9.06
0.9874	7.38	9.14
0.9873	7.45	9.22
0.9872	7.51	9.29
0.9871	7.58	9.37
0.9870	7.64	9.45
0.9869	7.71	9.53
0.9868	7.77	9.61
0.9867	7.84	9.68
0.9866	7.90	9.76
0.9865	7.97	9.84
0.9864	8.03	9.92
0.9863	8.10	10.00
0.9862	8.16	10.07
0.9861	8.23	10.15
0.9860	8.29	10.23
0.9859	8.35	10.31
0.9858	8.42	10.38
0.9857	8.48	10.47
0.9856	8.55	10.55
0.9855	8.61	10.63
0.9854	8.68	10.71
0.9853	8.74	10.79
0.9852	8.81	10.87
0.9851	8.87	10.95
0.9850	8.94	11.03
0.9849	9.00	11.10
0.9848	9.06	11.18
0.9847	9.13	11.26
0.9846	9.19	11.34
0.9845	9.26	11.42
0.9844	9.32	11.50
0.9843	9.39	11.58
0.9842	9.45	11.66
0.9841	9.52	11.74
0.9840	9.58	11.82
0.9839	9.65	11.90
0.9838	9.72	11.98
0.9837	9.78	12.06
0.9836	9.85	12.14
0.9835	9.92	12.23
0.9834	9.99	12.31
0.9833	10.06	12.39

AQUEOUS METHYL ALCOHOL AT $\frac{15.6°}{15.6°}$ C. (Continued)

Specific gravity $\frac{15.6°}{15.6°}$ C.	% Alcohol by weight	% Alcohol by volume
0.9832	10.12	12.47
0.9831	10.19	12.55
0.9830	10.26	12.63
0.9829	10.33	12.71
0.9828	10.40	12.79
0.9827	10.46	12.87
0.9826	10.53	12.95
0.9825	10.60	13.04
0.9824	10.67	13.12
0.9823	10.74	13.20
0.9822	10.80	13.28
0.9821	10.87	13.36
0.9820	10.94	13.44
0.9819	11.01	13.52
0.9818	11.07	13.61
0.9817	11.14	13.69
0.9816	11.21	13.78
0.9815	11.27	13.86
0.9814	11.34	13.94
0.9813	11.41	14.03
0.9812	11.47	14.11
0.9811	11.54	14.20
0.9810	11.61	14.28
0.9809	11.67	14.36
0.9808	11.74	14.45
0.9807	11.80	14.53
0.9806	11.87	14.62
0.9805	11.94	14.70
0.9804	12.00	14.78
0.9803	12.07	14.87
0.9802	12.14	14.95
0.9801	12.20	15.04
0.9800	12.27	15.12
0.9799	12.34	15.21
0.9798	12.41	15.29
0.9797	12.48	15.38
0.9796	12.55	15.46
0.9795	12.62	15.55
0.9794	12.69	15.63
0.9793	12.76	15.72
0.9792	12.83	15.80
0.9791	12.90	15.89
0.9790	12.97	15.97
0.9789	13.04	16.06
0.9788	13.11	16.14
0.9787	13.18	16.23
0.9786	13.25	16.31
0.9785	13.32	16.40
0.9784	13.39	16.48
0.9783	13.46	16.57
0.9782	13.53	16.65
0.9781	13.60	16.74
0.9780	13.67	16.82
0.9779	13.74	16.91
0.9778	13.82	16.99
0.9777	13.89	17.08
0.9776	13.96	17.16
0.9775	14.03	17.25
0.9774	14.11	17.33
0.9773	14.18	17.42
0.9772	14.25	17.50
0.9771	14.32	17.59
0.9770	14.40	17.68
0.9769	14.47	17.76
0.9768	14.54	17.85
0.9767	14.61	17.93
0.9766	14.69	18.02
0.9765	14.76	18.10
0.9764	14.83	18.19
0.9763	14.90	18.27
0.9762	14.98	18.36
0.9761	15.05	18.44
0.9760	15.12	18.53
0.9759	15.19	18.62
0.9758	15.27	18.70
0.9757	15.34	18.79
0.9756	15.41	18.88
0.9755	15.49	18.96
0.9754	15.56	19.05
0.9753	15.63	19.14
0.9752	15.70	19.22
0.9751	15.78	19.31
0.9750	15.85	19.40
0.9749	15.92	19.48
0.9748	16.00	19.56
0.9747	16.07	19.65
0.9746	16.14	19.74
0.9745	16.22	19.83
0.9744	16.29	19.91
0.9743	16.36	20.00
0.9742	16.43	20.09
0.9741	16.51	20.17
0.9740	16.58	20.26
0.9739	16.65	20.35
0.9738	16.72	20.43
0.9737	16.79	20.52
0.9736	16.86	20.60
0.9735	16.93	20.69
0.9734	17.00	20.77
0.9733	17.07	20.86
0.9732	17.14	20.94
0.9731	17.21	21.03
0.9730	17.28	21.11
0.9729	17.35	21.20
0.9728	17.42	21.28
0.9727	17.49	21.37
0.9726	17.56	21.45
0.9725	17.63	21.54
0.9724	17.70	21.62
0.9723	17.77	21.71
0.9722	17.84	21.79
0.9721	17.91	21.88
0.9720	17.98	21.96
0.9719	18.05	22.05
0.9718	18.12	22.13
0.9717	18.19	22.22
0.9716	18.26	22.30
0.9715	18.33	22.39
0.9714	18.40	22.47
0.9713	18.47	22.56
0.9712	18.54	22.64
0.9711	18.61	22.73
0.9710	18.68	22.82
0.9709	18.75	22.90
0.9708	18.82	22.99
0.9707	18.89	23.07
0.9706	18.96	23.16
0.9705	19.03	23.24
0.9704	19.10	23.33
0.9703	19.17	23.41
0.9702	19.24	23.50
0.9701	19.31	23.58
0.9700	19.38	23.67
0.9699	19.45	23.75
0.9698	19.52	23.84
0.9697	19.59	23.92
0.9696	19.66	24.00
0.9695	19.73	24.09
0.9694	19.80	24.17
0.9693	19.87	24.25
0.9692	19.94	24.34
0.9691	20.01	24.42
0.9690	20.09	24.51
0.9689	20.16	24.59
0.9688	20.23	24.67
0.9687	20.30	24.76
0.9686	20.37	24.84
0.9685	20.44	24.92
0.9684	20.51	25.01
0.9683	20.58	25.09
0.9682	20.65	25.17
0.9681	20.72	25.26
0.9680	20.79	25.34
0.9679	20.86	25.42
0.9678	20.93	25.51
0.9677	21.00	25.59
0.9676	21.07	25.68
0.9675	21.14	25.76
0.9674	21.21	25.84
0.9673	21.28	25.93
0.9672	21.35	26.01
0.9671	21.42	26.10
0.9670	21.49	26.18
0.9669	21.56	26.26
0.9668	21.63	26.35
0.9667	21.70	26.43
0.9666	21.77	26.52
0.9665	21.84	26.60
0.9664	21.91	26.68
0.9663	21.98	26.77
0.9662	22.05	26.85
0.9661	22.12	26.94
0.9660	22.19	27.02
0.9659	22.26	27.10
0.9658	22.33	27.18
0.9657	22.40	27.26
0.9656	22.47	27.34
0.9655	22.54	27.43
0.9654	22.61	27.51
0.9653	22.68	27.59

(Continued on following page.)

AQUEOUS METHYL ALCOHOL AT $\frac{15.6°}{15.6°}$ C. (Continued)

Specific gravity $\frac{15.6°}{15.6°}$C.	% Alcohol by weight	% Alcohol by volume
0.9652	22.75	27.67
0.9651	22.82	27.75
0.9650	22.89	27.83
0.9649	22.96	27.91
0.9648	23.03	27.99
0.9647	23.10	28.07
0.9646	23.17	28.15
0.9645	23.24	28.24

Specific gravity $\frac{15.6°}{15.6°}$C.	% Alcohol by weight	% Alcohol by volume
0.9644	23.31	28.32
0.9643	23.38	28.40
0.9642	23.45	28.48
0.9641	23.52	28.56
0.9640	23.59	28.64
0.9639	23.66	28.72
0.9638	23.73	28.80
0.9637	23.80	28.88

Specific gravity $\frac{15.6°}{15.6°}$C.	% Alcohol by weight	% Alcohol by volume
0.9636	23.88	28.96
0.9635	23.95	29.04
0.9634	24.02	29.11
0.9633	24.09	29.19
0.9632	24.16	29.27
0.9631	24.23	29.35
0.9630	24.31	29.43
0.9629	24.38	29.51

METHYL ALCOHOL

Specific gravity of aqueous solutions of methyl alcohol by weight.

% Alcohol by weight	$d\frac{0°}{4°}$C	$d\frac{10°}{4°}$C	$d\frac{20°}{4°}$C
0	0.9999	0.9997	0.9982
1	0.9981	0.9980	0.9965
2	0.9963	0.9962	0.9948
3	0.9946	0.9945	0.9931
4	0.9930	0.9929	0.9914
5	0.9914	0.9912	0.9896
6	0.9899	0.9896	0.9880
7	0.9884	0.9881	0.9863
8	0.9870	0.9865	0.9847
9	0.9856	0.9849	0.9831
10	0.9842	0.9834	0.9815
11	0.9829	0.9820	0.9799
12	0.9816	0.9805	0.9784
13	0.9804	0.9791	0.9768
14	0.9792	0.9778	0.9754
15	0.9780	0.9764	0.9740
16	0.9769	0.9751	0.9725
17	0.9758	0.9739	0.9710
18	0.9747	0.9726	0.9696
19	0.9736	0.9713	0.9681
20	0.9725	0.9700	0.9666
21	0.9714	0.9687	0.9651
22	0.9702	0.9673	0.9636
23	0.9690	0.9660	0.9622
24	0.9678	0.9646	0.9607
25	0.9666	0.9632	0.9592
26	0.9654	0.9618	0.9576
27	0.9642	0.9604	0.9562
28	0.9629	0.9590	0.9546
29	0.9616	0.9575	0.9531
30	0.9604	0.9560	0.9515
31	0.9590	0.9546	0.9499
32	0.9576	0.9531	0.9483
33	0.9563	0.9516	0.9466
34	0.9549	0.9500	0.9450
35	0.9534	0.9484	0.9433
36	0.9520	0.9469	0.9416
37	0.9505	0.9453	0.9398
38	0.9490	0.9437	0.9381
39	0.9475	0.9420	0.9363
40	0.9459	0.9403	0.9345
41	0.9443	0.9387	0.9327

% Alcohol by weight	$d\frac{0°}{4°}$C	$d\frac{10°}{4°}$C	$d\frac{20°}{4°}$C
42	0.9427	0.9370	0.9309
43	0.9411	0.9352	0.9290
44	0.9395	0.9334	0.9272
45	0.9377	0.9316	0.9252
46	0.9360	0.9298	0.9234
47	0.9342	0.9279	0.9214
48	0.9324	0.9260	0.9196
49	0.9306	0.9240	0.9176
50	0.9287	0.9221	0.9156
51	0.9269	0.9202	0.9135
52	0.9250	0.9182	0.9114
53	0.9230	0.9162	0.9094
54	0.9211	0.9142	0.9073
55	0.9191	0.9122	0.9052
56	0.9172	0.9101	0.9032
57	0.9151	0.9080	0.9010
58	0.9131	0.9060	0.8988
59	0.9111	0.9039	0.8968
60	0.9090	0.9018	0.8946
61	0.9068	0.8998	0.8924
62	0.9046	0.8977	0.8902
63	0.9024	0.8955	0.8879
64	0.9002	0.8933	0.8856
65	0.8980	0.8911	0.8834
66	0.8958	0.8888	0.8811
67	0.8935	0.8865	0.8787
68	0.8913	0.8842	0.8763
69	0.8891	0.8818	0.8738
70	0.8869	0.8794	0.8715
71	0.8847	0.8770	0.8690
72	0.8824	0.8747	0.8665
73	0.8801	0.8724	0.8641
74	0.8778	0.8699	0.8616
75	0.8754	0.8676	0.8592
76	0.8729	0.8651	0.8567
77	0.8705	0.8626	0.8542
78	0.8680	0.8602	0.8518
79	0.8657	0.8577	0.8494
80	0.8634	0.8551	0.8469
81	0.8610	0.8527	0.8446
82	0.8585	0.8501	0.8420
83	0.8560	0.8475	0.8394

METHYL ALCOHOL (Continued)

% Alcohol by weight	$d\frac{0°}{4°}$ C	$d\frac{10°}{4°}$ C.	$d\frac{20°}{4°}$ C
84	0.8535	0.8449	0.8366
85	0.8510	0.8422	0.8340
86	0.8483	0.8394	0.8314
87	0.8456	0.8367	0.8286
88	0.8428	0.8340	0.8258
89	0.8400	0.8314	0.8230
90	0.8374	0.8287	0.8202
91	0.8347	0.8261	0.8174

% Alcohol by weight	$d\frac{0°}{4°}$ C.	$d\frac{10°}{4°}$ C.	$d\frac{20°}{4°}$ C.
92	0.8320	0.8234	0.8146
93	0.8293	0.8208	0.8118
94	0.8266	0.8180	0.8090
95	0.8240	0.8152	0.8062
96	0.8212	0.8124	0.8034
97	0.8186	0.8096	0.8005
98	0.8158	0.8068	0.7976
99	0.8130	0.8040	0.7948
100	0.8102	0.8009	0.7917

IMMERSION REFRACTOMETER READINGS OF METHYL ALCOHOL AND ETHYL ALCOHOL AT 17.5°C.—DETERMINATION OF MIXTURES OF METHYL ALCOHOL AND ETHYL ALCOHOL IN AQUEOUS SOLUTION

The data in the table below are given in the *Official and Tentative Methods of Analysis*, 4th ed. (1935), p. 175; reprinted by permission of the Association of Official Agricultural Chemists, Washington, D. C.

The method for the determination of mixtures of these two alcohols is that of Leach and Lithgoe, *Jour. Amer. Chem. Soc.* 27, 964 (1905) as corrected by Williams, *Ind. Eng. Chem.* 19, 844 (1927).

Example.—To calculate the percentage of methyl and ethyl alcohols in an aqueous mixture, assuming a distillate with an immersion refractometer reading of 35.0 at 17.5°C. and a specific gravity of 0.9793 at 15.56°/15.56°C.

By reference to the table below, an aqueous solution of methyl alcohol of specific gravity 0.9793 at 15.56°/15.56°C. has an immersion reading of 23.2; an aqueous solution of ethyl alcohol of specific gravity 0.9793 at 15.56°/15.56°C. has an immersion reading of 39.4. The difference between these two values is: (39.4 − 23.2), or 16.2; therefore, (39.4 − 35.0) ÷ 16.2, or 27.2% of the alcohols present in the mixture is methyl alcohol.

By reference to tables showing the percentages of these alcohols corresponding to the various specific gravities, an aqueous methyl alcohol solution having a specific gravity of 0.9793 at 15.56°/15.56°C. contains 15.72% by volume of methyl alcohol. An aqueous solution of ethyl alcohol of the same specific gravity contains 16.80% by volume of ethyl alcohol. A distillate of this same specific gravity in which 27.2% of the alcohol is methyl alcohol and 72.8% is ethyl alcohol would contain: 16.80 − [(16.80 − 15.72) ÷ 27.2], or 16.76% by volume of total alcohols. Since 27.2% of this volume is methyl alcohol, 100 cc. of the solution contain 4.56 cc. of methyl alcohol and 12.20 cc. of ethyl alcohol. At 15.56°C., 1 cc. of methyl alcohol weighs 0.7958 g., and 1 cc. of ethyl alcohol weighs 0.7939 g. Therefore, 100 cc. of the distillate contain 4.56 × 0.7958, or 3.63 g. of methyl alcohol; and, 12.20 × 0.7939, or 9.69 g. of ethyl alcohol. As 100 cc. of the distillate weigh 97.93 g., the distillate contains: 3.63 ÷ 97.93, or 3.71% by weight of methyl alcohol; and, 9.69 ÷ 97.93, or 9.89% by weight of ethyl alcohol

This shows that there is present:	By weight	By volume
Methyl alcohol :	3.71%	4.56%
Ethyl alcohol :	9.89%	12.20%

Sp. Gr. $\frac{15.56°}{15.56°}$ C.	Scale Readings		Sp. Gr. $\frac{15.56°}{15.56°}$ C.	Scale Readings	
	Methyl Alcohol	Ethyl Alcohol		Methyl Alcohol	Ethyl Alcohol
1.0000	15.0	15.0	.9800	22.8	38.3
.9990	15.3	15.8	.9790	23.4	39.9
.9980	15.6	16.6	.9780	24.0	41.5
.9970	15.9	17.5	.9770	24.5	43.1
.9960	16.2	18.5	.9760	25.0	44.8
.9950	16.5	19.4	.9750	25.5	46.5
.9940	16.9	20.4	.9740	26.0	48.2
.9930	17.2	21.4	.9730	26.5	49.8
.9920	17.5	22.5	.9720	27.0	51.5
.9910	17.9	23.6	.9710	27.5	53.0
.9900	18.2	24.7	.9700	28.1	54.6
.9890	18.6	25.9	.9690	28.7	56.1
.9880	19.0	27.1	.9680	29.2	57.6
.9870	19.5	28.4	.9670	29.6	59.1
.9860	19.9	29.6	.9660	30.1	60.6
.9850	20.4	31.0	.9650	30.6	62.0
.9840	20.8	32.4	.9640	31.0	63.3
.9830	21.3	33.8	.9630	31.5	64.6
.9820	21.8	35.2	.9620	31.9	65.8
.9810	22.3	36.7	.9610	32.4	67.0

(Completed on following page.)

IMMERSION REFRACTOMETER READINGS OF METHYL ALCOHOL AND ETHYL ALCOHOL AT 17.5°C.—DETERMINATION OF MIXTURES OF METHYL ALCOHOL AND ETHYL ALCOHOL IN AQUEOUS SOLUTION (Continued)

Sp. Gr. $\frac{15.56°}{15.56°}$ C.	Scale Readings		Sp. Gr. $\frac{15.56°}{15.56°}$ C.	Scale Readings	
	Methyl Alcohol	Ethyl Alcohol		Methyl Alcohol	Ethyl Alcohol
.9600	32.8	68.1	.9520	35.9	75.4
.9590	33.3	69.2	.9510	36.2	76.2
.9580	33.7	70.2	.9500	36.5	76.9
.9570	34.1	71.2	.9490	36.8	77.6
.9560	34.5	72.1	.9480	37.0	78.3
.9550	34.9	73.0	.9470	37.3	79.0
.9540	35.3	73.8	.9460	37.6	79.7
.9530	35.6	74.6			

CONVERSION OF PERCENTAGES OF ETHYL ALCOHOL

The following expressions show the various relations between percentage by weight (W), percentage by volume (V), percentage proof spirit (P), and specific gravity (D).

$$W=\frac{P}{D\times 2.208} \qquad V=\frac{W\times D}{0.7938}=W\times D\times 1.26$$

$$W=\frac{V\times 0.7938}{D} \qquad V=P\times 0.5706 \qquad P=\frac{V}{0.5706}=V\times 1.7525$$

$$P=W\times D\times 2.208$$

DENSITIES OF VARIOUS SOLIDS AND LIQUIDS

Approximate values at ordinary temperatures.

Name	Grams per cc	Pounds per cu. ft.
Agate	2.5–2.8	156–174
Alabaster	2.3–2.8	143–174
Amber	1.0–1.1	62.3–68.5
Amphoboles	2.9–3.2	181–199
Anthracite	1.4–1.7	87–106
Argillite	2.76–2.88	172–179
Asbestos	2.1–2.8	131–174
Asbestos paper	1.2	75
Asphalt	1.1–1.5	68.5–93.5
Barley	0.51–0.69	31.8–43.0
Basalt	2.7–3.2	168–199
Bone	1.7–2.0	106–125
Brick	1.4–1.6	87–100
Butter	0.94–0.95	58.5–59.2
Calcspar	2.6–2.8	162–174
Caoutchouc	0.92–0.99	57.3–61.4
Cast iron	7.25	452
Celluloid	1.4	87
Cement	0.82–1.95	51–121
Chalk	1.8–2.6	112–162
Charcoal	0.4	25
Charcoal, air free	1.4–1.5	87–93
China, Chinese	2.38	148
China, French	2.24	140
China, German	2.29–2.49	143–155
Cinnabar	8.12	506
Clay	1.8–2.6	112–162
Clinker brick	1.7–2.0	106–125
Coal	1.2–1.5	75–93
Coal, pressed	1.25	77.9
Coke	1.4	87
Concrete	1.80–2.45	112–153
Copal	1.04–1.14	64.8–71.0
Cork	0.24	15
Corkboard, black	0.56	35
Corkboard, white	0.25	15.6
Cotton, air dried	1.47–1.50	91.6–93.5
Diamond	3.01–3.52	187.5–219
Earth, loamy, dry	1.6–1.9	100–118
Earth, loamy, pressed	2.0	125
Ebonite	1.15	71.6
Feldspar	3.25–3.50	202–218
Feldspar	2.5	156
Fire brick	1.85–2.2	115–137
Flax, air dried	1.5	93
Flint	2.6–2.8	162–174
Flour, loose	0.4–0.5	25–31
Flour, pressed	0.7–0.8	44–50

DENSITIES OF VARIOUS SOLIDS AND LIQUIDS (Continued)

Name	Grams per cc	Pounds per cu. ft.
Gamboge	1.2	75
Garnet	3.4–4.3	212–268
Gas carbon	1.88	117
Gasoline	0.66–0.69	41–43
Gelatine	1.27	79.1
Glass, crystal	2.9–3.0	181–187
Glass, flask	2.6	162
Glass, flint	3.15–3.90	196–243
Glass, mirror	2.45–2.72	153–169
Glass, window	2.4–2.6	150–162
Glue	1.27	79.1
Gneiss	2.4–2.7	150–168
Granite	2.51–3.05	156–190
Graphite	2.30–2.72	143–169
Gravel	1.8–2.0	112–125
Gum arabic	1.31–1.45	81.6–90.3
Gunpowder, loose	0.9	56
Gunpowder, pressed	1.75	109
Guttapercha	0.96–0.99	60–61.6
Gypsum, calcined	1.81	113
Gypsum, dry, moulded	0.97	60.4
Gypsum, sifted	1.25	77.9
Hemp, fiber, air dried	1.5	93
Ice	0.88–0.92	54.8–57.3
India rubber	0.91–0.93	56.7–57.9
Ivory	1.83–1.92	114–120
Kaolin	2.2–2.5	137–156
Lava, basaltic	2.8–3.0	174–187
Lava, trachitic	2.0–2.7	125–168
Leather	1.02	63.5
Leather, dried	0.86	53.6
Lignite	1.2–1.5	75–93
Lime mortar, dry	1.60–1.65	99.7–102.8
Lime mortar, fresh	1.75–1.80	109–112
Lime stone	2.46–2.84	153–177
Linoleum	1.15–1.3	71.6–81
Litharge, artificial	9.3–9.4	579–586
Litharge, natural	7.83–7.98	488–497
Loam, dried	1.5–1.6	93–100
Loam, fresh	1.67–1.85	104–115
Marble	2.52–2.85	157–177.5
Marl	2.3–2.5	143–156
Masonry brick, dry	1.42–1.46	88.5–91.0
Masonry brick, fresh	1.57–1.63	97.8–101.5
Meerschaum	0.99–1.28	61.7–79.7
Mica	2.65–3.2	165–199
Milk	1.028–1.035	64.04–64.48
Millstone quartz	1.25–1.60	77.9–99.7
Oats	0.43	26.8

Name	Grams per cc	Pounds per cu. ft.
Ocher	3.5	218
Opal	2.2	137
Paper	0.70–1.15	43.6–71.6
Paraffin	0.87–0.91	54.2–56.7
Peat	0.64	39.9
Petroleum ether	0.665	41.5
Pig iron, gray	6.7–7.6	417–473
Pig iron, white	7.0–7.8	436–486
Pitch	1.07–1.10	66.7–68.5
Pitch peat	0.84	52.5
Polishing slate	2.1	131
Porcelain clay	2.2	137
Porphyry	2.4–2.8	150–174
Potato	1.06–1.13	66.0–70.4
Pumice	0.37–0.9	23–56
Quicklime	2.3–3.2	143–199
Red lead	8.6–9.1	536–567
Rock salt	2.28–2.41	143–150
Rosin	1.07	66.7
Rubber fabric	1.0–2.0	62.3–125
Rubber, gum	0.92–0.96	57.3–59.8
Rubber, raw	0.92–0.96	57.3–59.8
Rye	0.68–0.79	42.4–49.2
Sand, coarse	1.4–1.5	87–93.5
Sand, fine, dry	1.40–1.65	87.2–102.8
Sand, fine, moist	1.90–2.05	118.4–127.7
Sandstone	2.2–2.5	137–156
Sandstone, artificial	2.0–2.1	125–131
Sea water	1.025	63.86
Siderite	3.7–3.9	231–243
Silica	2.66	166
Silk, raw	1.56	97.2
Slag, blast furnace	2.5–3.0	156–187
Slaked lime	1.15–1.25	69.6–77.9
Slate	2.65–2.70	165–168
Snow, loose	0.125	7.79
Soapstone	2.7	168
Starch, lumps	1.53–1.56	95.3–97.2
Steel, ingot	7.87	490
Sugar, white	1.61	100.3
Tallow	0.90–0.97	56.1–60.4
Tar	1.02	63.6
Tufa, lump	1.3	81
Tufa, tile	0.8–0.9	50–56
Verdigris	1.9	118
Wax, sealing	1.8	112
Wheat	0.7–0.8	44–50
White lead	6.7	417
Wood	0.31–1.33	19.3–82.9
Wood naphtha	0.810–0.848	50.5–52.9
Wool, air dried	1.32	82.2

RELATIVE DENSITY AND VOLUME OF WATER* AND OF MERCURY AT VARIOUS TEMPERATURES

These values are based upon the mass of one milliliter of water at 4°C. as unity. To convert to absolute density in C. G. S. units multiply the value for relative density by 0.999973.

WATER			MERCURY		
Temp. Degree C.	Relative Density g/ml	Volume ml/g	Relative Density g/ml	Volume ml/g	Temp. Degree C.
−20	.....	.....	13.6450	0.0732869	−20
−19	.....	.....	13.6425	0.0733002	−19
−18	.....	.....	13.6400	0.0733135	−18
−17	.....	.....	13.6375	0.0733269	−17
−16	.....	.....	13.6350	0.0733402	−16
−15	.....	.....	13.6326	0.0733535	−15
−14	.....	.....	13.6301	0.0733670	−14
−13	.....	.....	13.6276	0.0733805	−13
−12	.....	.....	13.6251	0.0733940	−12
−11	.....	.....	13.6226	0.0734074	−11
−10	0.99815	1.00186	13.6202	0.0734205	−10
−9	0.99843	1.00157	13.6177	0.0734338	−9
−8	0.99869	1.00131	13.6152	0.0734472	−8
−7	0.99892	1.00108	13.6127	0.0734608	−7
−6	0.99912	1.00088	13.6103	0.0734739	−6
−5	0.99930	1.00070	13.6078	0.0734873	−5
−4	0.99945	1.00055	13.6053	0.0735006	−4
−3	0.99958	1.00042	13.6029	0.0735140	−3
−2	0.99970	1.00031	13.6004	0.0735273	−2
−1	0.99979	1.00021	13.5979	0.0735407	−1
0	0.99987	1.00013	13.5955	0.0735540	0
1	0.99993	1.00007	13.5930	0.0735674	1
2	0.99997	1.00003	13.5905	0.0735808	2
3	0.99999	1.00001	13.5880	0.0735943	3
4	1.00000	1.00000	13.5856	0.0736075	4
5	0.99999	1.00001	13.5831	0.0736209	5
6	0.99997	1.00003	13.5806	0.0736342	6
7	0.99993	1.00007	13.5782	0.0736476	7
8	0.99988	1.00012	13.5757	0.0736610	8
9	0.99981	1.00019	13.5732	0.0736746	9
10	0.99973	1.00027	13.5708	0.0736877	10
11	0.99963	1.00037	13.5683	0.0737011	11
12	0.99952	1.00048	13.5658	0.0737145	12
13	0.99940	1.00060	13.5634	0.0737278	13
14	0.99927	1.00073	13.5609	0.0737412	14
15	0.99913	1.00087	13.5584	0.0737550	15
16	0.99897	1.00103	13.5560	0.0737680	16
17	0.99880	1.00120	13.5535	0.0737813	17
18	0.99862	1.00138	13.5511	0.0737947	18
19	0.99843	1.00157	13.5486	0.0738081	19
20	0.99823	1.00177	13.5461	0.0738215	20
21	0.99802	1.00198	13.5437	0.0738348	21
22	0.99780	1.00221	13.5412	0.0738487	22
23	0.99756	1.00244	13.5388	0.0738617	23
24	0.99732	1.00268	13.5363	0.0738754	24
25	0.99707	1.00294	13.5339	0.0738888	25
26	0.99681	1.00320	13.5314	0.0739022	26
27	0.99654	1.00347	13.5290	0.0739153	27
28	0.99626	1.00375	13.5265	0.0739289	28
29	0.99597	1.00405	13.5241	0.0739423	29
30	0.99567	1.00435	13.5216	0.0739558	30
31	0.99537	1.00466	13.5191	0.0739691	31
32	0.99505	1.00497	13.5167	0.0739825	32
33	0.99473	1.00530	13.5142	0.0739960	33
34	0.99440	1.00563	13.5118	0.0740094	34
35	0.99406	1.00598	13.5094	0.0740228	35

*See also the table: Properties of Saturated Steam.

RELATIVE DENSITY AND VOLUME OF WATER AND OF MERCURY AT VARIOUS TEMPERATURES

WATER			MERCURY		
Temp. Degree C.	Relative Density g/ml	Volume ml/g	Relative Density g/ml	Volume ml/g	Temp. Degree C.
36	0.99371	1.00633	13.5069	0.0740362	36
37	0.99336	1.00669	13.5045	0.0740496	37
38	0.99299	1.00706	13.5020	0.0740630	38
39	0.99262	1.00743	13.4996	0.0740765	39
40	0.99224	1.00782	13.4971	0.0740898	40
41	0.99186	1.00821	13.4947	0.0741033	41
42	0.99147	1.00861	13.4922	0.0741167	42
43	0.99107	1.00901	13.4898	0.0741301	43
44	0.99066	1.00943	13.4873	0.0741435	44
45	0.99025	1.00985	13.4849	0.0741570	45
46	0.98982	1.01028	13.4825	0.0741704	46
47	0.98940	1.01072	13.4800	0.0741838	47
48	0.98896	1.01116	13.4776	0.0741972	48
49	0.98852	1.01162	13.4751	0.0742107	49
50	0.98807	1.01207	13.4727	0.0742241	50
51	0.98762	1.01254	13.4703	0.0742375	51
52	0.98715	1.01301	13.4678	0.0742510	52
53	0.98669	1.01349	13.4654	0.0742644	53
54	0.98621	1.01398	13.4630	0.0742778	54
55	0.98573	1.01448	13.4605	0.0742913	55
60	0.98324	1.01705	13.4484	0.0743585	60
65	0.98059	1.01979	13.4362	0.0744257	65
70	0.97781	1.02270	13.4241	0.0744930	70
75	0.97489	1.02576	13.4120	0.0745602	75
80	0.97183	1.02899	13.3999	0.0746276	80
85	0.96865	1.03237	13.3878	0.0746949	85
90	0.96534	1.03590	13.3757	0.0747623	90
95	0.96192	1.03959	13.3637	0.0748294	95
100	0.95838	1.04343	13.3516	0.0748971	100
110	0.9510	1.0515	13.328	0.075032	110
120	0.9434	1.0601	13.304	0.075167	120
130	0.9352	1.0693	13.280	0.075303	130
140	0.9264	1.0794	13.256	0.075439	140
150	0.9173	1.0902	13.232	0.075575	150
160	0.9075	1.1019	13.208	0.075712	160
170	0.8973	1.1145	13.184	0.075849	170
180	0.8866	1.1279	13.160	0.075986	180
190	0.8750	1.1429	13.137	0.076124	190
200	0.8628	1.1590	13.113	0.076262	200
210	0.850	1.177	13.089	0.076400	210
220	0.837	1.195	13.065	0.076539	220
230	0.823	1.215	13.042	0.076678	230
240	0.809	1.236	13.018	0.076818	240
250	0.794	1.259	12.994	0.076958	250
260	.....	.....	12.970	0.077099	260
270	.....	.....	12.947	0.077239	270
280	.....	.....	12.923	0.077371	280
290	.....	.....	12.899	0.077513	290
300	.....	.....	12.876	0.077666	300
			Under 20 ATM.		
310	.....	.....	12.853	0.077810	310
320	.....	.....	12.829	0.077954	320
330	.....	.....	12.805	0.078099	330
340	.....	.....	12.781	0.078245	340
350	.....	.....	12.758	0.078391	350
360	.....	.....	12.734	0.078538	360
370	.....	.....	12.710	0.078685	370
380	.....	.....	12.686	0.078834	380
390	.....	.....	12.662	0.078993	390
400	.....	.....	12.638	0.079133	400
450	.....	.....	12.517	0.079897	450
500	.....	.....	12.395	0.080686	500

ABSOLUTE DENSITY OF WATER

This table gives the weight in grams of a cubic centimeter of water at temperatures from 0° to 30°C. Water attains its maximum density at 3.98°C. at which temperature the density is 0.999973 (C. G. S.)

Temp. °C.	Density	Temp. °C.	Density	Temp. °C.	Density	Temp. °C.	Density
0.0	0.999841	7.6	0.999872	15.2	0.999069	22.8	0.997585
0.2	9854	7.8	9861	15.4	9038	23.0	7538
0.4	9866	8.0	9849	15.6	9007	23.2	7490
0.6	9878	8.2	9837	15.8	8975	23.4	7442
0.8	9889	8.4	9824	16.0	8943	23.6	7394
1.0	9900	8.6	9810	16.2	8910	23.8	7345
1.2	9909	8.8	9796	16.4	8877	24.0	7296
1.4	9918	9.0	9781	16.6	8843	24.2	7246
1.6	9927	9.2	9766	16.8	8809	24.4	7196
1.8	9934	9.4	9751	17.0	8774	24.6	7146
2.0	9941	9.6	9734	17.2	8739	24.8	7095
2.2	9947	9.8	9717	17.4	8704	25.0	7044
2.4	9953	10.0	9700	17.6	8668	25.2	6992
2.6	9958	10.2	9682	17.8	8632	25.4	6941
2.8	9962	10.4	9664	18.0	8595	25.6	6888
3.0	9965	10.6	9645	18.2	8558	25.8	6836
3.2	9968	10.8	9625	18.4	8520	26.0	6783
3.4	9970	11.0	9605	18.6	8482	26.2	6729
3.6	9972	11.2	9585	18.8	8444	26.4	6676
3.8	9973	11.4	9564	19.0	8405	26.6	6621
4.0	9973	11.6	9542	19.2	8365	26.8	6567
4.2	9973	11.8	9520	19.4	8325	27.0	6512
4.4	9972	12.0	9498	19.6	8285	27.2	6457
4.6	9970	12.2	9475	19.8	8244	27.4	6401
4.8	9968	12.4	9451	20.0	8203	27.6	6345
5.0	9965	12.6	9427	20.2	8162	27.8	6289
5.2	9961	12.8	9402	20.4	8120	28.0	6232
5.4	9957	13.0	9377	20.6	8078	28.2	6175
5.6	9952	13.2	9352	20.8	8035	28.4	6118
5.8	9947	13.4	9326	21.0	7992	28.6	6060
6.0	9941	13.6	9299	21.2	7948	28.8	6002
6.2	9935	13.8	9272	21.4	7904	29.0	5944
6.4	9927	14.0	9244	21.6	7860	29.2	5885
6.6	9920	14.2	9216	21.8	7815	29.4	5826
6.8	9911	14.4	9188	22.0	7770	29.6	5766
7.0	9902	14.6	9159	22.2	7724	29.8	5706
7.2	9893	14.8	9129	22.4	7678	30.0	5646
7.4	9883	15.0	9099	22.6	7632		

FREEZING MIXTURES

The table below gives the percent of the anhydrous material as shown in the column on the left in the eutectic mixture with ice. The eutectic temperature is the lowest temperature which can be obtained from a mixture of the substance with ice. To obtain the maximum cooling effect, the freezing mixture should be prepared with ice rather than with water and the other ingredient should be cooled to 0°C. For most purposes sodium chloride and ice, or calcium chloride and ice, mixtures are most common providing temperatures of -21.2°C. and -55°C. respectively.

Formula of Substance	%	Eutectic Temp. °C.
$BaCl_2$	22.5	−7.8
$CaCl_2$	29.8	−55
$Ca(NO_3)_2$	35	−16
$CuCl_2$	36	−40
$Cu(NO_3)_2$	36	−24
$CuSO_4$	11.9	−1.6
$FeCl_3$	33.1	−55
$FeSO_4$	13.04	−1.824
HCl	24.8	−86
HNO_3	32.7	−43
K_2CO_3	39.5	−36.5
KCl	19.75	−11.1
K_2CrO_4	36.6	−11.3
KOH	31.5	−65
KNO_3	10.9	−2.9
$MgCl_2$	21.6	−33.6
$Mg(NO_3)_2$	34.6	−29
$MgSO_4$	19	−3.9

Formula of Substance	%	Eutectic Temp. °C.
$MnSO_4$	32.2	−10.5
NH_4Cl	18.6	−15.8
NH_4NO_3	41.2	−17.35
$(NH_4)_2SO_4$	38.3	−19.05
NaBr	40.3	−28
Na_2CO_3	5.9	−2.1
NaCl	23.3	−21.13
NaOH	19	−28
$NaNO_3$	37	−18.5
Na_2SO_4	12.7	−3.55
$Na_2S_2O_3$	30	−11
$NiSO_4$	20.6	−4.15
SO_3	32	−75
$SrCl_2$	26	−18.7
$Sr(NO_3)_2$	24.5	−5.75
$ZnCl_2$	51	−62
$Zn(NO_3)_2$	39.4	−29
$ZnSO_4$	27.2	−6.55

NON-AQUEOUS COOLING BATHS

Low temperatures may be produced by mixtures of various substances with carbon dioxide snow or by evaporation of low boiling liquids.*

Substance	Deg. C.
Alcohol-carbon dioxide	−72
Ammonia, boiling point	−33.4
Chloroform-carbon dioxide	−77
Ether-carbon dioxide	−100
Ethyl chloride, boiling point	+12.5
Liquid air, boiling point	−190

Substance	Deg. C.
Nitrogen, boiling point	−196
Oxygen, boiling point	−183
Sulfur dioxide, boiling point	−10

* The assertion that certain baths with CO_2 snow, especially the acetone bath, give a temperature materially lower than pure dry CO_2 snow is erroneous. Cf. Thiel and Caspar, *Z. physik. Chem.* **86,** *257–93 (1914); C. A.* **8,** *1229 (1914).* Liquid air poured into ethyl alcohol until a slush is formed gives a cooling bath −115° to −125°C.

COMPOSITION OF AQUEOUS ANTI-FREEZE SOLUTIONS

FREEZING POINT OF ALCOHOL-WATER MIXTURES

Specific Gravity 20°/4°C. (68°F.)	% alcohol by weight	% alcohol by volume	Freezing Point °C.	Freezing Point °F.
0.99363	2.5	3.13	−1.0	30.2
0.98971	4.8	6.00	−2.0	28.4
0.98658	6.8	8.47	−3.0	26.6
0.98006	11.3	14.0	−5.0	23.0
0.97670	13.8	17.0	−6.1	21.0
0.97336	16.4	20.2	−7.5	18.5
0.97194	17.5	21.5	−8.7	16.3
0.97024	18.8	23.1	−9.4	15.1
0.96823	20.3	24.8	−10.6	12.9
0.96578	22.1	27.0	−12.2	10.0
0.96283	24.2	29.5	−14.0	6.8
0.95914	26.7	32.4	−16.0	3.2
0.95400	29.9	36.1	−18.9	−2.0
0.94715	33.8	40.5	−23.6	−10.5
0.93720	39.0	46.3	−28.7	−19.7
0.92193	46.3	53.8	−33.9	−29.0
0.90008	56.1	63.6	−41.0	−41.8
0.86311	71.9	78.2	−51.3	−60.3

FREEZING POINT OF GLYCEROL (GLYCERINE)—WATER MIXTURES

The values are those reported by Bosart and Snoddy (*Jour. Ind. and Eng. Chem.*, 19, 506 (1927)), and Lane (*Jour. Ind. and Eng. Chem.*, 17, 924 (1925))but modified by adding 2°F to all temperatures below 0°F in accordance with the suggestion of the Procter and Gamble Co.

% Glycerol by Weight	Specific Gravity 15°/15°C. (59°F.)	Specific Gravity 20°/20°C. (68°F.)	Freezing Point °C.	Freezing Point °F.
10	1.02415	1.02395	−1.6	29.1
20	1.04935	1.04880	−4.8	23.4
30	1.07560	1.07470	−9.5	14.9
40	1.10255	1.10135	−15.4	4.3
50	1.12985	1.12845	−22.0	−7.4
60	1.15770	1.15605	−33.6	−28.5
70	1.18540	1.18355	−37.8	−36.0
80	1.21290	1.21090	−19.2	−2.3
90	1.23950	1.23755	−1.6	29.1
100	1.26557	1.26362	17.0	62.6

FREEZING POINT OF PRESTONE *—WATER MIXTURES

% Prestone By Weight	% Prestone By Volume	Specific Gravity 15°/15C. (59°F.)	Freezing Point °C.	Freezing Point °F.
10	9.2	1.013	−3.6	25.6
15	13.8	1.019	−5.6	22.0
20	18.3	1.026	−7.9	17.8
25	23.0	1.033	−10.7	12.8
30	28.0	1.040	−14.0	6.8
40	37.8	1.053	−22.3	−8.2
50	47.8	1.067	−33.8	−28.8
60	58.1	1.079	−49.3	−56.7

* Eveready Prestone (manufactured by the National Carbon Co.), marketed for anti-freeze purposes, is 97% ethylene glycol containing fractional percentages of soluble and insoluble ingredients to prevent foaming, creepage and water corrosion in automobile cooling systems.

FREEZING POINT OF MAGNESIUM CHLORIDE BRINES

% $MgCl_2$ by weight	Spec. Grav. 15.6°C. (60°F.)	Freezing Point °C.	Freezing Point °F.
5	1.043	−3.11	26.4
6	1.051	−3.89	25.0
7	1.060	−4.72	23.5
8	1.069	−5.67	21.8
9	1.078	−6.67	20.0
10	1.086	−7.83	17.9
11	1.096	−9.05	15.7
12	1.105	−10.5	13.1
13	1.114	−12.1	10.3
14	1.123	−13.7	7.3
15	1.132	−15.6	4.0
16	1.142	−17.6	0.4
17	1.151	−19.7	−3.5

% $MgCl_2$ by weight	Spec. Grav. 15.6°C. (60°F.)	Freezing Point °C.	Freezing Point °F.
18	1.161	−22.1	−7.7
19	1.170	−25.6	−12.2
20	1.180	−27.4	−17.3
21	1.190	−30.6	−23.0
22	1.200	−32.8	−27.0
23	1.210	−28.9	−20.0
24	1.220	−25.6	−14.0
25	1.230	−23.3	−10.0
26	1.241	−21.1	−6.0
27	1.251	−19.4	−3.0
28	1.262	−18.3	−1.0
29	1.273	−17.2	+1.0
30	1.283	−16.7	2.0

FREEZING POINT OF SODIUM CHLORIDE BRINES

Compiled in collaboration with C. D. Looker, Ph.D., International Salt Co., Inc.

% NaCl by weight	Spec. Grav. 15°C. (59°F.)	Freezing Point °C.	Freezing Point °F.
0	1.000	0.00	32.0
1	1.007	−0.58	31.0
2	1.014	−1.13	30.0
3	1.021	−1.72	28.9
4	1.028	−2.35	27.8
5	1.036	−2.97	26.7
6	1.043	−3.63	25.5
7	1.051	−4.32	24.2
8	1.059	−5.03	22.9
9	1.067	−5.77	21.6
10	1.074	−6.54	20.2
11	1.082	−7.34	18.8
12	1.089	−8.17	17.3
13	1.097	−9.03	15.7
14	1.104	−9.94	14.1

% NaCl by weight	Spec. Grav. 15°C. (59°F.)	Freezing Point °C.	Freezing Point °F.
15	1.112	−10.88	12.4
16	1.119	−11.90	10.6
17	1.127	−12.93	8.7
18	1.135	−14.03	6.7
19	1.143	−15.21	4.6
20	1.152	−16.46	2.4
21	1.159	−17.78	+0.0
22	1.168	−19.19	−2.5
23	1.176	−20.69	−5.2
23.3 (*E*)	1.179	−21.13	−6.0
24	1.184	−17.0*	+1.4*
25	1.193	−10.4*	13.3*
26	1.201	−2.3*	27.9*
26.3	1.203	0.0*	32.0*

* Saturation temperatures of sodium chloride dihydrate; at these temperatures $NaCl \cdot 2H_2O$ separates leaving the brine of the eutectic composition (*E*).

FREEZING POINT OF CALCIUM CHLORIDE BRINES

Reproduced from "Dow Calcium Chloride for Refrigeration," copyright 1929 by The Dow Chemical Co., by permission.

Density of Brine @ 60°F.		Freezing Point °F.	Freezing Point °C.	Ammonia Suction Pressure lbs. gauge Corresponding to Freezing Point	Calcium Chloride Content of Brine in Per Cent		Anhydrous Calcium Chloride Content of Brine†		Weight of Brine @ 60° F.		SPECIFIC HEAT OF BRINE Referred to Water @ 68° F. Temperature °F.					HEAT CAPACITY OF BRINE (In BTU's. Per Gallon Temperature °F.				
Specific Gravity	Baume Scale				Anhydrous $CaCl_2$	Dow 73-75% $CaCl_2$	Pounds Per Gallon	Pounds Per Cu. Ft.	Pounds Per Gallon	Pounds Per Cu. Ft.	−20	−10	0	+10	+20	−20	−10	0	+10	+20
1.00	0.0	+32.0	0.0	47.6	0.0	0.0	0.0	0.0	8.34	62.4	.....	.....	.....	.....	.....	....	....	....	....	....
1.01	1.4	+31.1	−0.5	46.4	1.1	1.48	0.093	0.69	8.41	63.1	.....	.....	.....	.....	.....	....	....	....	....	....
1.02	2.8	+30.2	− 1.0	45.3	2.3	3.11	0.196	1.46	8.50	63.7	.....	.....	.....	.....	.....	....	....	....	....	....
1.03	4.2	+29.1	− 1.8	43.9	3.5	4.73	0.301	2.25	8.59	64.3	.....	.....	.....	.....	.....	....	....	....	....	....
1.04	5.6	+28.0	− 2.2	42.6	4.7	6.35	0.407	3.04	8.67	64.9	.....	.....	.....	.....	.....	....	....	....	....	....
1.05	6.9	+27.0	− 2.8	41.4	5.8	7.99	0.508	3.80	8.75	65.5	.....	.....	.....	.....	.....	....	....	....	....	....
1.06	8.2	+25.9	− 3.2	40.1	7.0	9.46	0.619	4.62	8.84	36.2	.....	.....	.....	.....	.....	....	....	....	....	....
1.07	9.5	+24.6	− 4.1	38.6	8.1	10.93	0.723	5.40	8.92	66.8	.....	.....	.....	.....	.....	....	....	....	....	....
1.08	10.7	+23.4	− 4.8	37.2	9.2	12.41	0.829	6.19	9.00	67.4	.....	.....	.....	.....	.....	....	....	....	....	....
1.09	12.0	+21.7	− 5.9	35.4	10.4	14.08	0.945	7.06	9.09	68.1	.....	.....	.....	.....	.....	....	....	....	....	....
1.10	13.2	+20.3	− 6.5	33.8	11.4	15.40	1.05	7.81	9.17	68.7	.....	.....	.....	.....	0.829	....	....	....	....	7.60
1.11	14.4	+18.5	− 7.5	31.9	12.5	16.90	1.16	8.64	9.25	69.3	.....	.....	.....	.....	0.815	....	....	....	....	7.55
1.12	15.5	+16.5	− 8.6	29.9	13.5	18.25	1.26	9.42	9.34	69.9	.....	.....	.....	.....	0.802	....	....	....	....	7.49
1.13	16.7	+14.4	− 9.9	27.9	14.6	19.75	1.38	10.28	9.42	70.6	.....	.....	.....	.....	0.789	....	....	....	....	7.44
1.14	17.8	+12.0	−11.1	25.6	15.6	21.05	1.48	11.08	9.50	71.2	.....	.....	.....	.....	0.776	....	....	....	....	7.38
1.15	18.9	+ 9.7	−12.4	23.5	16.6	22.41	1.59	11.89	9.58	71.8	.....	.....	.....	0.759	0.764	....	....	....	7.28	7.33
1.16	20.0	+ 7.0	−13.9	21.2	17.6	23.80	1.70	12.71	9.67	72.4	.....	.....	.....	0.748	0.753	....	....	....	7.24	7.29
1.17	21.1	+ 4.1	−15.6	18.9	18.6	25.15	1.81	13.56	9.75	73.1	.....	.....	.....	0.737	0.742	....	....	....	7.19	7.24
1.18	22.1	+ 1.4	−17.0	16.8	19.5	26.38	1.92	14.34	9.83	73.7	.....	.....	.....	0.727	0.732	....	....	....	7.15	7.20
1.19	23.2	− 2.2	−19.0	14.2	20.5	27.75	2.02	15.20	9.92	74.3	.....	.....	0.712	0.717	0.722	....	....	7.07	7.12	7.17
1.20	24.2	− 5.8	−21.0	11.7	21.5	29.06	2.13	16.07	10.01	74.9	.....	.....	0.703	0.707	0.712	....	....	7.03	7.08	7.13
1.21	25.2	− 9.4	−23.0	9.4	22.4	30.30	2.25	16.89	10.08	75.5	.....	.....	0.694	0.699	0.704	....	....	7.00	7.05	7.10
1.22	26.2	−13.2	−25.1	7.3	23.3	31.50	2.37	17.71	10.17	76.2	.....	0.681	0.686	0.691	0.696	....	6.93	6.98	7.03	7.08
1.23	27.1	−17.1	−27.2	5.1	24.2	32.70	2.48	18.54	10.25	76.8	.....	0.674	0.679	0.683	0.688	....	6.92	6.96	7.01	7.06
1.24	28.1	−21.3	−29.6	3.1	25.1	33.97	2.60	19.39	10.33	77.4	0.663	0.667	0.672	0.676	0.681	6.84	6.89	6.94	6.99	7.04
1.25	29.0	−25.8	−32.1	1.3	26.0	35.13	2.71	20.25	10.41	78.1	0.657	0.661	0.665	0.669	0.674	6.84	6.89	6.93	6.98	7.02
1.26	29.9	−30.8	−34.9	* 1.7	26.9	36.40	2.83	21.12	10.50	78.7	0.651	0.655	0.659	0.663	0.667	6.84	6.88	6.92	6.96	7.00
1.27	30.8	−36.4	−38.0	* 6.1	27.8	37.60	2.94	21.93	10.58	79.3	0.646	0.650	0.653	0.657	0.660	6.84	6.88	6.91	6.95	6.98
1.28	31.7	−44.1	−42.3	*11.2	28.7	38.80	3.06	22.89	10.66	79.9	0.642	0.645	0.647	0.650	0.654	6.84	6.87	6.90	6.93	6.97
1.29	32.6	−59.8	−51.0	*18.5	29.6	40.00	3.18	23.79	10.75	80.5	0.637	0.640	0.642	0.645	0.648	6.85	6.88	6.90	6.93	6.96
1.30	33.5	−41.8	−41.0	* 9.9	30.5	41.20	3.30	24.70	10.84	81.2	0.633	0.635	0.637	0.640	0.643	6.86	6.88	6.91	6.94	6.97

* Inches of mercury below one standard atmosphere (29.92 in.)

† To find equivalent weight of Dow 73-75% Solid multiply by 1.35 and for weight of Dow Flake 77-80% Calcium Chloride multiply by 1.28.

PHYSICAL PROPERTIES OF REFRIGERANTS

Compiled from information contained in a private communication from KINETIC CHEMICALS, INC., Wilmington, Del., U.S.A. and from Cir. No. 2, *Am. Soc. Refrigeration Engineers (1926)*.

Refrigerant	Ammonia	Carbon Dioxide	Ethyl Chloride	Methyl Chloride	Sulfur Dioxide	Freon*	F—11*	F—21*	F—114*
Chemical symbol	NH_3	CO_2	C_2H_5Cl	CH_3Cl	SO_2	CCl_2F_2	CCl_3F	$CHCl_2F$	$C_2Cl_2F_4$
Molecular weight	17.032	44.00	64.50	50.48	64.06	120.914	137.371	102.922	170.914
Color of liquid	colorless	colorless	colorless	colorless	colorless	colorless	colorless	colorless	colorless
Odor	pungent aromatic	odorless	pungent etherial odor; sweetish taste	similar to chloroform, but less sweet	pungent characteristic	etherial odor	etherial odor	etherial odor	etherial odor
Density of liquid (Water=1) at, deg. C.	0.6818 −33.35	See Note X	0.9232 0.0	0.998 −24.09	1.4601 −10.0	1.445 −15.0	1.568 −15.0	1.446 −15.0	1.570 −15.0
Density of gas, grams 1 liter (See Note Y)	0.7708	1.9768		2.3045	2.9267	5.44	6.20	4.60	7.75
(Air=1)	0.5962	1.5290	2.31	1.7824	2.2636	4.21	4.80	3.56	6.0
Boiling point at 1 atm., deg. C.	−33.35	See Note X	13.1	−24.09	−10.0	−29.8	23.7	8.9	3.5
deg. F.	−28.03		55.6	−11.36	14.0	−21.7	74.67	48.0	38.4
Melting point, deg. C.	−77.70	−78.52	−138.7	−91.5	−75.2	−155.0	−88.0	−127.0	−105.5
deg. F.	−107.86	−109.34	−217.7	−132.7	−103.4	−247.0	−126.4	−196.6	−158.0
Critical temperature, deg. C.	132.9	31.00	182.8	143.12	157.12	111.7	196.6		146.1
deg. F.	271.2	87.80	361.0	289.6	314.82	233.0	386.0		295.0
Critical pressure, atm. abs.	112.3	72.85	53.3	65.93	77.65	39.4	41.7		35.5
lbs. per sq. in. abs.	1651	1071	784	969.2	1141.5	580	612		550
Specific heat of constant pressure (C_p)	0.5202	0.2025	0.273	0.24	0.1511	0.1476	0.147	0.18	
Specific heat of constant volume (C_v)	0.4011	0.1558		0.20		0.1297	0.1296	0.1607	
Ratio of specific heats (C_p/C_v) at deg. C.	1.2969	1.3003 0.0	1.1257 73	1.1991 66—86	1.256 16—34	1.138	1.135	1.12	1.106
Latent heat of vaporization at 1 atm., BTU per lb.	589.4	256.3 See Note X	168.6	180.6	172.3	71.95	78.8	101.8	58.3
Suction pressure at 5°F., lb. per sq. in. abs.	34.5	331.8	4.65	20.89	11.82	26.51	2.96	5.5	7.2
Head pressure at 86°F., lb. per sq. in. abs.	168.5	1039.6	27.1	95.53	65.9	107.9	18.3	30.5	35.8

*Trade names for dichlorodifluoromethane, trichloromonofluoromethane, dichloromonofluoromethane, and dichlorotetrafluoroethane.
Note X—Carbon Dioxide not a liquid at atmospheric pressure.
Note Y—Density of gas at 0°C. (32°F.) and 760 mm. (1 atm.), except for Ethyl Chloride for which no temperature has been given.

SPECIFIC AND LATENT HEAT OF VARIOUS FOOD PRODUCTS AND THEIR COLD STORAGE TEMPERATURES

Published in "Dow Calcium Chloride for Refrigeration," copyright 1929 by The Dow Chemical Co., from information furnished by the York Ice Machinery Corporation, York, Penna., and reproduced by permission.

Article	Composition		Specific Heat		Latent Heat of Freezing	Cold Storage Temperature °F.
	Water	Solid	Above Freezing	Below Freezing		
Fruit						
Apples	63.5	36.5	.708	.39	91.5	32–36
Banana (Edible Portions)	75.5	24.5	.804	.426	108.5	34
Berries (Fresh)	86.5	13.5	.892	.46	124.5	36
Cranberries	89.0	11.0	.912	.467	128.0	33–36
Cantaloupes (Whole)	45.0	55.0	.560	.335	65.0	40
Dates, Figs, Etc.	79.0	21.0	8.32	.437	104.0	50–55
Fruits (Dried)	15–30	70–85	.290–.47	.215–.320	21.6–43.2	35–40
Grapes (Whole)	58.0	42.0	.664	.374	83.5	34–36
Lemons (Whole)	62.5	37.5	.700	.387	90.0	33–45
Oranges (Whole)	63.5	36.5	.708	.390	91.5	34–45
Peaches (Whole)	73.5	26.5	.788	.420	106.0	34–36
Pears, Watermelons	76.0	24.0	.808	.428	109.0	34–36
Meats						
Brined	52.0	48.0	.616	.356	75.0	38
Beef (Fresh)	68.0	32.0	.744	.404	98.0	33
Beef (Fat)	51.0	49.0	.608	.353	73.5	30
Beef (Lean)	72.0	28.0	.776	.416	102.0	30
Beef (Dried)	5–15	95–85	.22–.34	.195–.265	7.2–21.6	36–40
Hams, Ribs (Not Brined)	60.0	40.0	.680	.380	86.5	20
Shoulders (Not Brined)	76.0	24.0	.808	.428	109.0	20
Lard						38
Livers	65.5	34.5	.724	.396	93.5	20–30
Lamb	58.0	42.0	.664	.374	83.5	32
Pork (Edible Portion)	60.0	40.0	.680	.380	86.5	29–32
Pork (Fat)	39.0	61.0	.512	.317	56.2	30–35
Sausage Casings						20
Tenderloins, Butts, Etc.	67.0	33.0	.736	.401	96.5	33
Veal	63.0	37.0	.704	.390	91.0	32–33
Fish						
Fresh Fish	70.0	30.0	.760	.410	101.0	20–28
Dried Fish	45.0	55.0	.560	.335	65.0	36
Oysters in Shell	80.38	19.62	.843	.441	115.7	30–40
Oysters in Tubs	87.0	13.0	.896	.461	125.1	25–35
Canned Goods						
Fruits		Same	As	Fresh.		35–40
Meats		Same	As	Fresh.		35–40
Sardines	70.0	30.0	.760	.410	101.0	35–40
Butter, Eggs, Etc.						
Butter	12.75	87.25	.302	.238	18.4	18–20
Cheese	35.0	65.0	.480	.305	50.5	34
Eggs	70.0	30.0	.760	.410	100.0	31
Milk	87.5	12.5	.900	.462	124.0	35
Flour, Meal (Wheat)	10–20	90–80	.26–.38	.210–.280	14.4–28.8	36–40
Vegetables						
Asparagus	94.0	6.0	.952	.482	134.0	34–35
Cabbage	91.0	9.0	.928	.473	131.0	34–35
Carrots	83.0	17.0	.864	.449	119.5	34–35
Celery (Edible Portion)	94.0	6.0	.952	.482	135.0	34–35
Dried Beans	12.5	87.5	.300	.237	18.0	32–45
Dried Corn	10.5	89.5	.284	.231	15.1	35–45
Dried Peas	9.5	90.5	.276	.224	13.7	35–45
Onions	87.5	12.5	.900	.462	126.0	36
Parsnips	83.0	17.0	.864	.449	119.5	34–35
Potatoes	74.0	26.0	.792	.422	106.5	36–40
Sauerkraut	89.0	11.0	.912	.467	128.0	35
Miscellaneous						
Cigars, Tobacco						35–42
Furs, Woolens, Etc.						35
Honey	18.0	82.0	.344	.254	25.9	36–40
Hops						32–40
Maple Syrup	36.0	64.0	.488	.308	51.8	40–45
Maple Sugar	5.0	95.0	.240	.215	7.2	40–45
Poultry Dressed Iced	73.7	26.3	.790	.421	105.0	28–30
Poultry Dry Picked	65.0	35.0	.720	.395	93.5	26–28
Poultry Scalded	75.0	25.0	.800	.425	108.0	20
Game Frozen	60.0	40.0	.680	.380	86.5	15–28
Poultry Frozen	60.0	40.0	.680	.380	86.5	15–28
Nuts (Dried)	3–10	97-90	.21–.294	.195–.244	4.3–14.4	35–40

MOLECULAR DEPRESSION OF THE FREEZING POINT

The constant K_F gives the depression of the freezing point in °C. produced by solution of one gram molecular weight of a substance in 1000 grams of any one of the solvents listed below.

Compound	Freezing Point °C.	K_F	Heat of Fusion gram-cal. per gram
Acetic acid	16.7	3.9	43.2
Aluminum bromide	97.5	26.8	10.47
Barium chloride	962	108	27.8
Benzene	5.5	5.12	30.1
Benzophenone	48.5	9.8	23.5
Bromoform	7.8	14.4	10.9
Camphor*	178.4	37.7	10.74
Cyclohexane	6.5	20.0	7.4
m-Dinitrobenzene	89.8	10.6	24.7
1, 4-Dioxane	10.5	4.9	.....
Diphenyl	70.0	8.0	28.8
Diphenylamine	52.9	8.6	25.2
Ethylene bromide	9.98	12.5	13.5
Formamide	2	3.8	.....
Formic acid	8.6	2.77	58.9
Naphthalene	80.2	6.9	36.0

Compound	Freezing Point °C.	K_F	Heat of Fusion gram-cal. per gram
β-Naphthol	122.5	11.25	31.3
Nitrobenzene	5.7	8.1	22.46
Phenanthrene	99.3	12.0	25.0
Phenol	42	7.27	29.0
Salol	43	12.3	16.13
Stannic bromide	31	28.0	6.49
Stearic acid	69	4.5	47.6
Strontium chloride	873	107	25.6
Sulfuric acid	10.5	6.81	24.03
p-Toluidine	44.5	5.2	39.9
Tribromophenol	96	20.4	13.4
Triphenyl methane	93	12.45	21.1
Triphenyl phosphate	49.9	11.76	17.56
Urethane	49.7	5.14	40.9
Water	0	1.86	79.67
p-Xylene	13.2	4.3	38.1

*According to Rast (*Ber.* 55, 1051, 3727 (1922)) molecular weight determinations may be made with an ordinary thermometer.

MOLECULAR ELEVATION OF THE BOILING POINT

The constant K_B gives the elevation of the boiling point in °C. produced by solution of one gram molecular weight of a substance in 1000 grams of any one of the solvents listed below. In the column headed *Barometric Correction* is given the number of degrees for each mm. of difference between the barometric reading and 760 mm. of mercury to be subtracted from K_B if the pressure is lower, or added if higher, than 760 mm. Cf. Hoyt and Fink, *J. Phys. Chem.* 41, 453 (1937).

Compound	Boiling Point °C.	K_B	Barometric Correction per mm. Hg	Heat of Vaporization gram-cal. per gram.
Acetic Acid	118.5	3.07	0.0008	96.8
Acetone	56.00	1.71	0.0004	124.5
Aniline	184.3	3.52	0.0009	103.7
Benzene	80.15	2.53	0.0007	94.3
Bromobenzene	155.83	6.26	0.0016	57.6
Camphor	208.25	5.95	0.0015	74.23
Carbon disulfide	46.13	2.34	0.0006	84.1
Carbon tetrachloride	76.50	5.03	0.0013	46.4
Chlorobenzene	131.98	4.15	0.0011	77.6
Chloroform	60.19	3.63	0.0009	59.0
Cyclohexane	80.88	2.79	0.0007	85.6
Diphenyl	254.9	7.08	0.0018	78.42
Ethanol	78.26	1.22	0.0003	204
Ethyl acetate	77.13	2.77	0.0007	88.4
Ethyl ether	34.42	2.02	0.0005	83.9
Ethyl Iodide	72.5	5.05	0.0013	45.6
Ethylene bromide	131.5	6.44	0.0016	46.2
n-Heptane	98.42	3.43	0.0008	76.3
n-Hexane	68.59	2.75	0.0007	79.3
Iodobenzene	188.47	8.53	0.0021	.....
Methanol	64.67	0.83	0.0002	262.8
Methyl acetate	57.1	2.15	0.0005	98.1
Naphthalene	218.0	5.65	0.0014	75.5
Nitrobenzene	210.85	5.24	0.0013	79.1
n-Octane	125.80	4.02	0.0010	70.9
n-Pentane	36.00	2.04	0.0005	.....
Phenol	181.2	3.56	0.0009	114.3
Stannic chloride	114.1	9.43	0.0024	30.3
Toluene	110.7	3.33	0.0008	.....
Water	100.00	0.512	0.0001	539.6

AZEOTROPIC MIXTURES

These tables give the data for various binary and ternary azeotropic or constant boiling mixtures.

For a thorough discussion of Azeotropy, see Lecat, *Traite de Chimie Organique*, V. Grignard, Mason et Cie, Paris, 1935, Tome I, pp. 121 to 267; or Young, *Distillation Principles and Processes*, Macmillan, London, 1922.

The boiling points listed are in °C. at 760 mm.

These data are taken from Lecat, "*L'Azeotropisme*", Brussels, 1918; *Ann. soc. sci. Bruxelles 45B, 169–76, 284–94 (1926)*; *47B, i, 21–7, 63–71, 108–14, 149–58 (1927)*; *48B, i, 13–22, 54–62, 113–26; ii, 1–18 (1928)*; *49B, ii, 17–47, 109–43 (1929)*; *50B, 21–33 (1930)*; *55B, 43–7, 253–65 (1935)*; *56B, 41–54, 221–34 (1936)*; *Rec. trav. chim. Pays-Bas 45, 620–7 (1926)*; *46, 240–7 (1927)*; *47, 13–18 (1928)*, unless otherwise designated as follows:

(1) Young and Fortey, *Trans. Chem. Soc., 81, 717, 739, 752 (1902)*; *83, 45 (1903)*.
(2) Roscoe, *Quart. Jour. Chem. Soc., 13, 146 (1861)*; *15, 270 (1862)*.
(3) Bogin, *U. S. P. Re. 17, 157.*
(4) Young, "*Distillation Principles and Processes*", Macmillan, London, 1922.
(5) Miller and Bliss, *Ind. Eng. Chem., 32, 123 (1940)*.
(6) Hannotte, *Bull. Soc. Chim. Belg., 35, 85–109 (1926)*.
(7) Wuyts, *ibid., 33, 167–192 (1924)*.
(8) Beduwe, *ibid., 34, 41–55 (1925)*.
(9) Atkins, *Trans. Chem. Soc., 117, 218–20 (1920)*.
(10) Booklet by Shell Chemical Co., "Organic Chemicals Manufactured by Shell Chemical Company", 1939.

TABLE I

BINARY AZEOTROPES CONTAINING WATER

	B.P. 760 mm.		% By weight	
	Other component	Azeotrope	Water	Other component
A—Alcohols				
Ethyl alcohol (1)	78.4	78.1	4.5	95.5
n-Propyl alcohol (1)	97.2	87.7	28.3	71.7
iso-Propyl alcohol (1)	82.5	80.4	12.1	87.9
n-Butyl alcohol	117.8	92.4	38	62
iso-Butyl alcohol	108.0	90.0	33.2	66.8
sec-Butyl alcohol	99.5	88.5	32.1	67.9
tert-Butyl alcohol	82.8	79.9	11.7	88.3
n-Amyl alcohol (Pentanol-1)	137.8	96.0	54.0	46.0
Prim-*iso*-amyl alcohol (Methyl-2-butanol-4)	131.4	95.2	49.6	50.4
tert-Amyl alcohol (Methyl-2-butanol-2)	102.3	87.4	27.5	72.5
sec-Amyl alcohol (Pentanol-3)	115.4	91.7	36.0	64.0
Act.-*sec*-amyl alcohol (Pentanol-2)	119.3	92.5	38.5	61.5
n-Hexyl alcohol	157.9	97.8	75	25
n-Heptyl alcohol	176.2	98.7	83	17
n-Octyl alcohol	195.2	99.4	90	10

AZEOTROPIC MIXTURES

	B.P. 760 mm.		% By weight	
	Other component	Azeotrope	Water	Other component
Allyl alcohol	97.0	88.2	27.1	72.9
Benzyl alcohol	205.2	99.9	91	9
Furfuryl alcohol	169.4	98.5	80	20
B—Hydrocarbons				
Benzene	80.2	69.3	8.9	91.1
Toluene	110.8	84.1	13.5	86.5
C—Substituted Hydrocarbons				
Ethylene chloride	83.7	72	8.3	91.7
Propylene chloride	96.8	78	12	88
D—Ethers				
Diethyl ether	34.5	34.2	1.3	98.7
Di-*iso*-propyl ether	68.4	62.2	4.5	95.5
Ethyl *n*-propyl ether	63.6	59.5	4	96
Di-*iso*-butyl ether	122.2	88.6	23	77
Di-*iso*-amyl ether	172.6	97.4	54	46
Diphenyl ether	259.3	99.3	96.8	3.2
Phenetole	170.4	97.3	59	41
Anisole	153.9	95.5	40.5	59.5
Resorcinol diethyl ether	235.0	99.7	91	9
E—Esters				
n-Propyl formate	80.9	71.9	3.6	96.4
n-Butyl formate	106.8	83.8	15	85
iso-Butyl formate	98.4	80.4	7.8	92.2
n-Amyl formate	132.0	91.6	28.4	71.6
iso-Amyl formate	123.9	89.7	23.5	76.5
Benzyl formate	202.3	99.2	80	20
Ethyl acetate	77.1	70.4	6.1	93.9
n-Propyl acetate	101.6	82.4	14	86
iso-Propyl acetate	91.0	77.4	6.2	93.8
n-Butyl acetate	126.2	90.2	28.7	71.3
iso-Butyl acetate	117.2	87.5	19.5	80.5
n-Amyl acetate	148.8	95.2	41	59
iso-Amyl acetate	142.1	93.8	36.2	63.8
Benzyl acetate	214.9	99.6	87.5	12.5
Phenyl acetate	195.7	98.9	75.1	24.9
Methyl propionate	79.9	71.4	3.9	96.1
Ethyl propionate	99.2	81.2	10	90
n-Propyl propionate	122.1	88.9	23	77
iso-Butyl propionate	136.9	92.8	32.2	67.8
iso-Amyl propionate	160.3	96.6	48.5	51.5
Methyl butyrate	102.7	82.7	11.5	88.5
Ethyl butyrate	120.1	87.9	21.5	78.5
n-Propyl butyrate	142.8	94.1	36.4	63.6
n-Butyl butyrate	165.7	97.2	53	47
iso-Butyl butyrate	156.8	96.3	46	54
iso-Amyl butyrate	178.5	98.1	63.5	36.5
Methyl *iso*-butyrate	92.3	77.7	6.8	93.2
Ethyl *iso*-butyrate	110.1	85.2	15.2	84.8
n-Propyl *iso*-butyrate	133.9	92.2	30.8	69.2

AZEOTROPIC MIXTURES

	B.P. 760 mm.		% By weight	
	Other component	Azeotrope	Water	Other component
iso-Butyl *iso*-butyrate	147.3	95.5	39.4	60.6
iso-Amyl *iso*-butyrate	168.9	97.4	56.0	44.0
Methyl *iso*-valerate	116.3	87.2	19.2	80.8
Ethyl *iso*-valerate	134.7	92.2	30.2	69.8
n-Propyl *iso*-valerate	155.8	96.2	45.2	54.8
iso-Butyl *iso*-valerate	168.7	97.4	55.8	44.2
iso-Amyl *iso*-valerate	193.5	98.8	74.1	25.9
Ethyl caproate	166.8	97.2	54	46
Methyl cinnamate	261.9	99.9	95.5	4.5
Methyl benzoate	199.5	99.1	79.2	20.8
Ethyl benzoate	212.4	99.4	84.0	16.0
n-Propyl benzoate	230.9	99.7	90.9	9.1
n-Butyl benzoate	249.8	99.9	94	6
iso-Butyl benzoate	242.2	99.8	92.6	7.4
iso-Amyl benzoate	262.3	99.9	95.6	4.4
Ethyl phenylacetate	228.8	99.7	91.3	8.7
Ethyl nitrate	87.7	74.4	22	78
n-Propyl nitrate	110.5	84.8	20	80
iso-Butyl nitrate	122.9	89.0	25	75
F—Organic Acids				
Formic acid (Max.)	100.8	107.3	22.5	77.5
Acetic acid	118.1	No	Azeotrope	
Propionic acid	141.1	99.98	82.3	17.7
Butyric acid	163.5	99.4	81.6	18.4
iso-Butyric acid	154.5	99.3	79	21
G—Inorganic Acids (2)				
Nitric acid (Max.)	86.0	120.5	32	68
Perchloric acid (Max.)	110.0	203	28.4	71.6
Hydrofluoric acid (Max.)	19.4	120	63	37
Hydrochloric acid (Max.)	−84	110	79.76	20.24
Hydrobromic acid (Max.)	−73	126	52.5	47.5
Hydriodic acid (Max.)	−34	127	43	57
H—Ketones				
Methyl ethyl ketone	79.6	73.5	11	89
Methyl *n*-propyl ketone (10)	102.0	83.3	19.5	80.5
Methyl *iso*-butyl ketone (10)	115.9	87.9	24.3	75.7
Mesityl oxide (10)	129.5	91.8	34.8	65.2
Diacetone alcohol (10)	166	98.8	87.3	12.7
I—Aldehydes				
Furfural	161.5	97.5	65	35
Butyraldehyde (3)	75.7	68	6	94
J—Amines				
Pyridine	115.5	92.6	43	57

TABLE II

BINARY AZEOTROPES CONTAINING ALCOHOLS

	B.P. 760 mm.		% By weight	
	Other component	Azeotrope	Alcohol	Other component
A*—*Methyl Alcohol (B.P. 64.7°)				
Methylal	42.3	41.9	8.2	91.8
Dimethyl sulfide	37.3	34.0	15	85
Methyl borate	68.7	54.6	32	68
Dimethyl carbonate	90.4	62.7	70	30
Methyl acetate	57.0	53.8	18.7	81.3
Methyl propionate	79.8	62.5	47.5	52.5
Ethyl formate	54.1	51.0	16	84
Ethyl acetate	77.1	62.3	44	56
iso-Propyl acetate	91.0	64.5	80	20
n-Pentane	36.2	30.8	9	91
n-Hexane	68.9	50.6	28	72
n-Heptane	98.5	59.1	51.5	48.5
Benzene	80.2	58.3	39.6	60.4
Toluene	110.8	63.8	69	31
Cyclohexane	80.8	54.2	37.2	62.8
Nitromethane	101.2	64.6	91	9
Methyl iodide	42.6	38.0	6.5	93.5
Chloroform	61.1	53.5	12.6	87.4
Carbon tetrachloride (4)	76.8	55.7	20.6	79.4
Ethyl bromide	38.4	35.0	4.5	95.5
Ethylene chloride	83.7	61.0	32	68
n-Propyl chloride	46.6	40.5	9.5	90.5
n-Propyl bromide	71.0	54.5	21	79
iso-Propyl chloride	36.3	33.4	6	94
iso-Propyl bromide	59.8	48.6	15.0	85.0
iso-Propyl iodide	89.4	61.0	38	62
n-Butyl chloride	78.1	57.0	27	73
iso-Butyl bromide	91.0	61.3	41.7	58.3
Di-*n*-propyl ether	90.4	63.8	72	28
Acetone	56.5	55.7	12.1	87.9
B*—*Ethyl Alcohol (B.P. 78.3°)				
Methyl acetate	57.0	56.9	3	97
Methyl propionate	79.7	72.0	33	67
Ethyl nitrate	87.7	71.9	44	56
Ethyl acetate	77.1	71.8	30.8	69.2
Ethyl propionate	99.2	78.0	75	25
n-Propyl formate	80.8	71.8	38	62
n-Propyl acetate	101.6	78.2	85	15
iso-Propyl acetate	91.0	76.8	57	43
Benzene	80.2	68.2	32.4	67.6
Toluene	110.8	76.7	68	32
n-Pentane	36.2	34.3	5	95
n-Hexane	68.9	58.7	21	79
n-Heptane	98.5	70.9	49	51
n-Octane	125.6	77.0	78	22
Methyl iodide	42.6	41.2	3.2	96.8
Ethylene chloride	83.7	70.5	37	63
Carbon tetrachloride	76.8	65.1	15.8	84.2
Allyl chloride	45.7	44	5	95

AZEOTROPIC MIXTURES

	B.P. 760 mm.		% By weight	
	Other component	Azeotrope	Alcohol	Other component
Chloroform	61.1	59.4	7	93
n-Propyl chloride	46.7	45.0	6	94
n-Propyl bromide	71.0	62.8	20.5	79.5
n-Propyl iodide	102.4	75.4	44	56
iso-Propyl chloride	36.3	35.6	2.8	97.2
iso-Propyl bromide	59.8	55.6	10.5	89.5
iso-Propyl iodide	89.4	71.5	27	73
n-Butyl chloride	78.1	65.7	20.3	79.7
n-Butyl bromide	100.3	75.0	43	57
iso-Butyl bromide	91.0	72.5	31	69
Acetal	103.6	78.0	76	24
Di-*n*-propyl ether	90.4	74.5	44	56
Methyl ethyl ketone	79.6	74.8	40	60
C—iso-Propyl Alcohol (B.P. 82.5°)				
Methyl propionate	79.8	76.4	37	63
Ethyl acetate	77.1	75.3	25	75
iso-Propyl acetate	91.0	81.3	60	40
Benzene	80.2	71.9	33.3	66.7
Toluene	110.8	81.3	79	21
n-Pentane	36.2	35.5	6	94
n-Hexane	68.9	62.7	23	77
n-Heptane	98.5	76.3	54	46
Carbon tetrachloride	76.8	69.0	18	82
Chloroform	61.1	60.8	4.2	95.8
Allyl bromide	70.8	66.5	20	80
Ethyl iodide	72.3	67.1	15	85
Ethylene chloride	83.7	74.7	43.5	56.5
iso-Propyl bromide	59.8	57.8	12	88
iso-Propyl iodide	89.4	76.0	32	68
n-Propyl chloride	46.7	46.4	2.8	97.2
n-Propyl bromide	71.0	66.8	20.5	79.5
n-Propyl iodide	102.4	79.8	42	58
n-Butyl chloride	78.1	70.8	23	77
Acetal	103.6	81.3	63	37
Ethyl *n*-propyl ether	63.6	62.0	10	90
Di-*iso*-propyl ether (5)	82.3	66.2	14.1	85.9
Methyl ethyl ketone	79.0	77.5	32	68
D—n-Propyl Alcohol (B.P. 97.2°)				
Methyl butyrate	102.7	94.4	49	51
Ethyl propionate	99.2	93.4	48	52
n-Propyl formate	80.8	80.65	3	97
n-Propyl acetate	101.6	94.7	51	49
Benzene	80.2	77.1	16.9	83.1
Toluene	110.8	92.4	52.5	47.5
n-Hexane	68.9	65.7	4	96
Carbon tetrachloride	76.8	73.1	11.5	88.5
Chlorobenzene	132.0	96.9	83	17
Ethylene chloride	83.7	80.7	19	81
n-Propyl bromide	71.0	69.7	9	91
n-Butyl chloride	78.1	74.8	18	82
Acetal	103.6	92.4	37	63
Di-*n*-propyl ether	90.4	85.7	30	70

AZEOTROPIC MIXTURES

	B.P. 760 mm.		% By weight	
	Other component	Azeotrope	Alcohol	Other component
***E*—*iso*-Butyl Alcohol** (B.P. 107.9°)				
Methyl butyrate	102.7	101.3	25	75
iso-Butyl formate	97.9	97.4	12	88
iso-Butyl acetate	117.5	107.6	92	8
Benzene	80.2	79.8	9.3	90.7
Toluene	110.8	100.9	44.5	55.5
m-Xylene	139.0	107.7	87	13
Cyclohexane	80.8	78.1	14	86
n-Hexane	68.9	68.3	2.5	97.5
Chlorobenzene	132.0	107.1	63	37
Ethylene chloride	83.7	83.5	6.5	93.5
n-Butyl chloride	78.1	77.7	4	96
n-Butyl bromide	100.3	95.0	21	79
iso-Butyl bromide	91.0	88.8	12	88
iso-Butyl iodide	120.4	104.0	36	64
iso-Amyl chloride	99.8	94.5	22	78
Acetal	103.6	98.2	20	80
***F*—*n*-Butyl Alcohol** (B.P. 117.8°)				
Ethyl butyrate	120.0	115.7	64	36
n-Butyl formate	106.6	105.8	23.7	76.3
n-Butyl acetate	126.2	117.2	47	53
Toluene	110.8	105.7	27	73
m-Xylene	139.0	116.0	80	20
Cyclohexane	80.8	79.8	4	96
n-Heptane	98.5	94.4	18	82
Carbon tetrachloride	76.8	76.6	2.5	97.5
Chlorobenzene	132.0	115.3	56	44
iso-Butyl bromide	91.0	90.2	7	93
iso-Butyl iodide	120.4	110.5	30	70
Acetal	103.6	101	13	87
***G*—*iso*-Amyl Alcohol** (B.P. 131.4°)				
iso-Amyl formate	123.8	123.7	10	90
iso-Amyl acetate	142.1	131.3	98.5	1.5
Toluene	110.8	110.0	14	86
m-Xylene	139.0	127.0	53.3	46.7
Chlorobenzene	132.0	124.3	35	65
iso-Amyl bromide	120.3	116.8	21	79
iso-Amyl iodide	147.7	129.2	54	46
Paraldehyde	124.0	122.9	22	78
***H*—*n*-Amyl Alcohol** (B.P. 137.8°)				
n-Amyl formate	132.0	130.4	43	57
Di-*n*-butyl ether	142.1	134.0	52	48
***I*—Cyclohexyl Alcohol** (B.P. 160.7°)				
o-Xylene	143.6	143.0	14	86
iso-Amyl iodide	147.5	147.0	10	90
Furfural	161.4	155.6	45	55
Di-*iso*-amyl ether	172.6	158.8	78	22
Phenetole	170.4	159.2	72	28

AZEOTROPIC MIXTURES

	B.P. 760 mm.		% By weight	
	Other component	Azeotrope	Alcohol	Other component
J*—*Allyl Alcohol (B.P. 97.0°)				
Methyl butyrate	102.7	93.8	55	45
n-Propyl acetate	101.6	94.2	53	47
Benzene	80.2	76.8	17.4	82.6
Toluene	110.8	92.4	50	50
Cyclohexane	80.8	74	20	80
Allyl iodide	102.0	89.4	28	72
Chlorobenzene	132.0	96.2	85	15
Ethylene chloride	83.7	79.9	18	82
K*—*Benzyl Alcohol (B.P. 205.2°)				
Nitrobenzene	210.8	204.0	58	42
Iodobenzene	188.6	187.8	12	88
o-Bromotoluene	181.4	181.25	7	93
Naphthalene	218.1	204.1	60	40
m-Cresol (Max.)	202.2	207.1	61	39
Dimethyl aniline	194.1	193.9	6.5	93.5
L*—*Ethylene Glycol (B.P. 197.4°)				
Ethyl benzoate	212.6	186.1	46.5	53.5
iso-Amyl acetate	142.1	141.95	3	97
Diphenyl	254.9	192.0	64	36
Mesitylene	164.6	156.0	13	87
Naphthalene	218.1	183.9	51	49
Toluene	110.8	110.2	6.5	93.5
m-Xylene	139.0	135.6	15	85
Ethylene bromide	131.7	129.8	4	96
Nitrobenzene	210.9	185.9	59	41
Chlorobenzene	132.0	130.1	94.4	5.6
Benzyl chloride	179.3	167.0	30	70
Benzyl alcohol	205.1	193.1	56	44
Di-*n*-butyl ether	142.1	140.0	10	90
Diphenyl ether	259.3	193.1	60	40
Anisole	153.9	150.5	10.5	89.5
β-Phenylethyl alcohol	219.4	194.4	69	31
Acetophenone	202.1	185.7	52	48
Aniline	184.4	180.6	24	76
Dimethyl aniline	194.1	175.9	33.5	66.5
o-Cresol	191.1	189.6	27	73
M*—*Glycerol (B.P. 291.0°)				
n-Propyl benzoate	230.9	228.8	8	92
n-Butyl benzoate	249.8	243.0	17	83
Diphenyl	254.9	243.8	55	45
Naphthalene	218.1	215.2	10	90
p-Dibromobenzene	220.3	217.1	10	90
Diphenyl ether	257.7	246.3	22	78

TABLE III

BINARY AZEOTROPES CONTAINING ORGANIC ACIDS

	B.P. 760 mm.		% By weight	
	Other component	Azeotrope	Acid	Other component
A*—*Formic Acid **(B.P. 100.8°)**				
Benzene	80.2	71.7	31	69
Toluene	110.8	85.8	50	50
m-Xylene	139.0	94.2	70.2	29.8
n-Pentane	36.2	34.2	10	90
n-Hexane	68.9	60.6	28	72
n-Heptane	98.5	78.2	43.5	56.5
n-Octane	125.8	90.5	63	37
Chloroform	61.2	59.2	15	85
Carbon tetrachloride	76.8	66.7	18.5	81.5
Carbon disulfide	46.3	42.6	17	83
Methyl iodide	42.6	42.1	6	94
Ethyl bromide	38.4	38.2	3	97
Ethylene chloride	83.6	77.4	14	86
Ethylene bromide	131.7	94.7	51.5	48.5
n-Propyl chloride	46.7	45.6	8	92
n-Propyl bromide	71.0	64.7	27	73
iso-Propyl chloride	34.8	34.7	1.5	98.5
iso-Propyl bromide	59.4	56.0	14	86
iso-Butyl chloride	68.9	63.0	19	81
iso-Amyl chloride	99.8	80.0	33.5	66.5
Chlorobenzene	132.0	95.0	55	45
Diethyl ketone (Max.)	102.2	105.4	33	67
Methyl *n*-propyl ketone (Max.)	102.3	105.3	32	68
B*—*Acetic Acid **(B.P. 118.5°)**				
Benzene	80.2	80.05	2	98
Toluene	110.8	105.0	34	66
m-Xylene	139.0	115.4	72.5	27.5
n-Heptane	98.5	92.3	30	70
n-Octane	125.8	109.0	50	50
Carbon tetrachloride	76.8	76.6	3	97
Ethylene bromide	131.7	114.4	55	45
iso-Propyl iodide	89.2	88.3	9	91
n-Butyl bromide	100.4	97.6	18	82
iso-Butyl bromide	91.3	90.2	12	88
iso-Amyl chloride	99.8	97.2	18.5	81.5
Chlorobenzene	132.0	114.7	58.5	41.5
C*—*Propionic Acid **(B.P. 140.9°)**				
m-Xylene	139.0	132.7	35.5	64.5
Ethylene bromide	131.7	127.8	17.5	82.5
iso-Butyl iodide	120.4	119.5	9	91
iso-Amyl bromide	120.3	119.2	10	90
Chlorobenzene	132.0	128.9	18	82
Anisole	153.9	140.8	96	4
D*—*Butyric Acid **(B.P. 162.5°)**				
m-Xylene	139.0	138.3	6	94
Ethylene bromide	131.7	131.1	3.5	96.5
Chlorobenzene	132.0	131.8	2.8	97.2

AZEOTROPIC MIXTURES

	B.P. 760 mm.		% By weight	
	Other component	Azeotrope	Acid	Other component
Benzyl chloride	179.3	160.8	65	35
Anisole	153.9	152.9	12	88
Furfural	161.5	159.4	42.5	57.5
E*—*Iso-Butyric Acid (B.P. 154.4°)				
m-Xylene	139.0	136.8	14	86
Ethylene bromide	131.7	130.5	6.5	93.5
Chlorobenzene	132.0	131.2	8	92
Benzyl chloride	179.3	153.5	80	20
Anisole	153.9	148.5	42	58
F*—*iso-Valeric Acid (B.P. 176.5°)				
Mesitylene	164.6	162.8	20	80
Benzyl chloride	179.3	171.2	36	64
Benzaldehyde	179.2	174.5	68	32
iso-Amyl butyrate	178.5	176.1	70	30
Phenetole	170.5	168.5	20	80
G*—*Caproic Acid (B.P. 205.2°)				
Naphthalene	218.1	202.0	70	30
Benzyl chloride	179.3	179.0	3	97
Nitrobenzene	210.8	202.0	70	30
H*—*Caprylic Acid (B.P. 237.5°)				
Naphthalene	218.1	216.2	6	94
p-Dibromobenzene	220.3	218.8	10	90
I*—*Chloroacetic Acid (B.P. 189.4°)				
Mesitylene	164.6	162	17	83
Naphthalene	218.1	187.1	78	22
Benzyl chloride	179.3	173.8	25	75
p-Dichlorobenzene	174.1	167.6	24.5	75.5
o-Cresol	191.1	187.5	54	46
J*—*Phenylacetic Acid (B.P. 266.5°)				
α-Chloronaphthalene	262.7	255.9	30	70
Diphenyl	255.9	252.2	23.3	76.7
iso-Amyl benzoate	262.0	259.9	26	74
Methyl cinnamate	261.9	261.8	3	97
Diphenyl ether	259.3	255.4	27.8	72.2
K*—*Benzoic Acid (B.P. 250.5°)				
Diphenyl	255.9	245.9	50.5	49.5
Naphthalene	218.1	217.7	5	95
p-Dibromobenzene	220.3	219.5	3.8	96.2
p-Nitrotoluene	239.0	237.4	11	89
Ethyl salicylate	234.0	233.85	6	94
iso-Butyl benzoate	241.9	241.2	12	88
Diphenyl ether	259.3	247.0	59	41

TABLE IV

TERNARY AZEOTROPES CONTAINING WATER AND ALCOHOLS

	B.P. 760 mm.		% By weight		
	Other component	Azeotrope	Water	Alcohol	Other component
A—Ethyl Alcohol (B.P. 78.3°)					
Ethyl acetate (6)	77.1	70.3	7.8	9.0	83.2
Diethyl formal (7)	87.5	73.2	12.1	18.4	69.5
Diethyl acetal (8)	103.6	77.8	11.4	27.6	61.0
Cyclohexane	80.8	62.1	7	17	76
Benzene (4)	80.2	64.9	7.4	18.5	74.1
Chloroform	61.2	55.5	3.5	4.0	92.5
Carbon tetrachloride	76.8	61.8	4.3	9.7	86.0
Ethyl iodide	72.3	61	5	9	86
Ethylene chloride	83.7	66.7	5	17	78
B—n-Propyl Alcohol (B.P. 97.2°)					
n-Propyl formate (6)	80.9	70.8	13	5	82
n-Propyl acetate (6)	101.6	82.2	21.0	19.5	59.5
Di-*n*-propyl formal (7)	137.4	86.4	8.0	44.8	47.2
Di-*n*-propyl acetal (8)	147.7	87.6	27.4	51.6	21.0
Di-*n*-propyl ether (7)	91.0	74.8	11.7	20.2	68.1
Cyclohexane	80.8	66.6	8.5	10.0	81.5
Benzene (4)	80.2	68.5	8.6	9.0	82.4
Carbon tetrachloride	76.8	65.4	5	11	84
Diethyl ketone	102.2	81.2	20	20	60
C—iso-Propyl Alcohol (B.P. 82.5°)					
Cyclohexane	80.8	64.3	7.5	18.5	74.0
Benzene (4)	80.2	66.5	7.5	18.7	73.8
D—n-Butyl Alcohol (B.P. 117.8°)					
n-Butyl formate (6)	106.6	83.6	21.3	10.0	68.7
n-Butyl acetate (6)	126.2	89.4	37.3	27.4	35.3
Di-*n*-butyl ether (7)	141.9	91	29.3	42.9	27.7
E—iso-Butyl Alcohol (B.P. 108.0°)					
iso-Butyl formate (6)	94.4	80.2	17.3	6.7	76.0
iso-Butyl acetate	117.2	86.8	30.4	23.1	46.5
F—tert-Butyl Alcohol (B.P. 82.6°)					
Benzene (4)	80.2	67.3	8.1	21.4	70.5
Carbon tetrachloride (9)	76.8	64.7	3.1	11.9	85.0
G—n-Amyl Alcohol (B.P. 137.8°)					
n-Amyl formate (6)	131.0	91.4	37.6	21.2	41.2
n-Amyl acetate (6)	148.8	94.8	56.2	33.3	10.5
H—iso-Amyl Alcohol (B.P. 131.4°)					
iso-Amyl formate (6)	124.2	89.8	32.4	19.6	48.0
iso-Amyl acetate (6)	142.0	93.6	44.8	31.2	24.0
I—Allyl Alcohol (B.P. 97.0°)					
n-Hexane	69.0	59.7	5	5	90
Cyclohexane	80.8	66.2	8	11	81
Benzene	80.2	68.2	8.6	9.2	82.2
Carbon tetrachloride	76.8	65.2	5	11	84

IONIZATION CONSTANTS OF ACIDS

Acid	Formula	K	Temp.° C.
Acetic	$HC_2H_3O_2$	1.86×10^{-5}	25
Alanine (α)	$HC_3H_6O_2N$	9×10^{-10}	25
Aluminum hydroxide	H_3AlO_3	6.3×10^{-13}	25
Arsenic	H_3AsO_4	5×10^{-3}	25
"	"	4×10^{-5} (2H)	25
"	"	6×10^{-10} (3H)	25
Arsenious	H_3AsO_3	6×10^{-10}	25
Barbituric	$HC_4H_3O_3N_2$	1.05×10^{-4}	25
Benzoic	$HC_7H_5O_2$	6.6×10^{-5}	25
Boric	H_3BO_3	6.4×10^{-10}	25
Bromoacetic	$HC_2H_2O_2Br$	1.38×10^{-3}	25
Bromopropionic (α)	$HC_3H_4O_2Br$	1.08×10^{-3}	25
Bromopropionic (β)	$HC_3H_4O_2Br$	9.8×10^{-5}	25
Butyric	$HC_4H_7O_2$	1.48×10^{-5}	25
Caffeine	$C_8H_{10}O_2N_4$	$<1\times10^{-14}$	25
Carbonic	H_2CO_3	3×10^{-7}	18
"	"	6×10^{-11} (2H)	25
Chloroacetic	$HC_2H_2O_2Cl$	1.55×10^{-3}	25
Chloropropionic (α)	$HC_3H_4O_2Cl$	1.47×10^{-3}	25
Chloropropionic (β)	$HC_3H_4O_2Cl$	8.59×10^{-5}	25
Citraconic	$H_2C_5H_4O_4$	8.2×10^{-4}	25
Citric	$H_3C_6H_5O_7$	8×10^{-4}	25
Crotonic	$HC_4H_5O_2$	2.0×10^{-5}	25
Cyanuric	$H_3C_3O_3N_3$	2.0×10^{-7}	25
Dichloroacetic	$HC_2HO_2Cl_2$	5×10^{-2}	25
Formic	$HCHO_2$	2.14×10^{-4}	25
Fumaric	$H_2C_4H_2O_4$	1×10^{-3}	25
"	"	3×10^{-5} (2H)	25
Glutaric	$H_2C_5H_6O_4$	4.7×10^{-5}	25
Hexahydrobenzoic	$HC_7H_{11}O_2$	1.26×10^{-5}	25
Hippuric	$HC_9H_8O_3N$	2.3×10^{-4}	25
Hydrocyanic	HCN	7.2×10^{-10}	25
Hydroquinone	$C_6H_6O_2$	1.1×10^{-10}	18
Hydrosulfuric	H_2S	9.1×10^{-8}	18
"	"	1.2×10^{-15} (2H)	18
Hydrazoic	HN_3	1.9×10^{-5}	25
Hypochlorous	$HClO$	3.7×10^{-8}	17
Iodic	HIO_3	1.9×10^{-1}	25
Isobutyric	$HC_4H_7O_2$	1.5×10^{-5}	25
Isocrotonic	$HC_4H_5O_2$	3.6×10^{-5}	25
Isovaleric	$HC_5H_9O_2$	1.7×10^{-5}	25
Itaconic	$H_2C_5H_4O_4$	1.5×10^{-4}	25
"	"	2.8×10^{-6} (2H)	25
Lactic	$HC_3H_5O_3$	1.55×10^{-4}	25
Maleic	$H_2C_4H_2O_4$	1.5×10^{-2}	25
"	"	2.6×10^{-7} (2H)	25
Malic	$H_2C_4H_4O_5$	4×10^{-4}	25
"	"	9×10^{-6} (2H)	25
Malonic	$H_2C_3H_2O_4$	1.61×10^{-3}	25
"	"	2.1×10^{-6} (2H)	25
Mandelic	$HC_8H_7O_3$	4.29×10^{-4}	25
Mesaconic	$H_2C_5H_4O_4$	7.9×10^{-4}	25
Mucic	$H_2C_6H_8O_8$	6.3×10^{-4}	25
Naphthoic (α)	$HC_{11}H_7O_2$	2×10^{-4}	25
Naphthoic (β)	$HC_{11}H_7O_2$	6.8×10^{-5}	25
Nicotinic	$HC_6H_4O_2N$	1.4×10^{-5}	25

IONIZATION CONSTANTS OF ACIDS

Acid	Formula	K	Temp. °C.
Nitrous	HNO_2	4×10^{-4}	18
Oxalic	$H_2C_2O_4$	3.8×10^{-2}	25
"	"	4.9×10^{-5} (2H)	25
Periodic	HIO_4	2.3×10^{-2}	25
Phenol	HC_6H_5O	1.3×10^{-10}	25
Phosphoric	H_3PO_4	1.1×10^{-2}	18
"	"	2×10^{-7} (2H)	18
"	"	3.6×10^{-13} (3H)	18
Phosphorous	H_3PO_3	5×10^{-2}	25
"	"	2×10^{-5} (2H)	25
Phenolphthalein	$C_{20}H_{14}O_4$	2×10^{-10}	25
Phthalic	$H_2C_8H_4O_4$	1.26×10^{-3}	25
"	"	3.1×10^{-6} (2H)	25
Picolinic	$HC_6H_4O_2N$	3×10^{-6}	25
Picric	$HC_6H_2O_7N_3$	1.6×10^{-1}	18
Propionic	$HC_3H_5O_2$	1.4×10^{-5}	25
Pyromucic	$HC_5H_3O_3$	7.1×10^{-4}	25
Pyrophosphoric	$H_4P_2O_7$	1.4×0^{-1}	18
"	"	1.1×10^{-2} (2H)	18
"	"	2.9×10^{-7} (3H)	18
"	"	3.6×10^{-9} (4H)	18
Pyrotartaric	$H_2C_5H_6O_4$	8.7×10^{-5}	25
Salicylic	$HC_7H_5O_3$	1.06×10^{-3}	25
"	"	1×10^{-13} (2H)	20
Selenious	H_2SeO_3	3×10^{-3}	25
"	"	5×10^{-8} (2H)	25
Stannic	H_2SnO_3	4×10^{-10}	25
Suberic	$H_2C_8H_{12}O_4$	2.98×10^{-5}	25
Suberonic	$C_8H_{14}O_4$	3.0×10^{-5}	25
Succinic	$H_2C_4H_4O_4$	6.6×10^{-5}	25
"	"	2.8×10^{-6} (2H)	25
Sulfanilic	$HC_6H_5O_3NS$	6.2×10^{-4}	25
Sulfuric	H_2SO_4	4×10^{-1} (?)	25
"	"	1.9×10^{-2} (2H)	18
Sulfurous	H_2SO_3	1.7×10^{-2}	25
"	"	5×10^{-6} (2H)	25
Tartaric	$H_2C_4H_4O_6$	1.1×10^{-3}	25
"	"	6.9×10^{-5} (2H)	25
Tartronic	$H_2C_3H_2O_5$	5×10^{-3}	25
Telluric	H_2TeO_4	6×10^{-7}	25
"	"	4×10^{-11} (2H)	25
Tellurous	H_2TeO_3	3×10^{-3}	25
"	"	2×10^{-8} (2H)	25
Tetrolic	$HC_4H_3O_2$	2.46×10^{-3}	25
Thiosulfuric	$H_2S_2O_3$	1×10^{-2}	25
Trichloroacetic	$HC_2O_2Cl_3$	2×10^{-1}	18
Uric	$C_5H_4O_3N_4$	1.5×10^{-6}	25
Valeric	$HC_5H_9O_2$	1.6×10^{-5}	25
Vanillic	$HC_8H_7O_4$	3.0×10^{-5}	25

IONIZATION CONSTANTS OF BASES

Base	Formula	K	Temp.°C
Acetamide	CH_3CONH_2	3.1×10^{-15}	25
Acetanilide	$CH_3CONHC_6H_5$	4.1×10^{-14}	40
Alanine (α)	$NH_2\cdot C_3H_5O_2$	5.1×10^{-12}	25
Ammonium hydroxide	NH_4OH	1.4×10^{-5}	0
"	"	1.6×10^{-5}	10
"	"	1.8×10^{-5}	25
"	"	2×10^{-5}	40
"	"	1.4×10^{-5}	100
Aniline	$C_6H_5\cdot NH_2$	4.6×10^{-10}	25
Anthranilic acid	$NH_2\cdot C_7H_5O_2$	1.4×10^{-12}	25
Arsenious oxide	As_2O_3	1.1×10^{-14}	25
Benzylamine	$NH_2\cdot C_7H_7$	2.4×10^{-5}	25
Beryllium hydroxide	$Be(OH)_2$	5×10^{-11} (2 OH)	25
Brucine	$C_{23}H_{26}O_4N_2$	7.2×10^{-4}	25
"	"	2.5×10^{-11} (2 OH)	25
Butylamine (*sec.*)	$C_4H_9\cdot NH_2$	4.4×10^{-4}	25
Caffeine	$C_8H_{10}O_2N_4$	4.1×10^{-14}	40
Cinchonine	$C_{19}H_{22}ON_2$	1.6×10^{-7}	15
"	"	3.3×10^{-10} (2 OH)	15
Cocaine	$C_{17}H_{21}O_4N$	4×10^{-7}	25
Coniine	$C_8H_{17}N$	1.3×10^{-3}	25
Creatine (anhydrous)	$C_4H_9O_2N_3$	1.9×10^{-11}	40
Creatinine	$C_4H_7ON_3$	3.7×10^{-11}	40
Diethylbenzylamine	$C_{11}H_{17}N$	3.6×10^{-5}	25
Diethylamine	$(C_2H_5)_2NH$	1.26×10^{-3}	25
Diisoamylamine	$(C_5H_{11})_2NH$	9.6×10^{-4}	25
Diisobutylamine	$(C_4H_9)_2NH$	4.8×10^{-4}	25
Dimethylamine	$(CH_3)_2NH$	7.4×10^{-4}	25
Dimethylbenzylamine	$C_9H_{13}N$	1.05×10^{-5}	25
Dipropylamine	$(C_3H_7)_2NH$	1.02×10^{-3}	25
Ethylamine	$C_2H_5NH_2$	5.6×10^{-4}	25
Ethylenediamine	$C_2H_4(NH_2)_2$	8.5×10^{-5}	25
Guanine	$C_5H_5ON_5$	8.4×10^{-12}	40
Hydrazine	$(NH_2)_2\cdot H_2O$	3×10^{-6}	25
Isoamylamine	$C_5H_{11}NH_2$	5×10^{-4}	25
Isobutylamine	$C_4H_9NH_2$	3.1×10^{-4}	25
Lead hydroxide	$Pb(OH)_2$	3×10^{-8} (2 OH)	25
Leucine	$C_6H_{13}O_2N$	2.3×10^{-12}	25
Methylamine	CH_3NH_2	5×10^{-4}	25
Methyldiethylamine	$C_5H_{13}N$	2.7×10^{-4}	25
Methyl red	$C_{15}H_{15}O_2N_3$	3×10^{-12}	18
Naphthylamine (α)	$C_{10}H_7NH_2$	9.9×10^{-11}	25
Naphthylamine (β)	$C_{10}H_7NH_2$	2×10^{-10}	25
o-Phenylenediamine	$C_6H_4(NH_2)_2$	3.3×10^{-10}	25
Phenylhydrazine	$C_6H_5\cdot N_2H_3$	1.6×10^{-9}	40
Piperidine	$C_5H_{11}N$	1.6×10^{-3}	25
n-Propylamine	$C_3H_7\cdot NH_2$	4.7×10^{-4}	25
Propylcyanide	$C_3H_7\cdot CN$	1.8×10^{-15}	25
Pyridine	C_5H_5N	2.3×10^{-9}	25
Quinine	$C_{20}H_{24}O_2N_2$	2.2×10^{-7}	15
"	"	3.3×10^{-10} (2 OH)	15
Quinoline	C_9H_7N	1×10^{-9}	25
Sarcosine	$C_3H_7O_2N$	1.8×10^{-12}	25
Semicarbazide	$CH_3ON_2\cdot NH_2$	2.7×10^{-11}	40
Silver hydroxide	$AgOH$	1.1×10^{-4}	25
Strychnine	$C_{21}H_{22}O_4N_2$	1×10^{-7}	15

IONIZATION CONSTANTS OF BASES

Base	Formula	K	Temp. °C.
Strychnine	$C_{21}H_{22}O_4N_2$	6×10^{-11} (2 OH)	15
Tetramethylenediamine	$C_4H_8(NH_2)_2$	5.1×10^{-4}	25
Theobromine	$C_7H_8O_2N_4$	4.8×10^{-14}	40
Thiazole	C_3H_3NS	3.3×10^{-12}	25
Thiourea	$CS(NH_2)_2$	1.1×10^{-13}	25
o-Toluidine	$C_7H_7\cdot NH_2$	3.3×10^{-10}	25
m-Toluidine	$C_7H_7\cdot NH_2$	5.5×10^{-10}	25
p-Toluidine	$C_7H_7\cdot NH_2$	2×10^{-9}	25
Triethylamine	$(C_2H_5)_3N$	6.4×10^{-4}	25
Triisobutylamine	$(C_4H_9)_3N$	2.6×10^{-4}	25
Trimethylamine	$(CH_3)_3N$	7.4×10^{-5}	25
Trimethylenediamine	$C_3H_6(NH_2)_2$	3.5×10^{-4}	25
Tripropylamine	$(C_3H_7)_3N$	5.5×10^{-4}	25
Urea	$CO(NH_2)_2$	1.5×10^{-14}	25
Xanthine	$C_5H_4O_2N_4$	4.8×10^{-14}	40
Zinc hydroxide	$Zn(OH)_2$	1.5×10^{-9} (2 OH)	25

EQUIVALENT CONDUCTANCE OF THE SEPARATE IONS

Johnston, *Jour. Am. Chem. Soc.*, *31*, *1010* (*1909*).

The equivalent conductivity at infinite dilution of a salt may be obtained by adding the equivalent conductivity of the separate ions as given below. Thus Λ_o for KCl at 18° C. is 64.6 + 65.5 = 130.1.

	Λ_o in $cm^{-1}ohm^{-1}$ / gram equivalents per cm^3							
Ion	0°C.	18°C.	25°C.	50°C.	75°C.	100°C.	128°C.	156°C.
Ag	32.9	54.3	63.5	101	143	188	245	299
½Ba	33	55	65	104	149	200	262	322
$C_2H_3O_2$	20.3	34.6	40.8	67	96	130	171	211
⅓$C_6H_5O_7$ (citrate)	36	60	70	113	161	214	...	...
½C_2O_4	39	63	73	115	163	213	275	336
½Ca	30	51	60	98	142	191	252	312
Cl	41.1	65.5	75.5	116	160	207	264	318
¼$Fe(CN)_6$	58	95	111	173	244	321	....	....
H	240	314	350	465	565	644	722	777
K	40.4	64.6	74.5	115	159	206	263	317
⅓La	35	61	72	119	173	235	312	388
NH_4	40.2	64.5	74.5	115	159	207	264	319
NO_3	40.4	61.7	70.6	104	140	178	222	263
Na	26	43.5	50.9	82	116	155	203	249
OH	105	172	192	284	360	439	525	592
½SO_4	41	68	79	125	177	234	303	370

ELECTRICAL CONDUCTIVITY OF AQUEOUS SOLUTIONS

In the table below are given values for the conductivity and the equivalent conductivity of various aqueous solutions. The percent by weight is that of the anhydrous substance. The conductivity in mhos/cm. divided by the conductivity in gram-equivalents per cubic centimeter is the equivalent conductivity.

Formula	Temp. °C.	% by Weight	Cond. mho/cm ×10⁴	Equiv. Cond.
$AgNO_3$	18	5	256	83.4
		10	476	74.3
		20	872	62.0
		40	1565	45.0
		60	2101	31.1
$BaCl_2$	18	5	389	77.7
		10	733	69.8
		15	1051	63.6
		24	1534	53.0
$Ba(NO_3)_2$	18	4.2	209	63.0
		8.4	352	51.2
$Ba(OH)_2$	18	1.25	250	169.4
		2.5	479	160.2
CH_3CO_2H	18	0.3	3.18	6.36
		1	5.84	3.50
		5	12.25	1.464
		10	15.26	0.904
		20	16.05	0.470
		30	14.01	0.2698
		40	10.81	0.1546
		50	7.40	0.0838
		60	4.56	0.0428
		70	2.35	0.0189
		99.7	0.0004	0.00023
$C_2H_5CO_2H$	18	1.00	4.79	3.549
		5.01	9.25	1.364
		10.08	11.13	0.809
		20.02	10.42	0.379
		30.03	8.18	0.1970
		50.09	3.77	0.0541
		69.99	0.85	0.0088
		100	0.0007	0.00052
$C_3H_7CO_2H$	18	1.00	4.55	3.99
		5.02	8.63	1.51
		10.07	9.86	0.857
		15.03	9.55	0.555
		20.01	8.88	0.388
		50.04	2.96	0.0519
		70.01	0.56	0.0071
		100	0.0006	.....
$(CO_2H)_2$	18	3.5	508	64.3
		7.0	783	48.8
$CaCl_2$	18	5	643	68.6
		10	1141	58.3
		20	1728	40.6
		25	1781	32.12
		30	1658	23.87
		35	1366	16.13
$Ca(NO_3)_2$	18	6.25	491	61.5
		12.5	804	47.9
$Ca(NO_3)_2$	18	25	1048	28.2
		37.5	876	14.15
		50	469	5.10
$CdBr_2$	18	0.0324	2.31	96.7
		0.0748	4.70	85.1
		0.154	8.44	74.7
		0.506	21.3	57.0
		1	35.7	48.2
		5	109	28.4
		10	164	20.4
		20	236	14.3
		30	273	9.30
		43	261	5.34
$CdCl_2$	18	0.0503	4.95	90.0
		0.200	15.6	71.2
		0.599	36.4	55.2
		1	55.1	50.1
		5	167	29.2
		10	241	20.2
		15	282	15.0
		20	299	11.39
		30	282	6.47
		40	221	3.40
		50	137	1.49
CdI_2	18	1	21.2	38.5
		5	60.9	21.4
		10	103.9	17.5
		15	146	15.6
		20	186	14.2
		30	254	11.7
		40	303	9.35
		45	314	8.11
$Cd(NO_3)_2$	18	1	69.4	81.6
		5	289	65.5
		10	513	55.7
		20	827	41.0
		30	956	28.7
		40	903	18.35
		48	755	11.62
$CdSO_4$	18	0.0289	2.47	88.8
		0.0999	6.92	72.0
		0.495	23.93	49.9
		1	41.6	42.9
		5	146	29.0
		10	247	23.3
		25	430	13.82
		36	421	8.25
$CuCl_2$	18	1.35	187	936
		9	716	493
		18.2	924	316

ELECTRICAL CONDUCTIVITY OF AQUEOUS SOLUTIONS

Formula	Temp. °C.	% by Weight	Cond. mho/cm ×10⁴	Equiv. Cond.
$CuCl_2$	18	28.75	897	155
		35.2	699	92
$Cu(NO_3)_2$	15	5	365	65.6
		10	635	54.7
		15	858	47.1
		20	1018	40.0
		25	1089	32.8
		35	1062	20.7
$CuSO_4$	18	2.5	109	34.0
		5	189	28.7
		10	320	23.1
		15	421	19.19
		17.5	458	17.41
HBr	15	5	1908	299.5
		10	3549	269.3
		15	4940	241.5
HCO_2H	18	4.94	55.0	5.03
		9.55	75.6	3.55
		20.34	98.4	2.12
		29.83	103.8	1.491
		39.95	98.4	1.033
		50.02	86.4	0.709
		70.06	52.3	0.294
		89.02	18.7	0.0803
		100	2.8	0.0105
HCl	15	5	3948	281.0
		10	6302	219.1
		20	7615	126.2
		30	6620	69.8
		40	5152	39.1
HF	18	0.004	2.5	131.8
		0.007	3.8	100.2
		0.015	5.0	65.9
		0.030	8.0	52.7
		0.060	12.3	40.5
		0.121	21.0	34.6
		0.242	36.3	29.9
		0.484	67.3	27.7
		1.50	198	26.2
		2.48	315	25.1
		4.80	593	24.3
		7.75	963	24.2
		15.85	1853	22.1
		24.5	2832	21.3
		29.8	3411	20.7
HI	15	5	1332	328.9
HNO_3	18	6.2	3123	307.1
		12.4	5418	257.0
		24.8	7676	169.3
		31.0	7819	133.1
		37.2	7545	103.4
		49.6	6341	61.1
		62.0	4964	36.4
H_3PO_4	15	10	566	17.54

Formula	Temp. °C.	% by Weight	Cond. mho/cm ×10⁴	Equiv. Cond.
H_3PO_4	15	20	1129	16.56
		30	1654	15.26
		35	1858	14.27
		50	2073	10.17
		70	1436	4.42
		80	979	2.47
		85	780	1.749
		87	709	1.566
H_2SO_4	18	5	2085	198.0
		10	3915	179.9
		15	5432	160.9
		20	6527	140.2
		25	7171	119.2
		30	7388	98.9
		35	7243	80.4
		40	6800	63.8
		50	5405	37.9
		60	3726	20.27
		65	2905	14.40
		70	2157	9.36
		75	1522	5.95
		80	1105	3.91
		85	980	3.172
		86	992	3.161
		87	1010	3.169
		88	1033	3.193
		89	1055	3.212
		90	1075	3.224
		91	1093	3.236
		92	1102	3.220
		93	1096	3.160
		94	1071	3.049
		95	1025	2.881
		96	944	2.624
		97	800	2.199
		99.4	85	0.228
$HgBr_2$	18	0.223	0.16	1.29
		0.422	0.26	1.10
$HgCl_2$	18	0.229	0.44	2.59
		1.013	1.14	1.51
		5.08	4.21	1.07
KBr	15	5	465	106.9
		10	928	102.9
		20	1907	98.1
		30	2923	92.4
		36	3507	87.9
$K{\cdot}CH_3CO_2$	15	4.67	347	71.4
		9.33	625	62.8
		28	1256	38.3
		46.67	1122	18.75
		65.33	479	5.25
KCN	15	3.25	527	104.2
		6.5	1026	99.7
K_2CO_3	15	5	561	74.2

ELECTRICAL CONDUCTIVITY OF AQUEOUS SOLUTIONS

Formula	Temp. °C.	% by Weight	Cond. mho/cm ×10⁴	Equiv. Cond.
K_2CO_3	15	10	1038	65.7
		20	1806	52.4
		30	2222	39.4
		40	2168	26.45
		50	1469	13.16
$K_2C_2O_4$	18	5	488	78.3
		10	915	70.8
KCl	18	5	690	99.9
		10	1359	95.2
		15	2020	91.5
		20	2677	88.9
		21	2810	87.5
KF	18	5	652	72.9
		10	1209	64.9
		20	2080	51.5
		30	2561	39.1
		40	2522	26.6
KI	18	5	338	108.3
		10	680	104.9
		20	1455	103.4
		30	2303	100.1
		40	3168	94.1
		55	4226	78.2
KNO_3	18	5	454	89.2
		10	839	79.8
		15	1186	72.9
		20	1505	67.2
		22	1625	65.1
KOH	15	4.2	1464	188.4
		8.4	2723	168.9
		16.8	4558	131.5
		25.2	5403	96.8
		33.6	5221	65.4
		42.0	4212	39.4
K_2S	18	3.18	845	139.7
		4.98	1284	136.5
		9.93	2343	120.3
		19.96	4020	94.7
		29.97	4563	66.2
		38.08	4106	44.1
		47.26	2579	20.63
K_2SO_4	18	5	458	76.8
		10	860	69.4
Li_2CO_3	18	0.20	34.3	63.5
		0.63	88.5	51.9
LiCl	18	2.5	410	68.7
		5	733	60.6
		10	1218	49.0
		20	1676	31.9
		30	1399	16.78
		40	844	7.14
LiI	18	5	296	76.5
		10	573	71.4
		20	1094	62.9

Formula	Temp. °C.	% by Weight	Cond. mho/cm ×10⁴	Equiv. Cond.
LiI	18	25	1346	59.4
LiOH	18	1.25	781	148.2
		2.5	1416	132.5
		5	2396	109.2
		7.5	2999	89.0
Li_2SO_4	15	5	400	42.2
		10	610	30.9
$MgCl_2$	18	5	683	62.4
		10	1128	49.5
		20	1402	28.37
		30	1061	13.18
		34	768	8.14
$Mg(NO_3)_2$	18	5	438	62.7
		10	770	53.1
		17	1102	42.3
$MgSO_4$	15	5	263	30.1
		10	414	22.55
		15	480	16.60
		25	415	7.77
$MnCl_2$	15	5	526	63.3
		10	844	48.8
		15	1055	38.9
		20	1134	30.0
		25	1090	22.00
		28	1016	17.80
$Na{\cdot}CH_3CO_2$	18	5	295	47.3
		20	651	24.20
		32	569	12.47
Na_2CO_3	18	5	451	45.5
		10	705	33.9
		15	836	25.51
NaCl	18	5	672	76.0
		10	1211	66.2
		15	1642	57.8
		20	1957	49.9
		25	2135	42.0
		26	2151	40.4
NaI	18	5	298	86.1
		10	581	81.6
		20	1144	73.1
		40	2111	55.9
$NaNO_3$	18	5	436	71.8
		10	782	62.3
		20	1303	48.5
		30	1606	37.1
NaOH	18	1	465	184.5
		2	887	173.7
		4	1628	156.3
		6	2242	140.5
		8	2729	125.6
		10	3093	111.7
		15	3490	80.0
		20	3284	53.95
		25	2717	34.22

ELECTRICAL CONDUCTIVITY OF AQUEOUS SOLUTIONS

Formula	Temp. °C.	% by Weight	Cond. mho/cm $\times 10^4$	Equiv. Cond.
NaOH	18	27.5	2386	26.69
		30	2074	20.83
		32.5	1798	16.35
		35	1560	12.93
		37.5	1361	10.34
		40	1206	8.44
		45	977	5.88
		50	820	4.30
Na_2S	18	2.02	612	115.7
		5.03	1321	97.2
		9.64	2017	73.7
		14.02	2359	56.7
		16.12	2243	46.0
		18.15	2184	38.7
Na_2SO_4	18	5	409	55.6
		10	687	44.7
		15	886	36.7
NH_3	15	0.10	2.51	4.25
		0.40	4.92	2.103
		0.80	6.57	1.408
		1.60	8.67	0.929
		4.01	10.95	0.475
		8.03	10.38	0.228
		16.15	6.32	0.0713
		30.5	1.93	0.0121
NH_4Cl	18	5	918	96.8
		10	1776	92.4
		15	2586	88.4
		20	3365	85.0
		25	4025	80.5
NH_4I	18	10	772	105.1
		20	1599	101.7
		50	4200	84.5
NH_4NO_3	15	5	590	92.6
		10	1117	85.9
NH_4NO_3	15	30	2841	67.1
		50	3633	47.4
$(NH_4)_2SO_4$	15	5	552	71.0
		10	1010	63.1
		20	1779	52.7
		30	2292	43.1
		31	2321	42.0
$Pb(NO_3)_2$	15	5	191	60.4
		10	322	48.7
		15	429	41.4
		20	521	35.8
		25	600	31.3
		30	668	27.6
$SrCl_2$	18	5	483	73.3
		10	886	64.3
		15	1231	56.8
		22	1583	46.5
$Sr(NO_3)_2$	15	5	309	62.8
		10	527	51.4
		15	690	43.0
		20	802	35.9
		25	866	29.66
		35	861	19.23
$ZnCl_2$	15	2.5	276	73.6
		5	483	62.8
		10	727	45.3
		20	912	26.1
		30	926	16.19
		40	845	10.12
		60	369	2.40
$ZnSO_4$	18	5	191	29.3
		10	321	23.42
		15	415	19.13
		25	480	11.88
		30	444	8.66

ELECTRICAL CONDUCTIVITY OF VARIOUS PURE LIQUIDS

Liquid	Temp. °C.	mhos/cm or $ohm^{-1}cm^{-1}$
Acetaldehyde	15	1.7×10^{-6}
Acetamide	100	$<4.3\times10^{-5}$
Acetic acid	0	5×10^{-9}
" "	25	1.12×10^{-8}
Acetic anhydride	0	1×10^{-6}
" "	25	4.8×10^{-7}
Acetone	18	2×10^{-8}
"	25	6×10^{-8}
Acetonitrile	20	7×10^{-6}
Acetophenone	25	6×10^{-9}
Acetyl bromide	25	2.4×10^{-6}
Acetyl chloride	25	4×10^{-7}
Alizarin	233	99×10^{-4}
Allyl alcohol	25	7×10^{-6}
Ammonia	−79	1.3×10^{-7}
Aniline	25	2.4×10^{-8}
Anthracene	230	3×10^{-10}
Arsenic tribromide	35	1.5×10^{-6}
Arsenic trichloride	25	1.2×10^{-6}
Benzaldehyde	25	1.5×10^{-7}
Benzene	...	7.6×10^{-8}
Benzoic acid	125	3×10^{-9}
Benzonitrile	25	5×10^{-8}
Benzyl alcohol	25	1.8×10^{-6}
Benzyl benzoate	25	$<1\times10^{-9}$
Benzylamine	25	$<1.7\times10^{-8}$

ELECTRICAL CONDUCTIVITY OF VARIOUS PURE LIQUIDS

Liquid	Temp. °C.	mhos/cm or $ohm^{-1}\,cm^{-1}$
Bromine	17.2	1.3×10^{-13}
Bromobenzene	25	$<2\times10^{-11}$
Bromoform	25	$<2\times10^{-8}$
iso-Butyl alcohol	25	8×10^{-8}
Capronitrile	25	3.7×10^{-6}
Carbon disulfide	1	7.8×10^{-18}
Carbon tetrachloride	18	4×10^{-18}
Chlorine	−70	$<1\times10^{-16}$
Chloroacetic acid	60	1.4×10^{-6}
m-Chloroaniline	25	5×10^{-8}
Chloroform	25	$<2\times10^{-8}$
Chlorohydrin	25	5×10^{-7}
m-Cresol	25	$<1.7\times10^{-8}$
Cyanogen	....	$<7\times10^{-9}$
Cymene	25	$<2\times10^{-8}$
Dichloroacetic acid	25	7×10^{-8}
Dichlorohydrin	25	1.2×10^{-5}
Diethyl carbonate	25	1.7×10^{-8}
Diethyl oxalate	25	7.6×10^{-7}
Diethyl sulfate	25	2.6×10^{-7}
Diethylamine	−33.5	2.2×10^{-9}
Dimethyl sulfate	0	1.6×10^{-7}
Epichlorohydrin	25	3.4×10^{-8}
Ethyl acetate	25	$<1\times10^{-9}$
Ethyl acetoacetate	25	4×10^{-8}
Ethyl alcohol	25	1.35×10^{-9}
Ethyl benzoate	25	$<1\times10^{-9}$
Ethyl bromide	25	$<2\times10^{-8}$
Ethyl ether	25	$<4\times10^{-13}$
Ethyl iodide	25	$<2\times10^{-8}$
Ethyl isothiocyanate	25	1.26×10^{-7}
Ethyl nitrate	25	5.3×10^{-7}
Ethyl thiocyanate	25	1.2×10^{-6}
Ethylamine	0	4×10^{-7}
Ethylene bromide	19	$<2\times10^{-10}$
Ethylene chloride	25	3×10^{-8}
Ethylidene chloride	25	$<1.7\times10^{-8}$
Eugenol	25	$<1.7\times10^{-8}$
Formamide	25	4×10^{-6}
Formic acid	18	5.6×10^{-5}
Formic acid	25	6.4×10^{-5}
Furfural	25	1.5×10^{-6}
Gallium	30	36,800
Germanium tetrabromide	30	7.8×10^{-5}
Glycerol	25	6.4×10^{-8}
Glycol	25	3×10^{-7}
Guaiacol	25	2.8×10^{-7}
Heptane	....	$<1\times10^{-13}$
Hexane	18	$<1\times10^{-18}$
Hydrogen bromide	−80	8×10^{-9}
Hydrogen chloride	−96	1×10^{-8}
Hydrogen cyanide	0	3.3×10^{-6}
Hydrogen iodide	B.P.	2×10^{-7}
Hydrogen sulfide	B.P.	1×10^{-11}

Liquid	Temp. °C.	mhos/cm or $ohm^{-1}\,cm^{-1}$
Iodine	110	1.3×10^{-10}
Kerosene	25	$<1.7\times10^{-8}$
Mercury	0	10,629.6
Methyl acetate	25	3.4×10^{-6}
Methyl alcohol	18	4.4×10^{-7}
Methyl ethyl ketone	25	1×10^{-7}
Methyl iodide	25	$<2\times10^{-8}$
Methyl nitrate	25	4.5×10^{-6}
Methyl thiocyanate	25	1.5×10^{-6}
Naphthalene	82	4×10^{-10}
Nitrobenzene	0	5×10^{-9}
Nitromethane	18	6×10^{-7}
o-or *m*-Nitrotoluene	25	$<2\times10^{-7}$
Nonane	25	$<1.7\times10^{-8}$
Oleic acid	15	$<2\times10^{-10}$
Pentane	19.5	$<2\times10^{-10}$
Petroleum	...	3×10^{-13}
Phenetole	25	$<1.7\times10^{-8}$
Phenol	25	$<1.7\times10^{-8}$
Phenyl isothiocyanate	25	1.4×10^{-6}
Phosgene	25	7×10^{-9}
Phosphorus	25	4×10^{-7}
Phosphorus oxychloride	25	2.2×10^{-6}
Pinene	23	$<2\times10^{-10}$
Piperidine	25	$<2\times10^{-7}$
Propionaldehyde	25	8.5×10^{-7}
Propionic acid	25	$<1\times10^{-9}$
Propionitrile	25	$<1\times10^{-7}$
n-Propyl alcohol	18	5×10^{-8}
" " "	25	2×10^{-8}
iso-Propyl alcohol	25	3.5×10^{-6}
n-Propyl bromide	25	$<2\times10^{-8}$
Pyridine	18	5.3×10^{-8}
Quinoline	25	2.2×10^{-8}
Salicylaldehyde	25	1.6×10^{-7}
Stearic acid	80	$<4\times10^{-13}$
Sulfonyl chloride, $SOCl_2$	25	2×10^{-6}
Sulfur	115	1×10^{-12}
"	130	5×10^{-11}
"	440	1.2×10^{-7}
Sulfur dioxide	35	1.5×10^{-8}
Sulfuric acid	25	1×10^{-2}
Sulfuryl chloride, SO_2Cl_2	25	3×10^{-8}
Toluene	....	$<1\times10^{-14}$
o-Toluidine	25	$<2\times10^{-6}$
p-Toluidine	100	6.2×10^{-8}
Trichloroacetic acid	25	3×10^{-9}
Trimethylamine	−33.5	2.2×10^{-10}
Turpentine	...	2×10^{-13}
iso-Valeric acid	80	$<4\times10^{-13}$
Water	18	4×10^{-8}
Xylene	...	$<1\times10^{-15}$

ELECTRICAL CONDUCTIVITY OF STANDARD SOLUTIONS

In the table below, the normal KCl solution was prepared by dissolving 74.59g of KCl in water and diluting to one liter at 18°C. The specific gravity of such a solution is 1.0449 at 18°C.

The concentrations of H_2SO_4 and of $MgSO_4$ are those of maximum conductivity at 18°C.

The NaCl solution is saturated at all the temperatures given, and has a specific gravity of 1.2014 at 18°C.

	Conductivity in mhos/centimeter, or $ohm^{-1}cm^{-1}$.						
Temp. °C.	KCl Normal	KCl 0.1 Normal	KCl 0.02 Normal	KCl 0.01 Normal	H_2SO_4 Sp. G. $1.223^{18°}$	NaCl Saturated	$MgSO_4$ Sp. G. $1.190^{18°}$
0	0.06541	0.00715	0.001521	0.000776	0.5184	0.1345	0.02877
1	0.06713	0.00736	0.001566	0.000800	0.5304	0.1386	0.02979
2	0.06886	0.00757	0.001612	0.000824	0.5425	0.1427	0.03083
3	0.07061	0.00779	0.001659	0.000848	0.5547	0.1469	0.03188
4	0.07237	0.00800	0.001705	0.000872	0.5669	0.1512	0.03294
5	0.07414	0.00822	0.001752	0.000896	0.5792	0.1555	0.03402
6	0.07593	0.00844	0.001800	0.000921	0.5915	0.1599	0.03512
7	0.07773	0.00866	0.001848	0.000945	0.6038	0.1643	0.03623
8	0.07954	0.00888	0.001896	0.000970	0.6161	0.1688	0.03735
9	0.08136	0.00911	0.001945	0.000995	0.6285	0.1734	0.03849
10	0.08319	0.00933	0.001994	0.001020	0.6408	0.1779	0.03963
11	0.08504	0.00956	0.002043	0.001045	0.6532	0.1826	0.04079
12	0.08689	0.00979	0.002093	0.001070	0.6656	0.1872	0.04197
13	0.08876	0.01002	0.002142	0.001095	0.6780	0.1919	0.04315
14	0.09063	0.01025	0.002193	0.001121	0.6904	0.1967	0.04434
15	0.09252	0.01048	0.002243	0.001147	0.7028	0.2015	0.04555
16	0.09441	0.01072	0.002294	0.001173	0.7151	0.2063	0.04676
17	0.09631	0.01095	0.002345	0.001199	0.7275	0.2112	0.04799
18	0.09822	0.01119	0.002397	0.001225	0.7398	0.2161	0.04922
19	0.10014	0.01143	0.002449	0.001251	0.7522	0.2210	0.05046
20	0.10207	0.01167	0.002501	0.001278	0.7645	0.2260	0.05171
21	0.10400	0.01191	0.002553	0.001305	0.7768	0.2310	0.05297
22	0.10594	0.01215	0.002606	0.001332	0.7890	0.2360	0.05424
23	0.10789	0.01239	0.002659	0.001359	0.8013	0.2411	0.05551
24	0.10984	0.01264	0.002712	0.001386	0.8135	0.2462	0.05679
25	0.11180	0.01288	0.002765	0.001413	0.8257	0.2513	0.05808
26	0.11377	0.01313	0.002819	0.001441	0.8378	0.2565	0.05937
27	0.11574	0.01337	0.002873	0.001468	0.8499	0.2616	0.06067
28	.....	0.01362	0.002927	0.001496	0.8620	0.2669	0.06197
29	.....	0.01387	0.002981	0.001524	0.8740	0.2721	0.06328
30	.....	0.01412	0.003036	0.001552	0.8860	0.2774	0.06459
31	.....	0.01437	0.003091	0.001581	0.8980	0.2827	0.06591
32	.....	0.01462	0.003146	0.001609	0.9099	0.2880	0.06723
33	.....	0.01488	0.003201	0.001638	0.9217	0.2933	0.06855
34	.....	0.01513	0.003256	0.001667	0.9335	0.2987	0.06988
35	.....	0.01539	0.003312	.....	0.9453	0.3041	0.07121
36	.....	0.01564	0.003368	.....	0.9570	0.3095	0.07254

HUMIDITY AND DEW POINT FROM WET AND DRY BULB READINGS

In the table below $d-w$ is the difference between the dry and the wet bulb thermometer readings, *r.h.* is the relative humidity, and *a.h.* is the absolute humidity.

	d − w = 0°C.			d − w = 1°C.			d − w = 2°C.			d − w = 3°C.		
Temp. °C.	r. h. %	dew point °C.	a. h. mm of Hg	r. h. %	dew point °C.	a. h. mm of Hg	r. h. %	dew point °C.	a. h. mm of Hg	r. h. %	dew point °C.	a. h. mm of Hg
−20	100	−20	0.8	..	.....	....	..	.....	....	..	.....	....
−10	100	−10	1.9	66	−14.6	1.3	32	−22.1	0.6	..	.....	....
− 5	100	− 5	3.0	75	− 8.3	2.3	51	−12.7	1.5	27	−19.4	0.8
0	100	0	4.6	81	− 2.5	3.7	63	− 5.5	2.9	45	− 9.3	2.1
+ 5	100	+ 5	6.5	86	+ 2.8	5.6	72	+ 0.3	4.7	58	− 2.3	3.8
10	100	10	9.2	88	8.1	8.1	76	6.1	7.0	65	+ 3.8	6.0
15	100	15	12.8	90	13.4	11.5	80	11.6	10.2	71	9.7	9.0
16	100	16	13.6	90	14.4	12.3	81	12.7	11.0	71	10.8	9.7
17	100	17	14.5	90	15.4	13.1	81	13.7	11.8	72	12.0	10.5
18	100	18	15.5	91	16.5	14.0	82	14.8	12.6	73	13.1	11.3
19	100	19	16.5	91	17.5	15.0	82	15.9	13.5	74	14.2	12.1
20	100	20	17.5	91	18.5	16.0	83	16.9	14.5	74	15.3	13.0
21	100	21	18.7	91	19.5	17.0	83	18.0	15.5	75	16.4	14.0
22	100	22	19.8	92	20.6	18.2	83	19.1	16.5	76	17.5	15.0
23	100	23	21.1	92	21.6	19.3	84	20.1	17.6	76	18.6	16.0
25	100	25	23.8	92	23.6	21.9	84	22.2	20.1	77	20.7	18.3
30	100	30	31.8	93	28.7	29.5	86	27.4	27.3	79	26.0	25.2

	d − w = 4°C.			d − w = 5°C.			d − w = 6°C.			d − w = 7°C.		
Temp. C.	r. h. %	dew point °C	a. h. mm of Hg	r. h. %	dew point °C.	a. h. mm of Hg	r. h. %	dew point °C.	a. h. mm of Hg	r. h. %	dew point °C.	a. h. mm of Hg
0	28	−14.6	1.3	11	−24.2	0.5	..	.....	....	..	.....	....
5	45	− 5.3	2.9	32	− 9.3	2.1	19	−15.2	1.2	6	−27.1	0.4
10	54	+ 1.2	5.0	44	− 1.5	4.0	34	− 4.6	3.1	24	− 8.7	2.2
12	57	3.9	6.0	48	+ 1.2	5.0	38	− 1.6	4.0	29	− 4.9	3.0
14	60	6.4	7.2	51	4.0	6.1	42	+ 1.3	5.0	34	− 1.6	4.0
15	61	7.6	7.8	52	5.4	6.7	44	2.8	5.6	36	− 0.1	4.5
16	62	8.8	8.5	54	6.7	7.3	46	4.3	6.2	37	+ 1.5	5.1
17	64	10.0	9.2	55	8.0	8.0	47	5.6	6.8	39	3.1	5.7
18	65	11.2	10.0	56	9.2	8.7	49	7.0	7.5	41	4.6	6.3
19	65	12.4	10.8	58	10.5	9.5	50	8.3	8.2	43	6.0	7.0
20	66	13.5	11.6	59	11.7	10.3	51	9.6	9.0	44	7.4	7.7
21	67	14.7	12.5	60	12.9	11.1	52	10.9	9.8	46	8.8	8.5
22	68	15.8	13.5	61	14.1	12.0	54	12.2	10.6	47	10.1	9.3
23	69	16.9	14.5	61	15.2	13.0	55	13.4	11.5	48	11.4	10.1
25	70	19.2	16.7	63	17.5	15.0	57	15.8	13.5	50	14.0	12.0
30	73	24.6	23.3	67	23.2	21.3	61	21.6	19.4	55	20.0	17.6

HUMIDITY AND DEW POINT FROM WET AND DRY BULB READINGS

	d −w =8°C.			d −w =9°C.			d −w =10°C.			d −w =11°C.		
Temp. °C.	r.h. %	dew point °C.	a.h. mm of Hg	r.h. %	dew point °C.	a.h. mm of Hg	r.h. %	dew point °C.	a.h. mm of Hg	r.h. %	dew point °C.	a.h. mm of Hg
8	7	−22.9	0.6	..	.....	....	..	.....	....	..	.....	....
10	14	−14.5	1.3	5	−26.0	0.4	..	.....	....	..	.....	....
12	20	− 9.1	2.1	11	−15.5	1.2	..	.....	....	..	.....	....
14	25	− 5.0	3.0	17	− 9.5	2.0	9	−16.3	1.1	..	.....	....
15	27	− 3.2	3.5	20	− 7.1	2.5	12	−12.6	1.5	5	−22.6	0.6
16	30	− 1.5	4.0	22	− 5.0	3.0	15	− 9.6	2.0	8	−16.8	1.0
17	32	+ 0.1	4.6	24	− 3.1	3.5	17	− 7.1	2.5	10	−12.8	1.5
18	34	1.8	5.2	27	− 1.3	4.1	20	− 4.9	3.0	13	− 9.6	2.0
19	35	3.4	5.8	29	+ 0.4	4.7	22	− 2.9	3.6	15	− 6.9	2.5
20	37	5.0	6.5	30	2.1	5.3	24	− 1.0	4.2	18	− 4.6	3.1
21	39	6.4	7.2	32	3.8	6.0	26	+ 0.8	4.8	20	− 2.5	3.7
22	40	7.9	8.0	34	5.4	6.7	28	2.6	5.5	22	− 0.6	4.3
23	42	9.3	8.8	36	6.9	7.5	30	4.3	6.2	24	+ 1.3	5.0
24	43	10.7	9.6	37	8.4	8.3	31	5.9	7.0	26	3.1	5.7
25	44	12.0	10.5	38	9.9	9.1	33	7.5	7.8	27	4.9	6.5
26	46	13.3	11.5	40	11.3	10.0	34	9.0	8.6	29	6.6	7.3
28	48	15.9	13.5	42	14.0	12.0	37	11.9	10.5	32	9.7	9.0
30	50	18.4	15.8	44	16.6	14.1	39	14.7	12.5	34	12.7	11.0

RELATIVE HUMIDITY TABLES

For Use with Hygrometer

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The following tables are computed from data supplied by the U. S. Bureau of Standards, and are correct at a barometric pressure of 29.92 inches or 760 mm. of mercury. The values above 140° dry-bulb are extrapolated. Complete tables covering barometric pressures may be obtained by applying to the Superintendent of Documents, Government Printing Office, Washington, D. C. for psychrometric tables WB No. 235.

Use of Tables.—Locate at either the top or bottom margin the reading corresponding to the dry-bulb indication. Locate at either side margin the reading corresponding to wet-bulb indication. At the intersection of these two columns can be read the relative humidity. For example—given dry-bulb temperature 144°F. and wet-bulb temperature 112° F., relative humidity is 36%.

Precautions.—When the wick of an hygrometer becomes hard the bulb will not be thoroughly wet and inaccurate readings will result. Care should be taken to keep the wick clean. It should not be handled unless the fingers are perfectly clean, and the water should be pure and soft; distilled water is preferable. If the wick surrounding the bulb becomes hard (which can be easily detected by feeling of it) it should be discarded and replaced by a new one.

Accurate Readings.—Accuracy with fixed position hygrometers can be obtained only by creating free circulation around the bulb. When taking observations, fan the bulb vigorously for a full minute or more, then immediately take the reading.

Use of Sling Psychrometer.—Saturate the wicking covering the bulb with water at room temperature, then whirl the instrument for 15 or 20 seconds, holding it away from the body. Stop and note the indication of wet-bulb thermometer; then repeat the operation until two or more readings agree at the lowest indication obtainable. The wicking must be kept perfectly clean and thoroughly saturated to secure accurate indication.

Humidity Below the Freezing Point.—At temperatures below freezing apply water to the bare wet bulb sparingly, a thin coat of ice will then be formed on the bulb, and evaporation from the frozen surface will go on as before. In the case of desk-type and wall-type hygrometers the capillary effect of the wicking is lost when frozen so that water will have to be applied directly to the bare bulb.

DRY BULB TEMPERATURE °F

WET BULB TEMPERATURE °F

WB	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	WB
14	1																																								14
15	15	4																																							15
16	28	17	7																																						16
17	42	31	20	10	1																																				17
18	56	44	33	22	13	4																																			18
19	71	58	46	35	25	16	7																																		19
20	85	71	59	47	37	27	18	10	3																																20
21	100	86	72	60	49	39	29	21	13	6																															21
22		100	86	73	62	51	41	32	23	16	8	2																													22
23			100	87	74	63	52	43	34	26	18	11	5																												23
24				100	87	75	64	54	44	36	28	20	14	8	2																										24
25					100	87	76	65	55	46	37	30	23	16	10	5																										25
26						100	88	76	66	56	47	39	32	25	19	13	7	2																							26
27							100	88	77	67	58	49	41	34	27	21	15	10	5																						27
28								100	88	78	68	59	51	43	36	29	23	17	12	7	3																				28
29									100	89	78	69	60	52	45	38	31	25	20	15	10	5																			29
30										100	89	79	70	62	54	46	40	33	27	22	17	12	8	4																		30
31											100	89	80	71	63	55	48	42	35	29	24	19	14	10	6																	31
32												100	90	81	72	64	57	50	43	37	31	26	21	16	12	8	5	1														32
33													100	90	81	73	65	58	51	45	39	33	28	23	18	14	10	7	3													33
34														100	91	82	74	66	59	52	46	40	35	30	25	20	16	12	9	5												34
35															100	91	83	75	67	60	54	47	42	36	31	26	22	18	14	10	7	4	1								35
36																100	91	83	75	68	61	55	48	43	38	32	28	23	19	16	12	9	6	3							36
37																	100	91	83	75	69	62	55	49	44	39	34	29	25	21	17	14	10	8	5	2					37
38																		100	92	83	76	69	63	56	51	45	40	35	31	27	23	19	16	12	9	7	4	1			38
39																			100	92	84	77	70	63	57	52	46	41	36	32	28	24	20	17	14	11	8	6	3	1	39
40																				100	92	85	77	71	64	58	52	47	42	38	34	29	26	22	19	16	13	10	7	5	40
41																					100	92	85	78	71	65	59	54	48	43	39	35	31	27	23	20	17	14	11	9	41
42																						100	92	85	78	72	66	60	54	49	45	40	36	32	28	25	22	18	16	13	42
43																							100	93	86	79	72	66	61	55	50	46	41	37	33	30	26	23	20	17	43
44																								100	93	86	79	73	67	61	56	51	47	42	38	34	31	27	24	21	44
45																									100	93	86	79	73	67	62	57	52	48	43	39	35	32	29	26	45
46																										100	93	86	80	74	68	63	58	53	49	44	40	37	33	30	46
47																											100	93	86	80	75	69	63	59	54	50	45	41	38	34	47
48																												100	93	87	81	75	69	64	59	55	50	46	42	39	48
49																													100	93	87	81	75	70	65	60	55	51	47	43	49
50																														100	94	87	81	76	70	65	61	56	52	48	50
51																															100	94	87	82	76	71	66	61	57	53	51
52																																100	94	88	82	76	71	66	62	58	52
53																																	100	94	88	82	77	72	67	63	53
54																																		100	94	88	82	77	72	68	54
WB	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	WB

These values are correct for air velocity of not less than 600 ft. per minute and a barometric pressure of 29.92 inches or 760 mm. of mercury.

DRY BULB TEMPERATURE °F

WET BULB TEMPERATURE °F

	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	
41	100	92	85	78	71	65	59	54	48	43	39	35	31	27	23	20	17	14	11	9	7	4	2																		41
42		100	92	85	78	72	66	60	54	49	45	40	36	32	28	25	22	18	16	13	10	8	6	4	2																	42
43			100	93	86	79	72	66	61	55	50	46	41	37	33	30	26	23	20	17	14	12	10	7	5	3	2															43
44				100	93	86	79	73	67	61	56	51	47	42	38	34	31	27	24	21	18	16	13	11	9	7	5	3	1													44
45					100	93	86	79	73	67	62	57	52	48	43	39	35	32	29	26	22	20	17	15	12	10	8	6	5	3	1											45
46						100	93	86	80	74	68	63	58	53	49	44	40	37	33	30	27	24	21	18	16	14	12	10	8	6	4	3	1								46
47							100	93	86	80	75	69	63	59	54	50	45	41	38	34	31	28	25	22	20	17	15	13	11	9	7	6	4	3	1						47
48								100	93	87	81	75	69	64	59	55	50	46	42	39	35	32	29	26	24	21	19	16	14	12	10	9	7	5	4	3	1				48
49									100	93	87	81	75	70	65	60	55	51	47	43	40	36	33	30	27	25	22	20	18	15	13	12	10	8	7	5	4	3	1		49
50										100	94	87	81	76	70	65	61	56	52	48	44	41	37	34	31	29	26	23	21	19	17	15	13	11	9	8	6	5	4	3	50
51											100	94	87	82	76	71	66	61	57	53	49	45	42	38	35	32	30	25	24	22	20	18	16	14	12	11	9	8	6	5	51
52												100	94	88	82	76	71	66	62	58	54	50	46	43	39	36	33	31	28	25	23	21	19	17	15	13	12	10	9	7	52
53													100	94	88	82	77	72	67	63	58	54	50	47	44	40	37	34	32	29	27	24	22	20	18	16	14	13	11	10	53
54														100	94	88	82	77	72	68	63	59	55	51	48	44	41	38	35	33	30	28	25	23	21	19	17	16	14	12	54
55															100	94	88	83	78	73	68	64	60	56	52	48	45	42	39	36	33	31	29	26	24	22	20	18	17	15	55
56																100	94	88	83	78	73	69	64	60	56	53	49	46	43	40	37	34	32	29	27	25	23	21	19	18	56
57																	100	94	89	83	78	74	69	65	61	57	53	50	47	44	41	38	35	33	30	28	26	24	22	20	57
58																		100	94	89	84	79	74	70	66	61	58	54	51	48	45	42	39	36	34	31	29	27	25	23	58
59																			100	94	89	84	79	74	70	66	62	58	55	51	48	45	42	39	37	34	32	30	28	26	59
60																				100	94	89	84	79	75	71	66	62	59	55	52	49	46	43	40	38	35	33	31	29	60
61																					100	94	89	84	80	75	71	67	63	59	56	53	50	47	44	41	39	36	34	32	61
62																						100	95	90	85	80	75	71	67	64	60	57	53	50	47	44	42	39	37	35	62
63																							100	95	90	85	80	76	72	68	64	61	57	54	51	48	45	43	40	38	63
64																								100	95	90	85	80	76	72	68	65	61	58	54	51	48	46	43	41	64
65																									100	95	90	85	81	77	72	69	65	61	58	55	52	49	46	44	65
66																										100	95	90	85	81	77	73	69	65	62	59	56	53	50	47	66
67																											100	95	90	86	81	77	73	69	66	62	59	56	53	50	67
68																												100	95	90	86	82	78	74	70	66	63	60	57	54	68
69																													100	95	90	86	82	78	74	70	67	63	60	57	69
70																														100	95	91	86	82	78	74	71	67	64	61	70
71																															100	95	91	86	82	78	74	71	68	64	71
72																																100	95	91	86	82	79	75	71	68	72
73																																	100	95	91	87	83	79	75	72	73
74																																		100	96	91	87	83	79	75	74
75																																			100	96	91	87	83	79	75
76																																				100	96	91	87	83	76
77																																					100	96	91	87	77
78																																						100	96	91	78
79																																							100	96	79
80																																								100	80
	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	

DRY BULB TEMPERATURE °F

WET BULB TEMPERATURE °F

	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120	122	124	126	128	130	132	134	136	138	140	142	144	146	148	150	152	154	156	158	160	
54	10	7	5	3	1																																				54
56	14	12	9	7	5	3																																				56
58	20	16	14	11	9	7	5	3																																	58
60	25	21	18	15	13	11	9	7	5																																60
62	30	26	23	20	17	15	12	10	8	7	5																														62
64	36	32	28	25	22	19	16	14	12	10	8	7	5																												64
66	42	37	33	30	26	23	20	18	15	13	11	10	8	7																											66
68	48	43	39	35	31	28	24	22	19	17	15	13	11	10	8	7	6																								68
70	55	49	44	40	36	32	29	26	23	21	18	16	14	12	11	9	8																								70
72	61	56	50	46	41	37	33	30	27	24	22	20	17	16	14	12	11	9	8																						72
74	69	62	57	51	47	42	38	35	32	28	26	23	21	19	17	15	13	12	11	9	8																				74
76	76	69	63	57	52	48	43	39	36	33	30	27	24	22	20	18	16	14	13	12	10	9	8																		76
78	84	76	70	64	58	53	49	44	40	37	34	31	28	25	23	21	19	17	16	14	13	11	10	9																	78
80	92	84	77	70	65	59	54	50	45	41	38	35	32	29	26	24	22	20	18	17	15	14	12	11	10																80
82	100	92	84	77	71	65	60	55	50	46	42	39	36	33	30	27	25	23	21	19	18	16	15	13	12	11															82
84		100	92	85	78	72	66	61	55	51	47	43	40	37	34	31	28	26	24	22	20	18	17	16	14	13	12														84
86			100	92	85	78	72	66	61	56	52	48	44	41	38	35	32	29	27	25	23	21	19	18	16	15	14	13													86
88				100	92	85	79	73	67	62	57	53	49	45	42	38	35	33	30	28	26	24	22	20	19	17	16	15	14												88
90					100	92	85	79	73	68	62	58	53	49	46	42	39	36	34	31	29	27	25	23	21	20	18	17	15	14											90
92						100	93	86	79	73	68	63	58	54	50	47	43	40	37	34	32	30	27	25	24	21	20	19	17	16	15											92
94							100	93	86	80	74	69	64	59	55	51	47	44	41	38	35	33	30	28	26	24	22	21	20	18	18	16									94
96								100	93	86	80	74	69	64	60	55	52	48	45	41	39	36	33	31	29	26	25	23	22	21	20	19	16								96
98									100	93	86	80	75	70	65	60	56	52	49	45	42	39	37	34	32	30	27	26	24	23	22	21	19	17							98
100										100	93	87	81	75	70	65	61	57	53	49	46	43	40	37	35	33	30	28	27	25	24	23	21	20	18						100
102											100	93	87	81	75	70	66	61	57	53	50	47	44	41	38	36	33	31	29	27	26	25	23	22	21	18					102
104												100	93	87	81	76	71	66	62	58	54	50	47	44	41	39	36	34	32	30	28	27	25	24	23	21	19				104
106													100	93	87	81	76	71	67	62	58	54	51	48	45	42	39	37	34	32	31	29	27	26	25	23	22	19			106
108														100	93	87	82	76	72	67	63	59	55	52	48	45	43	40	37	35	33	31	29	28	27	25	24	22	20		108
110															100	94	88	82	77	72	67	63	59	56	52	49	46	43	40	38	36	34	32	30	28	27	26	24	23		110
112																100	94	88	82	77	72	68	64	60	56	53	49	46	44	41	39	36	34	32	30	29	28	26	25	23	112
114																	100	94	88	82	77	73	68	64	60	56	53	50	47	44	42	39	37	35	33	31	30	28	27	25	114
116																		100	94	88	83	78	73	68	64	61	57	54	50	47	45	42	40	37	35	34	32	30	29	27	116
118																			100	94	88	83	78	73	69	65	61	57	54	51	48	45	43	40	38	36	34	32	31	29	118
120																				100	94	88	83	78	73	69	65	61	58	54	52	48	46	43	41	38	36	35	33	31	120
122																					100	94	88	83	78	74	69	65	62	58	55	52	49	46	43	41	39	37	35	33	122
124																						100	94	89	83	79	74	70	66	62	59	55	53	49	46	44	42	39	38	35	124
126																							100	94	89	84	79	74	70	66	63	59	55	53	49	47	44	42	40	38	126
128																								100	94	89	84	79	75	70	67	63	59	56	53	50	47	45	43	40	128
130																									100	94	89	84	79	75	71	67	63	60	56	54	50	47	45	43	130
132																										100	94	89	84	79	75	71	67	64	60	57	54	50	48	46	132
	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	112	114	116	118	120	122	124	126	128	130	132	134	136	138	140	142	144	146	148	150	152	154	156	158	160	

These values are correct for air velocity of not less than 600 ft. per minute. The values above 140° (Dry Bulb) are extrapolated.

DRY BULB TEMPERATURE °F

WET BULB TEMPERATURE °F

	134	136	138	140	142	144	146	148	150	152	154	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200	202	204	206	208	210	212	
112	49	46	44	41	39	36	34	33	30	29	28	26	25	23	22															100	96	92	88	84	81	78	76	73	70	67	192
114	53	50	47	44	42	39	37	35	33	31	30	28	27	25	24	22															100	96	92	88	85	81	79	76	73	70	194
116	57	54	50	47	45	42	40	37	35	34	32	30	29	27	26	24	23															100	96	92	89	86	82	79	76	73	196
118	61	57	54	51	48	45	43	40	38	36	34	32	31	29	28	27	25	23															100	96	92	89	86	82	79	77	198
120	65	61	58	54	52	48	46	43	41	38	36	35	33	31	30	29	27	25	23																100	96	92	90	86	82	79	200
122	69	65	62	58	55	52	49	46	43	41	39	37	35	33	32	31	29	27	25	24																100	96	93	90	86	83	202
124	74	70	66	62	59	55	53	49	46	44	42	39	38	35	34	32	31	29	27	26	24															100	96	93	90	86	204
126	79	74	70	66	63	59	55	53	49	47	44	42	40	38	36	34	33	31	29	28	26	25															100	96	93	90	206
128	84	79	75	70	67	63	59	56	53	50	47	45	43	40	39	37	35	33	31	30	28	27	25																100	96	93	208
130	89	84	79	75	71	67	63	60	56	54	50	47	45	43	41	39	37	35	33	32	30	29	27	26																100	96	210
132	94	89	84	79	75	71	67	64	60	57	54	50	48	46	44	41	40	38	35	34	32	31	29	28	26															100	212
134	100	94	89	84	80	75	71	68	64	60	57	54	51	48	47	44	42	40	38	36	34	33	31	30	28	26															
136		100	94	89	84	80	76	71	68	64	61	57	55	51	49	47	45	42	40	39	36	35	33	31	30	28	27														
138			100	95	90	84	80	76	71	68	65	61	57	55	51	49	48	45	42	41	39	37	35	33	32	30	28	27													
140				100	95	90	85	80	76	72	69	65	61	58	55	52	50	48	45	43	41	40	37	35	34	32	30	29	28												
142					100	95	90	85	80	76	72	69	65	62	58	56	53	50	48	46	43	42	40	37	36	34	32	31	30	28											
144						100	95	90	85	81	76	72	69	65	62	58	56	53	50	49	46	44	42	40	38	36	34	33	32	30	29										
146							100	95	90	85	81	77	72	69	66	62	59	57	53	51	49	47	44	42	41	38	37	35	33	32	31	29									
148								100	95	90	85	81	77	73	70	66	63	59	57	54	51	50	47	44	43	41	39	37	35	34	33	31	30								
150									100	95	90	85	81	77	73	70	66	63	60	58	54	52	50	47	45	43	42	39	37	36	34	33	32	30							
152										100	95	90	85	81	77	73	70	67	63	60	58	55	52	50	48	45	44	42	39	38	36	35	34	32	30						
154											100	95	90	85	82	78	74	70	67	63	61	58	55	52	50	48	46	44	42	40	38	37	35	34	32	30	29				
156												100	95	90	86	82	78	74	70	67	64	61	58	55	53	50	48	46	44	42	40	39	37	36	34	32	31	30			
158													100	95	91	86	82	78	74	71	67	64	61	58	56	53	51	48	46	44	42	40	39	38	36	34	33	32	30		
160														100	95	91	86	82	78	74	71	68	64	61	59	56	54	51	49	47	45	43	41	40	38	36	35	33	32	31	160
162															100	95	91	86	82	79	74	71	68	64	62	59	57	54	51	49	47	45	43	42	40	38	37	35	34	33	162
164																100	96	91	86	83	79	75	72	68	65	62	60	57	54	52	50	47	45	44	42	40	39	37	36	34	164
166																	100	96	91	87	83	79	75	72	69	65	63	60	57	55	52	50	48	46	45	42	41	39	38	36	166
168																		100	96	92	87	83	79	75	72	69	66	63	60	58	55	53	50	48	47	45	43	42	40	38	168
170																			100	96	92	87	83	79	76	72	69	66	63	61	58	55	53	51	49	47	45	44	42	40	170
172																				100	96	92	87	83	79	76	73	69	66	63	61	58	55	53	52	49	48	46	44	42	172
174																					100	96	92	87	83	79	76	73	69	67	63	61	58	56	54	52	50	48	46	44	174
176																						100	96	92	87	83	80	76	73	70	67	64	61	59	57	55	53	50	48	46	176
178																							100	96	92	87	83	80	76	73	70	67	64	62	60	58	55	53	50	48	178
180																								100	96	92	87	83	80	76	73	70	67	65	63	60	58	55	53	51	180
182																									100	96	92	87	83	80	76	74	70	68	66	63	60	58	56	54	182
184																										100	96	92	87	84	80	77	74	72	69	66	63	61	58	56	184
186																											100	96	92	88	84	80	77	75	72	69	66	64	61	58	186
188																												100	96	92	88	84	80	78	75	72	70	67	64	61	188
190																													100	96	92	88	84	80	78	75	73	70	67	64	190
	134	136	138	140	142	144	146	148	150	152	154	156	158	160	162	164	166	168	170	172	174	176	178	180	182	184	186	188	190	192	194	196	198	200	202	204	206	208	210	212	

SOLUTIONS FOR MAINTAINING CONSTANT HUMIDITY

A saturated aqueous solution in contact with an excess of a definite solid phase at a given temperature will maintain constant humidity in an enclosed space. The table below gives a number of salts suitable for this purpose listed in order of decreasing humidity. The aqueous tensions were obtained by multiplying the percent humidity by the vapor pressure of pure water (mm. of Hg) at the same temperature.

Solid Phase	Temp. °C.	% Humidity	Aqueous Tension
TlCl	100.097	99.7	760.5
$TlNO_3$	100.317	98.7	758.6
$Pb(NO_3)_2$	20	98	17.2
$CaSO_4 \cdot 5H_2O$	20	98	17.2
NaF	100.0	96.6	734
$Na_2SO_3 \cdot 7H_2O$	20	95	16.7
$Na_2HPO_4 \cdot 12H_2O$	20	95	16.7
$ZnSO_4 \cdot 7H_2O$	5	94.7	6.11
$NH_4H_2PO_4$	20.0	93.1	16.3
$NH_4H_2PO_4$	25.0	93.0	22.1
$Na_2SO_4 \cdot 10H_2O$	20	93	16.3
$NH_4H_2PO_4$	30.0	92.9	29.6
$NaBrO_3$	20	92	16.1
K_2HPO_4	20	92	16.1
$Na_2CO_3 \cdot 10H_2O$	18.5	92	14.7
$ZnSO_4 \cdot 7H_2O$	20	90	15.8
$Pb(NO_3)_2$	103.5	88.4	759
$BaCl_2 \cdot 2H_2O$	24.5	88	20.3
K_2CrO_4	20	88	15.4
$Na_2CO_3 \cdot 10H_2O$	24.5	87	20.1
$KHSO_4$	20	86	15.1
Tl_2SO_4	104.7	84.8	760.5
KBr	20	84	14.7
$(NH_4)_2SO_4$	30.0	81.1	25.8
$(NH_4)_2SO_4$	25.0	81.1	19.3
$(NH_4)_2SO_4$	20.0	81.0	14.2
NH_4Cl	30.0	79.5	25.3
NH_4Cl	25.0	79.3	18.8
NH_4Cl	20.0	79.2	13.9
$Na_2S_2O_3 \cdot 5H_2O$	20	78	13.7
$NaC_2H_3O_2 \cdot 3H_2O$	20	76	13.3
$H_2C_2O_4 \cdot 2H_2O$	20	76	13.3
$(NH_4)_2SO_4$	108.2	75	758.5
$NaClO_3$	20	75	13.2
$NH_4Cl + KNO_3$	20.0	72.6	12.7
$NH_4Cl + KNO_3$	25.0	71.2	16.9
KBr	100	69.2	526
$NH_4Cl + KNO_3$	30.0	68.6	21.8
$NaNO_2$	20	66	11.6
$Mg(C_2H_3O_2)_2 \cdot 4H_2O$	20	65	11.4
$NaBr \cdot 2H_2O$	20	58	10.2
KI	100.0	56.2	427
$Ca(NO_3)_2 \cdot 4H_2O$	18.5	56	8.94
$Mg(NO_3)_2 \cdot 6H_2O$	18.5	56	8.94
$NaClO_3$	100.0	54	410
$Mg(NO_3)_2 \cdot 6H_2O$	24.5	52	12.0
$NaHSO_4 \cdot H_2O$	20	52	9.12
$Na_2Cr_2O_7 \cdot 2H_2O$	20	52	9.12
$Ca(NO_3)_2 \cdot 4H_2O$	24.5	51	11.8
NaI	100.0	50.4	383
KCNS	20	47	8.24

SOLUTIONS FOR MAINTAINING CONSTANT HUMIDITY

Solid Phase	Temp. °C.	% Humidity	Aqueous Tension
KNO_2	20	45	7.36
$K_2CO_3 \cdot 2H_2O$	18.5	44	7.03
$K_2CO_3 \cdot 2H_2O$	24.5	43	9.92
$Zn(NO_3)_2 \cdot 6H_2O$	20	42	7.36
$CaCl_2 \cdot 6H_2O$	5	39.8	2.60
$CaCl_2 \cdot 6H_2O$	10	38	3.50
$NaCl + KClO_3$	16.39	36.58	5.114
CrO_3	20	35	6.14
$CaCl_2 \cdot 6H_2O$	18.5	35	5.59
$NaCl + KNO_3$	16.39	32.57	4.553
$CaCl_2 \cdot 6H_2O$	20.0	32.3	5.66
$CaCl_2 \cdot 6H_2O$	24.5	31	7.15
$NaCl + KNO_3 + NaNO_3$	16.39	30.49	4.263
KF	100.0	22.9	174
NaBr	100.0	22.9	174
$KC_2H_3O_2$	20	20	3.51
$LiCl \cdot H_2O$	20	15	2.63
$KC_2H_3O_2$	168	13	736
$ZnCl_2 \cdot 1\frac{1}{2}H_2O$	20	10	1.74
$H_3PO_4 \cdot \frac{1}{2}H_2O$	24.5	9	2.08

VAPOR PRESSURES OF VARIOUS SUBSTANCES

The following table gives the values of A and B in the equation: $\log_{10} P_{mm} = \frac{-52.23\,A}{T} + B$, where P_{mm} = vapor pressure of the substance in mm of Hg and where T = absolute temperature = t°C + 273.1. The values obtained by the use of this equation are valid within the temperature ranges indicated for each of the compounds. See also another table "Vapor Pressures of Various Substances" and the table "Orthobaric Densities or Volumes of Various Substances."

Name	Formula	Range, °C.	A	B
Acenaphthene	$C_{12}H_{10}$	147 to 288	54.279	8.033
Acetaldehyde	CH_3CHO	−24.3 to +27.5	27.707	7.8206
Acetic acid	CH_3CO_2H	−35 to +10	41.689	8.502
Acetic anhydride	$(CH_3CO)_2O$	100 to 140	45.585	8.688
Acetophenone	$CH_3COC_6H_5$	30 to 100	55.117	9.1352
		100 to 194	49.141	8.3170
Acetylene	C_2H_2	−140 to −82	21.914	8.933
Allylene	C_3H_4	−73 to −13	23.893	7.877
Alumina	Al_2O_3	1840 to 2200	540	14.22
Aluminum chloride	$AlCl_3$	70 to 190	115	16.24
Ammonia*	NH_3	−127 to −78	31.211	9.9974
Ammonium bromide	NH_4Br	250 to 400	90.208	9.9404
Ammonium chloride	NH_4Cl	100 to 400	83.486	10.0164
Ammonium cyanide	NH_4CN	7 to 17	41.484	9.978
Ammonium iodide	NH_4I	300 to 400	95.730	10.2700
Ammonium thiohydrate	NH_4SH	6 to 40	46.025	10.7500
Aniline	$C_6H_5NH_2$	145 to 185	45.9516	8.1278
Anthracene	$C_{14}H_{10}$	100 to 160	72	8.91
		223 to 342	59.219	7.910
Anthraquinone	$C_{14}H_8O_2$	224 to 286	110.04	12.305
		285 to 370	63.985	8.002
Antimony	Sb	1070 to 1325	189	9.051
Antimony tribromide	$SbBr_3$	235 to 324	55	8.005

* See also special tables

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Name	Formula	Range, °C.	A	B
Antimony trichloride	$SbCl_3$	170 to 253	49.44	8.090
Antimony tri-iodide	SbI_3	330 to 445	64.15	7.831
Argon	A	−207.62 to −189.19	7.8145	7.5741
Arsenic	As	440 to 815	133	10.800
		800 to 860	47.1	6.692
Arsenic trichloride	$AsCl_3$	50 to 100	39.11	7.953
Arsenic trioxide	As_2O_3	100 to 310	111.35	12.127
		315 to 490	52.12	6.513
Barium	Ba	930 to 1130	350	15.765
Benzene	C_6H_6	−58 to −30	42.904	9.556
		−30 to + 5	44.222	9.846
		0 to 42	34.172	7.9622
		42 to 100	32.295	7.6546
Benzoic acid	$C_6H_5CO_2H$	60 to 110	63.82	9.033
Benzophenone	$(C_6H_5)_2CO$	260 to 308	58.221	8.137
Benzoyl chloride	C_6H_5COCl	140 to 200	45.416	7.9245
Benzyl alcohol	$C_6H_5CH_2OH$	100 to 135	59.491	9.5152
		135 to 205	53.118	8.6977
Bismuth	Bi	1210 to 1420	200	8.876
Bismuth chloride	$BiCl_3$	91 to 213	13.125	2.681
Boron tribromide	BBr_3	−40 to +90	33.32	7.655
Boron trimethyl	$B(CH_3)_3$	−118 to −20	22.171	7.4595
Bromobenzene	C_6H_5Br	−26 to −15	42.5	8.075
p-Bromochlorobenzene	C_6H_4BrCl	23 to 63	69.755	11.629
n-Butane	C_4H_{10}	−100 to +12	23.450	7.395
iso-Butane	C_4H_{10}	−115 to −34	21.273	7.25
n-Butyl alcohol	C_4H_9OH	75 to 117.5	46.774	9.1362
iso-Butyl valerate	$C_4H_9CO_2C_4H_9$	90 to 170	44.482	8.143
n-Butyric acid	$C_3H_7CO_2H$	80 to 165	51.103	9.010
iso-Butyric acid	$C_3H_7CO_2H$	30 to 155	48.498	8.8193
Cadmium	Cd	150 to 320.9	109	8.564
		500 to 840	99.9	7.897
Cadmium iodide	CdI_2	385 to 450	122.2	9.269
Calcium	Ca	500 to 700	195	9.697
		960 to 1110	370	16.240
Camphor	$C_{10}H_{16}O$	0 to 180	53.559	8.799
Carbazole	$C_{12}H_9N$	244 to 352	64.715	8.280
Carbon	C	3880 to 4430	540	9.596
Carbon dioxide	CO_2	−135 to −56.7	26.1793	9.9082
Carbon monoxide	CO	−290 to −206	6.354	6.976
Carbon oxysulfide	COS	−80 to −50	19.22	7.383
Carbon suboxide	C_3O_2	−100 to +6	25.46	7.640
Carbon tetrachloride	CCl_4	−70 to −19	36.585	8.540
		−19 to +20	33.914	8.004
Cesium	Cs	200 to 350	73.4	6.949
Cesium bromide	CsBr	978 to 1305	153.6	7.990
Cesium chloride	CsCl	986 to 1295	163.2	8.340
Cesium fluoride	CsF	1033 to 1255	140.9	7.703
Cesium iodide	CsI	1052 to 1280	185.7	9.124
Chlorine	Cl	−154 to −103	29.293	9.950
Chlorine dioxide	ClO_2	−59 to +11	27.26	7.893
Chlorobenzene	C_6H_5Cl	−35 to −15	42.25	8.500
Cobalt	Co	2375	309	7.571
Copper	Cu	2100 to 2310	468	12.344
Cuprous bromide	CuBr	997 to 1351	79.9	5.460
Cuprous chloride	CuCl	878 to 1369	80.7	5.454
Cuprous iodide	CuI	991 to 1154	80.7	5.570

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Name	Formula	Range, °C.	A	B
Cyanogen	C_2N_2	−72 to −28	32.437	9.6539
		−32 to −6	23.75	7.808
Cyanogen bromide	CNBr	−17 to +35	47.051	10.328
Cyanogen chloride	CNCl	−5 to +40	27.1	7.840
Cyclohexane	C_6H_{12}	−5 to +5	37.394	8.594
Dibenzyl ketone	$(C_6H_5CH_2)_2CO$	285 to 325	62.118	8.257
p-Dichlorobenzene	$C_6H_4Cl_2$	30 to 50	72.218	12.480
Diphenylamine	$NH(C_6H_5)_2$	278 to 284	57.35	8.088
Diphenylmethane	$CH_2(C_6H_5)_2$	217 to 283	52.36	7.967
Dipropyl ether	$(C_3H_7)_2O$	8 to 90	34.295	7.821
Ethyl butyrate	$C_3H_7CO_2C_2H_5$	45 to 121	39.318	8.093
Ethyl chloride	C_2H_5Cl	−30 to +30	26.319	7.691
Ethyl mercaptan	C_2H_5SH	8 to 45	28.210	7.672
Ethylene	C_2H_4	−160 to −104	14.396	7.330
Ethylene bromide	$(CH_2Br)_2$	10 to 150	38.082	7.792
Ethylene chloride	$(CH_2Cl)_2$	0 to 30	35.598	8.126
		64 to 86	32.996	7.705
Ethylidene chloride	$CHCl_2CH_3$	0 to 30	31.706	7.909
		40 to 70	30.625	7.7165
Ferrous chloride	$FeCl_2$	700 to 930	135.2	8.33
Fluorene	$C_{13}H_{10}$	161 to 300	56.615	8.059
Germanium tetrachloride	$GeCl_4$	10.4 to 86	38.5	7.340
Gold	Au	2315 to 2500	385	9.853
Heptane	C_7H_{16}	−63 to −40	37.358	8.2585
Hexane	C_6H_{14}	−83 to −50	36.702	8.782
		−50 to −10	35.1627	8.399
		−10 to +90	31.679	7.724
Hydrogen bromide	HBr	−114 to −86	22.420	8.734
		−86 to −66	17.96	7.427
Hydrogen chloride	HCl	−158 to −110	19.588	8.4430
Hydrogen cyanide	HCN	−8 to +27	27.83	7.7446
		0 to 46	27.875	7.7526
Hydrogen fluoride	HF	−83 to +48	25.18	7.370
Hydrogen iodide	HI	−97 to −51	24.16	8.259
		−50 to −34	21.58	7.630
Hydrogen peroxide	H_2O_2	10 to 90	48.53	8.853
Hydrogen selenide	H_2Se	−66 to −26	20.21	7.431
Hydrogen selenite	H_2SeO_3	70 to 110	43	8.150
Hydrogen sulfide	H_2S	−110 to −83	20.69	7.880
Hydrogen telluride	H_2Te	−46 to 0	22.76	7.260
Iodobenzene	C_6H_5I	−30 to +18	43	7.500
Iron	Fe	2220 to 2450	309	7.482
Krypton	Kr	−188.7 to −169	10.065	7.1770
Lauric acid	$C_{11}H_{23}CO_2H$	164 to 205	74.386	9.768
Lead	Pb	525 to 1325	188.5	7.827
Lead bromide	$PbBr_2$	735 to 918	118	8.064
Lead chloride	$PbCl_2$	500 to 950	141.9	8.961
Lead fluoride	PbF_2	1078 to 1289	165.1	8.391
Lithium bromide	LiBr	1010 to 1265	152.7	8.068
Lithium chloride	LiCl	1045 to 1325	155.9	7.939
Lithium fluoride	LiF	1398 to 1666	218.4	8.753
Lithium iodide	LiI	940 to 1140	143.6	8.011
Magnesium	Mg	900 to 1070	260	12.993
Maleic anhydride	$C_2H_2(CO)_2O$	60 to 160	46.34	7.825
Manganese	Mn	1510 to 1900	267	9.300
Mercuric bromide	$HgBr_2$	130 to 270	79.8	10.094
		238 to 331	61.25	8.284

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Name	Formula	Range, °C.	A	B
Mercuric chloride	$HgCl_2$	60 to 130	85.03	10.888
		130 to 270	78.85	10.094
		275 to 309	61.02	8.409
Mercuric iodide	HgI_2	100 to 250	82.34	10.057
		266 to 360	62.77	8.115
Mercury	Hg	−80 to −38.87	73.0	10.383
		400 to 1300	58.7	7.752
Methane	CH_4	−194 to −184	9.8962	7.6509
		−174 to −163	8.5169	6.8626
Methyl alcohol	CH_3OH	−62 to −44	39.234	8.9547
		−10 to +80	38.324	8.8017
Methyl chloride	CH_3Cl	−47 to −10	21.988	7.481
Methyl ether	$(CH_3)_2O$	−70 to −20	23.025	7.720
Methyl ethyl ether	$CH_3OC_2H_5$	0 to 25	26.262	7.769
Methyl fluoride	CH_3F	−102 to −76	17.053	7.445
Methyl propyl ether	$CH_3OC_3H_7$	−0.5 to +40	28.952	7.729
Methyl salicylate	$C_6H_4OHCO_2CH_3$	175 to 215	48.67	8.008
Methylarsine dichloride	CH_3AsCl_2	−17 to +35	43.686	8.6944
Molybdenum	Mo	1800 to 2240	680	10.844
Myristic acid	$C_{13}H_{27}CO_2H$	190 to 224	75.783	9.541
Naphthalene	$C_{10}H_8$	0 to 80	71.401	11.450
		120 to 200	47.362	7.927
Nickel	Ni	2360	309	7.600
Nickel carbonyl	$Ni(CO)_4$	2 to 40	29.8	7.780
Nitric oxide	NO	−200 to −161	16.423	10.048
		−163.7 to −148	13.04	8.440
o-Nitroaniline	$O_2NC_6H_4NH_2$	150 to 260	63.881	8.8684
m-Nitroaniline	$O_2NC_6H_4NH_2$	170 to 260	65.88	8.8188
p-Nitroaniline	$O_2NC_6H_4NH_2$	190 to 260	77.345	9.5595
Nitrobenzene	$C_6H_5NO_2$	112 to 209	48.955	8.192
Nitrogen	N_2	−215.2 to 209.86	6.8813	7.66558
Nitrogen pentoxide	N_2O_5	−30 to +30	57.18	12.647
Nitrogen tetroxide	N_2O_4	−100 to −40	55.16	13.400
		−40 to −10	45.44	11.214
		−8 to +43.2	33.43	8.814
Nitrogen trioxide	N_2O_3	−25 to 0	39.4	10.30
Nitromethane	CH_3NO_2	47 to 100	36.914	8.033
o-Nitrotoluene	$O_2NC_6H_4CH_3$	50 to 225	48.114	7.9728
m-Nitrotoluene	$O_2NC_6H_4CH_3$	55 to 235	50.128	8.0655
p-Nitrotoluene	$O_2NC_6H_4CH_3$	80 to 240	49.95	7.9815
Nitrosyl chloride	NOCl	−61.5 to −5.4	25.5	7.870
Nitrous oxide	N_2O	−144 to −90	23.59	9.579
		−90.1 to −88.7	16.44	7.535
Osmium octofluoride	OsF_8	38 to 47.3	29.2	7.650
Osmium tetroxide	OsO_4	−38 to +40.1	56.5	10.7100
Oxalic acid	$(COOH)_2$	55 to 105	90.5026	12.2229
n-Pentane	C_5H_{12}	−20 to +50	27.691	7.558
Phenanthrene	$C_{14}H_{10}$	203 to 347	57.247	7.771
Phenol	C_6H_5OH	116 to 180	49.644	8.587
Phosgene	$COCl_2$	−90 to +25	24.684	7.460
Phosphonium bromide	PH_4Br	−80 to +40	48.115	10.9561
Phosphonium iodide	PH_4I	10 to 60	51.854	10.9500
Phosphorus (white)	P	20 to 44.1	63.123	9.6511
Phosphorus (violet)	P	380 to 590	108.51	11.0842
Phosphorus trichloride	PCl_3	0 to 70	31.86	7.681
Phthalic anhydride	$C_6H_4(CO)_2O$	160 to 285	54.92	8.022
Platinum	Pt	1425 to 1765	486	7.786

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Name	Formula	Range, °C.	A	B
Potassium	K	260 to 760	84.9	7.183
Potassium bromide	KBr	906 to 1063	168.1	8.2470
		1095 to 1375	163.8	7.936
Potassium chloride	KCl	906 to 1105	174.5	8.3526
		1116 to 1418	169.7	8.130
Potassium fluoride	KF	1278 to 1500	207.5	9.000
Potassium hydroxide	KOH	1170 to 1327	136	7.330
Potassium iodide	KI	843 to 1028	157.6	8.0957
		1063 to 1333	155.7	7.949
Propane	C_3H_8	−136 to −40	19.037	7.217
Propionic acid	$C_2H_5CO_2H$	20 to 140	46.15	8.715
n-Propyl alcohol	C_3H_7OH	−45 to −10	47.274	9.5180
n-Propyl bromide	C_3H_7Br	0 to 30	32.430	7.821
iso-Propyl bromide	C_3H_7Br	0 to 30	30.76	7.722
n-Propyl chloride	C_3H_7Cl	0 to 50	28.894	7.593
iso-Propyl chloride	C_3H_7Cl	0 to 30	27.242	7.493
n-Propyl iodide	C_3H_7I	0 to 30	35.334	7.826
iso-Propyl iodide	C_3H_7I	0 to 30	32.978	7.629
Propyl propionate	$C_2H_5CO_2C_3H_7$	45 to 125	39.221	8.0525
Propylene	C_3H_6	−95 to −48	19.693	7.4463
Quinoline	C_9H_7N	180 to 240	49.72	7.969
Rubidium	Rb	250 to 370	76	6.976
Rubidium bromide	RbBr	1050 to 1365	165	8.223
Rubidium chloride	RbCl	1142 to 1395	198.6	9.111
Rubidium fluoride	RbF	1142 to 1400	183.2	8.570
Rubidium iodide	RbI	1075 to 1325	156.6	8.067
Selenic acid	H_2SeO_4	25 to 56	82.4	14.130
Silver	Ag	1650 to 1950	250	8.762
Silver chloride	AgCl	1255 to 1442	185.5	8.179
Silica	SiO_2	1860 to 2230	506	13.43
Silicon	Si	1200 to 1320	170	5.950
Silicon hexahydride	Si_2H_6	−115 to −14.6	21.7	7.258
Silicon octahydride	Si_3H_8	−70 to +52	29.85	7.676
Silicon tetrachloride	$SiCl_4$	−70 to +5	30.1	7.644
Silicon tetrahydride	SiH_4	−160 to −112	12.69	6.996
Sodium	Na	180 to 883	103.3	7.553
Sodium bromide	NaBr	1138 to 1394	161.6	7.948
Sodium chloride	NaCl	976 to 1155	180.3	8.3297
		1156 to 1430	185.8	8.548
Sodium cyanide	NaCN	800 to 1360	155.52	7.472
Sodium fluoride	NaF	1562 to 1701	218.2	8.640
Sodium hydroxide	NaOH	1010 to 1402	132	7.030
Sodium iodide	NaI	1063 to 1307	165.1	8.371
Stannic chloride	$SnCl_4$	−52 to −38	46.74	9.824
Stannic hydride	SnH_4	−148 to −49	19.14	7.400
Strontium	Sr	940 to 1140	360	16.056
Sulfur chloride	S_2Cl_2	0 to 138	35.99	7.455
Sulfur dioxide	SO_2	−95 to −75	35.827	10.5916
Sulfur trioxide	SO_3	24 to 48	43.45	10.022
Thallium	Tl	950 to 1200	120	6.140
Thallium bromide	TlBr	634 to 817	105.4	7.940
Thallium chloride	TlCl	665 to 807	105.2	7.974
Thallium fluoride	TlF	282 to 298	105	12.52
Thallium iodide	TlI	693 to 822	105.4	7.902
Tin	Sn	1950 to 2270	328	9.643
Toluene	$C_6H_5CH_3$	−92 to +15	39.193	8.330
Tungsten	W	2230 to 2770	897	9.920

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Name	Formula	Range, °C.	A	B
Uranium hexafluoride	UF_6	0 to 69	41.73	9.521
Zinc	Zn	250 to 419.4	133	9.200
		600 to 985	118	8.108

VAPOR PRESSURES OF VARIOUS SUBSTANCES

In the table below, the vapor pressures are given in millimeters of mercury or in atmospheres (1 atmosphere 760 mm Hg) as indicated. Data on some compounds which are not listed in this table may be found in the International Critical Tables, vol. 3, pp 199-246 and in the Landolt-Bornstein Physikalisch-Chemische Tabellen, 5th ed., vol. 2 pp 1332-1381.

The following abbreviations are used: c.p., critical point; t.p., triple point; m.p., melting point.

See also special tables for mercury, ammonia, and water.

Acetic Acid CH_3CO_2H

t°C.	mm of Hg
20	11.7
30	20.6
40	34.8
50	56.6
60	88.9
62.5	100
70	136
72.3	150
80	202.3
85.5	250
90	293.7
95.1	350
100	417.1
105.4	500
110	580.8
118	760
120	794
130	1067.6
140	1414

Acetone CH_3COCH_3

t°C.	mm of Hg
−90	0.021
−70	0.34
−50	2.4
−30	11.2
−10	38.7
+ 5	89.1
10	115.6
15	147.1
20	184.8
25	229.2
30	282.7
35	346.4
40	421.5
45	510.5
50	612.6
56.30	760
60	860.6

Acetone (Cont.)

t°C.	mm of Hg
70	1190
80	1611
90	2142
100	2797
110	3594
120	4547
130	5670
140	6974

Acetylene C_2H_2

t°C.	mm of Hg
−143.2	1
−140.6	2.5
−134.6	6
−126.1	15
−119.9	30
−115.1	50
−108.2	100
−104.0	150
−100.6	200
− 95.8	300
− 92.3	400
− 89.5	500
− 87.0	600
− 85.9	650
− 85.1	700
− 84.5	730
− 84.0	760

Ammonia NH_3
See Special Table

Ammonium Chloride NH_4Cl

t°C.	mm of Hg
250	49.5
270	97.5
290	185.3
310	341.3
330	610.6
337.8	760.0

Ammonium Chloride (Cont.)

t°C.	p in atm
340	1.062
350	1.40
387	3
427	6
459	11
490	20
520	34.5

Aniline $C_6H_5NH_2$

t°C.	mm of Hg
50	2.4
60	5.7
70	10.6
80	18.0
90	29.2
100	45.7
110	69.2
120	96.6
130	144.5
140	204.0
146.5	250
152.1	300
157.0	350
161.4	400
165.3	450
169.3	500
172.5	550
175.6	600
178.5	650
181.2	700
184.3	760

Antimony Sb

t°C.	mm of Hg
1075	54
1175	206
1265	403
1325	745
1440	760

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Argon A

t°C.	mm of Hg
−205.3	38.3
−200	84.56
−195.6	208.8
−189.3	515.6 (m.p.)
−186.1	672.7
−185.9	760.0
−185.3	802.0
−183.0	1015.3
	p in atm
−161.2	7.43
−140.8	22.185
−135.1	29.0
−129.8	35.85
−125.5	42.46
−122.4	48.00 (c.p.)

Arsenic As

t°C.	mm of Hg
400	6
470	28
500	61
526	130
568.9	334.1

Benzene C_6H_6

t°C.	mm of Hg
−20	5.79
−10	14.83
0	26.54
+10	45.43
20	74.66
30	118.24
40	181.08
50	268.97
60	388.58
70	547.40
80	753.62
90	1016.1
100	1344.3
110	1748.2
120	2238.1
130	2824.9
140	3520.0
150	4334.8
160	5281.9
170	6374.1
180	7625.2
190	9049.4
	p in atm
200	14.03
220	19.11
240	25.49
260	33.39
280	43.12
284.3	45.52
288.5	47.91 (c.p.)

Benzoic Acid $C_6H_5CO_2H$

t°C.	mm of Hg
60	0.11
70	0.16
80	0.30
90	0.60
100	1.40
110	3.74
140	14.6
150	23.6
160	36.3
170	55.8
180	81.6
190	119.1
200	171.3
210	239
220	331.5
230	451
240	597
250	780

Benzonitrile C_6H_5CN

t°C.	mm of Hg
38.4	1
56.9	5
60	6.3
70	10.5
77.1	15
80	17.0
83.0	20
88.0	25
90	27.2
92.1	30
95.5	35
98.5	40
100	42.7
103.9	50
110	65
113.7	75
120	94.2
121.3	100
130	135.5
132.8	150
140	187.3
141.4	200
148.6	250
150	254.7
155.3	300
160	338.8
165.8	400
170	445.7
174.4	500
178.1	550
180	582.1
184.8	650
187.7	700
190	748.2
190.6	760

Benzophenone $(C_6H_5)_2CO$

t°C.	mm of Hg
257.2	250
260.1	270
262.9	290
265.6	310
268.2	330
270.7	350
273.0	370
275.2	390
277.4	410
279.4	430
281.4	450
283.3	470
285.1	490
286.9	510
288.6	530
290.3	550
291.9	570
293.5	590
295.0	610
296.5	630
298.0	650
299.4	670
300.8	690
302.2	710
303.5	730
304.2	740
304.8	750
305.4	760
306.1	770
306.7	780
307.3	790
307.9	800

Benzoyl Chloride C_6H_5COCl

t°C.	mm of Hg
38.6	1
40	1.1
46.8	2
50	2.4
56.7	4
60	4.8
70	8.2
73.8	10
80	13.6
82.1	15
88.2	20
90	21.8
93.1	25
97.2	30
100	33.9
106.7	45
110	51.4
120	75.1
128.0	100
130	107.8
140	152.0

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Benzoyl Chloride (Cont.)

t°C.	mm of Hg
148.9	200
156.2	250
162.5	300
167.7	350
172.7	400
177.0	450
180.9	500
184.5	550
187.8	600
191.0	650
193.8	700
197.1	760

Benzyl Alcohol $C_6H_5CH_2OH$

t°C.	mm of Hg
60.9	1
67.8	2
72.9	3
77.2	4
80.8	5
92.6	10
99.9	15
105.3	20
109.7	25
113.4	30
116.7	35
119.6	40
122.2	45
124.4	50
133.9	75
141.3	100
152.1	150
160.8	200
167.1	250
172.6	300
177.7	350
182.0	400
185.7	450
189.0	500
192.6	550
195.6	600
198.9	650
201.7	700
205.0	760

Bismuth

t°C.	mm of Hg
1200	102
1290	126
1310	257
1385	300
1490	760
	p in atm
1740	6.3
1950	11.7
2060	16.5

Boron Trichloride BCl_3

t°C.	mm of Hg
−80	4
−60	18
−40	67
−20	197
0	477
+12.4	753
20	807.5
40	1535.2
60	2658.5
80	4248.3

Bromine Br_2

t°C.	mm of Hg
−95	0.0022
−90	0.0052
−85	0.0117
−80	0.0251
−75	0.0513
−70	0.102
−65	0.192
−60	0.357
−55	0.628
−50	1.09
−45	1.83
−40	2.98
−35	4.77
−30	7.45
−25	11.4
−20	17.1
−15	25.2
−10	36.6
− 7.3	44.4 (m.p.)
− 5	50.5
0	65.9
+ 5	85.3
10	109
15	138
20	173
25	214
30	264
35	324
40	392
45	472
50	564
55	670
58.78	760
60	793

Bromobenzene C_6H_5Br

t°C.	mm of Hg
30	5.67
40	9.99
50	16.96
60	27.61
70	43.55
80	66.22

Bromobenzene C_6H_5Br (Cont.)

t°C.	mm of Hg
90	97.72
100	141.1
110	198.7
120	274.9
130	372.7
140	495.8
150	649.1
156.15	760
160	846.0
170	1077
180	1351
190	1685
200	2075
210	2525
220	3055
230	3660
240	4360
250	5160
260	6080
270	7105
397	33900 (c.p.)

α-Bromonaphthalene $C_{10}H_7Br$

t°C.	mm of Hg
110	3.55
120	5.55
130	8.5
140	12.8
150	18.9
160	27.4
180	54.95
200	102.4
220	178.7
230	232.6
240	300.3
250	381.5
260	482.0
270	604.0
280	743.0
281.1	760

n-Butane C_4H_{10}

t°C.	mm of Hg
−99.9	1
−93.2	3
−75.6	15
−58.3	50
−47.5	100
−34.6	200
−25.3	300
−18.1	400
−12.3	500
− 7.2	600
− 2.8	700
− 0.3	760

VAPOR PRESSURES OF VARIOUS SUBSTANCES

n-Butyric Acid $C_3H_7CO_2H$	
t°C.	mm of Hg
10	0.36
20	0.76
30	1.5
40	3.0
50	5.4
60	9.8
70	17.0
80	28.6
90	46.6
100	73.8
110	114.0
120	171.3
130	251.6
140	361.4
150	508.5
160	701.2
162.4	760

Camphor $C_{10}H_{16}O$	
t°C.	mm of Hg
18.9	0.46
23.4	0.55
28.4	0.94
30.8	1.04
40.2	1.70
52.5	2.72
55.0	3.12
62.0	4.22
66.6	5.61
78.0	6.4
92.4	15.4
101.0	27.2
109.4	35.0
116.7	46.0
127.4	66.3
134.2	88.6
136.3	92.8
140.3	105.0
141.7	109.4
147.0	155.1
154.3	197.6
157.9	218.5
160.1	240.7
168.0	297.8
176.7	350.6
178.9	370.3
180.3	385.9
182.0	400.8
182.6	405.3
184.5	421.1
194.8	555.2
198.7	593.2
201.8	646.1
206.7	731.0
207.3	746.3
208.25	760

Carbon C (Graphite)	
t°C.	*p* in atm
3752	0.40
3844	0.68
3917	1.00
4090	2.00
4249	4.00
4422	8.00

Carbon Dioxide CO_2	
t°C.	mm of Hg
−168.8	0.0006
−163.2	0.00282
−148.3	0.0882
−134.7	1.073
−127.2	3.50
−117.8	13.09
−109.7	35.7
−103.0	76.7
− 95.9	158.7
− 87.9	338.5
− 80.8	630.3
− 80.0	669.9
− 79.1	724.3
− 78.5	760
	p in atm
− 70.0	1.88
− 60.0	3.95
− 56.6	5.115(m.p.)
− 56	5.249
− 54	5.716
− 52	6.214
− 50	6.745
− 48	7.309
− 46	7.908
− 44	8.543
− 42	9.215
− 40	9.925
− 38	10.675
− 36	11.466
− 34	12.299
− 32	13.176
− 30	14.099
− 28	15.067
− 26	16.084
− 24	17.150
− 22	18.267
− 20	19.437
− 18	20.661
− 16	21.940
− 14	23.277
− 12	24.673
− 10	26.129
− 8	27.648
− 6	29.231
− 4	30.879
− 2	32.595
0	34.379

Carbon Dioxide (Cont.)	
t°C.	*p* in atm
+ 2	36.235
4	38.163
6	40.166
8	42.247
10	44.406
12	46.648
14	48.974
16	51.388
18	53.895
20	56.495
22	59.197
24	62.006
26	64.928
28	67.971
30	71.143
31.1	72.947(c.p.)

Carbon Disulfide CS_2	
t°C.	mm of Hg
−78.19	0.68
−42.59	11.81
−25.35	34.3
−21.52	42.69
0	127.0
+11.54	211.3
19.67	294.27
46.25	760.0
	p in atm
50	1.13
60	1.54
70	2.05
80	2.69
90	3.47
100	4.42
110	5.55
120	6.90
130	8.47
140	10.3
150	12.4
160	14.9
170	17.6
180	20.8
190	24.3
200	28.3
210	32.8
220	37.8
230	43.4
240	49.6
250	56.5
260	64.1
270	72.5
273	75(c. p.)

Carbon Monoxide CO	
t°C.	mm of Hg
−220.6	4

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Carbon Monoxide CO (Cont.)

t°C.	mm of Hg
−207	100
−205	114
−191	760
	p in atm
−180	3.2
−170	6.7
−160	12.4
−150	20.9
−140	33.2
−139	35 (c.p.)

Carbon Tetrachloride CCl_4

t°C.	mm of Hg
−69.7	0.145
−65.3	0.224
−59.6	0.384
−56.8	0.504
−54.8	0.595
−50.1	0.925
−40	2.208
−30	4.745
−20	9.708
−10	18.47
0	32.95
+10	55.97
20	90.99
25	114.5
30	143.0
35	176.2
40	215.8
45	262.5
50	317.1
55	379.3
60	450.8
65	530.9
70	622.3
76.75	760
80	843
90	1122
100	1463
	p in atm
110	2.483
120	3.149
130	3.904
140	4.880
150	5.994
160	7.288
170	8.738
180	10.39
190	12.25
200	14.39
210	16.79
220	19.47
230	22.44
240	25.83

Carbon Tetrachloride (Cont.)

t°C.	p in atm
250	29.49
260	33.59
270	38.15
280	43.16
283.15	45 (c.p.)

Cesium Cs

t°C.	mm of Hg
244	0.29
249.5	0.31
272	0.99
278.4	1.01
315	3.18
350	6.72
397	15.88
670	760

Cesium Chloride CsCl

t°C.	mm of Hg
1062	87.8
1078	95
1150	223
1180	271
1260	535.4
1295	760

Chlorine Cl_2

t°C.	mm of Hg
−153.9	0.0015
−147	0.0067
−126.5	0.26
−112	2.64
−103.1	8.9 (m.p.)
−100	11.8
− 95.5	17.4
− 90	27.8
− 80	58.7
− 75	82
− 70	115
− 60	211
− 55	278
− 50	363
− 40	594
− 34.6	760
	p in atm
− 30	1.23
− 20	1.84
− 10	2.63
0	3.66
+ 10	4.95
20	6.62
30	8.75
50	14.70
70	23.00
90	34.50
110	50.80

Chlorine Cl_2 (Cont.)

t°C.	p in atm
130	71.60
146	93.50 (c.p.)

Chorobenzene C_6H_5Cl

t°C.	mm of Hg
−35	0.169
−15	0.885
0	2.52
+10	4.86
20	8.76
30	15.45
40	26.00
50	41.98
60	65.54
70	97.90
80	144.75
90	208.35
100	292.75
110	402.55
120	542.80
130	718.95
132	760
140	939.4
150	1206
160	1534
170	1913
180	2367
190	2899
200	3518
210	4233
220	5054
230	5992
240	7060
250	8271
270	11185
280	12925
359.2	33926 (c.p.)

Chloroform $CHCl_3$

t°C.	mm of Hg
−60	0.81
−50	2.06
−40	4.7
−30	10.0
−20	19.6
−10	34.75
0	61.0
+10	100.5
20	159.6
25	199.1
30	246.0
35	301.3
40	366.4
45	439.0
50	526.0
55	625.2

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Chloroform (Cont.)

t°C.	mm of Hg
60	739.6
61.2	760
70	1019
80	1403
100	2429
120	3926
140	6000
160	8734

Chloropicrin CCl_3NO_2

t°C.	mm of Hg
−20	1.50
−19	1.70
−18	1.90
−10	3.0
0	5.71
+10	10.37
15	13.82
20	18.31
25	23.81
30	31.10
35	40.14

Copper Cu

t°C.	mm of Hg
1875	20
1980	100
2175	209
2215	300
2300	752
2310	760

o-Cresol C_7H_8O

t°C.	mm of Hg
36.6	1
50	1.87
57.3	3
60	3.55
65.5	5
70	6.5
77.6	10
80	11.5
85.0	15
90	19.4
95.1	25
100	31.6
105.2	40
110	49.2
120	74.1
127.4	100
130	109.4
138.4	150
140	158.1
146.7	200
150	222.9
153.5	250

o-Cresol (Cont.)

t°C.	mm of Hg
160	308.3
164.2	350
170	421.2
175.8	500
180	566.9
182.0	600
184.8	650
187.5	700
190.1	760

m-Cresol C_7H_8O

t°C.	mm of Hg
55.9	1
60	1.76
62.8	2
68.4	3
70	3.4
76.0	5
80	6.37
87.8	10
90	11.3
95.7	15
100	19.05
105.7	25
110	31.0
115.9	40
120	48.6
130	72.5
138.0	100
140	106.9
149.0	150
150	154.2
157.3	200
160	219.3
164.1	250
170	302.7
174.8	350
180	411.2
182.9	450
186.3	500
190	549.6
192.5	600
195.3	650
198.0	700
200.5	760

p-Cresol C_7H_8O

t°C.	mm of Hg
55.7	1
60	1.7
64.4	2
70	3.3
73.3	4
76.5	5
80	6.17
88.6	10

p-Cresol (Cont.)

t°C.	mm of Hg
90	10.8
96.2	15
100	18.3
106.2	25
110	30.1
113.4	35
116.4	40
120	47.4
121.3	50
130	71.0
138.4	100
140	105.0
149.4	150
150	152.1
157.7	200
160	216.8
164.5	250
170	300.0
175.2	350
180	407.4
183.4	450
186.8	500
190	548.3
193.0	600
195.8	650
198.5	700
201.1	760

Cyanogen Chloride CNCl

t°C.	mm of Hg
−30	68.3
−20	148.2
−10	270.5
− 7.04	..... (m.p.)
− 5	350.2
0	444.1
+20	1001.9
40	1988
60	3664
75	5595

Cyclohexane C_6H_{12}

t°C.	mm of Hg
0	27.55
10	47.05
20	76.9
30	121.3
40	181.7
50	269.2
60	385.0
70	540.8
80	741.3
90	992
100	1304
110	1687

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Cyclohexane (Cont.)

t°C.	mm of Hg
120	2152
130	2703
140	3362
150	4123
160	5028
170	6041
180	7194
190	8482
200	9977
	p in atm
210	15.33
220	17.77
230	20.53
240	23.65
250	27.01
270	35.09
280	39.82 (c.p.)

Cymene $C_{10}H_{14}$

t°C.	mm of Hg
0	4.65
10	5.2
20	6.3
30	8.15
40	10.95
50	15.15
60	21.4
70	30.45
80	43.55
90	62.1
100	87.85
110	122.85
120	169.25
130	229.45
140	304.65
150	398.0
160	519.6
170	672.7
175	760

Decane $C_{10}H_{22}$

t°C.	mm of Hg
0	0.6
5	0.9
10	1.3
15	1.9
20	2.7
25	3.8
30	5.0
35	6.7
40	8.9
45	11.7
50	15.2
55	19.5
60	24.7
65	31.1

Decane (Cont.)

t°C.	mm of Hg
70	38.8
75	48.0
80	59.0
85	71.9
90	87.3
95	105.1
100	125.9
105	150.1
110	178.0
115	210.1
120	247.0
125	289.0
130	336.9
140	453.2
150	601.7
160	789.8

Diethylaniline $C_{10}H_{15}N$

t°C.	mm of Hg
50	1.6
60	2.7
70	4.2
80	6.8
90	10.0
100	16.2
107.2	20
110	25.1
116.4	30
120	38.2
126.0	45
130	56.2
140	80.6
147.3	100
150	113.5
160	158.0
168.2	200
170	216.0
175.3	250
180	291.7
187.0	350
190	386.9
195.6	450
200	504.0
202.8	550
206.0	600
210	651.0
212.4	700
215.5	760
220	837.0

Dimethylaniline $C_8H_{11}N$

t°C.	mm of Hg
40	2.5
50	4.1
60	6.8
70	10.0

Dimethylaniline (Cont.)

t°C.	mm of Hg
80	15.4
87.5	20
90	24.3
96.3	30
100	37.9
105.6	45
110	56.8
118.3	75
120	81.8
125.7	100
130	116.2
137.1	150
140	163.9
146.0	200
150	227.1
153.4	250
160	307.0
164.5	350
170	408.1
173.6	450
177.4	500
180	536.0
183.9	600
187.0	650
190	695.4
193.1	760
195	787.5

Ethane C_2H_6

t°C.	mm of Hg
−159.7	1
−149.5	4
−140	14.1
−130	39.5
−128.2	50
−120	94.7
−110	202.8
−105.1	300
−102.4	354
−100	393.8
−96.9	500
−94	546
−90	705.2
−88.63	760
−80	1182
−75	1499
	p in atm
−70	2.58
−65	3.10
−60	3.79
−55	4.61
−50	5.60
−45	6.67
−40	7.80
−35	9.05

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Ethane (Cont.)

t°C.	p in atm
−30	10.5
−25	12.2
−20	14.05
−15	16.0
−10	18.2
− 5	20.7
0	23.6
+15	32.3
34.5	50 (c.p.)

Ethyl Acetate $CH_3CO_2C_2H_5$

t°C.	mm of Hg
−20	6.55
−10	12.95
0	24.3
+10	42.7
20	72.8
30	118.7
40	186.2
50	282.2
60	415.4
70	596.3
77.15	760
80	832.7
90	1130
100	1515
110	1995
120	2585
130	3300
140	4164
150	5176
160	6368
170	7736
180	9322
	p in atm
190	14.64
200	17.34
210	20.47
220	24.03
230	28.11
240	32.71
250	37.86 (c.p.)

Ethyl Alcohol C_2H_5OH

t°C.	mm of Hg
−65	0.021
−60	0.045
−55	0.087
−50	0.12
−45	0.24
−40	0.39
−35	0.63
−30	1.04
−25	1.63
−20	2.5
−15	3.65

Ethyl Alcohol (Cont.)

t°C.	mm of Hg
−10	5.6
− 5	8.3
0	12.2
+ 5	17.3
10	23.6
15	32.2
20	43.9
25	59.0
30	78.8
35	103.7
40	135.3
45	174.0
50	222.2
55	280.6
60	352.7
65	448.8
70	542.5
75	666.1
78.32	760
80	812.6
85	986.3
	p in atm
90	1.562
100	2.228
110	3.107
120	4.243
130	5.685
140	7.486
150	9.700
160	12.39
170	15.61
180	19.44
190	23.94
200	29.20
210	35.31
220	42.38
230	50.53
240	59.92
243.1	63.11 (c.p.)

Ethylaniline $C_6H_5NHC_2H_5$

t°C.	mm of Hg
40	1.1
50	2.4
60	4.0
70	6.1
80	10.0
90	16.0
100	24.0
110	36.4
120	54.5
130	79.0
140	112.0
150	158.0
160	218.8
170	296.0

Ethylaniline (Cont.)

t°C.	mm of Hg
180	394.2
190	518.0
200	674.4
204.7	760
210	867

Ethylbenzene $C_6H_5C_2H_5$

t°C.	mm of Hg
0	5.9
10	9.6
20	15.3
30	23.75
40	36.1
50	53.8
60	78.65
70	113.0
80	160.0
90	223.1
100	307.0
110	414.15
120	545.9
130	695.95
133.9	760

Ethyl Bromide C_2H_5Br

t°C.	mm of Hg
−20	59.2
−10	101.5
0	165.6
+10	257.4
20	387.0
30	564.5
38.4	760
40	801.9
50	1113
60	1512
70	2015
80	2639
90	3399
100	4312
110	5394
120	6658
130	8116
140	9780

Ethyl Chloride C_2H_5Cl

t°C.	mm of Hg
−30	110.2
−20	187.6
−10	302.1
0	465.2
+10	691.1
12.7	760
20	996.2
30	139.9
40	1920

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Ethyl Chloride (Cont.)

t°C.	mm of Hg
50	2579
60	3401
70	4405
80	5614
90	7048
100	8723

Ethylene C_2H_4

t°C.	mm of Hg
−150	14.9
−145	26.7
−140	45.6
−135	74.4
−130	117.2
−125	177.8
−120	260.5
−115	371.9
−110	518.8
−105	705.1
−103.9	760
	p in atm
−100	1.24
− 90	2.10
− 80	3.35
− 70	5.07
− 60	7.38
− 50	10.4
− 40	14.2
− 30	18.9
− 20	24.8
− 10	31.9
0	40.6
+ 9.6	50.6 (c.p.)

Ethyl Ether $(C_2H_5)_2O$

t°C.	mm of Hg
−100	0.05
− 80	0.6
− 60	4.1
− 53.5	7.01
− 44.2	14.17
− 40	19.0
− 32.4	31.93
− 30	37.6
− 10	112.3
0	185.3
+ 5	233.2
− 10	291.7
15	360.7
20	442.2
25	537.0
30	647.3
34.6	760
35	775.5
40	921.3
45	1090

Ethyl Ether (Cont.)

t°C.	*p* in atm
50	1.680
60	2.275
70	3.021
80	3.939
90	5.054
100	6.394
110	7.987
120	9.861
130	12.05
140	14.58
150	17.48
160	20.80
170	24.57
180	28.81
185	31.12
190	33.57
193.8	35.52 (c.p.)

Ethyl Formate $HCO_2C_2H_5$

t°C.	mm of Hg
−20	22.5
−10	41.5
0	72.4
+10	120.3
20	192.5
30	297.5
40	446.7
50	649.4
54.35	760
	p in atm
60	1.208
70	1.667
80	2.251
90	2.983
100	3.883
110	4.978
120	6.290
130	7.846
140	9.674
150	11.80
160	14.26
170	17.07
180	20.28
190	23.91
200	28.00
210	32.59
220	37.70
225	40.47
230	43.39
235.3	46.65 (c.p.)

Ethyl Propionate $C_2H_5CO_2C_2H_5$

t°C.	mm of Hg
−10	4.05
0	8.30

Ethyl Propionate (Cont.)

t°C.	mm of Hg
+10	15.55
20	27.75
30	47.75
40	77.9
50	123
60	188
70	280
80	403.6
90	569.5
99.1	760
	p in atm
100	1.027
110	1.383
120	1.828
130	2.376
140	3.042
150	3.840
160	4.788
170	5.904
180	7.206
190	8.727
200	10.45
210	12.45
220	14.73
230	17.33
240	20.28
250	23.62
260	27.40
265	29.48
270	31.69
272.9	33.03 (c.p.)

Formic Acid HCO_2H

t°C.	mm of Hg
10	18.9
20	33.1
30	52.2
40	82.6
50	125.9
60	189.7
70	279.6
80	398.1
90	552.1
100	753.4
100.5	760

Germanium Tetrachloride $GeCl_4$

t°C.	mm of Hg
10.4	0.073
30.0	0.151
50.0	0.33
70.7	0.67
86.0	1.00
185.0	7.00
215.0	15.0
276.9	38.0

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Glycol $C_2H_4(OH)_2$

t°C.	mm of Hg
120	39
130	62
136.7	83
140	96.8
150	147.9
160	218.8
170	316.2
173.2	357.3
180	446.2
186.5	544.3
190	615.9
197.0	760

Gold Au

t°C.	mm of Hg
2315	130
2450	296
2500	400
2610	760

Helium He

t°C.	mm of Hg
−271.655	4.15
−269.614	359.5
−268.925	757.5
−268.23	1329
−267.97	16680
−267.93	17180 (c.p.)

n-Heptane C_7H_{16}

t°C.	mm of Hg
0	11.45
10	20.5
20	35.5
30	58.35
40	92.05
50	140.9
60	208.9
70	302.3
30	426.6
90	588.8
98.42	760
100	795.2
110	1047
120	1367
130	1753
	p in atm
140	2.933
150	3.663
160	4.539
170	5.542
180	6.699
190	8.020
200	9.554
210	11.31
220	13.30

n-Heptane (Cont.)

t°C.	*p* in atm
230	15.54
240	18.14
250	21.03
260	24.30
266.85	26.88 (c.p.)

n-Hexane C_6H_{14}

t°C.	mm of Hg
−99	0.009
−83	0.050
−66.4	0.327
−56.3	0.880
−46.9	2.002
−30	6.95
−20	14.10
−10	25.90
0	46.3
+10	76.8
20	122.5
30	188.6
40	281.4
50	408.1
60	576.6
68.95	760
70	795.8
80	1062
90	1407
100	1836
110	2358
120	2982
130	3719
140	4606
150	5610
160	6795
170	8126
180	9650
	p in atm
190	14.99
200	17.57
210	20.50
220	23.82
230	27.57
234.8	29.62 (c.p.)

Hydrogen H_2

t°C.	mm of Hg
−259.14	51.4 (t.p.)
−258.93	61.8
−258.46	79.9
−257.99	100
−257.77	114.0
−257.21	149.7
−256.61	191.9
−256.19	232.5
−255.16	350.0
−254.73	397.6

Hydrogen (Cont.)

t°C.	mm of Hg
−252.92	728.8
−252.74	760.0
−252.45	823.7
	p in atm
−248.54	2.894
−245.91	4.877
−243.26	7.915
−240.53	11.75
−239.95	12.80 (c.p.)

Hydrogen Bromide HBr

t°C.	mm of Hg
−104.2	96
− 96.3	185
− 87.1	284
− 83.0	357
− 76.0	517
− 74.0	575
− 68.6	739
− 68.4	775
	p in atm
− 42.4	3.0
− 21	6.63
+ 5	17.04
36	30.01
70	59.15
84	75.9
90	84.44 (c.p.)

Hydrogen Chloride HCl

t°C.	mm of Hg
−117.6	75.6
−108.8	159.3
−100.5	289.9
− 90.69	545.5
− 87.12	674.1
− 85.03	760
	p in atm
− 73.3	1.80
− 70.0	2.03
− 55.0	4.26
− 36.1	8.53
− 35	8.73
− 20.0	14.35
0.0	25.94
+ 25	46.42
50	78.49
51.4	81.55 (c.p.)

Hydrogen Cyanide HCN

t°C.	*p* in atm
25.65	1.00
30	1.14
40	1.67
50	2.31
60	3.15

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Hydrogen Cyanide (Cont.)

t°C.	p in atm
70	4.20
80	5.52
90	7.16
100	9.16
110	11.6
120	14.5
130	18.0
140	22.1
150	27.0
160	32.7
170	39.3
180	47.1
183.5	50 (c.p.)

Hydrogen Iodide HI

t°C.	mm of Hg
−77.9	74
−68.4	126
−59.5	224
−49.2	450
−43.0	638
−39.5	743
	p in atm
−32.7	1.28
− 6.5	3.1
0	3.97
+ 5.5	4.49
56.5	16.43
100	37.68
138.6	68.34
150	80.8 (c.p.)

Hydrogen Selenide H_2Se

t°C.	p in atm
−42	1
+ 0.2	4.5
18	8.6
30.8	12
52	21.5
100	47.1
137	91.0

Hydrogen Sulfide H_2S

t°C.	mm of Hg
−84	193
−81.7	220
−75.1	353
−62.2	676
−59.5	760
	p in atm
−50	1.60
−40	2.50
−30	3.74
−20	5.39
−10	7.53
0	10.2

Hydrogen Sulfide (Cont.)

t°C.	p in atm
+10	13.6
20	17.7
30	22.6
40	28.3
50	35.1
60	43.0
70	52.1
80	62.6
90	74.5
100.4	88.9 (c.p.)

Iodine I

t°C.	mm of Hg
−50	0.0_437
−40	0.0_319
−30	0.0_380
−20	0.0030
−10	0.0099
0	0.0299
+10	0.0808
20	0.202
30	0.471
40	1.03
50	2.16
60	4.31
70	8.22
80	15.1
90	26.8
100	45.5
110	74.9
114.15	90.1 (m.p.)
115	92.9
120	111
130	157
140	217
150	294
160	394
170	521
180	679
184.35	760
190	869
553.4	... (c.p.)

Iodobenzene C_6H_5I

t°C.	mm of Hg
−30	0.0182
−20	0.0422
−10	0.0920
0	0.189
+10	0.369
+18	0.610
30	1.48
40	2.24
50	4.85
60	8.30
70	13.65

Iodobenzene (Cont.)

t°C.	mm of Hg
80	21.78
90	33.50
100	50.23
110	73.88
120	105.4
130	148.3
140	204.9
150	276.7
160	367.3
170	479.7
180	618.7
188.45	760.0
190	793.0
200	991.0
210	1232
220	1520
230	1855
240	2245
250	2700
260	3220
270	3815
448	33900 (c.p.)

Krypton Kr

t°C.	p in atm
−151.8	1.000
−150	1.175
−130	4.315
−110	11.32
− 90	24.27
− 70	41.12
− 62.6	54.24 (c.p.)

Lead Pb

t°C.	mm of Hg
808	0.08
996	1.75
1178	16.8
1275	73
1315	105
1365	166
1410	266
1415	289
1525	760
	p in atm
1870	6.3
2100	11.7

Lead Chloride $PbCl_2$

°C.	mm of Hg
400	0.00174
425	0.0058
450	0.0178
475	0.051
500	0.141
925	600
945	754

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Lithium Bromide LiBr

t°C.	mm of Hg
1010	55
1110	140
1114	148
1176	400
1265	763

Magnesium Mg

t°C.	mm of Hg
772	1
1070	760

Manganese Mn

t°C.	mm of Hg
1227	1
1900	760

Mercuric Bromide $HgBr_2$

t°C.	mm of Hg
110	0.18
140	1.33
170	6.30
200	24.1
206	29
229	73
230	78.2
255	174
260	199.9
266	255
290	411.8
320	761.2
331	947

Mercuric Chloride $HgCl_2$

t°C.	mm of Hg
60	0.003
90	0.05
120	0.38
150	2.37
180	9.80
195	20
200	23.8
231	82
260	235.5
280	447.0
283	481
286.1	505
302	723
308	821

Mercuric Iodide HgI_2

t°C.	mm of Hg
100	0.061
140	0.45
170	2.30
177	3
200	9.4

Mercuric Iodide (Cont.)

t°C.	mm of Hg
203	10
230	32.4
260	97.9
266	108
300	256.4
320	392.9
353.6	758
360.5	861

Mercurous Chloride Hg_2Cl_2

t°C.	mm of Hg
140	0.038
160	0.15
180	0.45
300	74.4
320	140.5
340	251.4
360	428.0
380	696.8
383.7	760.0

Mercury
(see special table)

Methane CH_4

t°C.	mm of Hg
−183.2	70
−182	92.6
−181	105.1
−180	118.9
−179	134.4
−178	151.1
−177	169.6
−176	190.0
−175	212.1
−174	236.1
−173	262.0
−172	290.0
−171	320.4
−170	353.2
−169	388.8
−168	427.2
−167	468.2
−166	512.3
−165	559.3
−164	609.6
−163	663.8
−162	722.4
−161.5	760
−161	783
−160	848
−159	916
−158	988
−157	1064
−156	1145
−154	1318
−152	1510

Methane (Cont.)

t°C.	p in atm
−150	2.35
−140	4.38
−130	7.45
−120	11.84
−110	17.83
−100	25.7
−90	35.9
−82.1	45.8 (c.p.)

Methyl Acetate $CH_3CO_2CH_3$

t°C.	mm of Hg
−20	19
−10	35.1
0	62.1
+10	104.8
20	169.8
30	265.8
40	400.4
50	588.2
57.1	760
60	837.5
70	1.537
80	2.092
90	2.791
100	3.659
110	4.719
120	5.998
130	7.523
140	9.325
150	11.43
160	13.88
170	16.71
180	19.95
190	23.64
200	27.84
210	32.56
220	37.92
230	43.92
233.7	46.31 (c.p.)

Methyl Alcohol CH_3OH

t°C.	mm of Hg
−67.4	0.102
−60.4	0.212
−54.5	0.379
−48.1	0.702
−44.4	0.986
−10	15.5
0	29.6
+10	54.7
20	96.0
30	160
40	260.5
50	406
60	625
64.7	760

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Methyl Alcohol (Cont.)

t°C.	p in atm
70	1.22
80	1.764
90	2.494
100	3.452
110	4.688
120	6.255
130	8.213
140	10.63
150	13.57
160	17.11
170	21.34
180	26.35
190	32.23
200	39.08
210	47.03
220	56.18
225	61.25
230	66.67
235	72.47
240.0	78.67 (c.p.)

Methylamine CH_3NH_2

t°C.	p in atm
−7.55	0.947
−6.6	1.000
0	1.33
+10	2.00
20	2.92
30	4.16
40	5.93
50	7.70
60	10.15
70	13.12
80	16.7
90	20.9
100	25.9
110	31.9
120	38.5
130	46.3
140	55.1
150	65.5
156.9	73.6 (c.p.)

Methylaniline $C_6H_5NHCH_3$

t°C.	mm of Hg
40	1.0
50	2.5
60	4.4
70	7.5
80	12.1
90	19.6
100	31.5
110	49.3
120	72.8
130	104.0
140	147.6

Methylaniline (Cont.)

t°C.	mm of Hg
150	207.1
160	286.0
170	380.9
180	502.6
190	654.5
195.7	760.0
200	843.5

Methyl n-Butyrate $C_3H_7CO_2CH_3$

t°C.	mm of Hg
−10	3.55
0	7.3
+10	13.8
20	24.55
30	41.95
40	69.2
50	109.7
60	167.5
70	250.3
80	361.4
90	507.0
100	700.7
102.7	760
110	941.0
120	1247
130	1624

t°C.	p in atm
140	2.749
160	4.378
180	6.603
200	9.587
220	13.53
240	18.67
260	25.18
270	29.36
280	33.62
281.2	34.21 (c.p.)

Methyl *iso*-Butyrate $C_3H_7CO_2CH_3$

t°C.	mm of Hg
−10	6.22
0	12.15
+10	22.4
20	38.9
30	65.45
40	104.7
50	162.0
60	243.8
70	355.2
80	505.0
90	707.0
92.2	760
100	956.0
110	1269
120	1660

Methyl *iso*-Butyrate (Cont.)

t°C.	p in atm
130	2.820
140	3.591
150	4.500
160	5.580
170	6.826
180	8.264
190	9.924
200	11.85
210	14.05
220	16.53
230	19.37
240	22.61
250	26.25
260	30.42
267.55	33.86 (c.p.)

Methyl Chloride CH_3Cl

t°C.	p in atm
−47.29	0.3173
−39.28	0.4869
−30	0.762
−23.47	1.000
−20	1.16
−10	1.72
0	2.49
+10	3.50
20	4.82
30	6.50
35	7.50
40	8.75
50	11.20
60	14.30
70	18.87
80	22.15
90	27.65
100	33.90
110	41.00
130.1	52.60
143.1	65.8 (c.p.)

Methyl Ether $(CH_3)_2O$

t°C.	p in atm
−30	0.759
−25	0.942
−23.7	1.000
−20	1.17
−10	1.74
0	2.54
+10	3.59
20	4.95
30	6.62
40	8.69
50	11.25
60	14.27
70	17.90
80	22.10

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Methyl Ether (Cont.)

t°C.	p in atm
90	26.9
100	32.6
110	39.0
115	42.5
120	46.3
125	50.3
126.9	52.0 (c.p.)

Methyl Ethyl Ether $CH_3OC_2H_5$

t°C.	p in atm
7.5	1.000
10	1.10
20	1.61
30	2.29
40	3.14
50	4.24
60	5.56
70	7.21
80	9.16
90	11.4
100	14.2
110	17.3
120	20.9
130	25.0
140	29.6
150	34.7
160	40.5
164.7	43.4 (c.p.)

Methyl Formate HCO_2CH_3

t°C.	mm of Hg
−20	67.7
−10	117.6
0	195.0
+10	309.4
20	476.4
30	707.9
31.75	760
40	1029
50	1451
	p in atm
60	2.608
70	3.500
80	4.610
90	5.969
100	7.614
110	9.582
120	11.91
130	14.64
140	17.83
150	21.46
160	25.64
170	30.40
180	35.76
190	41.78

Methyl Formate (Cont.)

t°C.	p in atm
200	48.50
210	55.95
214.0	59.15 (c.p.)

Methyl Propionate $C_2H_5CO_2CH_3$

t°C.	mm of Hg
−20	5.6
−10	11.5
0	21.9
+10	38.8
20	66.2
30	107.8
40	169.3
50	256.7
60	380.3
70	548.0
79.75	760
80	771
90	1048
100	1408
	p in atm
110	2.440
120	3.165
130	4.043
140	5.096
150	6.345
160	7.812
170	9.523
180	11.50
190	13.78
200	16.38
210	19.33
220	22.68
230	26.46
240	30.70
245	33.01
250	35.46
255	38.04
257.4	39.34 (c.p.)

Methyl Salicylate $HOC_6H_4CO_2CH_3$

t°C.	mm of Hg
175	215.1
180	249.4
185	287.8
190	330.9
195	378.9
200	432.4
205	491.7
210	557.5
215	630.2
220	710.2
222.9	760
225	798.1

Methyl Sulfide $(CH_3)_2S$

t°C.	mm of Hg
0	172
10	275.4
20	418.8
30	616.6
35.9	760
40	873
	p in atm
50	1.60
60	2.15
70	2.84
80	3.68
90	4.70
100	5.97
110	7.45
120	9.14
130	11.1
140	13.4
150	16.0
160	19.1
170	22.4
180	26.2
190	30.6
200	35.6
210	41.5
220	47.0
229.9	54.6 (c.p.)

Molybdenum Mo

t°C.	mm of Hg
1727	7.89×10^{-7}
1827	6.12×10^{-6}
1927	3.96×10^{-5}
2027	2.14×10^{-4}
2127	1.03×10^{-3}
2293	0.001

Naphthalene $C_{10}H_8$

t°C.	mm of Hg
0	0.006
5	0.010
10	0.021
15	0.035
20	0.054
25	0.082
30	0.133
35	0.210
40	0.320
45	0.518
50	0.815
55	1.26
60	1.83
65	2.65
70	3.95
75	5.43
80	7.4 (m.p.)
85	9.8

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Naphthalene (Cont.)	
t°C.	mm of Hg
90	12.6
95	15.5
100	18.5
110	27.3
120	40.2
130	61.9
140	87.37
145	103.0
150	121.0
155	141.8
160	165.5
165	192.4
170	222.7
175	256.9
180	295.2
185	337.9
190	385.5
195	438.2
200	496.5
205	560.8
210	631.6
212	661.8
214	693.1
216	725.3
218	759.3
220	794.2
222	830.3
224	867.8
226	906.6
228	946.7
230	988.2
235	1098
240	1218
245	1347
250	1487
255	1639
260	1802
265	1977
270	2166
275	2368
280	2585
290	3065
300	3613

α-Naphthol $C_{10}H_8O$	
t°C.	mm of Hg
110	1.7
120	2.8
130	4.6
140	7.4
150	11.5
160	17.9
170	25.8
180	37.5
190	53.5
200	74.7

α-Naphthol (Cont.)	
t°C.	mm of Hg
210	102.9
220	139.0
230	185.2
240	243.2
250	315.4
260	403.7
270	511.3
280	639.0
288	760
290	797.3
295	879.1

β-Naphthol $C_{10}H_8O$	
t°C.	mm of Hg
130	3.6
140	5.8
150	9.0
160	13.6
170	20.2
180	29.5
190	42.1
200	59.2
210	81.9
220	111.5
230	149.8
240	198.5
250	259.9
260	336.2
270	430.0
280	544.3
290	685.1
294.85	760
300	848.7

Neon Ne	
t°C.	mm of Hg
−257.48	2.4
−252.7	12.8
−248.71	323.5
−247.53	451.6
−246.70	605.2
−245.96	760
	p in atm
−243.73	1.888
−241.81	2.98
−236.86	7.970
−231.75	17.43
−228.70	26.05
−228.39	27.11 (c.p.)

Nitric Oxide NO	
t°C.	mm of Hg
−198.8	0.059
−190.6	0.460
−186.9	1.224
−176.5	18

Nitric Oxide (Cont.)	
t°C.	mm of Hg
−174.4	23
−160.6	168 (m.p.)
−157.3	356
−150.2	760
	p in atm
−125.9	9.8
−109.2	27.7
−96.3	55.6
−92.9	64.6 (c.p.)

Nitrogen N_2	
t°C.	mm of Hg
−216.13	21.8
−215.24	28.8
−213.18	46.95
−211.11	71.9
−210.90	96.4 (m.p.)
−208.62	120.9
−206.20	177.6
−202.16	329.4
−198.30	561.3
−197.27	631.3
−195.82	760.0
−193.95	938.6
−192.65	1086
	p in atm
−188.92	2.092
−186.92	2.507
−182.47	3.725
−173.62	7.370
−161.31	15.949
−155.51	21.82
−152.11	25.889
−147.17	33.46 (c.p.)

Nitrogen Dioxide NO_2	
t°C.	mm of Hg
−90	0.0051
−78	0.040
−60	0.500
−45.2	4.84
−36	12.7
−23	53
−15	102
−14	114
−10.8	146 (m.p.)
−10	151.6
0	257.5
+12.1	483
21.5	752
	p in atm
39.0	2.20
54.25	4.10
72.7	8.00
93.7	16.1
115.6	31.45
142.75	66.5

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Nitrogen Dioxide NO_2 (Cont.)

	p in atm
157.4	97.2
158.2	100(c.p.)

Nitrous Oxide N_2O

t°C.	mm of Hg
−144.1	1.2
−131.3	7
−117.2	50
− 99.5	300
− 90.6	660
− 90.1	700
− 88.7	760
	p in atm
− 60	5.05
− 34	13.19
0	30.75
+ 20	49.4
40	83.37

n-Octane C_8H_{18}

t°C.	mm of Hg
−35	0.17
−30	0.28
−20	0.64
−10	1.39
0	2.94
+10	5.62
20	10.45
30	18.40
40	30.85
50	49.35
60	77.55
70	117.9
80	174.8
90	253.4
100	353.6
110	481.9
120	646.4
125.8	760
130	859
140	1114
150	1425
160	1807
170	2255
180	2776
190	3382
200	4099
210	4927
220	5873
230	6948
240	8219
250	9612
	p in atm
260	14.72
270	17.08
280	19.76

n-Octane C_8H_{18} (Cont.)

	p in atm
290	22.54
296.2	24.70(c.p.)

Oxygen O_2

t°C.	mm of Hg
−215.73	2.68
−210.76	9.59
−209.97	11.52
−205.82	28.07
−204.56	36.11
−201.42	64.01
−200.39	75.7
−196.39	129.5
−195.54	162.15
−192.73	239.5
−192.05	263.2
−189.47	366.2
−187.61	457.6
−186.95	493.3
−183.95	687.8
−183.00	760.0
−182.44	807.18
	p in atm
−154.91	9.096
−149.29	12.506
−138.99	21.328
−135.96	24.528
−130.68	30.914
−125.32	38.571
−121.37	45.142
−118.86	49.713(c.p.)

Ozone O_3

t°C.	mm of Hg
−193.1	0.015
−183.1	0.17
−173.1	1.3
−163.1	6.87
−153.1	25.4
−143.1	74.6
−133.1	182.8
−123.1	387.7
−112.4	760
	p in atm
−5	67(c.p.)

Phenol C_6H_5OH

t°C.	mm of Hg
44.8	1
55.8	3
62.5	5
73.5	10
80.5	15
85.8	20
90.2	25
93.8	30

Phenol (Cont.)

t°C.	mm of Hg
97.0	35
99.8	40
102.3	45
104.7	50
113.7	75
120.2	100
131.0	150
139.0	200
145.5	250
151.0	300
155.8	350
160.0	400
163.8	450
167.0	500
170.1	550
173	600
176	650
179	700
181.4	760

Phosgene CCl_2O

t°C.	*p* in atm
7.95	1.00
10	1.08
20	1.55
30	2.17
40	2.97
50	3.99
60	5.25
70	6.81
80	8.68
90	10.94
100	13.6
110	16.7
120	20.3
130	24.4
140	29.1
150	34.4
160	40.4
170	47.0
180	54.4
182	56(c.p.)

Phosphine PH_3

t°C.	mm of Hg
−132.7	30.2
−115.15	135.3
−111.6	174.8
−95.86	481.7
−89.71	673.9
	p in atm
+25	38.5
35	46.5
45	57
51.3	64.5(c.p.)

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Phosphonium Bromide PH_4Br

t°C.	mm of Hg
−80	1
−50	3
−24	8
− 9.8	25
0	56
+ 7.5	101
19.0	222
19.8	266.8
34.3	602
38.8	794

Phosphonium Chloride PH_4Cl

t°C.	mm of Hg
−80	9.6
−60	62.0
−45	186.4
−40	284
−30	603
−20	1260
	p in atm
0	8.9
+12.8	17.4
18.2	22.6
22.8	32.0
28.2	48.7(m.p.)
30.0	50.2
40.3	60.5
50.1	75.0(c.p.)

Phosphorus P

t°C.	mm of Hg
(white)	
20	0.0253
30	0.0724
40	0.1221
44.1	0.173(m.p.)
69.92	0.823
100.11	3.66
119.85	8.60
150.0	27.20
200	110
210	152
252	410
280.5	760
	p in atm
331.8	2.47
355.7	3.88
504	23.2
550	33.0
581	41.1
(solid violet)	
308.5	0.07
379.5	0.35
433.5	1.49
486.5	5.46
522.5	11.61

Phosphorus P (Cont.)

t°C.	*p* in atm
578	34.35
589.5	43.1(m.p.)
593	44.2
608	49.0
634	58.6
695	82.2(c.p.)

Phosphorus Pentachloride PCl_5

t°C.	mm of Hg
98.08	31
101.4	37.58
108.31	60
122.2	133.4
126.1	158
136.7	266.1
143.68	347
157.63	608
162.58	748
166.89	915

Platinum Pt

t°C.	mm of Hg
1427	4.65×10^{-7}
1527	3.5×10^{-6}
1627	2.13×10^{-5}
1727	1.07×10^{-4}

Potassium K

t°C.	mm of Hg
162	0.001
249.5	0.05
268.8	0.11
317.3	0.57
344	1.0
364	1.86
398.6	4.01
758	760

Potassium Chloride KCl

t°C.	mm of Hg
1123	71
1202	130.7
1225	157
1279	256
1364	526
1414	756

Propane C_3H_8

t°C.	mm of Hg
−136.1	1
−124.2	3
−109.2	15
−93.3	50
−82.8	100
−71.1	200
−62.9	300

Propane (Cont.)

t°C.	mm of Hg
−57.7	400
−53.2	500
−49.4	600
−46.1	700
−44.1	760
	p in atm
−19	2.7
−15	3.1
−11	3.6
− 5	4.1
− 2	4.8
+ 1	5.1
5.5	5.9
12.5	7.1
22	9.0
53	17
85	35
102	48.5(c.p.)

n-Propyl Alcohol C_3H_7OH

t°C.	mm of Hg
−43.3	0.068
−38.2	0.134
−32.8	0.219
−29.7	0.295
−26.2	0.403
−23.1	0.549
−18.4	0.815
−15.7	1.036
−12.9	1.310
0	3.44
+10	7.26
20	14.5
30	27.6
40	50.2
50	87.2
55	113.6
60	147.0
65	186.8
70	239.0
75	301.0
80	376
85	466
90	574
95	697
97.19	760
100	842.5
105	1097
110	1206
115	1428
120	1683
130	2293
	p in atm
140	4.045
150	5.332
160	6.916

VAPOR PRESSURES OF VARIOUS SUBSTANCES

n-Propyl Alcohol (Cont.)

t°C.	p in atm
170	8.809
180	11.03
190	13.77
200	16.84
210	20.49
220	24.58
230	29.15
240	34.47
250	40.51
260	47.50
263.7	50.16 (c.p.)

n-Propylbenzene $C_6H_5C_3H_7$

t°C.	mm of Hg
0	6.25
10	7.7
20	10.0
30	13.55
40	18.8
50	26.6
60	38.0
70	54.4
80	77.65
90	110.05
100	154.4
110	213.6
120	291.0
130	389.6
140	511.9
150	659.1
156.28	760

Propyl Formate $HCO_2C_3H_7$

t°C.	mm of Hg
−10	11.4
0	21.4
+10	37.85
20	63.9
30	104.1
40	163.6
50	249.4
60	364.9
70	523.9
80	734.5
81.1	760
90	1003
100	1343
110	1772
120	2288
130	2914
140	3673
150	4560
160	5617
180	8175
	p in atm
200	15.16

Propyl Formate (Cont.)

t°C.	p in atm
220	20.88
230	24.24
240	28.23
250	32.60
260	37.43
264.85	40.06 (c.p.)

Quinoline C_9H_7N

t°C.	mm of Hg
80	3.1
90	5.2
100	8.5
110	13.4
120	20.7
130	31.0
140	45.3
150	65.3
160	91.4
170	127.0
180	172.4
190	230.4
200	303.4
210	394.2
220	505.7
222	530.8
224	556.9
226	584.0
228	612.1
230	641.3
232	671.6
234	703.1
236	735.7
237.2	760
238	769.5
240	804.6

Radon (Niton) Rn

t°C.	p in atm
−70.5	0.658
−61.8	1.000
−50	2.065
−38.6	2.64
−20	5.26
−10.3	6.59
+17.2	13.2
48.6	26.4
70	37.67
91.3	52.8
100	59.43
104.4	62.44 (c.p.)

Rubidium Rb

t°C.	mm of Hg
250	0.06
292	0.98
331.5	2.80

Rubidium Rb (Cont.)

t°C.	mm of Hg
366	5.82
698	760

Rubidium Bromide RbBr

t°C.	mm of Hg
1050	55
1100	94.9
1117	104
1147	140
1223	268.8
1295	545
1358	767.5
1365	785

Rubidium Chloride RbCl

t°C.	mm of Hg
1142	55
1162	130.1
1241	262.8
1300	390
1327	530.2
1395	758

Rubidium Iodide RbI

t°C.	mm of Hg
1035	66.2
1080	125.4
1144	221
1169	246.9
1261	522.0
1325	760

Selenium Se

t°C.	mm of Hg
193.6	0.00084
200	0.0015
205	0.0022
210	0.0032
215	0.0047
217.4	0.0055 (m.p.)
219	0.0059
238	0.0138
390	3.0
440	11.0
500	42.0
620	313
660	550
688	760
710	970

Selenium Dioxide SeO_2

t°C.	mm of Hg
70	12.5
72	13.43
112.5	21.28

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Selenium Dioxide (Cont.)

t°C.	mm of Hg
180.9	39.0
199	40.6
213.5	50.12
232	67.8
260	112.7
299	450,6
311	610.9
317	760.0
319.9	849.0

Silane SiH_4

t°C.	mm of Hg
−160	11
−150	41
−140	102
−130	230
−120	470
−115	630
−112	750

Silicon Si

t°C.	mm of Hg
719	0.001
1205	0.87
1219	1.0
1315	2.3
2620	760

Silicon Tetrachloride $SiCl_4$

t°C.	mm of Hg
−50	4
−40	7.5
−30	14
−20	26.5
−10	46.5
0	78.0
+10	125.9
20	195.9
30	294.5
40	429.1
50	607.5
56.8	760
60	837.2

Silver Ag

t°C.	mm of Hg
1178	0.144
1316	0.82
1435	3.9
1660	102
1758	200
1780	263
1940	744
1955	760

Sodium Na

t°C.	mm of Hg
238	0.001
350	0.08
355	0.12
397	0.26
441	1.0
473	2.01
500	3.59
540	7.90
565	12.41
882	760

Sodium Chloride NaCl

t°C.	mm of Hg
1156	50.3
1189	82.5
1298	206.9
1331	335
1346	385
1439	760

Stannic Chloride $SnCl_4$

t°C.	mm of Hg
−69.7	0.145
−65.3	0.224
−56.8	0.504
−50.1	0.925
−10	2.78
0	5.53
+10	10.33
20	18.58
30	31.3
40	50.82
60	122.2
80	256.7
90	360.5
100	496.0
120	895.4
	p in atm
150	2.49
200	6.77
250	11.55
280	22.96
318.7	37.92 (c.p.)

Strontium Sr

t°C.	mm of Hg
713.4	0.001
899	1
1154	760

Sulfur S

t°C.	mm of Hg
50	0.0002
60	0.0004
70	0.0010
80	0.0023

Sulfur S (Cont.)

t°C.	mm of Hg
90	0.0049
100	0.010
110	0.021
114.5	0.028 (m.p.)
120	0.040
130	0.074
140	0.13
150	0.22
160	0.37
170	0.59
180	0.91
190	1.4
200	2.1
210	3.1
220	4.4
230	6.3
240	8.7
250	12
260	16
270	21
280	28
290	37
300	48
310	60
320	76
330	95
340	118
350	146
360	179
370	218
380	263
390	325
400	376
410	446
420	525
430	613
440	711
444.6	760
450	821
460	948
470	1093
480	1257
490	1441
500	1647
510	1876
520	2130
530	2410
540	2718
550	3055
560	3423
570	3824
1040	.... (c.p.)

Sulfur Dioxide SO_2

t°C.	*p* in atm
−72.5	0.02145

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Sulfur Dioxide (Cont.)

t°C.	p in atm
−70	0.02635
−68	0.03095
−66	0.03623
−64	0.04227
−62	0.04916
−60	0.05699
−58	0.06586
−56	0.07589
−54	0.08719
−52	0.09989
−50	0.11411
−48	0.1300
−46	0.1477
−44	0.1674
−42	0.1893
−40	0.2135
−38	0.2401
−36	0.2695
−34	0.3018
−32	0.3371
−30	0.3759
−28	0.4181
−26	0.4641
−24	0.5142
−22	0.5686
−20	0.6274
−18	0.6911
−16	0.7599
−14	0.8340
−12	0.9138
−10	0.9995
− 8	1.091
− 6	1.190
− 4	1.295
− 2	1.408
0	1.529
+ 2	1.657
4	1.793
6	1.938
8	2.092
10	2.256
12	2.429
14	2.613
16	2.807
18	3.012
20	3.228
22	3.456
24	3.697
26	3.951
28	4.217
30	4.498
32	4.793
34	5.102
36	5.427
38	5.768
40	6.125

Sulfur Dioxide (Cont.)

t°C.	p in atm
42	6.499
44	6.890
46	7.300
48	7.729
50	8.176
55	9.385
60	10.729
65	12.219
70	13.867
75	15.684
80	17.682
85	19.872
90	22.268
95	24.878
100	27.714
105	30.784
110	34.091
115	37.641
120	41.432
125	45.457
130	49.705
135	54.157
140	58.783
145	63.549
150	68.405
155	73.296
157	75.245
157.2	77.7 (c.p.)

Sulfur Trioxide SO_3

t°C.	mm of Hg
24	240
36	476
44.6	760
	p in atm
60	2.0
80	4.3
100	8.0
110	10.4
120	13.3
130	16.7
140	20.6
150	25.1
160	30.3
170	36.4
180	43.4
190	51.5
200	61.1
210	72.5
218.3	83.6 (c.p.)

Tellurium Hydride TeH_2

t°C.	mm of Hg
−60	34
−50	79
−45.4	102 (m.p.)
−40	139
−30	234
−20	370
−10	555
0	808

Thallium Tl

t°C.	mm of Hg
413	0.001
634	0.056
748	1.0
783	1.3
950	10.5
1000	17.5
1100	37.0
1200	78.0
1650	760

Tin Sn

t°C.	mm of Hg
1130	0.13
1360	1.5
1970	101
2005	126
2100	262
2160	372
2270	760

Toluene $C_6H_5CH_3$

t°C.	mm of Hg
−91.9	0.0017
−81.7	0.00474
−77.4	0.0074
−67.5	0.0202
−64.3	0.0294
−57.7	0.0604
−48.1	0.138
−38.0	0.393
−37.7	0.503
−34.9	0.631
−32.4	0.778
−24.5	1.438
−24.2	1.470
−17.5	2.17
−9.6	3.65
−2.9	5.72
+5.4	9.62
15.0	16.77
25.8	28.75
30	36.7
40	59.1
50	92.6
60	139.5

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Toluene (Cont.)

t°C.	mm of Hg
70	202.4
80	289.7
90	404.6
100	557.2
110.7	760

o-Toluidine $H_2NC_6H_4CH_3$

t°C.	mm of Hg
40	1.1
50	2.1
60	3.7
70	6.4
80	10.5
90	17.3
100	27.2
110	41.7
120	62.3
130	91.2
140	129.9
150	180.5
154.0	200
160	250.2
166.2	300
170	338.0
176.2	400
180	450.2
183.9	500
187.3	550
190	590.7
193.2	650
196.2	700
199.84	760
200	762.9
205	863.9

m-Toluidine $H_2NC_6H_4CH_3$

t°C.	mm of Hg
45	1.3
50	1.9
60	3.4
70	5.7
80	9.4
90	15.2
100	23.9
110	36.7
120	54.8
130	80.4
140	115.5
150	162.6
157.6	200
160	224.9
164.1	250
170	305.9
175.1	350
180	410.6
183.8	450

m-Toluidine (Cont.)

t°C.	mm of Hg
187.5	500
190	541.9
194.0	600
196.8	650
200	706.7
202.86	760
205	803.4

p-Toluidine $H_2NC_6H_4CH_3$

t°C.	mm of Hg
40	1.1
50	2.0
60	3.7
70	6.3
80	10.5
90	16.9
100	26.6
110	40.6
120	60.6
130	88.4
140	126.3
150	177.2
154.7	200
160	244.0
166.9	300
170	330.6
176.9	400
180	441.3
184.6	500
188.0	550
190	580.4
191.1	600
193.9	650
196.9	700
200.35	760
205	854.2

Trinitrotoluene $C_6H_2CH_3(NO_2)_3$

t°C.	mm of Hg
80	0.042
85	0.053
90	0.067
95	0.085
100	0.106

Tungsten W

t°C.	mm of Hg
2500	2.94×10^{-7}
2700	6.95×10^{-6}
2900	1.06×10^{-4}
3100	1.14×10^{-3}
4450	1.0
6383	760

Urethane $H_2NCO_2C_2H_5$

t°C.	mm of Hg
103	54
120	103
130	146
140	203
150	283
160	392
170	551
176.8	697

n-Valeric Acid $C_4H_9CO_2H$

t°C.	mm of Hg
45	0.1
50	0.5
60	2.07
70	4.8
80	9.3
90	17.0
100	28.2
110	48.6
120	70.5
130	106.9
140	159.6
150	234.5
160	336.1
165.0	400
170	475.3
174.5	550
177.0	600
180	660.7
181.8	700
184.4	760

iso-Valeric Acid $C_4H_9CO_2H$

t°C.	mm of Hg
10	0.17
20	0.37
30	0.76
40	1.5
50	2.9
60	5.3
70	9.4
80	16.4
90	27.3
100	44.2
110	69.8
120	107.4
130	159.8
140	236.0
150	338.3
160	654.9

Water H_2O
See Special Table

Xenon Xe

t°C.	p in atm
−109.1	1.000

VAPOR PRESSURES OF VARIOUS SUBSTANCES

Xenon Xe (Cont.)

t°C.	p in atm
−100	1.629
−80	4.064
−60	8.570
−40	15.85
−20	26.73
0.0	41.24
+16.6	58.22(c.p.)

o-Xylene $C_6H_4(CH_3)_2$

t°C.	mm of Hg
0	4.0
10	6.4
20	10.05
30	15.55
40	23.7
50	35.5
60	52.4
70	76.15
80	108.9
90	153.5
100	213.1
110	291.7
120	393.85
130	524.6
140	689.9
143.61	760

m-Xylene $C_6H_4(CH_3)_2$

t°C.	mm of Hg
0	1.75
10	3.45
20	6.43
30	11.43
40	19.48
50	31.94
60	50.59
70	77.62
80	115.72
90	168.05
100	238.22
110	330.33
120	448.85
130	598.59
139.00	760
140	784.64

p-Xylene $C_6H_4(CH_3)_2$

t°C.	mm of Hg
0	8.29
10	11.52
20	16.35
30	23.52
40	34.00
50	49.22
60	70.64
70	100.76
80	142.04
90	197.48

p-Xylene (Cont.)

t°C.	mm of Hg
100	270.46
110	364.23
120	481.33
130	624.93
138.30	760
140	794.84

Zinc Zn

t°C.	mm of Hg
256.8	0.00012
291.4	0.00084
296.3	0.001
363.0	0.0182
419.4	0.143(m.p.)
490.7	1.069
544.5	3.687
588.8	9.051
632.3	20
641.1	23.02
720.4	81.42
836.0	356.2
905.7	760
	p in atm
950	1.515
980	2.0
1120	6.3
1280	21.5
1510	53.0

VAPOR PRESSURE OF MERCURY
From −38° to 1300°C.

Temp. °C.	mm of Hg	Temp. °C.	mm of Hg	Temp. °C.	mm of Hg
−38	0.0_5145	88	0.1413	214	26.826
−36	0.0_5197	90	0.1582	216	28.504
−34	0.0_5266	92	0.1769	218	30.271
−32	0.0_5359	94	0.1976	220	32.133
−30	0.0_5478	96	0.2202	222	34.092
−28	0.0_5630	98	0.2453	224	36.153
−26	0.0_5828	100	0.2729	226	38.318
−24	0.0_4108	102	0.3032	228	40.595
−22	0.0_4140	104	0.3366	230	42.989
−20	0.0_4181	106	0.3731	232	45.503
−18	0.0_4232	108	0.4132	234	48.141
−16	0.0_4298	110	0.4572	236	50.909
−14	0.0_4380	112	0.5052	238	53.812
−12	0.0_4481	114	0.5576	240	56.855
−10	0.0_4606	116	0.6150	242	60.044
− 8	0.0_4762	118	0.6776	244	63.384
− 6	0.0_4954	120	0.7457	246	66.882
− 4	0.0_3119	122	0.8198	248	70.543
− 2	0.0_3149	124	0.9004	250	74.375
0	0.0_3185	126	0.9882	252	78.381
+ 2	0.0_3228	128	1.084	254	82.568
4	0.0_3276	130	1.186	256	86.944
6	0.0_3335	132	1.298	258	91.518
8	0.0_3406	134	1.419	260	96.296
10	0.0_3490	136	1.551	262	101.28
12	0.0_3588	138	1.692	264	106.48
14	0.0_3706	140	1.845	266	111.91
16	0.0_3846	142	2.010	268	117.57
18	0.001009	144	2.188	270	123.47
20	0.001201	146	2.379	272	129.62
22	0.001426	148	2.585	274	136.02
24	0.001691	150	2.807	276	142.69
26	0.002000	152	3.046	278	149.64
28	0.002359	154	3.303	280	156.87
30	0.002777	156	3.578	282	164.39
32	0.003261	158	3.873	284	172.21
34	0.003823	160	4.189	286	180.34
36	0.004471	162	4.528	288	188.79
38	0.005219	164	4.890	290	197.57
40	0.006079	166	5.277	292	206.70
42	0.007067	168	5.689	294	216.17
44	0.008200	170	6.128	296	226.00
46	0.009497	172	6.596	298	236.21
48	0.01098	174	7.095	300	246.80
50	0.01267	176	7.626	302	257.78
52	0.01459	178	8.193	304	269.17
54	0.01677	180	8.796	306	280.98
56	0.01925	182	9.436	308	293.21
58	0.02206	184	10.116	310	305.89
60	0.02524	186	10.839	312	319.02
62	0.02883	188	11.607	314	332.62
64	0.03287	190	12.423	316	346.70
66	0.03740	192	13.287	318	361.26
68	0.04251	194	14.203	320	376.33
70	0.04825	196	15.173	322	391.92
72	0.05469	198	16.200	324	408.04
74	0.06189	200	17.287	326	424.71
76	0.06993	202	18.437	328	441.94
78	0.07889	204	19.652	330	459.74
80	0.08880	206	20.936	332	478.13
82	0.1000	208	22.292	334	497.12
84	0.1124	210	23.723	336	516.74
86	0.1261	212	25.233	338	537.00

VAPOR PRESSURE OF MERCURY

Temp. °C.	mm of Hg	Temp. °C.	mm of Hg	Temp. °C.	mm of Hg
340	557.90	374	1028.9	520	7691
342	579.45	376	1064.4	550	10650
344	601.69	378	1100.9	600	22.87atm.
346	624.64	380	1138.4	650	35.49atm.
348	648.30	382	1177.0	700	52.51atm.
350	672.69	384	1216.6	750	74.86atm.
352	697.83	386	1257.3	800	103.31atm.
354	723.73	388	1299.1	850	138.42atm.
356	750.43	390	1341.9	900	180.92atm.
358	777.92	392	1386.1	950	226.58atm.
360	806.23	394	1431.3	1000	290.5atm.
362	835.38	396	1477.7	1050	358.1atm.
364	865.36	398	1525.2	1100	437.3atm.
366	896.23	400	1574.1	1150	521.3atm.
368	928.02	430	2464	1200	616.8atm.
370	960.66	460	3715	1250	721.4atm.
372	994.34	490	5420	1300	835.9atm.

VAPOR PRESSURE OF LIQUID AMMONIA, NH_3

See also Orthobaric Densities or Volumes of Various Substances.

t°C.	p in atm	t°C.	p in atm	t°C.	p in atm
−78	0.0582	−6	3.3677	66	29.784
−76	0.0683	−4	3.6405	68	31.211
−74	0.0797	-2	3.9303	70	32.687
−72	0.0929	0	4.2380	72	34.227
−70	0.1078	+2	4.5640	74	35.813
−68	0.1246	4	4.9090	76	37.453
−66	0.1437	6	5.2750	78	39.149
−64	0.1651	8	5.6610	80	40.902
−62	0.1891	10	6.0685	82	42.712
−60	0.2161	12	6.4985	84	44.582
−58	0.2461	14	6.9520	86	46.511
−56	0.2796	16	7.4290	88	48.503
−54	0.3167	18	7.9310	90	50.558
−52	0.3578	20	8.4585	92	52.677
−50	0.4034	22	9.0125	94	54.860
−48	0.4536	24	9.5940	96	57.111
−46	0.5087	26	10.2040	98	59.429
−44	0.5693	28	10.8430	100	61.816
−42	0.6357	30	11.512	102	64.274
−40	0.7083	32	12.212	104	66.804
−38	0.7875	34	12.943	106	69.406
−36	0.8738	36	13.708	108	72.084
−34	0.9676	38	14.507	110	74.837
−32	1.0695	40	15.339	112	77.668
−30	1.1799	42	16.209	114	80.578
−28	1.2992	44	17.113	116	83.570
−26	1.4281	46	18.056	118	86.644
−24	1.5671	48	19.038	120	89.802
−22	1.7166	50	20.059	122	93.045
−20	1.8774	52	21.121	124	96.376
−18	2.0499	54	22.224	126	99.796
−16	2.2349	56	23.372	128	103.309
−14	2.4328	58	24.562	130	106.913
−12	2.6443	60	25.797	132	110.613
−10	2.8703	62	27.079	132.9	112.3(c.p.)
− 8	3.1112	64	28.407		

PROPERTIES OF AMMONIA

U. S. Bu. Standards.

Temperature, °F.	Pressure, lbs. per Sq. Inch Absolute	Specific Vol. Cu. Ft. per Lb. Liquid	Specific Vol. Cu. Ft. per Lb. Vapor	Total Heat of Liquid	Latent Heat of Evaporation	Total Heat of Vapor	Entropy Liquid	Entropy Evap.	Entropy Vapor
−40	10.41	0.02322	24.84	0.0	597.0	597.0	0.000	1.423	1.423
−35	12.05	0.02333	21.66	5.3	593.6	598.9	0.013	1.398	1.411
−30	13.91	0.02345	18.96	10.7	590.2	600.9	0.025	1.374	1.399
−25	15.98	0.02357	16.64	16.0	586.8	602.8	0.037	1.350	1.387
−20	18.30	0.02369	14.67	21.4	583.3	604.7	0.050	1.327	1.377
−15	20.88	0.02381	12.97	26.7	579.7	606.4	0.062	1.304	1.366
−10	23.75	0.02393	11.50	32.1	576.1	608.2	0.074	1.281	1.355
−5	26.92	0.02406	10.22	37.5	572.4	609.9	0.086	1.259	1.345
0	30.42	0.02419	9.114	42.9	568.7	611.6	0.097	1.237	1.334
5	34.28	0.02432	8.149	48.3	564.9	613.2	0.109	1.216	1.325
10	38.51	0.02446	7.304	53.8	561.0	614.8	0.121	1.195	1.316
15	43.15	0.02460	6.562	59.2	557.1	616.3	0.132	1.174	1.306
20	48.21	0.02474	5.910	64.7	553.1	617.8	0.144	1.153	1.297
25	53.73	0.02488	5.336	70.2	549.1	619.3	0.155	1.133	1.288
30	59.74	0.02503	4.827	75.7	544.9	620.6	0.166	1.113	1.279
35	66.26	0.02518	4.375	81.2	540.7	621.9	0.177	1.093	1.270
40	73.32	0.02533	3.974	86.8	536.5	623.3	0.189	1.074	1.263
45	80.95	0.02548	3.616	92.3	532.1	624.4	0.200	1.054	1.254
50	89.19	0.02564	3.296	97.9	527.7	625.6	0.211	1.036	1.247
55	98.05	0.02581	3.010	103.5	523.1	626.6	0.221	1.017	1.238
60	107.6	0.02597	2.754	109.2	518.5	627.7	0.232	0.998	1.230
65	117.8	0.02614	2.522	114.8	513.7	628.5	0.243	0.979	1.222
70	128.8	0.02632	2.314	120.5	508.9	629.4	0.254	0.961	1.215
75	140.5	0.02650	2.126	126.2	504.1	630.3	0.264	0.943	1.207
80	153.1	0.02668	1.956	132.0	499.1	631.1	0.275	0.925	1.200
85	166.4	0.02687	1.803	137.7	494.0	631.7	0.285	0.907	1.192
90	180.7	0.02707	1.663	143.5	488.8	632.3	0.296	0.889	1.185
95	195.8	0.02727	1.536	149.3	483.5	632.8	0.306	0.872	1.178
100	211.9	0.02747	1.419	155.2	478.0	633.2	0.316	0.854	1.170
105	228.9	0.02769	1.314	161.1	472.5	633.6	0.327	0.837	1.164
110	247.0	0.02790	1.217	167.0	466.7	633.7	0.337	0.819	1.156
115	266.1	0.02813	1.129	173.0	460.9	633.9	0.347	0.802	1.149
120	286.4	0.02836	1.048	179.0	454.9	633.9	0.358	0.785	1.143

VAPOR PRESSURE OF WATER IN MILLIMETERS OF MERCURY

For Temperatures from −10° to 118°C

The values in the table below are for water in contact with its own vapor. Where the water is in contact with air at a temperature t°C, the following correction must be added: Correction for temperatures up to 40°C $= p(0.0775 - 3.13 \times 10^{-4} t)/100$; for temperatures above 50°C $= p(0.0652 - 8.75 \times 10^{-5} t)/100$.

See also Steam Table.

t°C.	p mm Hg	t°C.	p mm Hg	t°C.	p mm Hg
−10.0	2.149	−4.5	3.284	1.0	4.926
−9.9	2.167	−4.4	3.309	1.1	4.962
−9.8	2.184	−4.3	3.334	1.2	4.998
−9.7	2.201	−4.2	3.359	1.3	5.034
−9.6	2.219	−4.1	3.384	1.4	5.070
−9.5	2.236	−4.0	3.410	1.5	5.107
−9.4	2.254	−3.9	3.436	1.6	5.144
−9.3	2.271	−3.8	3.461	1.7	5.181
−9.2	2.289	−3.7	3.487	1.8	5.219
−9.1	2.307	−3.6	3.514	1.9	5.256
−9.0	2.326	−3.5	3.540	2.0	5.294
−8.9	2.343	−3.4	3.567	2.1	5.332
−8.8	2.362	−3.3	3.593	2.2	5.370
−8.7	2.380	−3.2	3.620	2.3	5.408
−8.6	2.399	−3.1	3.647	2.4	5.447
−8.5	2.418	−3.0	3.673	2.5	5.486
−8.4	2.437	−2.9	3.702	2.6	5.525
−8.3	2.456	−2.8	3.730	2.7	5.565
−8.2	2.475	−2.7	3.757	2.8	5.605
−8.1	2.495	−2.6	3.785	2.9	5.645
−8.0	2.514	−2.5	3.813	3.0	5.685
−7.9	2.533	−2.4	3.841	3.1	5.725
−7.8	2.553	−2.3	3.871	3.2	5.766
−7.7	2.572	−2.2	3.898	3.3	5.807
−7.6	2.593	−2.1	3.927	3.4	5.848
−7.5	2.613	−2.0	3.956	3.5	5.889
−7.4	2.633	−1.9	3.986	3.6	5.931
−7.3	2.654	−1.8	4.016	3.7	5.973
−7.2	2.674	−1.7	4.045	3.8	6.015
−7.1	2.695	−1.6	4.075	3.9	6.058
−7.0	2.715	−1.5	4.105	4.0	6.101
−6.9	2.736	−1.4	4.135	4.1	6.144
−6.8	2.757	−1.3	4.165	4.2	6.187
−6.7	2.778	−1.2	4.196	4.3	6.230
−6.6	2.800	−1.1	4.227	4.4	6.274
−6.5	2.822	−1.0	4.258	4.5	6.318
−6.4	2.843	−0.9	4.289	4.6	6.363
−6.3	2.866	−0.8	4.320	4.7	6.408
−6.2	2.887	−0.7	4.353	4.8	6.453
−6.1	2.909	−0.6	4.385	4.9	6.498
−6.0	2.931	−0.5	4.416	5.0	6.543
−5.9	2.955	−0.4	4.448	5.1	6.589
−5.8	2.976	−0.3	4.480	5.2	6.635
−5.7	3.000	−0.2	4.513	5.3	6.681
−5.6	3.022	−0.1	4.546	5.4	6.728
−5.5	3.046	0.0	4.579	5.5	6.775
−5.4	3.069	+0.1	4.613	5.6	6.822
−5.3	3.092	0.2	4.647	5.7	6.869
−5.2	3.115	0.3	4.681	5.8	6.917
−5.1	3.139	0.4	4.715	5.9	6.965
−5.0	3.163	0.5	4.750	6.0	7.013
−4.9	3.187	0.6	4.785	6.1	7.062
−4.8	3.211	0.7	4.820	6.2	7.111
−4.7	3.235	0.8	4.855	6.3	7.160
−4.6	3.259	0.9	4.890	6.4	7.209

VAPOR PRESSURE OF WATER IN MILLIMETERS OF MERCURY

t°C.	p mm Hg	t°C.	p mm Hg	t°C.	p mm Hg
6.5	7.259	12.8	11.085	19.1	16.581
6.6	7.309	12.9	11.158	19.2	16.685
6.7	7.360	13.0	11.231	19.3	16.789
6.8	7.411	13.1	11.305	19.4	16.894
6.9	7.462	13.2	11.379	19.5	16.999
7.0	7.513	13.3	11.453	19.6	17.105
7.1	7.565	13.4	11.528	19.7	17.212
7.2	7.617	13.5	11.604	19.8	17.319
7.3	7.669	13.6	11.680	19.9	17.427
7.4	7.722	13.7	11.756	20.0	17.535
7.5	7.775	13.8	11.833	20.1	17.644
7.6	7.828	13.9	11.910	20.2	17.753
7.7	7.882	14.0	11.987	20.3	17.863
7.8	7.936	14.1	12.065	20.4	17.974
7.9	7.990	14.2	12.144	20.5	18.085
8.0	8.045	14.3	12.223	20.6	18.197
8.1	8.100	14.4	12.302	20.7	18.309
8.2	8.155	14.5	12.382	20.8	18.422
8.3	8.211	14.6	12.462	20.9	18.536
8.4	8.267	14.7	12.543	21.0	18.650
8.5	8.323	14.8	12.624	21.1	18.765
8.6	8.380	14.9	12.706	21.2	18.880
8.7	8.437	15.0	12.788	21.3	18.996
8.8	8.494	15.1	12.870	21.4	19.113
8.9	8.551	15.2	12.953	21.5	19.231
9.0	8.609	15.3	13.037	21.6	19.349
9.1	8.668	15.4	13.121	21.7	19.468
9.2	8.727	15.5	13.205	21.8	19.587
9.3	8.786	15.6	13.290	21.9	19.707
9.4	8.845	15.7	13.375	22.0	19.827
9.5	8.905	15.8	13.461	22.1	19.948
9.6	8.965	15.9	13.547	22.2	20.070
9.7	9.025	16.0	13.634	22.3	20.193
9.8	9.086	16.1	13.721	22.4	20.316
9.9	9.147	16.2	13.809	22.5	20.440
10.0	9.209	16.3	13.898	22.6	20.565
10.1	9.271	16.4	13.987	22.7	20.690
10.2	9.333	16.5	14.076	22.8	20.815
10.3	9.395	16.6	14.166	22.9	20.941
10.4	9.458	16.7	14.256	23.0	21.068
10.5	9.521	16.8	14.347	23.1	21.196
10.6	9.585	16.9	14.438	23.2	21.324
10.7	9.649	17.0	14.530	23.3	21.453
10.8	9.714	17.1	14.622	23.4	21.583
10.9	9.779	17.2	14.715	23.5	21.714
11.0	9.844	17.3	14.809	23.6	21.845
11.1	9.910	17.4	14.903	23.7	21.977
11.2	9.976	17.5	14.997	23.8	22.110
11.3	10.042	17.6	15.092	23.9	22.243
11.4	10.109	17.7	15.188	24.0	22.377
11.5	10.176	17.8	15.284	24.1	22.512
11.6	10.244	17.9	15.380	24.2	22.648
11.7	10.312	18.0	15.477	24.3	22.785
11.8	10.380	18.1	15.575	24.4	22.922
11.9	10.449	18.2	15.673	24.5	23.060
12.0	10.518	18.3	15.772	24.6	23.198
12.1	10.588	18.4	15.871	24.7	23.337
12.2	10.658	18.5	15.971	24.8	23.476
12.3	10.728	18.6	16.071	24.9	23.616
12.4	10.799	18.7	16.171	25.0	23.756
12.5	10.870	18.8	16.272	25.1	23.897
12.6	10.941	18.9	16.374	25.2	24.039
12.7	11.013	19.0	16.477	25.3	24.182

VAPOR PRESSURE OF WATER IN MILLIMETERS OF MERCURY

t°C.	p mm Hg	t°C.	p mm Hg	t°C.	p mm Hg
25.4	24.326	31.7	35.062	38.0	49.692
25.5	24.471	31.8	35.261	38.1	49.961
25.6	24.617	31.9	35.462	38.2	50.231
25.7	24.764	32.0	35.663	38.3	50.502
25.8	24.912	32.1	35.865	38.4	50.774
25.9	25.060	32.2	36.068	38.5	51.048
26.0	25.209	32.3	36.272	38.6	51.323
26.1	25.359	32.4	36.477	38.7	51.600
26.2	25.509	32.5	36.683	38.8	51.879
26.3	25.660	32.6	36.891	38.9	52.160
26.4	25.812	32.7	37.099	39.0	52.442
26.5	25.964	32.8	37.308	39.1	52.725
26.6	26.117	32.9	37.518	39.2	53.009
26.7	26.271	33.0	37.729	39.3	53.294
26.8	26.426	33.1	37.942	39.4	53.580
26.9	26.582	33.2	38.155	39.5	53.867
27.0	26.739	33.3	38.369	39.6	54.156
27.1	26.897	33.4	38.584	39.7	54.446
27.2	27.055	33.5	38.801	39.8	54.737
27.3	27.214	33.6	39.018	39.9	55.030
27.4	27.374	33.7	39.237	40.0	55.324
27.5	27.535	33.8	39.457	40.2	55.91
27.6	27.696	33.9	39.677	40.4	56.51
27.7	27.858	34.0	39.898	40.6	57.11
27.8	28.021	34.1	40.121	40.8	57.72
27.9	28.185	34.2	40.344	41.0	58.34
28.0	28.349	34.3	40.569	41.2	58.96
28.1	28.514	34.4	40.796	41.4	59.58
28.2	28.680	34.5	41.023	41.6	60.22
28.3	28.847	34.6	41.251	41.8	60.86
28.4	29.015	34.7	41.480	42.0	61.50
28.5	29.184	34.8	41.710	42.2	62.14
28.6	29.354	34.9	41.942	42.4	62.80
28.7	29.525	35.0	42.175	42.6	63.46
28.8	29.697	35.1	42.409	42.8	64.12
28.9	29.870	35.2	42.644	43.0	64.80
29.0	30.043	35.3	42.880	43.2	65.48
29.1	30.217	35.4	43.117	43.4	66.16
29.2	30.392	35.5	43.355	43.6	66.86
29.3	30.568	35.6	43.595	43.8	67.56
29.4	30.745	35.7	43.836	44.0	68.26
29.5	30.923	35.8	44.078	44.2	68.97
29.6	31.102	35.9	44.320	44.4	69.69
29.7	31.281	36.0	44.563	44.6	70.41
29.8	31.461	36.1	44.808	44.8	71.14
29.9	31.642	36.2	45.054	45.0	71.88
30.0	31.824	36.3	45.301	45.2	72.62
30.1	32.007	36.4	45.549	45.4	73.36
30.2	32.191	36.5	45.799	45.6	74.12
30.3	32.376	36.6	46.050	45.8	74.88
30.4	32.561	36.7	46.302	46.0	75.65
30.5	32.747	36.8	46.556	46.2	76.43
30.6	32.934	36.9	46.811	46.4	77.21
30.7	33.122	37.0	47.067	46.6	78.00
30.8	33.312	37.1	47.324	46.8	78.80
30.9	33.503	37.2	47.582	47.0	79.60
31.0	33.695	37.3	47.841	47.2	80.41
31.1	33.888	37.4	48.102	47.4	81.23
31.2	34.082	37.5	48.364	47.6	82.05
31.3	34.276	37.6	48.627	47.8	82.87
31.4	34.471	37.7	48.891	48.0	83.71
31.5	34.667	37.8	49.157	48.2	84.56
31.6	34.864	37.9	49.424	48.4	85.42

VAPOR PRESSURE OF WATER IN MILLIMETERS OF MERCURY

t°C.	p mm Hg	t°C.	p mm Hg	t°C.	p mm Hg
48.6	86.28	71.0	243.9	92.2	571.26
48.8	87.14	71.5	249.3	92.4	575.55
49.0	88.02	72.0	254.6	92.6	579.87
49.2	88.90	72.5	260.2	92.8	584.22
49.4	89.79	73.0	265.7	93.0	588.60
49.6	90.69	73.5	271.5	93.2	593.00
49.8	91.59	74.0	277.2	93.4	597.43
50.0	92.51	74.5	283.2	93.6	601.89
50.5	94.86	75.0	289.1	93.8	606.38
51.0	97.20	75.5	295.3	94.0	610.90
51.5	99.65	76.0	301.4	94.2	615.44
52.0	102.09	76.5	307.7	94.4	620.01
52.5	104.65	77.0	314.1	94.6	624.61
53.0	107.20	77.5	320.7	94.8	629.24
53.5	109.86	78.0	327.3	95.0	633.90
54.0	112.51	78.5	334.2	95.2	638.59
54.5	115.28	79.0	341.0	95.4	643.30
55.0	118.04	79.5	348.1	95.6	648.05
55.5	120.92	80.0	355.1	95.8	652.82
56.0	123.80	80.5	362.4	96.0	657.62
56.5	126.81	81.0	369.7	96.2	662.45
57.0	129.82	81.5	377.3	96.4	667.31
57.5	132.95	82.0	384.9	96.6	672.20
58.0	136.08	82.5	392.8	96.8	677.12
58.5	139.34	83.0	400.6	97.0	682.07
59.0	142.60	83.5	408.7	97 2	687.04
59.5	145.99	84.0	416.8	97.4	692.05
60.0	149.38	84.5	425.2	97.6	697.10
60.5	152.91	85.0	433.6	97.8	702.17
61.0	156.43	85.5	442.3	98.0	707.27
61.5	160.10	86.0	450.9	98.2	712.40
62.0	163.77	86.5	459.8	98.4	717.56
62.5	167.58	87.0	468.7	98.6	722.75
63.0	171.38	87.5	477.9	98.8	727.98
63.5	175.35	88.0	487.1	99.0	733.24
64.0	179.31	88.5	496.6	99.2	738.53
64.5	183.43	89.0	506.1	99.4	743.85
65.0	187.54	89.5	515.9	99.6	749.20
65.5	191.82	90.0	525.76	99.8	754.58
66.0	196.09	90.2	529.77	100.0	760.00
66.5	200.53	90.4	533.80	102	815.86
67.0	204.96	90.6	537.86	104	875.06
67.5	209.57	90.8	541.95	106	937.92
68.0	214.17	91.0	546.05	108	1004.4
68.5	218.95	91.2	550.18	110	1074.6
69.0	223.73	91.4	554.35	112	1148.7
69.5	228.72	91.6	558.53	114	1227.2
70.0	233.7	91.8	562.75	116	1309.9
70.5	238.8	92.0	566.99	118	1397.2

VAPOR PRESSURE OF ICE IN MILLIMETERS OF MERCURY

For Temperatures from −99° to 0°C

The values in the table below are for ice in contact with its own vapor. Where the ice is in contact with air at a temperature t°C, the following correction must be added: Correction $= 20p/100\,(t+273)$.

t°C.	p mm Hg	t°C.	p mm Hg	t°C.	p mm Hg
−99	0.000012	−41	0.0862	−25.3	0.462
−98	0.000015	−40	0.0966	−25.2	0.467
−97	0.000018	−39	0.1081	−25.1	0.471
−96	0.000022	−38	0.1209	−25.0	0.476
−95	0.000027	−37	0.1351	−24.9	0.481
−94	0.000033	−36	0.1507	−24.8	0.486
−93	0.000040	−35	0.1681	−24.7	0.490
−92	0.000048	−34	0.1873	−24.6	0.495
−91	0.000058	−33	0.2084	−24.5	0.500
−90	0.000070	−32	0.2318	−24.4	0.505
−89	0.000084	−31	0.2575	−24.3	0.510
−88	0.00010	−30	0.2859	−24.2	0.515
−87	0.00012	−29.9	0.289	−24.1	0.520
−86	0.00014	−29.8	0.292	−24.0	0.526
−85	0.00017	−29.7	0.295	−23.9	0.531
−84	0.00020	−29.6	0.298	−23.8	0.536
−83	0.00024	−29.5	0.301	−23.7	0.541
−82	0.00029	−29.4	0.304	−23.6	0.547
−81	0.00034	−29.3	0.307	−23.5	0.552
−80	0.00040	−29.2	0.311	−23.4	0.558
−79	0.00047	−29.1	0.314	−23.3	0.563
−78	0.00056	−29.0	0.317	−23.2	0.569
−77	0.00066	−28.9	0.320	−23.1	0.574
−76	0.00077	−28.8	0.324	−23.0	0.580
−75	0.00090	−28.7	0.327	−22.9	0.586
−74	0.00105	−28.6	0.330	−22.8	0.592
−73	0.00123	−28.5	0.334	−22.7	0.597
−72	0.00143	−28.4	0.337	−22.6	0.603
−71	0.00167	−28.3	0.341	−22.5	0.609
−70	0.00194	−28.2	0.344	−22.4	0.615
−69	0.00225	−28.1	0.348	−22.3	0.621
−68	0.00261	−28.0	0.351	−22.2	0.627
−67	0.00302	−27.9	0.355	−22.1	0.633
−66	0.00349	−27.8	0.359	−22.0	0.640
−65	0.00403	−27.7	0.362	−21.9	0.646
−64	0.00464	−27.6	0.366	−21.8	0.652
−63	0.00534	−27.5	0.370	−21.7	0.659
−62	0.00614	−27.4	0.374	−21.6	0.665
−61	0.00703	−27 3	0.377	−21.5	0.672
−60	0.00808	−27.2	0.381	−21.4	0.678
−59	0.00925	−27.1	0.385	−21.3	0.685
−58	0.0106	−27.0	0.389	−21.2	0.691
−57	0.0121	−26.9	0.393	−21.1	0.698
−56	0.0138	−26.8	0.397	−21.0	0.705
−55	0.0157	−26.7	0.401	−20.9	0.712
−54	0.0178	−26.6	0.405	−20.8	0.719
−53	0.0203	−26.5	0.409	−20.7	0.726
−52	0.0230	−26.4	0.414	−20.6	0.733
−51	0.0261	−26.3	0.418	−20.5	0.740
−50	0.0296	−26.2	0.422	−20.4	0.747
−49	0.0334	−26.1	0.426	−20.3	0.754
−48	0.0378	−26.0	0.430	−20.2	0.761
−47	0.0426	−25.9	0.435	−20.1	0.769
−46	0.0481	−25.8	0.439	−20.0	0.776
−45	0.0541	−25.7	0.444	−19.9	0.783
−44	0.0609	−25.6	0.448	−19.8	0.791
−43	0.0684	−25.5	0.453	−19.7	0.799
−42	0.0768	−25.4	0.457	−19.6	0.806

VAPOR PRESSURE OF ICE IN MILLIMETERS OF MERCURY

t°C.	p mm Hg	t°C.	p mm Hg	t°C.	p mm Hg
−19.5	0.814	−13.0	1.490	−6.5	2.649
−19.4	0.822	−12.9	1.504	−6.4	2.672
−19.3	0.830	−12.8	1.518	−6.3	2.695
−19.2	0.838	−12.7	1.532	−6.2	2.718
−19.1	0.846	−12.6	1.546	−6.1	2.742
−19.0	0.854	−12.5	1.559	−6.0	2.765
−18.9	0.862	−12.4	1.574	−5.9	2.790
−18.8	0.870	−12.3	1.588	−5.8	2.813
−18.7	0.879	−12.2	1.602	−5.7	2.838
−18.6	0.887	−12.1	1.617	−5.6	2.862
−18.5	0.895	−12.0	1.632	−5.5	2.887
−18.4	0.904	−11.9	1.646	−5.4	2.912
−18.3	0.912	−11.8	1.661	−5.3	2.937
−18.2	0.921	−11.7	1.676	−5.2	2.962
−18.1	0.930	−11.6	1.691	−5.1	2.987
−18.0	0.939	−11.5	1.707	−5.0	3.013
−17.9	0.947	−11.4	1.722	−4.9	3.039
−17.8	0.956	−11.3	1.737	−4.8	3.065
−17.7	0.966	−11.2	1.753	−4.7	3.091
−17.6	0.975	−11.1	1.769	−4.6	3.117
−17.5	0.984	−11.0	1.785	−4.5	3.144
−17.4	0.993	−10.9	1.800	−4.4	3.171
−17.3	1.002	−10.8	1.817	−4.3	3.198
−17.2	1.012	−10.7	1.833	−4.2	3.225
−17.1	1.021	−10.6	1.849	−4.1	3.252
−17.0	1.031	−10.5	1.866	−4.0	3.280
−16.9	1.041	−10.4	1.883	−3.9	3.308
−16.8	1.051	−10.3	1.899	−3.8	3.336
−16.7	1.060	−10.2	1.916	−3.7	3.364
−16.6	1.070	−10.1	1.934	−3.6	3.393
−16.5	1.080	−10.0	1.950	−3.5	3.422
−16.4	1.091	−9.9	1.968	−3.4	3.451
−16.3	1.101	−9 8	1.985	−3.3	3.480
−16.2	1.111	−9.7	2.003	−3.2	3.509
−16.1	1.121	−9.6	2.021	−3.1	3.539
−16.0	1.132	−9.5	2.039	−3.0	3.568
−15.9	1.142	−9.4	2.057	−2.9	3.599
−15.8	1.153	9.3	2.075	−2.8	3.630
−15.7	1.164	9.2	2.093	−2.7	3.660
−15.6	1.175	9.1	2.112	−2.6	3.691
−15.5	1.186	9.0	2.131	−2.5	3.722
−15.4	1.196	−8.9	2.149	−2.4	3.753
−15.3	1.208	−8.8	2.168	−2.3	3.785
−15.2	1.219	−8.7	2.187	−2.2	3.816
−15.1	1.230	−8.6	2.207	−2.1	3.848
−15.0	1.241	−8.5	2.226	−2.0	3.880
−14.9	1.253	−8.4	2.246	−1.9	3.913
−14.8	1.264	−8.3	2.266	−1.8	3.946
−14.7	1.276	−8.2	2.285	−1.7	3.979
−14.6	1.288	−8.1	2.306	−1.6	4.012
−14.5	1.300	−8.0	2.326	−1.5	4.045
−14.4	1.312	−7.9	2.346	−1.4	4.079
−14.3	1.324	−7.8	2.367	−1.3	4.113
−14.2	1.336	−7.7	2.387	−1.2	4.147
−14.1	1.348	−7.6	2.408	−1.1	4.182
−14.0	1.361	−7.5	2.429	−1.0	4.217
−13.9	1.373	−7.4	2.450	−0.9	4.252
−13.8	1.386	−7.3	2.472	−0.8	4.287
−13.7	1.399	−7.2	2.493	−0.7	4.323
−13.6	1.411	−7.1	2.515	−0.6	4.359
−13.5	1.424	−7.0	2.537	−0.5	4.395
−13.4	1.437	−6.9	2.559	−0.4	4.431
−13.3	1.450	−6.8	2.581	−0.3	4.467
−13.2	1.464	−6.7	2.603	−0.2	4.504
−13.1	1.477	−6.6	2.626	−0.1	4.542
				0.0	4.579

BOILING POINT OF WATER AT VARIOUS BAROMETRIC PRESSURES

Temp. °C.	0.0°	0.2°	0.4°	0.6°	0.8°
	mm of Hg	mm of Hg	mm of Hg	mm of Hg	mm of Hg
80	355.40	358.28	361.19	364.11	367.06
81	370.03	373.01	376.02	379.05	382.09
82	385.16	388.25	391.36	394.49	397.64
83	400.81	404.00	407.22	410.45	413.71
84	416.99	420.29	423.61	426.95	430.32
85	433.71	437.12	440.55	444.01	447.49
86	450.99	454.51	458.06	461.63	465.22
87	468.84	472.48	476.14	479.83	483.54
88	487.28	491.04	494.82	498.63	502.46
89	506.32	510.20	514.11	518.04	521.99
90	525.97	529.98	534.01	538.07	542.15
91	546.26	550.40	554.56	558.75	562.96
92	567.20	571.47	575.76	580.08	584.43
93	588.80	593.20	597.63	602.09	606.57
94	611.08	615.62	620.19	624.79	629.41
95	634.06	638.74	643.45	648.19	652.96
96	657.75	662.58	667.43	672.32	677.23
97	682.18	687.15	692.15	697.19	702.25
98	707.35	712.47	717.63	722.81	728.03
99	733.28	738.56	743.87	749.22	754.59
100	760.00	765.44	770.91	776.42	781.95

BOILING POINT OF WATER AT VARIOUS PRESSURES

The table below gives the boiling point of water in degrees Centigrade at various pressures in millimeters of mercury at 0°C.

See also Steam Table.

Pressure	Tenths of a millimeter of Hg									
mm of Hg	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
690	97.317°	321	325	329	333	337	341	345	349	353
691	97.357°	361	365	369	373	377	381	385	389	393
692	97.397°	401	405	409	413	417	421	425	429	433
693	97.437°	441	445	449	453	457	461	465	469	473
694	97.477°	480	484	488	492	496	500	504	508	512
695	97.516°	520	524	528	532	536	540	544	548	552
696	97.556°	560	564	568	572	576	580	584	588	592
697	97.596°	599	603	607	611	615	619	623	627	631
698	97.635°	639	643	647	651	655	659	663	667	671
699	97.675°	678	682	686	690	694	698	702	706	710
700	97.714°	718	722	726	730	734	738	742	746	750
701	97.754°	757	761	765	769	773	777	781	785	789
702	97.793°	797	801	805	809	813	816	820	824	828
703	97.832°	836	840	844	848	852	856	860	864	868
704	97.872°	876	879	883	887	891	895	899	903	907
705	97.911°	915	919	923	927	931	935	939	943	947
706	97.950°	954	958	962	966	970	974	977	981	985
707	97.989°	993	996	*000	*004	*008	*012	*016	*020	*024
708	98.028°	032	036	040	043	047	051	055	059	063
709	98.067	071	075	079	082	086	090	094	098	102
710	98.106°	110	114	118	121	125	129	133	137	141
711	98.145°	149	153	157	160	164	168	172	176	180
712	98.184°	188	192	195	199	203	207	211	215	219
713	98.223°	227	230	234	238	242	246	250	254	258
714	98.262°	266	270	274	278	282	286	290	293	297
715	98.301°	304	308	312	316	320	323	327	331	335
716	98.339°	343	347	351	355	358	362	366	370	374
717	98.378°	382	385	389	393	397	401	405	409	413
718	98.417°	420	424	428	432	436	440	443	447	451
719	98.455°	459	463	467	470	474	478	482	486	490

BOILING POINT OF WATER AT VARIOUS PRESSURES

Pressure	Tenths of a millimeter of Hg									
mm of Hg	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
720	98.494°	497	501	505	509	513	517	520	524	528
721	98.532°	536	540	544	547	551	555	559	563	567
722	98.571°	574	578	582	586	590	593	597	601	605
723	98.609°	613	617	620	624	628	632	636	640	644
724	98.648°	652	655	659	663	667	671	675	678	682
725	98.686°	689	693	697	701	705	709	712	716	720
726	98.724°	728	732	735	739	743	747	751	755	758
727	98.762°	766	770	774	777	781	785	789	793	797
728	98.801°	804	808	812	816	819	823	827	831	835
729	98.839°	843	846	850	854	858	861	865	869	873
730	98.877°	880	884	888	892	896	899	903	907	911
731	98.915°	918	922	926	930	934	937	941	945	949
732	98.953°	956	960	964	968	972	975	979	983	987
733	98.991°	994	998	*002	*006	*010	*013	*017	*021	*025
734	99.029°	032	036	040	044	048	051	055	059	063
735	99.067°	070	074	078	082	085	089	093	097	101
736	99.105°	109	112	116	119	123	127	131	135	138
737	99.142°	146	150	153	157	161	165	169	172	176
738	99.180°	184	187	191	195	199	203	206	210	214
739	99.218°	221	225	229	233	236	240	244	248	252
740	99.255°	259	263	267	270	274	278	282	285	289
741	99.293°	297	300	304	308	312	316	319	323	327
742	99.331°	334	338	342	346	349	353	357	361	364
743	99.368°	372	376	379	383	387	391	394	398	402
744	99.406°	409	413	417	421	424	428	432	436	439
745	99.443°	447	451	454	458	462	466	469	473	477
746	99.481°	484	488	492	495	499	503	507	510	514
747	99.518°	522	525	529	533	537	540	544	548	551
748	99.555°	559	563	566	570	574	578	581	585	589
749	99.593°	596	600	604	607	611	615	619	622	626
750	99.630°	633	637	641	645	648	652	656	659	663
751	99.667°	671	674	678	682	686	689	693	697	700
752	99.704°	708	712	715	719	723	726	730	734	738
753	99.741°	745	749	752	756	760	764	767	771	775
754	99.778°	782	786	790	793	797	801	804	808	812
755	99.815°	819	823	827	830	834	838	841	845	849
756	99.852°	856	860	863	867	871	875	878	882	886
757	99.889°	893	897	900	904	908	911	915	919	923
758	99.926°	930	934	937	941	945	948	952	956	959
759	99.963°	967	970	974	978	982	985	989	993	996
760	100.000°	004	007	011	015	018	022	026	029	033
761	100.037°	040	044	048	052	055	059	063	066	070
762	100.073°	077	081	085	088	092	096	099	103	107
763	100.110°	114	118	121	125	129	132	136	140	143
764	100.147°	151	154	158	162	165	169	173	176	180
765	100.184°	187	191	195	198	202	206	209	213	216
766	100.220°	224	227	231	235	238	242	246	249	253
767	100.257°	260	264	268	271	275	279	283	286	290
768	100.293°	297	300	304	308	311	315	319	322	326
769	100.330°	333	337	341	344	348	352	355	359	363
770	100.366°	370	373	377	381	384	388	392	395	399
771	100.402°	406	410	414	417	421	424	428	432	435
772	100.439°	442	446	450	453	457	461	464	468	472
773	100.475°	479	483	486	490	493	497	501	504	508
774	100.511°	515	519	522	526	530	533	537	540	544
775	100.547°	551	555	559	562	566	569	573	577	580
776	100.584°	588	591	595	598	602	606	609	613	616
777	100.620°	624	627	631	634	638	642	645	649	653
778	100.656°	660	663	667	671	674	678	681	685	689
779	100.692°	696	699	703	707	710	714	718	721	725

BOILING POINT OF WATER AT VARIOUS PRESSURES

Pressure	Tenths of a millimeter of Hg									
mm of Hg	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
780	100.728°	732	735	739	743	746	750	753	757	761
781	100.764°	768	772	775	779	782	786	789	793	797
782	100.800°	804	807	811	815	818	822	825	829	833
783	100.836°	840	843	847	851	854	858	861	865	869
784	100.872°	876	879	883	886	890	894	897	901	904
785	100.908°	912	915	919	922	926	929	933	937	940
786	100.944°	947	951	954	958	962	965	969	972	976
787	100.980°	984	988	991	995	998	*002	*006	*009	*013
788	101.016°	020	023	027	030	034	037	040	044	047
789	101.051°	054	058	062	065	069	072	076	079	083
790	101.087°	090	094	097	101	104	108	112	115	119
791	101.122°	126	129	133	136	140	144	147	151	154
792	101.158°	161	165	168	172	176	179	183	186	190
793	101.194°	197	201	204	208	211	215	218	222	225
794	101.229°	232	236	239	243	246	250	254	257	261
795	101.265°	269	272	276	279	283	287	290	294	297
796	101.300°	303	307	310	314	317	321	324	328	332
797	101.335°	339	342	346	349	353	356	360	363	367
798	101.371°	375	378	382	385	388	392	395	399	402
799	101.406°	409	413	416	420	423	427	430	434	437
800	101.441°									

Pressure, atm.	Boiling Point, °C.	Pressure, atm.	Boiling Point, °C.	Pressure, atm.	Boiling Point, °C.	Pressure, atm.	Boiling Point, °C.
0.5	80.9	7	164.2	14	194.1	21	213.9
1	100.0	8	169.6	15	197.4	22	216.2
2	119.6	9	174.5	16	200.4	23	218.5
3	132.9	10	179.0	17	203.4	24	220.8
4	142.9	11	183.2	18	206.1	25	222.9
5	151.1	12	187.1	19	208.8	26	225.0
6	158.1	13	190.7	20	211.4	27	227.0

PROPERTIES OF

METRIC AND

The values given in the table below are based upon the values given in Keenan's Steam Tables. (Copyright 1930 by The American Society of Mechanical Engineers, by permission.) The B. T. U. is 778.57 ft.-lb. (= J) which is 1/180 of the change in total heat along the saturated liquid line between 32°F. and 212° F. as determined by Osborne, Fiock and Stimson at the Bu. of Standards. The values given in calories per kilogram have been computed from the values in B. T. U. per pound by means of the conversion factor 0.5556. The heat of vaporization *hfg* is the heat required to vaporize unit mass of water at the indicated temperature and pressure. Total heat

Temperature Degrees Fahrenheit.	Pressure			Heat						Temperature Degrees Centigrade.
				Of the liquid		Of vaporization.		Equivalent of internal work of evapn.		
	Pounds per square inch.	Kilograms per square centimeter.	Millimeters of mercury.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	
t	p	p	p	hf	hf	hfg	hfg	ρ	ρ	t
32	0.0887	0.00624	4.587	0.00	0.00	1073.4	596.4	1019.2	566.3	0.0
34	0.0961	0.00676	4.970	2.01	1.12	1072.3	595.7	1017.9	565.5	1.1
36	0.1041	0.00732	5.384	4.03	2.24	1071.2	595.2	1016.6	564.8	2.2
38	0.1126	0.00792	5.823	6.04	3.36	1070.2	594.6	1015.4	564.2	3.3
40	0.1217	0.00856	6.294	8.05	4.47	1069.1	594.0	1014.1	563.4	4.4
42	0.1315	0.00925	6.801	10.05	5.58	1068.0	593.4	1012.7	562.7	5.6
44	0.1420	0.00998	7.344	12.05	6.69	1066.9	592.8	1011.4	561.9	6.7
46	0.1532	0.01077	7.923	14.06	7.81	1065.8	592.2	1010.1	561.2	7.8
48	0.1652	0.01161	8.543	16.06	8.92	1064.7	591.5	1008.8	560.5	8.9
50	0.1780	0.01251	9.205	18.06	10.03	1063.6	590.9	1007.5	559.8	10.0
52	0.1918	0.01348	9.919	20.06	11.15	1062.5	590.3	1006.2	559.0	11.1
54	0.2063	0.01450	10.669	22.06	12.26	1061.4	589.7	1004.8	558.3	12.2
56	0.2219	0.01560	11.476	24.05	13.36	1060.3	589.1	1003.5	557.5	13.3
58	0.2384	0.01676	12.329	26.05	14.47	1059.3	588.5	1002.3	556.9	14.4
60	0.2561	0.01801	13.244	28.05	15.58	1058.2	587.9	1001.0	556.2	15.6
62	0.2749	0.01933	14.216	30.05	16.70	1057.1	587.3	999.7	555.4	16.7
64	0.2949	0.02073	15.251	32.04	17.80	1056.0	586.7	998.3	554.7	17.8
66	0.3162	0.02223	16.352	34.04	18.91	1054.9	586.1	997.0	553.9	18.9
68	0.3388	0.02382	17.52	36.03	20.02	1053.8	585.5	995.7	553.2	20.0
70	0.3628	0.02551	18.76	38.03	21.13	1052.7	584.9	994.4	552.5	21.1
72	0.3883	0.02730	20.08	40.02	22.24	1051.6	584.5	993.1	551.8	22.2
74	0.4153	0.02920	21.48	42.02	23.35	1050.6	583.7	991.9	551.1	23.3
76	0.4440	0.03122	22.96	44.01	24.45	1049.5	583.1	990.5	550.3	24.4
78	0.4744	0.03335	24.53	46.00	25.56	1048.4	582.5	989.2	549.6	25.6
80	0.5067	0.03562	26.20	48.00	26.67	1047.3	581.9	987.9	548.9	26.7
82	0.5409	0.03803	27.97	50.00	27.78	1046.2	581.3	986.6	548.2	27.8
84	0.5772	0.04058	29.85	52.00	28.89	1045.1	580.7	985.3	547.4	28.9
86	0.6153	0.04326	31.82	54.00	30.00	1044.0	580.0	983.9	546.7	30.0
88	0.6555	0.04609	33.90	56.00	31.11	1042.9	579.4	982.6	545.9	31.1
90	0.6980	0.04907	36.10	58.00	32.22	1041.8	578.8	981.3	545.2	32.2
92	0.7429	0.05223	38.42	59.98	33.32	1040.7	578.2	980.0	544.5	33.3
94	0.7902	0.05556	40.87	61.97	34.43	1039.6	577.6	978.7	543.8	34.4
96	0.8403	0.05908	43.46	63.96	35.54	1038.5	577.0	977.4	543.0	35.6
98	0.8930	0.06278	46.18	65.94	36.64	1037.4	576.4	976.1	542.3	36.7
100	0.9487	0.06670	49.06	67.93	37.74	1036.3	575.8	974.7	541.5	37.8
102	1.0072	0.07081	52.09	69.92	38.85	1035.2	575.2	973.4	540.8	38.9
104	1.0689	0.07515	55.28	71.91	39.95	1034.1	574.5	972.1	540.1	40.0
106	1.1338	0.07971	58.63	73.90	41.06	1033.0	573.9	970.8	539.4	41.1
108	1.2020	0.08451	62.16	75.90	42.17	1031.9	573.3	969.5	538.7	42.2
110	1.274	0.08957	65.88	77.89	43.28	1030.8	572.7	968.2	537.9	43.3
112	1.350	0.09491	69.82	79.89	44.39	1029.6	572.0	966.8	537.2	44.4

SATURATED STEAM

ENGLISH UNITS

involved is $H=hfg+hf$. The external work is pv and the corresponding amount of heat is Apv where A is 144/778.57. The heat equivalent of internal work is $\rho=hfg-Apv$. The values in kilograms per square centimeter and in millimeters of mercury have been computed from the values in pounds per square inch by means of the conversion factors 0.070307 and 51.715 respectively. The values in cubic meters per kilogram have been computed from the values in cubic feet per pound by means of the factor 0.062428. The densities are the reciprocals of the corresponding specific volumes.

Temperature Degrees Fahrenheit.	Heat equivalent of external work.		Saturated vapor						Temperature Degrees Centigrade.
					Specific volume		Density		
	B.T.U. per pound.	Calories per kilogram.	Entropy of the liquid.	Entropy of vaporization.	Cubic feet per pound.	Cubic meters per kilogram.	Pounds per cubic foot.	Kilograms per cubic meter.	
t	Apv	Apv	Sf	Sfg	vg	vg			t
32	54.154	30.09	0.0000	2.1834	3301	206.1	0.000303	0.003845	0.0
34	54.371	30.21	0.0041	2.1723	3059	191.0	0.000327	0.005236	1.1
36	54.588	30.33	0.0081	2.1614	2835	177.0	0.000352	0.005650	2.2
38	54.814	30.45	0.0122	2.1505	2632	164.3	0.000380	0.006086	3.3
40	55.034	30.58	0.0162	2.1397	2445	152.6	0.000409	0.006553	4.4
42	55.258	30.70	0.0202	2.1290	2272	141.8	0.000441	0.007052	5.6
44	55.468	30.82	0.0242	2.1184	2112	131.8	0.000474	0.007587	6.7
46	55.687	30.94	0.0282	2.1078	1965.3	122.7	0.000509	0.008150	7.8
48	55.905	31.06	0.0321	2.0974	1829.7	114.2	0.000546	0.008757	8.9
50	56.125	31.18	0.0361	2.0870	1704.8	106.4	0.000586	0.009398	10.0
52	56.344	31.30	0.0400	2.0767	1588.3	99.15	0.000629	0.01009	11.1
54	56.563	31.43	0.0439	2.0665	1482.4	92.54	0.000674	0.01081	12.2
56	56.781	31.55	0.0478	2.0564	1383.5	86.37	0.000722	0.01158	13.3
58	57.004	31.67	0.0517	2.0464	1292.8	80.71	0.000773	0.01239	14.4
60	57.219	31.79	0.0555	2.0364	1208.0	75.41	0.000828	0.01326	15.6
62	57.438	31.91	0.0594	2.0265	1129.7	70.52	0.000885	0.01418	16.7
64	57.657	32.03	0.0632	2.0167	1057.1	65.99	0.000948	0.01515	17.8
66	57.874	32.15	0.0670	2.0069	989.6	61.78	0.001010	0.01619	18.9
68	58.094	32.28	0.0708	1.9973	927.1	57.88	0.001079	0.01728	20.0
70	58.311	32.40	0.0746	1.9877	869.0	54.25	0.001151	0.01843	21.1
72	58.532	32.52	0.0783	1.9782	815.0	50.88	0.001227	0.01965	22.2
74	58.745	32.64	0.0820	1.9687	764.8	47.74	0.001307	0.02095	23.3
76	58.962	32.76	0.0858	1.9593	718.0	44.82	0.001398	0.02231	24.4
78	59.182	32.88	0.0895	1.9500	674.5	42.11	0.001488	0.02375	25.6
80	59.397	33.00	0.0932	1.9407	633.8	39.57	0.001577	0.02527	26.7
82	59.615	33.12	0.0969	1.9316	595.9	37.20	0.001678	0.02688	27.8
84	59.837	33.25	0.1006	1.9224	560.5	34.99	0.001784	0.02856	28.9
86	60.053	33.37	0.1042	1.9134	527.7	32.94	0.001894	0.03036	30.0
88	60.267	33.48	0.1079	1.9044	497.1	31.03	0.002012	0.03222	31.1
90	60.482	33.60	0.1115	1.8955	468.5	29.25	0.002134	0.03419	32.2
92	60.704	33.73	0.1152	1.8866	441.8	27.58	0.002263	0.03626	33.3
94	60.916	33.84	0.1188	1.8778	416.8	26.02	0.002399	0.03843	34.4
96	61.125	33.96	0.1224	1.8691	393.3	24.55	0.002542	0.04073	35.6
98	61.342	34.08	0.1260	1.8604	371.4	23.19	0.002692	0.04312	36.7
100	61.553	34.20	0.1295	1.8518	350.8	21.90	0.002851	0.04566	37.8
102	61.772	34.32	0.1331	1.8432	331.6	20.70	0.003016	0.04831	38.9
104	61.998	34.45	0.1366	1.8347	313.6	19.58	0.003188	0.05107	40.0
106	62.197	34.56	0.1402	1.8262	296.6	18.52	0.003371	0.05400	41.1
108	62.426	34.68	0.1437	1.8179	280.8	17.53	0.003561	0.05704	42.2
110	62.631	34.80	0.1472	1.8095	265.8	16.59	0.003762	0.06028	43.3
112	62.846	34.92	0.1507	1.8012	251.7	15.71	0.003973	0.06365	44.4

Temperature Degrees Fahrenheit.	Pressure			Heat						Temperature Degrees Centigrade.
				Of the liquid		Of vaporization		Equivalent of internal work of evapn.		
	Pounds per square inch.	Kilograms per square centimeter.	Millimeters of mercury.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	
t	p	p	p	hf	hf	hfg	hfg	ρ	ρ	t
114	1.429	0.10047	73.90	81.89	45.50	1028.5	571.4	965.4	536.4	45.6
116	1.512	0.10630	78.19	83.88	46.60	1027.4	570.8	964.1	535.7	46.7
118	1.600	0.11249	82.74	85.88	47.71	1026.2	570.2	962.7	534.9	47.8
120	1.692	0.11896	87.50	87.88	48.83	1025.1	569.5	961.4	534.2	48.9
122	1.788	0.12571	92.47	89.88	49.94	1024.0	568.9	960.1	533.4	50.0
124	1.889	0.13281	97.69	91.88	51.05	1022.8	568.3	958.7	532.7	51.1
126	1.995	0.14026	103.17	93.87	52.15	1021.7	567.7	957.3	531.9	52.2
128	2.105	0.14800	108.86	95.87	53.27	1020.5	567.0	955.9	531.1	53.3
130	2.221	0.15615	114.86	97.86	54.37	1019.4	566.4	954.6	530.4	54.4
132	2.343	0.16473	121.17	99.86	55.48	1018.2	565.7	953.2	529.6	55.6
134	2.470	0.17366	127.74	101.85	56.59	1017.0	565.0	951.8	528.8	56.7
136	2.603	0.18301	134.61	103.85	57.70	1015.9	564.4	950.5	528.1	57.8
138	2.742	0.19278	141.80	105.84	58.80	1014.7	563.8	949.1	527.3	58.9
140	2.887	0.20298	149.30	107.84	59.92	1013.6	563.2	947.8	526.6	60.0
142	3.039	0.21366	157.16	109.84	61.03	1012.4	562.5	946.4	525.8	61.1
144	3.198	0.22484	165.38	111.84	62.14	1011.2	561.8	945.0	525.0	62.2
146	3.363	0.23644	173.92	113.84	63.25	1010.0	561.2	943.6	524.3	63.3
148	3.536	0.24861	182.86	115.84	64.36	1008.9	560.5	942.3	523.5	64.4
150	3.716	0.26126	192.17	117.84	65.47	1007.7	559.9	940.9	522.8	65.6
152	3.904	0.27448	201.90	119.85	66.59	1006.5	559.2	939.5	522.0	66.7
154	4.100	0.28826	212.03	121.85	67.70	1005.3	558.5	938.1	521.2	67.8
156	4.305	0.30267	222.63	123.85	68.81	1004.2	557.9	936.7	520.4	68.9
158	4.518	0.31765	233.65	125.85	69.92	1003.0	557.3	935.4	519.7	70.0
160	4.739	0.33318	245.08	127.85	71.03	1001.8	556.6	934.0	518.9	71.1
162	4.970	0.34943	257.02	129.85	72.14	1000.6	555.9	932.6	518.2	72.2
164	5.210	0.36630	269.44	131.85	73.26	999.4	555.3	931.2	517.4	73.3
166	5.460	0.38388	282.36	133.85	74.37	998.2	554.6	929.8	516.6	74.4
168	5.720	0.40216	295.81	135.85	75.48	997.0	553.9	928.3	515.8	75.6
170	5.990	0.42114	309.77	137.85	76.59	995.8	553.3	927.0	515.0	76.7
172	6.272	0.44097	324.36	139.85	77.70	994.6	552.6	925.6	514.3	77.8
174	6.565	0.46157	339.51	141.85	78.81	993.4	551.9	924.2	513.5	78.9
176	6.869	0.48294	355.23	143.86	79.93	992.2	551.3	922.8	512.7	80.0
178	7.184	0.50509	371.52	145.86	81.04	991.0	550.6	921.4	511.9	81.1
180	7.510	0.52801	388.38	147.87	82.16	989.8	549.9	920.0	511.2	82.2
182	7.849	0.55184	405.91	149.87	83.27	988.6	549.3	918.6	510.4	83.3
184	8.201	0.57659	424.11	151.87	84.38	987.4	548.6	917.2	509.6	84.4
186	8.566	0.60225	442.99	153.88	85.50	986.2	547.9	915.8	508.8	85.6
188	8.944	0.62883	462.54	155.88	86.61	985.0	547.3	914.4	508.0	86.7
190	9.336	0.65639	482.81	157.89	87.72	983.8	546.6	913.0	507.3	87.8
192	9.744	0.68507	503.91	159.90	88.84	982.6	545.9	911.6	506.5	88.9
194	10.168	0.71488	525.84	161.91	89.96	981.4	545.3	910.2	505.7	90.0
196	10.605	0.74561	548.44	163.92	91.07	980.2	544.6	908.8	504.9	91.1
198	11.057	0.77738	571.81	165.93	92.19	978.9	543.9	907.3	504.1	92.2
200	11.525	0.81029	596.0	167.94	93.31	977.7	543.2	905.9	503.3	93.3
202	12.010	0.84439	621.1	169.95	94.42	976.5	542.5	904.6	502.6	94.4
204	12.512	0.87968	647.1	171.96	95.54	975.2	541.8	903.1	501.8	95.6
206	13.031	0.91617	673.9	173.97	96.66	974.0	541.1	901.7	501.0	96.7
208	13.568	0.95393	701.7	175.98	97.77	972.7	540.4	900.2	500.2	97.8
210	14.123	0.99295	730.4	177.99	98.89	971.5	539.8	898.8	499.4	98.9
212	14.696	1.0332	760.0	180.00	100.01	970.2	539.0	897.3	498.5	100.0
214	15.288	1.0749	790.6	182.02	101.13	968.9	538.3	895.8	497.7	101.1
216	15.900	1.1179	822.3	184.03	102.25	967.6	537.6	894.4	496.9	102.2

SATURATED STEAM
ENGLISH UNITS

Temperature Degrees Fahrenheit.	Heat equivalent of external work		Entropy of the liquid.	Entropy of vaporization.	Saturated vapor: Specific volume		Saturated vapor: Density		Temperature Degrees Centigrade.
	B.T.U. per pound.	Calories per kilogram.			Cubic feet per pound.	Cubic meters per kilogram.	Pounds per cubic foot.	Kilograms per cubic meter.	
t	Apv	Apv	Sf	Sfg	vg	vg			t
114	63.062	35.04	0.1542	1.7930	238.6	14.90	0.004291	0.06711	45.6
116	63.257	35.15	0.1576	1.7848	226.2	14.12	0.004420	0.07082	46.7
118	63.476	35.27	0.1611	1.7766	214.5	13.39	0.004662	0.07468	47.8
120	63.715	35.40	0.1646	1.7685	203.6	12.71	0.004921	0.07868	48.9
122	63.924	35.52	0.1680	1.7605	193.3	12.07	0.005173	0.08285	50.0
124	64.111	35.62	0.1714	1.7525	183.5	11.46	0.005449	0.08726	51.1
126	64.351	35.75	0.1748	1.7446	174.4	10.89	0.005734	0.09182	52.2
128	64.551	35.86	0.1782	1.7366	165.8	10.35	0.006031	0.09662	53.3
130	64.756	35.98	0.1816	1.7288	157.64	9.841	0.006345	0.1016	54.4
132	64.955	36.09	0.1850	1.7210	149.91	9.359	0.006670	0.1068	55.6
134	65.163	36.20	0.1884	1.7133	142.66	8.906	0.007008	0.1123	56.7
136	65.369	36.32	0.1917	1.7056	135.80	8.478	0.007363	0.1179	57.8
138	65.579	36.44	0.1951	1.6979	129.33	8.074	0.007733	0.1239	58.9
140	65.784	36.55	0.1984	1.6903	123.22	7.692	0.008117	0.1300	60.0
142	65.993	36.67	0.2017	1.6827	117.43	7.331	0.008518	0.1364	61.1
144	66.200	36.78	0.2050	1.6752	111.94	6.988	0.008937	0.1431	62.2
146	66.398	36.89	0.2084	1.6678	106.77	6.665	0.009366	0.1500	63.3
148	66.603	37.00	0.2116	1.6603	101.86	6.359	0.009813	0.1572	64.4
150	66.811	37.12	0.2149	1.6530	97.23	6.070	0.01028	0.1647	65.6
152	67.015	37.23	0.2182	1.6456	92.83	5.795	0.01077	0.1726	66.7
154	67.217	37.35	0.2214	1.6383	88.66	5.535	0.01129	0.1807	67.8
156	67.424	37.46	0.2247	1.6311	84.69	5.287	0.01180	0.1891	68.9
158	67.627	37.57	0.2279	1.6239	80.94	5.053	0.01235	0.1979	70.0
160	67.823	37.68	0.2312	1.6168	77.40	4.832	0.01292	0.2070	71.1
162	68.031	37.80	0.2344	1.6096	74.02	4.621	0.01351	0.2164	72.2
164	68.233	37.91	0.2376	1.6026	70.82	4.421	0.01412	0.2262	73.3
166	68.427	38.02	0.2408	1.5956	67.78	4.231	0.01475	0.2364	74.4
168	68.629	38.13	0.2440	1.5886	64.89	4.051	0.01540	0.2469	75.6
170	68.832	38.24	0.2472	1.5816	62.14	3.879	0.01609	0.2578	76.7
172	69.022	38.35	0.2504	1.5747	59.52	3.716	0.01680	0.2691	77.8
174	69.223	38.46	0.2535	1.5679	57.03	3.560	0.01753	0.2809	78.9
176	69.417	38.57	0.2567	1.5610	54.66	3.412	0.01829	0.2931	80.0
178	69.624	38.68	0.2598	1.5543	52.41	3.272	0.01908	0.3056	81.1
180	69.811	38.79	0.2629	1.5475	50.28	3.139	0.01989	0.3186	82.2
182	70.016	38.90	0.2661	1.5408	48.24	3.012	0.02072	0.3320	83.3
184	70.213	39.01	0.2692	1.5342	46.30	2.890	0.02160	0.3460	84.4
186	70.407	39.12	0.2723	1.5276	44.45	2.775	0.02249	0.3604	85.6
188	70.586	39.22	0.2754	1.5210	42.69	2.665	0.02342	0.3752	86.7
190	70.779	39.32	0.2785	1.5144	41.01	2.560	0.02438	0.3906	87.8
192	70.970	39.43	0.2816	1.5079	39.40	2.460	0.02538	0.4065	88.9
194	71.162	39.54	0.2846	1.5014	37.86	2.363	0.02641	0.4232	90.0
196	71.357	39.65	0.2877	1.4950	36.40	2.272	0.02747	0.4401	91.1
198	71.535	39.74	0.2908	1.4886	35.00	2.185	0.02857	0.4577	92.2
200	71.728	39.85	0.2938	1.4822	33.67	2.102	0.02970	0.4753	93.3
202	71.926	39.96	0.2968	1.4759	32.39	2.022	0.03087	0.4946	94.4
204	72.109	40.06	0.2999	1.4695	31.17	1.946	0.03208	0.5139	95.6
206	72.280	40.16	0.3029	1.4633	30.01	1.873	0.03334	0.5339	96.7
208	72.473	40.27	0.3059	1.4570	28.90	1.804	0.03460	0.5543	97.8
210	72.669	40.37	0.3089	1.4508	27.83	1.737	0.03593	0.5757	98.9
212	72.845	40.47	0.3119	1.4446	26.82	1.674	0.03728	0.5974	100.0
214	73.036	40.58	0.3149	1.4384	25.84	1.613	0.03870	0.6200	101.1
216	73.196	40.67	0.3179	1.4322	24.91	1.555	0.04014	0.6431	102.2

Temperature Degrees Fahrenheit.	Pressure			Heat						Temperature Degrees Centigrade.
				Of the liquid		Of vaporization		Equivalent of internal work of evapn.		
	Pounds per square inch.	Kilograms per square centimeter.	Millimeters of mercury.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	
t	p	p	p	hf	hf	hfg	hfg	ρ	ρ	t
218	16.534	1.1625	855.1	186.04	103.36	966.4	536.9	892.9	496.1	103.3
220	17.188	1.2084	888.9	188.06	104.49	965.1	536.2	891.5	495.3	104.4
222	17.864	1.2560	923.8	190.07	105.60	963.8	535.5	890.0	494.5	105.6
224	18.560	1.3049	959.8	192.09	106.73	962.5	534.8	888.5	493.7	106.7
226	19.276	1.3552	996.9	194.11	107.85	961.2	534.0	887.0	492.8	107.8
228	20.015	1.4072	1035.1	196.13	108.97	959.9	533.3	885.6	492.0	108.9
230	20.78	1.4610	1074.6	198.15	110.09	958.6	532.6	884.1	491.2	110.0
232	21.57	1.5165	1115.5	200.17	111.21	957.3	531.9	882.6	490.4	111.1
234	22.38	1.5735	1157.4	202.19	112.34	955.9	531.1	881.0	489.5	112.2
236	23.22	1.6325	1200.8	204.21	113.46	954.6	530.4	879.6	488.7	113.3
238	24.08	1.6930	1245.3	206.24	114.59	953.3	529.7	878.1	487.9	114.4
240	24.97	1.7556	1291.3	208.26	115.71	952.0	528.9	876.6	487.0	115.6
242	25.88	1.8195	1338.4	210.29	116.84	950.6	528.2	875.0	486.2	116.7
244	26.83	1.8863	1387.5	212.31	117.96	949.3	527.4	873.6	485.4	117.8
246	27.80	1.9545	1437.7	214.33	119.08	947.9	526.7	872.0	484.5	118.9
248	28.79	2.0241	1488.9	216.36	120.21	946.6	525.9	870.5	483.6	120.0
250	29.82	2.0966	1542.1	218.39	121.34	945.2	525.2	869.0	482.9	121.1
252	30.88	2.1711	1597.0	220.42	122.47	943.9	524.4	867.6	482.0	122.2
254	31.97	2.2477	1653.3	222.45	123.59	942.5	523.7	866.0	481.2	123.3
256	33.09	2.3265	1711.2	224.48	124.72	941.1	522.9	864.8	480.5	124.4
258	34.24	2.4073	1770.7	226.52	125.85	939.8	522.2	863.0	479.5	125.6
260	35.43	2.4910	1832.3	228.55	126.98	938.4	521.4	861.4	478.6	126.7
262	36.65	2.5768	1895.4	230.58	128.11	937.0	520.6	859.9	477.7	127.8
264	37.90	2.6646	1960.0	232.62	129.24	935.6	519.8	858.3	476.9	128.9
266	39.18	2.7546	2026.2	234.66	130.38	934.2	519.0	856.8	476.0	130.0
268	40.50	2.8474	2094.5	236.70	131.51	932.8	518.3	855.2	475.2	131.1
270	41.85	2.9423	2164.3	238.74	132.64	931.4	517.5	853.7	474.3	132.2
272	43.25	3.0408	2236.7	240.78	133.78	930.0	516.7	852.1	473.4	133.3
274	44.67	3.1406	2310.1	242.82	134.91	928.5	515.9	850.5	472.5	134.4
276	46.14	3.2440	2386.1	244.86	136.04	927.1	515.1	848.9	471.6	135.6
278	47.65	3.3501	2464.2	246.90	137.18	925.7	514.3	847.4	470.8	136.7
280	49.20	3.4591	2544.4	248.95	138.32	924.2	513.5	845.7	469.9	137.8
282	50.79	3.5709	2626.6	251.00	139.46	922.8	512.7	844.2	469.0	138.9
284	52.42	3.6855	2710.9	253.05	140.59	921.4	511.9	842.6	468.1	140.0
286	54.09	3.8029	2797.3	255.10	141.73	919.9	511.1	841.0	467.2	141.1
288	55.80	3.9231	2885.7	257.15	142.87	918.5	510.3	839.4	466.4	142.2
290	57.55	4.0462	2976.2	259.20	144.01	917.0	509.5	837.8	465.5	143.3
292	59.35	4.1727	3069.3	261.26	145.16	915.5	508.7	836.1	464.6	144.4
294	61.19	4.3021	3164.4	263.31	146.30	914.1	507.9	834.6	463.7	145.6
296	63.09	4.4357	3262.7	265.36	147.43	912.6	507.0	833.0	462.8	146.7
298	65.03	4.5721	3363.0	267.42	148.58	911.1	506.2	831.3	461.9	147.8
300	67.01	4.7113	3465.4	269.48	149.72	909.6	505.4	829.7	461.0	148.9
302	69.04	4.8540	3570.4	271.54	150.87	908.1	504.5	828.1	460.0	150.0
304	71.12	5.0002	3678.0	273.60	152.01	906.6	503.7	826.4	459.2	151.1
306	73.26	5.1507	3788.6	275.67	153.16	905.1	502.9	824.8	458.3	152.2
308	75.44	5.3040	3901.4	277.73	154.31	903.6	502.0	823.2	457.3	153.3
310	77.68	5.4614	4017.2	279.80	155.46	902.1	501.2	821.6	456.4	154.4
312	79.97	5.6225	4135.6	281.87	156.61	900.6	500.4	819.9	455.6	155.6
314	82.31	5.7870	4256.7	283.94	157.76	899.0	499.5	818.7	454.6	156.7
316	84.70	5.9550	4380.3	286.02	158.91	897.5	498.7	816.6	453.8	157.8
318	87.15	6.1273	4507.0	288.09	160.06	896.0	497.8	815.0	452.8	158.9
320	89.65	6.3030	4636.2	290.17	161.22	894.4	496.9	813.3	451.8	160.0

SATURATED STEAM
ENGLISH UNITS

Temperature Degrees Fahrenheit.	Heat equivalent of external work				Saturated vapor				Temperature Degrees Centigrade.
					Specific volume		Density		
	B.T.U. per pound.	Calories per kilogram.	Entropy of the liquid.	Entropy of vaporization.	Cubic feet per pound.	Cubic meters per kilogram.	Pounds per cubic foot.	Kilograms per cubic meter.	
t	Apv	Apv	Sfg	Sfg	vg	vg			t
218	73.393	40.78	0.3209	1.4261	24.02	1.500	0.04163	0.6667	103.3
220	73.562	40.87	0.3238	1.4200	24.16	1.446	0.04318	0.6916	104.4
222	73.746	40.97	0.3268	1.4140	22.34	1.395	0.04476	0.7168	105.6
224	73.907	41.06	0.3298	1.4079	21.55	1.345	0.04640	0.7435	106.7
226	74.084	41.16	0.3327	1.4019	20.80	1.299	0.04808	0.7698	107.8
228	74.259	41.26	0.3357	1.3959	20.08	1.254	0.04980	0.7974	108.9
230	74.449	41.36	0.3386	1.3900	19.388	1.210	0.05157	0.8264	110.0
232	74.623	41.46	0.3416	1.3841	18.722	1.169	0.05341	0.8554	111.1
234	74.792	41.55	0.3445	1.3782	18.086	1.129	0.05528	0.8857	112.2
236	74.967	41.65	0.3474	1.3723	17.473	1.091	0.05723	0.9166	113.3
238	75.138	41.75	0.3503	1.3665	16.888	1.054	0.05930	0.9488	114.4
240	75.311	41.84	0.3532	1.3607	16.324	1.019	0.06125	0.9814	115.6
242	75.480	41.94	0.3560	1.3549	15.786	0.9855	0.06333	1.015	116.7
244	75.646	42.03	0.3589	1.3491	15.261	0.9527	0.06552	1.050	117.8
246	75.815	42.12	0.3618	1.3434	14.762	0.9216	0.06774	1.085	118.9
248	75.985	42.22	0.3646	1.3377	14.287	0.8919	0.06997	1.121	120.0
250	76.150	42.31	0.3675	1.3320	13.824	0.8630	0.07238	1.159	121.1
252	76.316	42.40	0.3703	1.3264	13.379	0.8352	0.07474	1.197	122.2
254	76.479	42.49	0.3732	1.3207	12.951	0.8085	0.07721	1.237	123.3
256	76.269	42.38	0.3760	1.3151	12.540	0.7828	0.07974	1.277	124.4
258	76.804	42.67	0.3789	1.3095	12.145	0.7582	0.08231	1.319	125.6
260	76.964	42.76	0.3817	1.3040	11.762	0.7343	0.08511	1.362	126.7
262	77.120	42.85	0.3845	1.2984	11.394	0.7113	0.08779	1.406	127.8
264	77.283	42.94	0.3873	1.2929	11.042	0.6893	0.09058	1.451	128.9
266	77.436	43.02	0.3902	1.2874	10.703	0.6682	0.09342	1.497	130.0
268	77.588	43.11	0.3930	1.2819	10.375	0.6477	0.09639	1.544	131.1
270	77.744	43.19	0.3958	1.2765	10.061	0.6281	0.09946	1.592	132.2
272	77.897	43.28	0.3986	1.2711	9.755	0.6090	0.1025	1.642	133.3
274	78.042	43.36	0.4014	1.2657	9.464	0.5908	0.1056	1.693	134.4
276	78.204	43.45	0.4042	1.2603	9.181	0.5732	0.1089	1.745	135.6
278	78.348	43.53	0.4069	1.2550	8.907	0.5560	0.1123	1.799	136.7
280	78.494	43.61	0.4097	1.2496	8.644	0.5396	0.1157	1.853	137.8
282	78.645	43.70	0.4125	1.2443	8.390	0.5238	0.1192	1.909	138.9
284	78.784	43.77	0.4152	1.2390	8.144	0.5084	0.1228	1.967	140.0
286	78.933	43.86	0.4180	1.2337	7.907	0.4936	0.1265	2.026	141.1
288	79.065	43.93	0.4207	1.2285	7.679	0.4794	0.1302	2.086	142.2
290	79.214	44.01	0.4234	1.2233	7.459	0.4657	0.1342	2.147	143.3
292	79.353	44.09	0.4262	1.2181	7.246	0.4524	0.1380	2.210	144.4
294	79.493	44.17	0.4289	1.2129	7.041	0.4396	0.1420	2.275	145.6
296	79.628	44.24	0.4316	1.2077	6.841	0.4271	0.1462	2.341	146.7
298	79.755	44.31	0.4343	1.2026	6.649	0.4151	0.1504	2.409	147.8
300	79.890	44.39	0.4370	1.1974	6.464	0.4035	0.1547	2.478	148.9
302	80.025	44.46	0.4397	1.1924	6.285	0.3924	0.1590	2.548	150.0
304	80.160	44.54	0.4424	1.1873	6.112	0.3816	0.1636	2.621	151.1
306	80.296	44.61	0.4451	1.1822	5.943	0.3710	0.1683	2.695	152.2
308	80.411	44.68	0.4478	1.1771	5.781	0.3609	0.1730	2.771	153.3
310	80.543	44.75	0.4505	1.1721	5.623	0.3510	0.1778	2.849	154.4
312	80.653	44.81	0.4532	1.1671	5.471	0.3415	0.1828	2.928	155.6
314	80.776	44.88	0.4558	1.1621	5.324	0.3324	0.1878	3.008	156.7
316	80.882	44.94	0.4585	1.1571	5.181	0.3234	0.1930	3.092	157.8
318	81.013	45.01	0.4612	1.1522	5.043	0.3148	0.1983	3.177	158.9
320	81.115	45.07	0.4638	1.1472	4.910	0.3065	0.2037	3.263	160.0

Temperature Degrees Fahrenheit.	Pressure			Heat						Temperature Degrees Centig. ade.
				Of the liquid		Of vaporization		Equivalent of internal work of evapn.		
	Pounds per square inch.	Kilograms per square centimeter.	Millimeters of mercury.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	
t	p	p	p	hf	hf	hfg	hfg	ρ	ρ	t
322	92.21	6.4830	4768.6	292.25	162.37	892.8	496.0	811.6	450.9	161.1
324	94.83	6.6672	4904.1	294.33	163.53	891.3	495.2	810.0	450.0	162.2
326	97.50	6.8549	5042.2	296.41	164.69	889.7	494.3	808.2	449.0	163.3
328	100.23	7.0469	5183.4	298.50	165.85	888.1	493.4	806.6	448.1	164.4
330	103.03	7.2437	5328.2	300.59	167.01	886.5	492.5	804.8	447.1	165.6
332	105.89	7.4448	5476.1	302.67	168.16	885.0	491.7	803.2	446.3	166.7
334	108.82	7.6508	5627.6	304.76	169.32	883.3	490.8	801.4	445.3	167.8
336	111.81	7.8610	5782.3	306.86	170.49	881.7	489.9	799.7	444.4	168.9
338	114.87	8.0762	5940.5	308.95	171.65	880.1	489.0	798.0	443.4	170.0
340	117.99	8.2955	6101.9	311.05	172.82	878.5	488.1	796.3	442.4	171.1
342	121.18	8.5198	6266.8	313.15	173.99	876.8	487.2	794.5	441.5	172.2
344	124.44	8.7490	6435.4	315.24	175.15	875.2	486.3	792.8	440.5	173.3
346	127.77	8.9831	6607.6	317.34	176.31	873.5	485.3	791.0	439.5	174.4
348	131.16	9.2215	6782.9	319.45	177.49	871.9	484.4	789.3	438.5	175.6
350	134.62	9.4647	6961.9	321.55	178.65	870.2	483.5	787.5	437.6	176.7
352	138.15	9.7129	7144.4	323.66	179.83	868.5	482.5	785.7	436.5	177.8
354	141.75	9.9660	7330.6	325.76	180.99	866.8	481.6	784.0	435.6	178.9
356	145.43	10.2247	7520.9	327.87	182.16	865.2	480.7	782.3	434.6	180.0
358	149.18	10.4884	7714.8	329.99	183.34	863.4	479.7	780.4	433.6	181.1
360	153.01	10.7577	7912.9	332.10	184.51	861.7	478.8	778.6	432.6	182.2
362	156.92	11.0326	8115.1	334.21	185.69	860.0	477.8	776.8	431.6	183.3
364	160.91	11.3131	8321.5	336.33	186.86	858.3	476.9	775.1	430.6	184.4
366	164.97	11.5985	8531.4	338.46	188.05	856.5	475.9	773.2	429.6	185.6
368	169.11	11.8896	8745.5	340.58	189.23	854.8	474.9	771.4	428.6	186.7
370	173.33	12.1863	8963.8	342.71	190.41	853.0	473.9	769.5	427.5	187.8
372	177.63	12.4886	9186.1	344.84	191.59	851.2	472.9	767.7	426.5	188.9
374	182.01	12.7966	9412.6	346.97	192.78	849.5	472.0	765.9	425.5	190.0
376	186.48	13.1108	9643.8	349.11	193.97	847.7	471.0	764.0	424.5	191.1
378	191.03	13.4307	9879.1	351.25	195.15	845.9	470.0	762.2	423.5	192.2
380	195.70	13.7591	10120.6	353.39	196.34	844.1	469.0	760.3	422.4	193.3
382	200.44	14.0923	10365.8	355.53	197.53	842.3	468.0	758.4	421.4	194.4
384	205.26	14.4312	10615.0	357.68	198.73	840.4	467.0	756.5	420.4	195.6
386	210.18	14.7771	10869.5	359.83	199.92	838.6	466.0	754.6	419.3	196.7
388	215.19	15.1294	11128.6	361.98	201.12	836.7	464.9	752.7	418.2	197.8
390	220.29	15.4879	11392.3	364.14	202.32	834.9	463.9	750.8	417.2	198.9
392	225.49	15.8535	11661.2	366.29	203.51	833.0	462.8	748.9	416.1	200.0
394	230.79	16.2262	11935.3	368.45	204.71	831.2	461.8	747.1	415.0	201.1
396	236.18	16.6051	12214.0	370.62	205.92	829.3	460.8	745.1	414.0	202.2
398	241.66	16.9904	12497.4	372.79	207.12	827.4	459.7	743.2	412.9	203.3
400	247.25	17.3834	12787	374.96	208.3	825.5	458.6	741.3	411.8	204.4
405	261.67	18.3972	13532	380.40	211.4	820.6	455.9	736.3	409.0	207.2
410	276.72	19.4554	14311	385.86	214.4	815.8	453.3	731.4	406.4	210.0
415	292.44	20.5606	15124	391.34	217.4	810.8	450.5	726.3	403.6	212.8
420	308.82	21.7122	15971	396.84	220.5	805.8	447.7	721.3	400.8	215.6
425	325.91	22.9138	16854	402.36	223.6	800.7	444.9	716.2	396.9	218.3
430	343.71	24.1652	17775	407.91	226.6	795.5	442.0	711.0	395.0	221.1
435	362.27	25.4701	18735	413.48	229.7	790.2	439.0	705.7	392.1	223.9
440	381.59	26.8284	19734	419.07	232.8	784.9	436.1	700.5	389.2	226.7
445	401.70	28.2423	20774	424.68	236.0	779.4	433.0	695.0	386.1	229.4
450	422.61	29.7124	21855	430.3	239.1	773.8	429.9	689.6	383.1	232.2
455	444.35	31.2409	22980	436.0	242.2	768.1	426.8	683.9	380.0	235.0
460	466.94	32.8292	24148	441.7	245.4	762.3	423.5	678.3	376.8	237.8

SATURATED STEAM
ENGLISH UNITS

Temperature Degrees Fahrenheit.	Heat equivalent of external work		Entropy of the liquid.	Entropy of vaporization.	Saturated vapor: Specific volume		Saturated vapor: Density		Temperature Degrees Centigrade.
	B.T.U. per pound.	Calories per kilogram.			Cubic feet per pound.	Cubic meters per kilogram.	Pounds per cubic foot.	Kilograms per cubic meter.	
t	Apv	Apv	Sf	Sfg	vg	vg			t
322	81.231	45.13	0.4665	1.1423	4.781	0.2985	0.2092	3.350	161.1
324	81.347	45.20	0.4691	1.1374	4.656	0.2906	0.2148	3.441	162.2
326	81.455	45.26	0.4718	1.1325	4.534	0.2830	0.2206	3.534	163.3
328	81.548	45.31	0.4744	1.1276	4.417	0.2757	0.2264	3.627	164.4
330	81.654	45.37	0.4770	1.1227	4.303	0.2686	0.2324	3.723	165.6
332	81.766	45.43	0.4797	1.1179	4.192	0.2617	0.2386	3.821	166.7
334	81.875	45.49	0.4823	1.1130	4.086	0.2551	0.2447	3.920	167.8
336	81.974	45.54	0.4849	1.1082	3.982	0.2486	0.2511	4.023	168.9
338	82.093	45.61	0.4875	1.1034	3.882	0.2423	0.2576	4.127	170.0
340	82.184	45.66	0.4901	1.0986	3.784	0.2362	0.2643	4.234	171.1
342	82.300	45.73	0.4927	1.0938	3.690	0.2304	0.2710	4.340	172.2
344	82.396	45.78	0.4953	1.0890	3.598	0.2246	0.2780	4.452	173.3
346	82.498	45.84	0.4979	1.0843	3.509	0.2191	0.2850	4.564	174.4
348	82.576	45.88	0.5005	1.0796	3.422	0.2136	0.2922	4.682	175.6
350	82.688	45.94	0.5031	1.0748	3.338	0.2084	0.2996	4.798	176.7
352	82.761	45.98	0.5057	1.0701	3.257	0.2033	0.3070	4.919	177.8
354	82.846	46.03	0.5082	1.0654	3.178	0.1984	0.3147	5.040	178.9
356	82.926	46.07	0.5108	1.0607	3.101	0.1936	0.3225	5.165	180.0
358	82.995	46.11	0.5134	1.0560	3.026	0.1889	0.3305	5.294	181.1
360	83.088	46.16	0.5160	1.0514	2.954	0.1844	0.3385	5.423	182.2
362	83.151	46.20	0.5185	1.0467	2.884	0.1800	0.3467	5.556	183.3
364	83.241	46.25	0.5211	1.0421	2.815	0.1757	0.3552	5.692	184.4
366	83.328	46.30	0.5237	1.0374	2.749	0.1716	0.3638	5.824	185.6
368	83.386	46.33	0.5262	1.0328	2.684	0.1676	0.3726	5.967	186.7
370	83.479	46.38	0.5288	1.0282	2.622	0.1637	0.3814	6.109	187.8
372	83.546	46.42	0.5313	1.0236	2.561	0.1599	0.3905	6.254	188.9
374	83.620	46.46	0.5339	1.0190	2.502	0.1562	0.3997	6.402	190.0
376	83.673	46.49	0.5364	1.0144	2.444	0.1526	0.4092	6.553	191.1
378	83.736	46.52	0.5390	1.0098	2.388	0.1491	0.4189	6.707	192.2
380	83.793	46.56	0.5415	1.0053	2.333	0.1456	0.4286	6.868	193.3
382	83.857	46.59	0.5440	1.0008	2.280	0.1423	0.4386	7.027	194.4
384	83.900	46.61	0.5466	0.9962	2.228	0.1391	0.4488	7.189	195.6
386	83.967	46.65	0.5491	0.9917	2.178	0.1360	0.4591	7.353	196.7
388	84.018	46.68	0.5516	0.9872	2.129	0.1329	0.4697	7.524	197.8
390	84.058	46.71	0.5542	0.9826	2.0816	0.1300	0.4804	7.692	198.9
392	84.107	46.73	0.5567	0.9782	2.0352	0.1271	0.4914	7.868	200.0
394	84.142	46.75	0.5592	0.9737	1.9898	0.1242	0.5026	8.052	201.1
396	84.163	46.76	0.5617	0.9692	1.9453	0.1214	0.5141	8.237	202.3
398	84.194	46.78	0.5642	0.9647	1.9023	0.1188	0.5257	8.418	203.3
400	84.239	46.80	0.5668	0.9602	1.8608	0.1162	0.537	8.606	204.4
405	84.346	46.86	0.5730	0.9491	1.7615	0.1100	0.568	9.091	207.2
410	84.412	46.90	0.5792	0.9381	1.6681	0.1041	0.599	9.606	210.0
415	84.458	46.92	0.5854	0.9271	1.5804	0.09866	0.633	10.14	212.8
420	84.488	46.94	0.5916	0.9161	1.4982	0.09353	0.663	10.69	215.6
425	84.522	46.96	0.5978	0.9052	1.4212	0.08872	0.704	11.27	218.3
430	84.517	46.96	0.6039	0.8942	1.3486	0.08419	0.742	11.88	221.1
435	84.491	46.94	0.6101	0.8833	1.2802	0.07992	0.781	12.51	223.9
440	84.445	46.92	0.6162	0.8724	1.2158	0.07590	0.823	13.18	226.7
445	84.371	46.88	0.6224	0.8616	1.1550	0.07210	0.866	13.87	229.4
450	84.173	46.77	0.6284	0.8507	1.0977	0.06853	0.911	14.59	232.2
455	84.165	46.76	0.6346	0.8398	1.0436	0.06515	0.958	15.35	235.0
460	84.031	46.69	0.6407	0.8290	0.9927	0.06197	1.007	16.14	237.8

Temperature Degrees Fahrenheit.	Pressure			Heat						Temperature Degrees Centigrade.
				Of the liquid		Of vaporization		Equivalent of internal work of evapn.		
	Pounds per square inch.	Kilograms per square centimeter.	Millimeters of mercury.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	B.T.U. per pound.	Calories per kilogram.	
t	p	p	p	hf	hf	hfg	hfg	ρ	ρ	t
465	490.40	34.4786	25361	447.4	248.6	756.4	420.3	672.5	373.7	240.6
470	514.76	36.1912	26621	453.2	251.8	750.3	416.9	666.6	370.4	243.3
475	540.04	37.9686	28445	459.1	255.1	744.1	413.4	660.6	367.0	246.1
480	566.26	39.8120	29284	465.0	258.4	737.8	409.9	654.5	363.6	248.9
485	593.47	41.7251	30691	470.9	261.6	731.3	406.3	648.3	360.2	251.7
490	621.67	43.7078	32150	477.0	265.0	724.7	402.6	642.0	356.6	254.4
495	650.87	45.7607	33660	483.0	268.4	718.0	398.9	635.6	353.1	257.2
500	681.09	47.8854	35223	489.1	271.7	711.1	395.1	629.0	349.5	260.0
505	712.40	50.0867	36842	495.3	275.2	704.1	391.2	622.4	345.8	262.8
510	744.74	52.3604	38514	501.6	278.7	696.9	387.2	615.6	342.0	265.6
515	778.16	54.7101	40243	507.8	282.1	689.6	383.1	608.7	338.2	268.3
520	812.72	57.1399	42030	514.2	285.7	682.1	379.0	601.7	334.3	271.1
525	848.43	59.6506	43877	520.5	289.2	674.6	374.8	594.7	330.4	273.9
530	885.31	62.2435	45784	527.0	292.8	666.8	370.5	587.5	326.4	276.7
535	923.39	64.9208	47753	533.4	296.4	659.0	366.1	580.2	322.3	279.4
540	962.73	67.6867	49788	540.0	300.0	651.0	361.7	572.8	318.2	282.2
545	1003.4	70.5460	51891	546.6	303.7	642.8	357.1	565.2	314.0	285.0
550	1045.4	73.4989	54063	553.2	307.4	634.5	352.5	557.5	309.7	287.8
555	1088.7	76.5432	56302	560.0	311.1	626.1	347.9	549.8	305.5	290.6
560	1133.4	79.6860	58614	566.7	314.9	617.5	343.1	541.9	301.1	293.3
565	1179.7	82.9412	61008	573.6	318.7	608.7	338.2	533.9	296.6	296.1
570	1227.6	86.3089	63485	580.4	322.5	599.7	333.2	525.7	292.1	298.9
575	1276.7	89.7609	66025	587.4	326.4	590.6	328.1	517.4	287.4	301.7
580	1327.2	93.3115	68636	594.4	330.2	581.3	323.0	508.9	282.8	304.4
585	1379.2	96.9674	71325	601.5	334.2	571.8	317.7	500.3	278.0	307.2
590	1432.7	100.729	74092	608.7	338.2	562.2	312.4	491.6	273.2	310.0
595	1487.8	104.603	76942	615.9	342.2	552.3	306.9	482.7	268.2	312.8
600	1544.6	108.596	79879	623.2	346.2	542.3	301.3	473.7	263.2	315.6
605	1603.0	112.702	82899	630.6	350.4	532.0	295.6	464.5	258.1	318.3
610	1663.2	116.935	86012	638.0	354.5	521.4	289.7	455.0	252.8	321.1
615	1725.1	121.287	89214	645.6	358.7	510.5	283.6	445.3	247.4	323.9
620	1788.8	125.765	92508	653.4	363.0	499.2	277.4	435.2	241.9	326.7
625	1854.4	130.377	95900	661.3	367.4	487.3	270.7	424.7	235.9	329.4
630	1921.9	135.123	99391	669.5	372.0	474.8	263.8	413.6	229.8	332.2
635	1991.4	140.009	102985	677.9	376.6	461.7	256.5	402.0	223.3	335.0
640	2062.8	145.029	106678	686.6	381.5	447.9	248.9	389.8	216.6	337.8
645	2136.0	150.176	110463	695.7	386.5	433.2	240.7	376.9	209.4	340.6
650	2211.4	155.477	114363	705.2	391.8	417.7	232.1	363.3	201.8	343.3
655	2289.0	160.933	118376	715.0	397.3	401.2	222.9	348.7	193.8	346.1
660	2368.6	166.529	122492	725.3	403.0	383.6	213.1	333.3	185.2	348.9
665	2450.3	172.273	126717	736.1	409.0	364.7	202.6	316.8	176.0	351.7
670	2534.2	178.172	131056	747.5	415.3	344.4	191.3	299.1	166.1	354.4
675	2620.6	184.247	135524	759.6	422.0	322.5	179.2	280.1	155.7	357.2
680	2709.7	190.511	140132	772.6	429.3	298.5	165.8	259.4	144.0	360.0
685	2801.7	196.979	144890	786.9	437.2	271.8	151.0	236.3	131.2	362.8
690	2896.8	203.665	149808	803.0	446.1	241.2	134.0	209.6	116.5	365.6
695	2994.9	210.562	154881	822.0	456.7	204.6	113.7	177.8	98.8	368.3
700	3096.4	217.699	160130	846.3	470.2	157.0	87.2	136.8	76.0	371.1
705	3202.0	225.123	165591	888.3	493.5	73.4	40.8	65.4	36.4	373.9
706.1	3226.0	226.810	166832	925.0	513.9	0	0	0	0	374.4

SATURATED STEAM
ENGLISH UNITS

Temperature Degrees Fahrenheit.	Heat equivalent of external work		Entropy of the liquid.	Entropy of vaporization.	Saturated vapor: Specific volume		Saturated vapor: Density		Temperature Degrees Centigrade.
	B.T.U. per pound.	Calories per kilogram.			Cubic feet per pound.	Cubic meters per kilogram.	Pounds per cubic foot.	Kilograms per cubic meter.	
t	Apv	Apv	Sf	Sfg	vg	vg			t
465	83.890	46.61	0.6468	0.8180	0.9446	0.05897	1.059	16.96	240.6
470	83.715	46.51	0.6530	0.8071	0.8991	0.05613	1.112	17.82	243.3
475	83.512	46.40	0.6592	0.7962	0.8560	0.05344	1.168	18.71	246.1
480	83.272	46.27	0.6654	0.7852	0.8151	0.05087	1.227	19.66	248.9
485	83.015	46.12	0.6716	0.7742	0.7764	0.04847	1.288	20.63	251.7
490	82.728	45.96	0.6779	0.7632	0.7398	0.04618	1.352	21.65	254.4
495	82.425	45.80	0.6842	0.7521	0.7050	0.04401	1.418	22.72	257.2
500	82.082	45.60	0.6904	0.7410	0.6721	0.04195	1.488	23.84	260.0
505	81.705	45.40	0.6968	0.7299	0.6408	0.04000	1.560	25.00	262.8
510	81.309	45.18	0.7031	0.7187	0.6110	0.03814	1.637	26.22	265.6
515	80.856	44.92	0.7094	0.7075	0.5826	0.03637	1.716	27.50	268.3
520	80.374	44.66	0.7158	0.6963	0.5557	0.03469	1.800	28.83	271.1
525	79.873	44.38	0.7222	0.6851	0.5301	0.03309	1.886	30.22	273.9
530	79.333	44.08	0.7286	0.6738	0.5058	0.03158	1.977	31.67	276.7
535	78.819	43.79	0.7350	0.6625	0.4828	0.03014	2.071	33.18	279.4
540	78.240	43.47	0.7414	0.6512	0.4610	0.02878	2.169	34.75	282.2
545	77.648	43.14	0.7478	0.6399	0.4401	0.02747	2.272	36.40	285.0
550	76.992	42.78	0.7543	0.6285	0.4201	0.02623	2.380	38.12	287.8
555	76.295	42.39	0.7607	0.6170	0.4010	0.02503	2.494	39.95	290.6
560	75.570	41.99	0.7672	0.6056	0.3828	0.02390	2.612	41.84	293.3
565	74.817	41.57	0.7737	0.5940	0.3654	0.02281	2.737	43.84	296.1
570	74.041	41.14	0.7802	0.5825	0.3488	0.02177	2.867	45.93	298.9
575	73.224	40.68	0.7867	0.5709	0.3330	0.02079	3.003	48.10	301.7
580	72.389	40.22	0.7932	0.5592	0.3180	0.01985	3.145	50.38	304.4
585	71.527	39.74	0.7998	0.5474	0.3037	0.01896	3.293	52.74	307.2
590	70.592	39.22	0.8064	0.5356	0.2900	0.01810	3.448	55.25	310.0
595	69.619	38.68	0.8131	0.5237	0.2769	0.01729	3.611	57.84	312.8
600	68.592	38.11	0.8198	0.5118	0.2642	0.01649	3.785	60.64	315.6
605	67.538	37.52	0.8265	0.4997	0.2522	0.01574	3.965	63.53	318.3
610	66.414	36.90	0.8332	0.4875	0.2406	0.01502	4.156	66.58	321.1
615	65.217	36.23	0.8401	0.4751	0.2294	0.01432	4.359	69.83	323.9
620	63.952	35.53	0.8470	0.4623	0.2186	0.01365	4.575	73.26	326.7
625	62.594	34.78	0.8540	0.4493	0.2082	0.01300	4.803	76.92	329.4
630	61.175	33.99	0.8612	0.4358	0.1982	0.01237	5.045	80.84	332.2
635	59.667	33.15	0.8686	0.4218	0.1885	0.01177	5.305	84.96	335.0
640	58.068	32.26	0.8763	0.4073	0.1791	0.01106	5.583	90.42	337.8
645	56.296	31.28	0.8842	0.3922	0.1699	0.01061	5.885	94.25	340.6
650	54.439	30.25	0.8924	0.3764	0.1610	0.01005	6.211	99.50	343.3
655	52.454	29.14	0.9009	0.3599	0.1522	0.009502	6.570	105.2	346.1
660	50.292	27.94	0.9097	0.3426	0.1437	0.008971	6.959	111.5	348.9
665	47.902	26.61	0.9190	0.3243	0.1353	0.008447	7.391	118.4	351.7
670	45.278	25.16	0.9287	0.3049	0.1269	0.007922	7.880	126.2	354.4
675	42.362	23.54	0.9389	0.2842	0.1186	0.007404	8.432	135.1	357.2
680	39.141	21.75	0.9499	0.2619	0.1102	0.006880	9.075	145.3	360.0
685	35.547	19.75	0.9620	0.2374	0.1019	0.006361	9.814	157.2	362.8
690	31.557	17.53	0.9755	0.2098	0.0936	0.005843	10.68	171.1	365.6
695	26.754	14.86	0.9914	0.1772	0.0848	0.005294	11.79	188.9	368.3
700	20.216	11.23	1.0117	0.1354	0.0747	0.004663	13.39	214.5	371.1
705	7.995	4.44	1.0472	0.0630	0.0597	0.003727	16.75	268.3	373.9
706.1	0	0	1.0785	0	0.0522	0.003259	19.16	306.8	374.4

ORTHOBARIC DENSITIES OR VOLUMES OF VARIOUS SUBSTANCES

Acetic Acid CH_3CO_2H

°C	atm	*d liq*, g/cc	*d vap*, g/cc
118.5(*l*)	1.000	0.9380	0.003150
120	1.058	0.9362	0.003271
130	1.426	0.9235	0.004275
140	1.884	0.9091	0.005515
150	2.452	0.8963	0.00703
160	3.149	0.8829	0.00887
170	3.994	0.8694	0.01084
180	5.014	0.8555	0.01370
190	6.233	0.8413	0.01681
200	7.682	0.8265	0.02052
210	9.391	0.8109	0.02488
220	11.39	0.7941	0.03021
230	13.73	0.7764	0.03626
240	16.42	0.7571	0.04327
250	19.52	0.7364	0.05163
260	23.07	0.7136	0.06165
270	27.11	0.6900	0.07365
280	31.67	0.6629	0.0883
290	36.79	0.6334	0.1073
300	42.54	0.5950	0.1331
310	48.93	0.5423	0.1718
320	56.01	0.4615	0.2417
321.6	57.21	0.3506	0.3506

Acetone CH_3COCH_3

°C	atm	*d liq*, g/cc	*d vap*, g/cc
56.1(*l*)	1.000	0.750	0.002
60	1.14	0.746	0.003
70	1.58	0.734	0.003
80	2.12	0.719	0.004
90	2.81	0.706	0.005
100	3.67	0.693	0.007
110	4.74	0.679	0.009
120	6.01	0.665	0.011
130	7.53	0.650	0.013
140	9.33	0.634	0.016
150	11.5	0.618	0.020
160	13.9	0.601	0.024
170	16.6	0.588	0.030
180	20.0	0.568	0.039
190	23.8	0.540	0.050
200	28.0	0.514	0.065
210	32.7	0.482	0.085
220	38.1	0.443	0.110
230	44.1	0.393	0.152
235	47.0	0.268	0.268

Acetonitrile CH_3CN

°C	atm	*d liq*, g/cc	*d vap*, g/cc
80(*l*)	.....	0.717	0.001
90	.....	0.706	0.002
100	.....	0.694	0.002
110	.....	0.682	0.003
120	.....	0.670	0.004
130	.....	0.658	0.005

Acetonitrile CH_3CN

C°	atm	*d liq*, g/cc	*dvap*, g/cc
140	.....	0.646	0.007
150	.....	0.633	0.009
160	.....	0.620	0.011
170	.....	0.605	0.013
180	.....	0.590	0.015
190	.....	0.573	0.018
200	.....	0.555	0.022
210	.....	0.536	0.027
220	.....	0.514	0.034
230	.....	0.492	0.042
240	.....	0.467	0.053
250	.....	0.439	0.068
260	.....	0.399	0.091
270	.....	0.342	0.139
274.7	.....	0.240	0.240

Acetylene C_2H_2

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−84.0(s)	1.00	.....	.....
−81.5(t.p)	1.20	0.618	0.0021
−70(*l*)	2.20	0.601	0.0036
−60	3.48	0.585	0.0056
−50	5.3	0.568	0.0085
−40	7.7	0.551	0.012
−30	10.9	0.532	0.017
−20	14.9	0.512	0.024
−10	20.0	0.490	0.033
0	26.3	0.464	0.045
+10	33.9	0.435	0.060
20	43.1	0.400	0.082
30	54.1	0.346	0.122
36.0	61.7	0.230	0.230

Ammonia NH_3

°C	atm	*V liq*, cc/g	*V vap*, cc/g
−75(*l*)	0.0738	1.3681	12781
−70	0.1078	1.3788	8976.2
−65	0.1541	1.3898	6429.9
−60	0.2161	1.4010	4690.3
−55	0.2977	1.4126	3479.0
−50	0.4034	1.4245	2620.7
−45	0.5383	1.4367	2002.4
−40	0.7083	1.4493	1550.2
−35	0.9197	1.4623	1214.8
−30	1.1799	1.4757	962.82
−25	1.4963	1.4895	771.06
−20	1.8774	1.5037	623.48
−15	2.3322	1.5185	508.68
−10	2.8703	1.5338	418.46
− 5	3.5020	1.5496	346.90
0	4.2380	1.5660	289.62
+ 5	5.0895	1.5831	243.39
10	6.0685	1.6008	205.79
15	7.1875	1.6193	174.97
20	8.4585	1.6386	149.53

ORTHOBARIC DENSITIES OR VOLUMES OF VARIOUS SUBSTANCES

Ammonia (Cont.)

°C	atm	V_{liq}, cc/g	V_{vap}, cc/g
25	9.8955	1.6588	128.40
30	11.512	1.6800	110.73
35	13.321	1.7023	95.865
40	15.339	1.7257	83.290
45	17.580	1.7504	72.594
50	20.059	1.7766	63.448
55	22.793	1.8044	.....
60	25.797	1.8341	48.8
65	29.089	1.8658	.....
70	32.687	1.9000	37.7
75	36.626	1.9370	.....
80	40.902	1.9774	29.3
85	45.539	2.0217	.....
90	50.558	2.0708	22.8
95	55.977	2.1258	.....
100	61.816	2.1885	17.6
105	68.096	2.2612	.....
110	74.837	2.3478	.....
115	82.064	2.4548	.....
120	89.802	2.5948	.....
125	98.075	2.7979	.....
130	106.913	3.1769	.....
132.9	112.3	4.2830	4.2830

Argon A

°C	atm	d_{liq}, g/cc	d_{vap}, g/cc
−183.15(*l*)	.....	1.37396	0.00801
−175.39	.....	1.32482	0.01457
−161.23	7.4332	1.22414	0.03723
−150.76	.....	1.13851	0.06785
−135.51	.....	0.97385	0.15994
−125.17	.....	0.77289	0.29534
−122.44	47.996	0.53078	0.53078

Benzene C_6H_6

°C	atm	d_{liq}, g/cc	d_{vap}, g/cc
80.2(*l*)	1.000	.....	.....
90	1.326	0.8041	0.0036
100	1.757	0.7927	0.0047
110	2.290	0.7809	0.0060
120	2.934	0.7692	0.0077
130	3.71	0.7568	0.0096
140	4.63	0.7440	0.0118
150	5.70	0.7310	0.0144
160	6.97	0.7185	0.0173
170	8.40	0.7043	0.0209
180	10.03	0.6906	0.0249
190	11.90	0.6758	0.0298
200	14.01	0.6605	0.0355
210	16.38	0.6432	0.0421
220	19.11	0.6255	0.0502
230	22.13	0.6065	0.0598
240	25.46	0.5851	0.0714
250	29.21	0.5609	0.0855
260	33.36	0.5328	0.1038

Benzene C_6H_6

°C	atm	d_{liq}, g/cc	d_{vap}, g/cc
270	37.96	0.4984	0.1287
280	43.16	0.4514	0.1660
288.5	47.90	0.3045	0.3045

Bromobenzene C_6H_5Br

°C	atm	d_{liq}, g/cc	d_{vap}, g/cc
156.15(*l*)	1.000	.....	.....
160	1.11	1.2994	0.0052
170	1.42	1.2847	0.0066
180	1.78	1.2697	0.0081
190	2.22	1.2534	0.0099
200	2.73	1.2385	0.0121
210	3.32	1.2210	0.0146
220	4.02	1.2037	0.0174
230	4.82	1.1876	0.0208
240	5.74	1.1689	0.0248
250	6.79	1.1510	0.0293
260	8.00	1.1310	0.0343
270	9.35	1.1099	0.0402
397	44.61	0.4859	0.4859

n-Butyric Acid $C_3H_7CO_2H$

°C	atm	d_{liq}, g/cc	d_{vap}, g/cc
160(*l*)	.....	0.818	0.003
170	.....	0.807	0.003
180	.....	0.796	0.004
190	.....	0.784	0.005
200	.....	0.771	0.007
210	.....	0.758	0.009
220	.....	0.744	0.012
230	.....	0.730	0.015
240	.....	0.715	0.018
250	.....	0.700	0.022
260	.....	0.685	0.027
270	.....	0.669	0.032
280	.....	0.652	0.038
290	.....	0.633	0.045
300	.....	0.612	0.053
355	.....	0.302	0.302

iso-Butyric Acid $C_3H_7CO_2H$

°C	atm	d_{liq}, g/cc	d_{vap}, g/cc
150(*l*)	.....	0.812	0.003
160	.....	0.801	0.004
170	.....	0.789	0.005
180	.....	0.777	0.007
190	.....	0.764	0.009
200	.....	0.751	0.012
210	.....	0.737	0.015
220	.....	0.723	0.018
230	.....	0.708	0.022
240	.....	0.692	0.026
250	.....	0.675	0.032
260	.....	0.657	0.039

ORTHOBARIC DENSITIES OR VOLUMES OF VARIOUS SUBSTANCES

iso-Butyric Acid (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
270	.....	0.638	0.047
280	.....	0.617	0.056
290	.....	0.594	0.067
300	.....	0.569	0.080
336	.....	0.304	0.304

Carbon Dioxide CO_2

°C	atm	*V liq*, cc/g	*V vap*, cc/g
−56.6(*l*)	5.1148	0.8482	.....
−56	5.2485	0.8496	.....
−54	5.7156	0.8554	.....
−52	6.2139	0.8606	.....
−50	6.7446	0.8658	.....
−48	7.3089	0.8718	.....
−46	7.9078	0.8780	.....
−44	8.5426	0.8834	.....
−42	9.2147	0.8897	.....
−40	9.9251	0.8961	.....
−38	10.675	0.9025	.....
−36	11.466	0.9091	.....
−34	12.299	0.9158	.....
−32	13.176	0.9226	.....
−30	14.099	0.9302	27.19
−28	15.067	0.9381	25.40
−26	16.084	0.9452	23.71
−24	17.150	0.9533	22.11
−22	18.267	0.9615	20.62
−20	19.437	0.9699	19.22
−18	20.661	0.9794	17.95
−16	21.940	0.9892	16.78
−14	23.277	0.9990	15.70
−12	24.673	1.0091	14.73
−10	26.129	1.0194	13.83
− 8	27.648	1.0309	13.01
− 6	29.231	1.0428	12.25
− 4	30.879	1.0548	11.54
− 2	32.595	1.0683	10.88
0	34.379	1.0810	10.26
+ 2	36.235	1.0953	9.68
4	38.163	1.1099	9.13
6	40.166	1.1261	8.59
8	42.247	1.1442	8.06
10	44.406	1.1628	7.57
12	46.648	1.1834	7.04
14	48.974	1.2063	6.58
16	51.388	1.2330	6.14
18	53.895	1.2626	5.68
20	56.495	1.2953	5.26
22	59.197	1.3351	4.83
24	62.006	1.3831	4.39
26	64.928	1.4430	3.97
28	67.971	1.5267	3.53
30	71.143	1.6722	3.00
31.1	72.947	2.1547	2.15

Carbon Disulfide CS_2

°C	atm	*d liq*, g/cc	*d vap*, g/cc
46.25(*l*)	1.00	1.225	.....
52.17	.....	.....	0.003559
53.53	.....	.....	0.003709
57.08	.....	.....	0.004064
59.95	.....	.....	0.004452
64.24	.....	.....	0.005000
66.96	.....	.....	0.005376
70.10	.....	.....	0.005797
75.55	.....	.....	0.006658
78.82	.....	.....	0.007288
85.03	.....	.....	0.008361
99.24	.....	.....	0.01167
130.48	.....	.....	0.02166
159.10	.....	.....	0.03484
171.52	.....	.....	0.04185
183.48	.....	.....	0.05846
193.05	.....	.....	0.07309
209.32	.....	.....	0.09907
217.35	.....	.....	0.1163
229.46	.....	.....	0.1420
262.8	.....	.....	0.2570
271.6	.....	.....	0.3215
273.0	75	0.3679	0.3679

Carbon Monoxide CO

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−192(*l*)	1.0	0.803	0.0044
−190	1.2	0.794	0.0054
−180	3.2	0.748	0.013
−170	6.7	0.697	0.027
−160	12.4	0.639	0.046
−150	20.9	0.560	0.088
−140	33.2	0.420	0.190
−139	35	0.303	0.303

Carbon Tetrachloride CCl_4

°C	atm	*d liq*, g/cc	*d vap*, g/cc
76.75(*l*)	1.000	.....	.....
80	1.103	1.4765	0.0061
90	1.463	1.4554	0.0080
100	1.917	1.4343	0.0103
110	2.474	1.4124	0.0131
120	3.145	1.3902	0.0164
130	3.947	1.3680	0.0204
140	4.901	1.3450	0.0250
150	5.993	1.3215	0.0304
160	7.283	1.2983	0.0365
170	8.737	1.2734	0.0437
180	10.39	1.2470	0.0525
190	12.26	1.2192	0.0625
200	14.39	1.1888	0.0742
210	16.79	1.1566	0.0879
220	19.46	1.1227	0.1040
230	22.45	1.0857	0.1232
240	25.79	1.0444	0.1464

ORTHOBARIC DENSITIES OR VOLUMES OF VARIOUS SUBSTANCES

Carbon Tetrachloride (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
250	29.49	0.9980	0.1754
260	33.60	0.9409	0.2146
270	38.16	0.8666	0.2710
280	43.16	0.7634	0.3597
283.15	45.00	0.5576	0.5576

Chlorine Cl_2

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−34.6 (*l*)	1.00	1.561	.....
−30	1.23	1.550	.....
−20	1.84	1.524	.....
−10	2.61	1.496	.....
0	3.65	1.468	0.0128
+10	4.96	1.438	0.0175
20	6.57	1.408	0.0226
30	8.60	1.377	0.0300
40	11.1	1.344	0.0384
50	14.1	1.310	0.0486
60	17.6	1.275	0.0600
70	21.6	1.240	0.0740
80	26.2	1.199	0.0910
90	31.5	1.156	0.1125
100	37.6	1.109	0.136
110	44.4	1.059	0.164
120	52.4	0.998	0.206
130	61.4	0.920	0.258
140	71.4	0.750	0.405
144	76.1	0.573	0.573

Chlorobenzene C_6H_5Cl

°C	atm	*d liq*, g/cc	*d vap*, g/cc
132 (*l*)	1.000	.....	.....
140	1.236	0.9723	0.0043
150	1.590	0.9599	0.0054
160	2.020	0.9480	0.0068
170	2.526	0.9354	0.0084
180	3.118	0.9224	0.0102
190	3.816	0.9091	0.0125
200	4.632	0.8955	0.0151
210	5.566	0.8815	0.0181
220	6.651	0.8672	0.0214
230	7.882	0.8518	0.0254
240	9.276	0.8356	0.0300
250	10.88	0.8196	0.0354
260	12.70	0.8016	0.0417
270	14.73	0.7834	0.0492
359.2	44.61	0.3654	0.3654

Cyclohexane C_6H_{12}

°C	atm	*d liq*, g/cc	*d vap*, g/cc
80.75 (*l*)	1.000	0.7199	0.0029
90	1.307	0.7098	0.0038
100	1.716	0.6988	0.0049
110	2.220	0.6883	0.0063
120	2.816	0.6775	0.0080

Cyclohexane (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
130	3.536	0.6667	0.0100
140	4.414	0.6553	0.0123
150	5.447	0.6435	0.0150
160	6.632	0.6313	0.0184
170	8.020	.....	.....
180	9.586	0.6060	0.0265
190	11.36	0.5917	0.0317
200	13.33	0.5773	0.0380
210	15.56	0.5614	0.0450
220	18.01	0.5443	0.0534
230	20.80	0.5257	0.0632
240	23.87	0.5058	0.0746
250	27.24	0.4824	0.0896
260	31.04	0.4537	0.1097
270	35.30	0.4154	0.1401
281.0	40.59	0.2703	0.2703

Diethylamine $NH(C_2H_5)_2$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
55.4 (*l*)	1.000	0.668	0.003
60	1.16	0.663	0.003
70	1.59	0.652	0.004
80	2.13	0.640	0.005
90	2.82	0.628	0.006
100	3.67	0.616	0.008
110	4.70	0.604	0.011
120	5.92	0.591	0.014
130	7.39	0.577	0.018
140	9.10	0.562	0.022
150	11.1	0.546	0.028
160	13.4	0.528	0.035
170	15.9	0.510	0.043
180	18.9	0.489	0.053
190	22.2	0.466	0.065
200	25.8	0.438	0.080
210	30.0	0.400	0.103
220	34.4	0.339	0.150
223.5	36.2	0.246	0.246

Ethane C_2H_6

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−88.62 (*l*)	1.000	0.546	0.00206
−80	1.556	0.535	0.00311
−70	2.471	0.522	0.00478
−60	3.743	0.509	0.00707
−50	5.449	0.496	0.0101
−40	7.672	0.482	0.0141
−30	10.50	0.468	0.0193
−20	14.02	0.453	0.0260
−10	18.34	0.435	0.0348
0	23.56	0.416	0.0463
+10	29.83	0.393	0.0619
20	37.28	0.363	0.085
30	46.1	0.30	0.14
32.2	48.2	0.220	0.220

ORTHOBARIC DENSITIES OR VOLUMES OF VARIOUS SUBSTANCES

Ethyl Acetate $CH_3CO_2C_2H_5$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
77.15(*l*)	1.000	0.8283	0.003230
80	1.093	0.8245	0.003495
90	1.494	0.8112	0.004677
100	2.000	0.7972	0.006158
110	2.630	0.7831	0.008006
120	3.404	0.7683	0.01030
130	4.340	0.7533	0.01314
140	5.461	0.7378	0.01650
150	6.789	0.7210	0.02070
160	8.349	0.7033	0.02577
170	10.17	0.6848	0.03165
180	12.27	0.6653	0.03883
190	14.68	0.6441	0.04751
200	17.45	0.6210	0.05797
210	20.59	0.5944	0.07128
220	24.15	0.5648	0.08905
230	28.16	0.5281	0.1131
240	32.68	0.4778	0.1499
245	35.14	0.4401	0.1802
250.1	37.80	0.3077	0.3077

Ethyl Alcohol C_2H_5OH

°C	atm	*d liq*, g/cc	*d vap*, g/cc
78.3(*l*)	1.000	0.7365	0.00165
80	1.069	0.7348	0.00174
90	1.562	0.7251	0.00250
100	2.228	0.7157	0.00351
110	3.107	0.7057	0.00486
120	4.243	0.6925	0.00658
130	5.685	0.6789	0.00877
140	7.486	0.6631	0.01152
150	9.700	0.6489	0.01488
160	12.39	0.6329	0.01916
170	15.61	0.6165	0.02446
180	19.44	0.5984	0.03115
190	23.94	0.5782	0.0397
200	29.20	0.5568	0.0508
210	35.31	0.5291	0.0655
220	42.38	0.4958	0.0854
230	50.53	0.4550	0.1135
240	59.92	0.3825	0.1715
243.1	63.11	0.2755	0.2755

Ethyl Chloride C_2H_5Cl

°C	atm	*d liq*, g/cc	*d vap*, g/cc
12.2(*l*)	1.00	0.9060	0.00285
20	1.33	0.8943	0.00372
30	1.86	0.8790	0.00513
40	2.55	0.8633	0.00692
50	3.42	0.8472	0.00917
60	4.50	0.8306	0.0120
70	5.82	0.8134	0.0152
80	7.41	0.7958	0.0190
90	9.31	0.7770	0.0236
100	11.5	0.7575	0.0294

Ethyl Chloride (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
110	14.2	0.737	0.035
120	17.2	0.715	0.043
130	20.7	0.691	0.052
140	24.7	0.665	0.064
150	29.2	0.636	0.079
160	34.3	0.602	0.099
170	40.1	0.559	0.128
180	46.6	0.494	0.178
187	51.6	0.331	0.331

Ethylene C_2H_4

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−103.8(*l*)	1.00	0.569	0.0022
−100	1.24	0.564	0.0026
− 90	2.10	0.549	0.0041
− 80	3.35	0.534	0.0063
− 70	5.07	0.517	0.0093
− 60	7.38	0.500	0.0133
− 50	10.4	0.481	0.019
− 40	14.2	0.461	0.025
− 30	18.9	0.439	0.034
− 20	24.8	0.414	0.046
− 10	31.9	0.384	0.062
0	40.6	0.345	0.088
+ 9.6	50.6	0.210	0.210

Ethyl Ether $(C_2H_5)_2O$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
34.6(*l*)	1.000	0.6962	0.003162
40	1.212	0.6894	0.003731
50	1.680	0.6764	0.005079
60	2.275	0.6658	0.006771
70	3.021	0.6532	0.00892
80	3.939	0.6402	0.01155
90	5.054	0.6250	0.01477
100	6.394	0.6105	0.01867
110	7.987	0.5942	0.02349
120	9.861	0.5764	0.02934
130	12.05	0.5580	0.03638
140	14.58	0.5385	0.04488
150	17.48	0.5179	0.05551
160	20.80	0.4947	0.06911
170	24.57	0.4658	0.08731
180	28.81	0.4268	0.1135
185	31.12	0.4018	0.1320
190	33.57	0.3663	0.1620
193.8	35.52	0.2625	0.2625

Ethyl Formate $HCO_2C_2H_5$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
54.35(*l*)	1.000	0.8767	0.002843
60	1.208	0.8689	0.003370
70	1.667	0.8552	0.004570
80	2.251	0.8409	0.006098
90	2.983	0.8262	0.007994

ORTHOBARIC DENSITIES OR VOLUMES OF VARIOUS SUBSTANCES

Ethyl Formate (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
100	3.883	0.8112	0.01032
110	4.978	0.7955	0.01312
120	6.290	0.7796	0.01657
130	7.846	0.7628	0.02073
140	9.674	0.7448	0.02564
150	11.80	0.7257	0.03164
160	14.26	0.7058	0.03876
170	17.07	0.6843	0.04739
180	20.28	0.6610	0.05747
190	23.91	0.6355	0.07018
200	28.00	0.6066	0.08621
210	32.59	0.5724	0.1073
220	37.70	0.5290	0.1379
225	40.47	0.5014	0.1587
230	43.39	0.4635	0.1890
235.3	46.65	0.3232	0.3232

Ethyl Mercaptan C_2H_5SH

°C	atm	*d liq*, g/cc	*d vap*, g/cc
34.4(*l*)	1.000	0.822	0.002
40	1.21	0.815	0.003
50	1.66	0.803	0.003
60	2.22	0.790	0.004
70	2.95	0.777	0.006
80	3.84	0.762	0.007
90	4.92	0.749	0.009
100	6.24	0.735	0.012
110	7.80	0.721	0.015
120	9.64	0.706	0.019
130	11.8	0.689	0.023
140	14.3	0.672	0.029
150	17.2	0.653	0.036
160	20.5	0.634	0.044
170	24.2	0.613	0.054
180	28.2	0.590	0.065
190	33.0	0.564	0.079
200	38.2	0.534	0.095
210	44.1	0.499	0.117
220	50.5	0.444	0.161
225.5	54.2	0.301	0.301

Ethyl Propionate $C_2H_5CO_2C_2H_5$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
99.0	1.000	0.7964	0.003489
100	1.027	0.7951	0.003580
110	1.383	0.7823	0.004748
120	1.828	0.7692	0.00620
130	2.376	0.7548	0.00800
140	3.042	0.7413	0.01024
150	3.840	0.7267	0.01292
160	4.788	0.7115	0.01615
170	5.904	0.6958	0.02004
180	7.206	0.6795	0.02469
190	8.727	0.6625	0.03012

Ethyl Propionate (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
200	10.45	0.6443	0.03676
210	12.45	0.6243	0.04464
220	14.73	0.6027	0.05435
230	17.33	0.5784	0.06667
240	20.28	0.5501	0.08230
250	23.62	0.5181	0.1030
260	27.40	0.4744	0.1337
265	29.48	0.4459	0.1562
270	31.69	0.4018	0.1957
272.9	33.03	0.2965	0.2965

Ethyl Propyl Ether $C_2H_5OC_3H_7$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
61.4(*l*)	1.000	0.682	0.008
70	1.30	0.672	0.010
80	1.73	0.659	0.013
90	2.27	0.646	0.015
100	2.94	0.633	0.018
110	3.76	0.620	0.021
120	4.72	0.607	0.025
130	5.89	0.593	0.029
140	7.28	0.579	0.032
150	8.89	0.564	0.036
160	10.7	0.548	0.041
170	12.9	0.530	0.047
180	15.2	0.511	0.055
190	18.0	0.491	0.067
200	21.2	0.462	0.082
210	24.8	0.433	0.104
220	28.8	0.385	0.142
227.4	32.1	0.258	0.258

Ethyl Sulfide $(C_2H_5)_2S$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
90.3(*l*)	1.000	0.765	0.003
100	1.32	0.755	0.003
110	1.75	0.744	0.004
120	2.26	0.732	0.005
130	2.90	0.721	0.006
140	3.66	0.709	0.008
150	4.58	0.697	0.009
160	5.68	0.684	0.011
170	6.93	0.671	0.013
180	8.36	0.656	0.017
190	10.00	0.641	0.022
200	12.0	0.625	0.027
210	14.2	0.608	0.034
220	16.6	0.590	0.041
230	19.3	0.571	0.050
240	22.3	0.549	0.061
250	25.6	0.524	0.075
260	29.3	0.494	0.094
270	33.2	0.457	0.121
280	37.6	0.395	0.175
283.8	39.1	0.279	0.279

ORTHOBARIC DENSITIES OR VOLUMES OF VARIOUS SUBSTANCES

Fluorobenzene C_6H_5F

°C	atm	*d liq*, g/cc	*d vap*, g/cc
85.2(*l*)	1.000	.....	.....
90	1.162	0.9366	0.0038
100	1.549	0.9233	0.0050
110	2.029	0.9096	0.0065
120	2.566	0.8955	0.0083
130	3.329	0.8811	0.0105
140	4.171	0.8665	0.0131
150	5.17	0.8519	0.0163
160	6.35	0.8363	0.0199
170	7.68	0.8203	0.0241
180	9.23	0.8037	0.0291
190	11.02	0.7857	0.0350
200	13.03	0.7671	0.0418
210	15.28	0.7480	0.0497
220	17.83	0.7265	0.0591
230	20.69	0.7036	0.0704
240	23.90	0.6789	0.0840
250	27.50	0.6504	0.1008
260	31.51	0.6163	0.1226
270	35.99	0.5739	0.1535
280	41.05	0.5133	0.2034
286.5	44.61	0.3541	0.3541

Helium He

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−271.93(*l*)	.....	0.1459	.....
−271.54	.....	0.1460	.....
−271.21	.....	0.1462	.....
−271.03	.....	0.1464	.....
−270.92	.....	0.1466	.....
−270.83	.....	0.1469	0.001159
−270.76	.....	0.1466	0.001368
−270.57	.....	0.1457	0.002079
−269.83	.....	0.1395	0.006435
−269.23	.....	0.1311	0.01176
−268.91	.....	0.1255	0.01618
−268.54	.....	0.1165	0.02389
−268.42	.....	0.1139	0.02699
−267.94	2.261	0.06930	0.06930

n-Heptane C_7H_{16}

°C	atm	*d liq*, g/cc	*d vap*, g/cc
98.4(*l*)	1.000	.....	.....
100	1.046	0.6124	0.0036
110	1.378	0.6027	0.0047
120	1.799	0.5926	0.0061
130	2.307	0.5821	0.0078
140	2.933	0.5711	0.0098
150	3.664	0.5598	0.0122
160	4.540	0.5481	0.0151
170	5.540	0.5359	0.0185
180	6.566	0.5232	0.0224
190	8.020	0.5066	0.0271
200	9.553	0.4952	0.0330
210	11.31	0.4793	0.0401

n-Heptane (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
220	13.30	0.4616	0.0489
230	15.54	0.4414	0.0600
240	18.14	0.4177	0.0745
250	21.03	0.3882	0.0954
260	24.30	0.3457	0.1287
266.85	26.84	0.2341	0.2341

n-Hexane C_6H_{14}

°C	atm	*d liq*, g/cc	*d vap*, g/cc
68.95(*l*)	1.000	.....	.....
70	1.036	0.6122	0.0034
80	1.397	0.6022	0.0045
90	1.851	0.5918	0.0058
100	2.416	0.5814	0.0075
110	3.103	0.5703	0.0096
120	3.921	0.5588	0.0120
130	4.895	0.5467	0.0150
140	6.060	0.5343	0.0187
150	7.382	0.5207	0.0230
160	8.934	0.5063	0.0283
170	10.68	0.4913	0.0347
180	12.70	0.4751	0.0423
190	13.66	0.4570	0.0516
200	17.57	0.4365	0.0633
210	20.50	0.4124	0.0790
220	23.82	0.3810	0.1011
230	27.57	0.3329	0.1405
234.8	29.61	0.2344	0.2344

Hydrogen H_2

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−258.27(*l*)	.....	0.07631	0.00020
−256.75	.....	0.07494	0.00038
−253.24	.....	0.07134	0.00116
−252.74	1.0000	.....	.....
−249.89	.....	0.06724	0.00264
−245.73	.....	0.06050	0.00613
−243.03	.....	0.05402	0.01081
−240.57	.....	0.04316	0.01922
−239.91	12.80	0.03102	0.03102

Hydrogen Chloride HCl

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−85.03(*l*)	1.00	1.191	0.0025
−80	1.32	1.178	0.0032
−70	2.19	1.151	0.0052
−60	3.45	1.122	0.0083
−50	5.20	1.093	0.012
−40	7.55	1.063	0.017
−30	10.62	1.031	0.023
−20	14.53	0.997	0.032
−10	19.43	0.962	0.042
0	25.46	0.924	0.054
+10	32.78	0.881	0.072
20	41.58	0.831	0.097

ORTHOBARIC DENSITIES OR VOLUMES OF VARIOUS SUBSTANCES

Hydrogen Chloride (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
30	52.08	0.772	0.130
40	64.52	0.697	0.180
50	79.19	0.592	0.260
51.5	81.6	0.424	0.424

Iodobenzene C_6H_5I

°C	atm	*d liq*, g/cc	*d vap*, g/cc
188.45(*l*)	1.000	.....	.....
190	1.043	1.5639	0.0059
200	1.304	1.5470	0.0073
210	1.621	1.5297	0.0089
220	2.000	1.5124	0.0108
230	2.441	1.4941	0.0130
240	2.954	1.4764	0.0156
250	3.553	1.4581	0.0185
260	4.237	1.4384	0.0220
270	5.020	1.4190	0.0260
448	44.61	0.5814	0.5814

Methane CH_4

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−161.5 (*l*)	1.00	0.4245	0.0018
−160	1.13	0.4222	0.0020
−150	2.35	0.4075	0.0039
−140	4.38	0.3916	0.0068
−130	7.45	0.3742	0.0112
−120	11.84	0.3547	0.0175
−110	17.83	0.3324	0.0269
−100	25.7	0.3050	0.0413
− 90	35.9	0.2668	0.0665
− 82.1	45.8	0.1615	0.1615

Methyl Acetate $CH_3CO_2CH_3$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
57.15(*l*)	1.000	0.8840	0.002830
60	1.104	0.8800	0.003076
70	1.537	0.8662	0.004193
80	2.092	0.8519	0.005618
90	2.791	0.8374	0.007440
100	3.659	0.8221	0.009671
110	4.719	0.8060	0.01239
120	5.998	0.7893	0.01570
130	7.523	0.7715	0.01970
140	9.325	0.7532	0.02454
150	11.43	0.7339	0.03026
160	13.88	0.7133	0.03731
170	16.71	0.6907	0.04598
180	19.95	0.6671	0.05682
190	23.64	0.6410	0.06993
200	27.84	0.6100	0.08658
210	32.56	0.5741	0.1091
220	37.92	0.5281	0.1416
230	43.92	0.4527	0.2028
233.7	46.31	0.3252	0.3252

Methyl Alcohol CH_3OH

°C	atm	*d liq*, g/cc	*d vap*, g/cc
64.7(*l*)	1.000	0.7510	0.001222
70	1.220	0.7460	0.001465
80	1.764	0.7355	0.002084
90	2.494	0.7250	0.002907
100	3.452	0.7140	0.003984
110	4.688	0.7020	0.005376
120	6.255	0.6900	0.007142
130	8.213	0.6770	0.009379
140	10.63	0.6640	0.01216
150	13.57	0.6495	0.01562
160	17.11	0.6340	0.01994
170	21.34	0.6161	0.02526
180	26.35	0.5980	0.03186
190	32.23	0.5770	0.04010
200	39.08	0.5530	0.05075
210	47.03	0.5255	0.06521
220	56.18	0.4900	0.08635
225	61.25	0.4675	0.1003
230	66.67	0.4410	0.1187
235	72.47	0.4054	0.1438
240.0	78.67	0.2722	0.2722

Methyl *n*-Butyrate $C_3H_7CO_2CH_3$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
102.75(*l*)	1.000	0.8035	0.003595
110	1.245	0.7945	0.004374
120	1.649	0.7816	0.005708
130	2.148	0.7685	0.007353
140	2.756	0.7551	0.009294
150	3.488	0.7415	0.01168
160	4.359	0.7270	0.01459
170	5.386	0.7122	0.01807
180	6.587	0.6964	0.02215
190	7.982	0.6800	0.02699
200	9.593	0.6633	0.03268
210	11.44	0.6448	0.03968
220	13.55	0.6251	0.04831
230	15.96	0.6018	0.05848
240	18.69	0.5773	0.07143
250	21.77	0.5505	0.08696
260	25.25	0.5166	0.1091
270	29.17	0.4721	0.1416
275	31.31	0.4386	0.1691
280	33.58	0.3812	0.2201
281.3	34.19	0.3002	0.3002

Methyl *iso*-Butyrate $C_3H_7CO_2CH_3$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
92.3	1.000	0.8040	0.003617
100	1.257	0.7945	0.004472
110	1.675	0.7815	0.005882
120	2.193	0.7680	0.007628
130	2.826	0.7539	0.009718
140	3.588	0.7396	0.01224
150	4.497	0.7248	0.01533

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Methyl *iso*-Butyrate (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
160	5.569	0.7095	0.01903
170	6.825	0.6933	0.02345
180	8.280	0.6767	0.02869
190	9.960	0.6593	0.03490
200	11.89	0.6411	0.04228
210	14.09	0.6200	0.05141
220	16.59	0.5961	0.06289
230	19.43	0.5690	0.07722
240	22.64	0.5386	0.09615
250	26.25	0.5021	0.1218
260	30.32	0.4495	0.1623
265	32.54	0.4036	0.2033
267.55	33.72	0.3012	0.3012

Methyl Chloride CH_3Cl

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−24.0	1.00	0.997	0.00255
−20	1.18	0.990	0.00297
−10	1.74	0.973	0.00427
0	2.50	0.955	0.00599
+10	3.49	0.937	0.00820
20	4.75	0.918	0.0110
30	6.35	0.898	0.0145
40	8.33	0.878	0.0189
50	10.7	0.856	0.0242
60	13.6	0.832	0.032
70	17.1	0.809	0.039
80	21.2	0.783	0.049
90	25.9	0.756	0.060
100	31.4	0.725	0.075
110	37.8	0.690	0.094
120	45.0	0.647	0.120
130	53.2	0.592	0.159
140	62.6	0.497	0.238
143.2	65.8	0.365	0.365

Methyl Ether $(CH_3)_2O$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−23.7	1.000	0.7222	0.0024
−20	1.17	0.7174	0.0027
−10	1.74	0.7040	0.0039
0	2.54	0.6905	0.0055
+10	3.59	0.6759	0.0076
20	4.95	0.6610	0.0104
30	6.62	0.6455	0.0142
40	8.69	0.6292	0.0188
50	11.25	0.6116	0.0241
60	14.27	0.5932	0.0306
70	17.90	0.5735	0.0385
80	22.10	0.5517	0.0484
90	26.9	0.5257	0.0623
100	32.6	0.4950	0.0810
110	39.0	0.4575	0.1060
115	42.5	0.4350	0.1222
120	46.3	0.4040	0.1465

Methyl Ether (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
125	50.3	0.3510	0.1930
126.9	52.0	0.2714	0.2714

Methyl Ethyl Ether $CH_3OC_2H_5$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
7.5	1.000	0.716	0.003
10	1.10	0.713	0.004
20	1.61	0.700	0.006
30	2.29	0.687	0.008
40	3.14	0.672	0.010
50	4.24	0.658	0.013
60	5.56	0.644	0.016
70	7.21	0.628	0.019
80	9.16	0.612	0.023
90	11.4	0.596	0.029
100	14.2	0.579	0.034
110	17.3	0.560	0.040
120	20.9	0.540	0.050
130	25.0	0.516	0.064
140	29.6	0.487	0.082
150	34.7	0.450	0.109
160	40.5	0.401	0.153
164.7	43.4	0.270	0.270

Methyl Formate HCO_2CH_3

°C	atm	*d liq*, g/cc	*d vap*, g/cc
31.9	1.000	0.9569	0.002468
40	1.355	0.9447	0.003236
50	1.903	0.9294	0.004456
60	2.608	0.9133	0.006039
70	3.500	0.8968	0.008032
80	4.610	0.8803	0.01049
90	5.969	0.8634	0.01350
100	7.614	0.8452	0.01723
110	9.582	0.8264	0.02160
120	11.91	0.8070	0.02688
130	14.64	0.7860	0.03344
140	17.83	0.7638	0.04124
150	21.46	0.7403	0.05063
160	25.64	0.7136	0.06231
170	30.40	0.6844	0.07634
180	35.76	0.6521	0.09434
190	41.78	0.6148	0.1178
200	48.50	0.5658	0.1524
210	55.95	0.4857	0.2188
214.0	59.15	0.3489	0.3489

Methyl Mercaptan CH_3SH

°C	atm	*d liq*, g/cc	*d vap*, g/cc
6.0	1.000	0.888	0.002
10	1.16	0.882	0.002
20	1.68	0.868	0.003
30	2.36	0.854	0.004
40	3.22	0.840	0.004
50	4.33	0.827	0.005

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Methyl Mercaptan (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
60	5.68	0.813	0.005
70	7.36	0.799	0.006
80	9.33	0.783	0.008
90	11.7	0.768	0.011
100	14.5	0.752	0.015
110	17.6	0.734	0.020
120	21.3	0.714	0.027
130	25.5	0.692	0.036
140	30.3	0.669	0.048
150	35.7	0.643	0.062
160	41.6	0.612	0.079
170	48.6	0.577	0.102
180	56.2	0.535	0.131
190	65.0	0.477	0.179
196.8	71.4	0.323	0.323

Methyl Propionate $C_2H_5CO_2CH_3$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
79.7	1.000	0.8412	0.003173
80	1.006	0.8408	0.003199
90	1.379	0.8273	0.004301
100	1.851	0.8137	0.005714
110	2.440	0.7996	0.007446
120	3.165	0.7852	0.009569
130	4.043	0.7705	0.01214
140	5.096	0.7553	0.01529
150	6.345	0.7390	0.01905
160	7.812	0.7221	0.02356
170	9.523	0.7045	0.02907
180	11.50	0.6856	0.03552
190	13.78	0.6657	0.04320
200	16.38	0.6445	0.05236
210	19.33	0.6207	0.06390
220	22.68	0.5938	0.07812
230	26.46	0.5635	0.09662
240	30.70	0.5220	0.1236
245	33.01	0.4976	0.1418
250	35.46	0.4655	0.1675
255	38.04	0.4151	0.2118
257.4	39.34	0.3124	0.3124

Methyl Sulfide $(CH_3)_2S$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
35.8	1.000	0.831	0.002
40	1.15	0.826	0.003
50	1.60	0.814	0.003
60	2.15	0.803	0.003
70	2.84	0.791	0.004
80	3.68	0.777	0.006
90	4.70	0.764	0.008
100	5.97	0.750	0.010
110	7.45	0.736	0.013
120	9.14	0.721	0.016
130	11.1	0.706	0.020
140	13.4	0.689	0.026

Methyl Sulfide (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
150	16.0	0.671	0.032
160	19.1	0.652	0.040
170	22.4	0.632	0.050
180	26.2	0.610	0.063
190	30.6	0.585	0.076
200	35.6	0.559	0.092
210	41.5	0.528	0.113
220	47.0	0.486	0.146
229.9	54.6	0.306	0.306

Nitrous Oxide N_2O

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−89.5	1.00	1.226	0.0031
−80	1.70	1.199	0.0050
−70	2.81	1.170	0.0080
−60	4.40	1.140	0.0122
−50	6.6	1.108	0.018
−40	9.5	1.075	0.025
−30	13.3	0.040	0.035
−20	18.1	1.001	0.048
−10	24.0	0.958	0.066
0	31.3	0.910	0.087
+10	40.0	0.856	0.115
20	50.3	0.784	0.161
30	62.6	0.679	0.240
36.5	71.7	0.451	0.451

n-Octane C_8H_{18}

°C	atm	*d liq*, g/cc	*d vap*, g/cc
125.8	1.000	.....	.....
130	1.130	0.6071	0.0042
140	1.466	0.5973	0.0054
150	1.875	0.5875	0.0068
160	2.378	0.5772	0.0085
170	2.967	0.5667	0.0107
180	3.651	0.5556	0.0132
190	4.454	0.5441	0.0161
200	5.395	0.5317	0.0196
210	6.480	0.5189	0.0236
220	7.730	0.5053	0.0287
230	9.145	0.4901	0.0348
240	10.79	0.4732	0.0424
250	12.63	0.4554	0.0512
260	14.71	0.4364	0.0622
270	17.08	0.4123	0.0772
280	19.74	0.3818	0.0983
290	22.57	0.3365	0.1346
296.2	24.61	0.2327	0.2327

Oxygen O_2

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−210.4	.....	1.2746	0.0_4865
−182.95	1.000	.....	.....
−182.0	.....	1.1415	0.00490
−154.5	.....	0.9758	0.0385

ORTHOBARIC DENSITIES OR VOLUMES OF VARIOUS SUBSTANCES

Oxygen (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−140.2	.....	0.8742	0.0805
−129.9	.....	0.7781	0.1320
−123.3	.....	0.6779	0.2022
−120.4	.....	0.6032	0.2701
−118.82	49.713	0.4299	0.4299

n-Pentane C_5H_{12}

°C	atm	*d liq*, g/cc	*d vap*, g/cc
36.15	1.000	.....	.....
40	1.149	0.6062	0.0034
50	1.570	0.5957	0.0045
60	2.112	0.5850	0.0060
70	2.788	0.5739	0.0079
80	3.599	0.5624	0.0101
90	4.605	0.5503	0.0129
100	5.803	0.5377	0.0163
110	7.217	0.5248	0.0202
120	8.868	0.5107	0.0250
130	10.78	0.4957	0.0310
140	13.01	0.4787	0.0386
150	15.54	0.4604	0.0476
160	18.49	0.4349	0.0591
170	21.78	0.4162	0.0735
180	25.46	0.3867	0.0935
190	29.61	0.3485	0.1269
195	31.91	0.3065	0.1609
197.2	33.03	0.2323	0.2323

iso-Pentane C_5H_{12}

°C	atm	*d liq*, g/cc	*d vap*, g/cc
27.95	1.000	.....	.....
30	1.078	0.6092	0.0033
40	1.500	0.5988	0.0045
50	2.020	0.5881	0.0060
60	2.679	0.5769	0.0078
70	3.495	0.5656	0.0101
80	4.454	0.5540	0.0129
90	5.632	0.5413	0.0162
100	7.033	0.5278	0.0202
110	8.664	0.5140	0.0251
120	10.55	0.4991	0.0311
130	12.74	0.4826	0.0383
140	15.30	0.4642	0.0473
150	18.16	0.4445	0.0583
160	21.45	0.4206	0.0729
170	25.14	0.3914	0.0934
180	29.20	0.3498	0.1258
185	31.58	0.3142	0.1574
187.8	32.90	0.2343	0.2343

Phosgene $COCl_2$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
7.95	1.00	1.409	0.005
10	1.08	1.405	0.005
20	1.55	1.381	0.007

Phosgene (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
30	2.17	1.357	0.009
40	2.97	1.332	0.012
50	3.99	1.306	0.016
60	5.25	1.280	0.020
70	6.81	1.252	0.024
80	8.68	1.224	0.030
90	10.94	1.195	0.037
100	13.6	1.165	0.046
110	16.7	1.134	0.057
120	20.3	1.100	0.072
130	24.4	1.062	0.090
140	29.1	1.017	0.112
150	34.4	0.966	0.142
160	40.4	0.903	0.182
170	47.0	0.826	0.239
180	54.4	0.685	0.359
182	56	0.520	0.520

Phosphine PH_3

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−87.5	1.00	0.746	0.0023
−80	1.46	0.738	0.0032
−70	2.30	0.725	0.0050
−60	3.47	0.712	0.0073
−50	5.0	0.698	0.010
−40	7.1	0.684	0.014
−30	9.7	0.668	0.019
−20	12.9	0.651	0.025
−10	16.8	0.633	0.033
0	21.6	0.613	0.042
+10	27.4	0.591	0.053
20	34.2	0.566	0.067
30	42.3	0.537	0.086
40	51.9	0.50	0.11
51	64	0.30	0.30

Propionic Acid $C_2H_5CO_2H$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
140	.....	0.860	0.004
150	.....	0.848	0.004
160	.....	0.837	0.005
170	.....	0.825	0.006
180	.....	0.813	0.008
190	.....	0.800	0.010
200	.....	0.786	0.012
210	.....	0.772	0.015
220	.....	0.757	0.019
230	.....	0.740	0.024
240	.....	0.722	0.029
250	.....	0.703	0.035
260	.....	0.683	0.043
270	.....	0.663	0.051
280	.....	0.642	0.060
290	.....	0.619	0.071

ORTHOBARIC DENSITIES OR VOLUMES OF VARIOUS SUBSTANCES

Propionic Acid (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
300	.....	0.595	0.083
339.5	.....	0.315	0.315

Propionitrile C_2H_5CN

°C	atm	*d liq*, g/cc	*d vap*, g/cc
90	.....	0.711	0.002
100	.....	0.700	0.002
110	.....	0.689	0.003
120	.....	0.678	0.003
130	.....	0.666	0.004
140	.....	0.654	0.005
150	.....	0.642	0.006
160	.....	0.629	0.007
170	.....	0.615	0.008
180	.....	0.602	0.010
190	.....	0.588	0.012
200	.....	0.573	0.015
210	.....	0.557	0.019
220	.....	0.541	0.025
230	.....	0.524	0.033
240	.....	0.505	0.041
250	.....	0.483	0.051
260	.....	0.458	0.063
270	.....	0.428	0.080
280	.....	0.388	0.108
290	.....	0.311	0.171
291.2	.....	0.241	0.241

Propyl Acetate $CH_3CO_2C_3H_7$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
101.55	1.000	0.7938	0.003495
110	1.284	0.7830	0.004405
120	1.703	0.7702	0.005760
130	2.223	0.7571	0.007440
140	2.851	0.7435	0.009497
150	3.611	0.7297	0.01195
160	4.518	0.7149	0.01489
170	5.581	0.6997	0.01848
180	6.832	0.6835	0.02268
190	8.276	0.6667	0.02778
200	9.947	0.6488	0.03390
210	11.86	0.6301	0.04115
220	14.05	0.6087	0.05025
230	16.54	0.5855	0.06154
240	19.36	0.5586	0.07576
250	22.54	0.5289	0.09390
260	26.13	0.4908	0.1205
270	30.16	0.4333	0.1661
275	32.36	0.3769	0.2169
276.2	32.91	0.2957	0.2957

Propyl Alcohol C_3H_7OH

°C	atm	*d liq*, g/cc	*d vap*, g/cc
97.4	1.000	0.7351	0.00208
100	1.100	0.7325	0.00226

Propyl Alcohol (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
110	1.577	0.7220	0.00320
120	2.208	0.7110	0.00443
130	3.022	0.6995	0.00605
140	4.055	0.6875	0.00805
150	5.341	0.6740	0.01060
160	6.915	0.6600	0.01380
170	8.817	0.6450	0.01770
180	11.08	0.6285	0.0225
190	13.75	0.6110	0.0282
200	16.86	0.5920	0.0353
210	20.46	0.5715	0.0442
220	24.57	0.5485	0.0556
230	29.26	0.5230	0.0704
240	34.57	0.4920	0.0904
250	40.55	0.4525	0.1180
260	47.27	0.3905	0.1610
263.7	49.95	0.2734	0.2734

Propyl Formate $HCO_2C_3H_7$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
80.9	1.000	0.8330	0.003136
90	1.320	0.8214	0.004107
100	1.769	0.8080	0.005432
110	2.327	0.7947	0.007047
120	3.010	0.7811	0.009033
130	3.836	0.7670	0.01140
140	4.821	0.7523	0.01422
150	5.984	0.7369	0.01770
160	7.343	0.7209	0.02179
170	8.921	0.7045	0.02667
180	10.74	0.6873	0.03236
190	12.82	0.6691	0.03891
200	15.20	0.6487	0.04717
210	17.90	0.6259	0.05698
220	20.94	0.6024	0.06897
230	24.39	0.5757	0.08403
240	28.27	0.5438	0.1045
250	32.63	0.5025	0.1340
260	37.54	0.4404	0.1848
264.85	40.13	0.3093	0.3093

Stannic Chloride $SnCl_4$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
114.1	1.00	1.978	0.0085
120	1.18	1.963	0.0099
130	1.53	1.935	0.0127
140	1.96	1.907	0.0162
150	2.48	1.878	0.0202
160	3.10	1.849	0.0251
170	3.82	1.819	0.0308
180	4.67	1.787	0.0374
190	5.66	1.755	0.0454
200	6.79	1.721	0.0546
220	9.55	1.649	0.0773
240	13.07	1.569	0.108

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Stannic Chloride (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
260	17.48	1.476	0.152
280	22.92	1.363	0.216
300	29.56	1.21	0.32
318.7	37.0	0.742	0.742

Sulfur Dioxide SO_2

°C	atm	*V liq*, cc/g	*V vap*, cc/g
−50	0.11411	0.6423	.....
−45	0.1576	0.6472	.....
−40	0.2135	0.6523	.....
−35	0.2857	0.6575	.....
−30	0.3759	0.6627	.....
−25	0.4892	0.6680	.....
−20	0.6274	0.6739	.....
−15	0.7970	0.6798	.....
−10	0.9995	0.6859	.....
− 5	1.243	0.6916	.....
0	1.529	0.6974	.....
2	1.657	0.6998	.....
4	1.793	0.7022	.....
6	1.938	0.7047	.....
8	2.092	0.7072	156.3
10	2.256	0.7097	147.1
12	2.429	0.7123	137.0
14	2.613	0.7153	128.2
16	2.807	0.7179	119.0
18	3.012	0.7205	111.1
20	3.228	0.7231	103.1
22	3.456	0.7262	97.09
24	3.697	0.7289	90.91
26	3.951	0.7315	86.21
28	4.217	0.7348	81.30
30	4.498	0.7375	75.76
32	4.793	0.7407	70.92
34	5.102	0.7440	66.67
36	5.427	0.7474	62.50
38	5.768	0.7508	58.14
40	6.125	0.7536	54.64
42	6.499	0.7570	51.02
44	6.890	0.7610	48.08
46	7.300	0.7646	45.25
48	7.729	0.7680	42.74
50	8.176	0.7722	40.65
52	.....	0.7758	38.61
54	.....	0.7794	36.76
56	.....	0.7837	34.84
58	.....	0.7874	33.33
60	10.729	0.7918	31.85
62	.....	0.7962	30.49
64	.....	0.8000	29.15
66	.....	0.8046	28.01
68	.....	0.8091	26.88
70	13.867	0.8137	25.77
72	.....	0.8183	24.81
74	.....	0.8230	23.81

Sulfur Dioxide (Cont.)

°C	atm	*V liq*, cc/g	*V vap*, cc/g
76	.....	0.8278	22.88
78	.....	0.8333	21.93
80	17.682	0.8382	20.92
82	.....	0.8432	19.96
84	.....	0.8489	19.01
86	.....	0.8547	18.15
88	.....	0.8606	17.24
90	22.268	0.8658	16.39
92	.....	0.8718	15.60
94	.....	0.8780	14.88
96	.....	0.8850	14.20
98	.....	0.8913	13.51
100	27.714	0.8977	12.94
105	30.784	0.9158	11.51
110	34.091	0.9355	10.31
115	37.641	0.9570	9.159
120	41.432	0.9823	8.078
125	45.457	1.0111	7.073
130	49.705	1.0449	6.146
135	54.157	1.0858	5.310
140	58.783	1.1363	4.554
145	63.549	1.2019	3.882
150	68.405	1.3038	3.256
155	73.296	.....	.....
157	75.245	.....	.....
157.2	77.7	1.9305	1.9305

Sulfur Trioxide SO_3

°C	atm	*d liq*, g/cc	*d vap*, g/cc
44.6	1.00	1.807	0.003
60	2.0	1.732	0.006
80	4.3	1.639	0.013
100	8.0	1.547	0.025
110	10.4	1.506	0.031
120	13.3	1.465	0.037
130	16.7	1.424	0.045
140	20.6	1.382	0.056
150	25.1	1.340	0.069
160	30.3	1.296	0.086
170	36.4	1.249	0.107
180	43.4	1.196	0.137
190	51.5	1.134	0.177
200	61.1	1.058	0.233
210	72.5	0.960	0.313
218.3	83.6	0.630	0.630

Triethylamine $N(C_2H_5)_3$

°C	atm	*d liq*, g/cc	*d vap*, g/cc
90	.....	0.661	0.005
100	.....	0.650	0.006
110	.....	0.638	0.008
120	.....	0.626	0.010
130	.....	0.614	0.013
140	.....	0.603	0.016
150	.....	0.591	0.019
160	.....	0.578	0.022

ORTHOBARIC DENSITIES OR VOLUMES OF VARIOUS SUBSTANCES

Triethylamine (Cont.)

°C	atm	*d liq*, g/cc	*d vap*, g/cc
170	.....	0.565	0.026
180	.....	0.552	0.030
190	.....	0.538	0.035
200	.....	0.523	0.040
210	.....	0.507	0.046
220	.....	0.488	0.056
230	.....	0.466	0.071
240	.....	0.437	0.090
250	.....	0.399	0.115
260	.....	0.335	0.175
262	.....	0.251	0.251

Xenon Xe

°C	atm	*d liq*, g/cc	*d vap*, g/cc
−70	.....	2.792	0.048
−60	8.570	2.699	0.079
−50	.....	2.605	0.108
−40	15.85	2.511	0.137
−30	.....	2.410	0.180
−20	26.73	2.292	0.238
−10	.....	2.169	0.313
0	41.24	1.987	0.421
+10	.....	1.745	0.602
15	.....	1.528	0.791
16	.....	1.468	0.844
16.6	58.22	1.154	1.154

SPECIFIC GRAVITY OF AIR AT VARIOUS TEMPERATURES

The table below gives the weight in grams $\times 10^4$ of one milliliter of air at 760 mm of mercury pressure and at the temperature indicated. Density in grams per milliliter is the same as the specific gravity referred to water at 4°C. as unity. To convert to density referred to air at 70°F. as unity, divide the values below by 12.00.

t°C.	Sp.Gr. $\times 10^4$	t°C.	Sp.Gr. $\times 10^4$	t°C.	Sp.Gr. $\times 10^4$	t°C.	Sp.Gr. $\times 10^4$
−25	14.240	15	12.255	60	10.596	140	8.541
−24	14.182	16	12.213	62	10.532	142	8.500
−23	14.125	17	12.170	64	10.470	144	8.459
−22	14.069	18	12.129	66	10.408	146	8.419
−21	14.013	19	12.087	68	10.347	148	8.379
−20	13.957	20	12.046	70	10.286	150	8.339
−19	13.902	21	12.004	72	10.227	155	8.242
−18	13.847	22	11.964	74	10.168	160	8.147
−17	13.793	23	11.923	76	10.109	165	8.054
−16	13.739	24	11.883	78	10.052	170	7.963
−15	13.685	25	11.843	80	9.995	175	7.874
−14	13.632	26	11.803	82	9.938	180	7.787
−13	13.580	27	11.764	84	9.882	185	7.702
−12	13.527	28	11.725	86	9.828	190	7.619
−11	13.476	29	11.686	88	9.773	195	7.537
−10	13.424	30	11.647	90	9.719	200	7.457
−9	13.373	31	11.609	92	9.666	205	7.379
−8	13.322	32	11.570	94	9.613	210	7.303
−7	13.272	33	11.533	96	9.561	215	7.228
−6	13.222	34	11.495	98	9.509	220	7.155
−5	13.173	35	11.458	100	9.458	230	7.013
−4	13.124	36	11.420	102	9.408	240	6.881
−3	13.075	37	11.383	104	9.358	250	6.753
−2	13.026	38	11.347	106	9.308	260	6.624
−1	12.978	39	11.310	108	9.259	270	6.504
0	12.931	40	11.274	110	9.211	280	6.389
+1	12.883	41	11.238	112	9.163	290	6.277
2	12.836	42	11.202	114	9.116	300	6.166
3	12.790	43	11.167	116	9.069	310	6.062
4	12.743	44	11.132	118	9.022	320	5.942
5	12.697	45	11.097	120	8.976	330	5.847
6	12.652	46	11.062	122	8.931	340	5.755
7	12.606	47	11.027	124	8.886	350	5.664
8	12.561	48	10.993	126	8.841	360	5.578
9	12.517	49	10.958	128	8.797	370	5.493
10	12.472	50	10.924	130	8.753	380	5.407
11	12.428	52	10.857	132	8.710	400	5.248
12	12.385	54	10.791	134	8.667	420	5.101
13	12.341	56	10.725	136	8.625	440	4.952
14	12.298	58	10.660	138	8.583	460	4.812

HEATS OF SOLUTION

The values given in this table are expressed in kilo-calories per gram mole of compound as shown by the formula and for a dilution as indicated (where this is not indicated the dilution is such that further dilution is without an appreciable, thermal effect); a positive value indicates an evolution of heat during solution. To convert from kilogram calories to B. T. U. multiply by the factor 3.9685.

Name	Formula	Dilution in moles of water	Heat of solution in kg-cal.	Temp. °C.
Acetic acid	$CH_3 \cdot COOH$	200	+0.375	18
Aluminum bromide	$AlBr_3$	2970	+85.3	9
Aluminum chloride	$AlCl_3$	1250	+76.845	18
Aluminum chloride	$AlCl_3$	960	+76.3	9
Aluminum iodide	AlI_3	2260	+89.0	9
Aluminum sulfate	$Al_2(SO_4)_3 \cdot 6H_2O$	....	+56.0	15
Aluminum sulfate	$Al_2(SO_4)_3 \cdot 18H_2O$	....	+8.02	15
Ammonium acetate	$NH_4C_2H_3O_2$	200	+0.25	24
Ammonium bicarbonate	NH_4HCO_3	220–440	−6.3	15
Ammonium bisulfide	NH_4HS	890	−3.25	12.5
Ammonium bisulfate	NH_4HSO_4	200	−0.02	18
Ammonium bromide	NH_4Br	200	−4.38	18
Ammonium chloride	NH_4Cl	200	−3.88	18
Ammonium chloroplatinate	$(NH_4)_2PtCl_4$	660	−8.48	15
Ammonium cyanide	NH_4CN	820	−4.4	15
Ammonium ferrocyanide	$(NH_4)_4Fe(CN)_6 \cdot 3H_2O$	....	−6.8	14
Ammonium fluoride	NH_4F	....	−1.5	15
Ammonium fluosilicate	$(NH_4)_2SiF_6$	2400	−8.4	7
Ammonium iodide	NH_4I	200	−3.55	15
Ammonium nitrate	NH_4NO_3	200	−6.32	18
Ammonium nitrate	NH_4NO_3	220–440	−6.2	10–15
Ammonium nitrite	NH_4NO_2	400	−4.75	12.5
Ammonium oxalate	$(NH_4)_2C_2O_4$	345–690	−8.0	15
Ammonium oxalate	$(NH_4)_2C_2O_4 \cdot H_2O$	395–790	−11.5	15
Ammonium sulfate	$(NH_4)_2SO_4$	400	−2.37	18
Ammonium sulfite	$(NH_4)_2SO_3$	220	−1.54	8
Ammonium persulfate	$(NH_4)_2S_2O_8$	1100	−9.7	9.4
Ammonium thiocyanate	NH_4CNS	....	−5.67	12
Antimony pentachloride	$SbCl_5$	1100	+35.2	15
Antimony trichloride	$SbCl_3$	....	+8.91	15
Arsenic acid	H_3AsO_4	....	−0.4	15
Arsenic trioxide	As_2O_3	....	−7.65	15
Barium acetate	$Ba(C_2H_3O_2)_2$	600	+5.2	10.8
Barium acetate	$Ba(C_2H_3O_2)_2 \cdot 3H_2O$	800	−1.15	18
Barium bromide	$BaBr_2$	400	+4.98	18
Barium bromide	$BaBr_2 \cdot 2H_2O$	400	−4.13	18
Barium chlorate	$Ba(ClO_3)_2$	500–1000	−6.7	10
Barium chlorate	$Ba(ClO_3)_2 \cdot H_2O$	600	−11.24	18
Barium chloride	$BaCl_2$	400	+2.07	18
Barium chloride	$BaCl_2 \cdot 2H_2O$	400	−4.93	18
Barium chloride	$BaCl_2 \cdot 2H_2O$	560	−5.2	10
Barium cyanide	$Ba(CN)_2$	....	+0.89	9
Barium cyanide	$Ba(CN)_2 \cdot H_2O$	....	−2.1	5
Barium cyanide	$Ba(CN)_2 \cdot 2H_2O$	....	−2.56	7
Barium ferrocyanide	$Ba_2Fe(CN)_6 \cdot 6H_2O$	....	−11.4	13.5
Barium fluoride	BaF_2	....	−1.90	15
Barium hydroxide	$Ba(OH)_2$	....	+12.26	18
Barium hydroxide	$Ba(OH)_2 \cdot H_2O$	....	+8.7	12
Barium hydroxide	$Ba(OH)_2 \cdot 8H_2O$	400	−15.21	18
Barium hypophosphate	$Ba(H_2PO_2)_2 \cdot H_2O$	800	+0.29	18

HEATS OF SOLUTION

Name	Formula	Dilution in moles of water	Heat of solution in kg-cal.	Temp. °C.
Barium iodide	BaI_2	....	+10.3	16
Barium iodide	$BaI_2 \cdot 7H_2O$	500	+6.85	18
Barium nitrate	$Ba(NO_3)_2$	800	−5.7	12
Barium nitrate	$Ba(NO_3)_2 \cdot H_2O$	800	−8.6	12
Barium nitride	BaN_6	700	−7.8	19.8
Barium oxide	BaO	666	+35.64	15
Barium oxide	$BaO \cdot H_2O$	666	+11.40	15
Barium oxide	$BaO \cdot 2H_2O$	666	+7.06	15
Barium oxide	$BaO \cdot 9H_2O$	666	−14.50	15
Barium perchlorate	$Ba(ClO_4)_2$	550–1100	−1.8	10
Barium perchlorate	$Ba(ClO_4)_2 \cdot 3H_2O$	650–1300	−9.4	15
Barium persulfate	$BaS_2O_8 \cdot 4H_2O$	1600	−11.8	12
Barium sulfate	$BaSO_4$	....	−5.58	18
Barium sulfide	BaS	....	+7.0	15
Beryllium chloride	$BeCl_2$	....	+44.5	15
Beryllium sulfate	$BeSO_4 \cdot 4H_2O$	400	+1.1	18
Bismuth chloride	$BiCl_3$	1600	+7.83	18
Boric acid	$B_2O_3 \cdot 3H_2O$	800	−10.79	16
Boric oxide	B_2O_3	....	+7.3	15
Cadmium bromide	$CdBr_2$	400	+0.44	18
Cadmium bromide	$CdBr_2 \cdot 4H_2O$	600	−7.29	18
Cadmium chloride	$CdCl_2$	400	+3.01	18
Cadmium chloride	$CdCl_2 \cdot H_2O$	400	+0.625	15
Cadmium chloride	$CdCl_2 \cdot 2H_2O$	400	+0.76	18
Cadmium iodide	CdI_2	400	−0.96	18
Cadmium nitrate	$Cd(NO_3)_2 \cdot H_2O$	400	+4.18	18
Cadmium nitrate	$Cd(NO_3)_2 \cdot 4H_2O$	400	−5.04	18
Cadmium sulfate	$CdSO_4$	400	+10.690	15
Cadmium sulfate	$CdSO_4 \cdot H_2O$	400	+6.05	18
Cadmium sulfate	$CdSO_4 \cdot \frac{8}{3}H_2O$	400	+2.539	15
Calcium acetate	$Ca(C_2H_3O_2)_2$	440	+7.0	15.5
Calcium acetate	$Ca(C_2H_3O_2)_2 \cdot H_2O$	600	+5.4	17
Calcium bromide	$CaBr_2$	400	+24.51	18
Calcium bromide	$CaBr_2 \cdot 6H_2O$	400	−1.09	18
Calcium chloride	$CaCl_2$	300	+17.41	18
Calcium chloride	$CaCl_2 \cdot 6H_2O$	400	−4.31	19.3
Calcium ferrocyanide	$Ca_2Fe(CN)_6 \cdot 12H_2O$	....	+4.6	10
Calcium fluoride	CaF_2	....	+2.70	15
Calcium hydroxide	$Ca(OH)_2$	2500	+2.79	18
Calcium iodide	CaI_2	....	+28.12	15
Calcium nitrate	$Ca(NO_3)_2$	400	+3.95	18
Calcium nitrate	$Ca(NO_3)_2 \cdot 4H_2O$	400	−7.25	18
Calcium oxide	CaO	2500	+18.33	18
Calcium sulfate	$CaSO_4$	....	+4.44	18
Calcium sulfate	$CaSO_4 \cdot 2H_2O$	....	−0.30	18
Calcium sulfide	CaS	....	+6.1	15
Cesium bisulfate	$CsHSO_4$	....	−3.73	15
Cesium bromide	$CsBr$	....	−6.73	15
Cesium chloride	$CsCl$	....	−4.75	15
Cesium fluoride	CsF	....	+8.37	15
Cesium hydroxide	$CsOH$	....	+16.423	15
Cesium hydroxide	$CsOH \cdot H_2O$	....	+4.317	15
Cesium iodide	CsI	....	−8.25	15
Cesium oxide	Cs_2O	....	+83.2	15
Cesium sulfate	Cs_2SO_4	....	−4.97	15

HEATS OF SOLUTION

Name	Formula	Dilution in moles of water	Heat of solution in kg-cal.	Temp. °C.
Chromium bromide (ic)	$CrBr_3 \cdot 6H_2O$-green	500	+0.7	15
Chromium bromide (ic)	$CrBr_3 \cdot 6H_2O$-blue	....	+14.35	15
Chromium chloride (ic)	$CrCl_3$	....	+35.9	15
Chromium chloride (ic)	$2CrCl_3 \cdot 13H_2O$-gray	....	+24.04	15
Chromium chloride (ic)	$2CrCl_3 \cdot 13H_2O$-green	....	−0.1	15
Chromium chloride (ous)	$CrCl_2$	....	+18.6	15
Chromium chloride (ous)	$CrCl_2 \cdot 4H_2O$	....	+2.0	15
Chromium sulfate (ic)	$Cr_2(SO_4)_3 \cdot 8H_2O$	....	+13.6	15
Chromium sulfate (ic)	$Cr_2(SO_4)_3 \cdot 16H_2O$	....	+6.2	15
Chromium trioxide	CrO_3	220	+1.9	19
Cobalt chloride	$CoCl_2$	400	+18.34	18
Cobalt chloride	$CoCl_2 \cdot 6H_2O$	400	−2.85	18
Cobalt nitrate	$Co(NO_3)_2$	280	+11.82	8
Cobalt nitrate	$Co(NO_3)_2 \cdot 6H_2O$	400	−4.96	18
Cobalt sulfate	$CoSO_4 \cdot 7H_2O$	800	−3.57	18
Copper acetate	$Cu(C_2H_3O_2)_2$	320	+2.4	16
Copper acetate	$Cu(C_2H_3O_2)_2 \cdot H_2O$	400	+0.2	18
Copper bromide	$CuBr_2$	400	+8.25	18
Copper bromide	$CuBr_2 \cdot 4H_2O$	....	−1.5	7.5
Copper chloride	$CuCl_2$	600	+11.08	18
Copper chloride	$CuCl_2 \cdot 2H_2O$	400	+4.21	18
Copper nitrate	$Cu(NO_3)_2$	280	+10.47	8
Copper nitrate	$Cu(NO_3)_2 \cdot 6H_2O$	400	-10.71	18
Copper sulfate	$CuSO_4$	400	+15.80	18
Copper sulfate	$CuSO_4 \cdot H_2O$	400	+9.34	18
Copper sulfate	$CuSO_4 \cdot 5H_2O$	400	−2.75	18
Cyanogen	C_2N_2	....	−73.0	15
Dysprosium sulfate	$Dy_2(SO_4)_3 \cdot 8H_2O$	1200	+6.3	18
Erbium acetate	$Er(C_2H_3O_2)_3 \cdot 4H_2O$	1500	+0.7	18
Gold bromic acid	$HAuBr_4 \cdot 5H_2O$	1000	−11.40	18
Gold bromide	$AuBr_3$	2000	−3.71	18
Gold chloride	$AuCl_3$	900	+4.45	18
Gold chloride	$AuCl_3 \cdot 2H_2O$	600	−1.69	18
Gold chloric acid	$HAuCl_4 \cdot 3H_2O$	400	−3.55	18
Gold chloric acid	$HAuCl_4 \cdot 4H_2O$	400	−5.83	18
Hydrobromic acid	HBr	....	+20.0	15
Hydrochloric acid	HCl	....	+17.4	15
Hydroferrocyanic acid	$H_4Fe(CN)_6$	200	+0.4	10
Hydriodic acid	HI	....	+19.6	15
Hydrogen selenide	H_2Se	....	+9.3	15
Hydrogen sulfide	H_2S	....	+4.56	15
Hydroxylamine	NH_2OH	....	−2.8	15
Iodine pentoxide	I_2O_5	....	−1.79	15
Iron chloride (ous)	$FeCl_2$	350	+17.85	18
Iron chloride (ous)	$FeCl_2 \cdot 2H_2O$	1100	+8.7	20
Iron chloride (ous)	$FeCl_2 \cdot 4H_2O$	400	+2.75	18
Iron chloride (ic)	$FeCl_3$	1000	+32.68	18
Iron chloride (ic)	$FeCl_3 \cdot 2\frac{1}{2}H_2O$	1200	+21.0	18
Iron chloride (ic)	$FeCl_3 \cdot 6H_2O$	1200	+5.65	20.8
Iron nitrate (ic)	$Fe(NO_3)_3 \cdot 9H_2O$	480	−9.0	15
Iron sulfate (ous)	$FeSO_4 \cdot 7H_2O$	400	−4.51	18
Lead acetate	$Pb(C_2H_3O_2)_2$	440	+1.4	16
Lead acetate	$Pb(C_2H_3O_2)_2 \cdot 3H_2O$	800	−6.14	18
Lead bromide	$PbBr_2$	2500	−10.04	18
Lead chloride	$PbCl_2$	1800	−6.8	18
Lead dithionate	$PbS_2O_6 \cdot 4H_2O$	400	−8.54	18

HEATS OF SOLUTION

Name	Formula	Dilution in moles of water	Heat of solution in kg-cal.	Temp. °C.
Lead nitrate	$Pb(NO_3)_2$	400	−7.61	18
Lithium bromide	LiBr	....	+11.25	15
Lithium chloride	LiCl	230	+8.37	15
Lithium chloride	$LiCl \cdot H_2O$	....	+4.211	15
Lithium chloride	$LiCl \cdot 2H_2O$	....	+0.981	15
Lithium fluoride	LiF	....	−1.04	15
Lithium fluosilicate	Li_2SiF_6	800	+1.8	15
Lithium hydroxide	LiOH	400	+5.82	15
Lithium hydroxide	$LiOH \cdot H_2O$	....	+0.720	18
Lithium iodide	LiI	....	+14.76	15
Lithium nitrate	$LiNO_3$	100	+0.30	18
Lithium oxide	Li_2O	222	+30.76	15
Lithium oxide	$4Li_2O \cdot 5H_2O$	888	+8.182	15
Lithium oxide	$4Li_2O \cdot 3H_2O$	888	+16.026	15
Lithium peroxide	Li_2O_2	....	+7.19	15
Lithium selenide	Li_2Se	....	+10.7	20
Lithium selenide	$Li_2Se \cdot 9H_2O$	1146–6426	−12.2	15
Lithuim sulfate	Li_2SO_4	200	+6.05	18
Lithium sulfate	$Li_2SO_4 \cdot H_2O$	400	+3.41	18
Magnesium ammonium sulfate	$MgSO_4 \cdot (NH_4)_2SO_4 \cdot 6H_2O$	....	−9.7	15
Magnesium bromide	$MgBr_2$	....	+43.3	15
Magnesium chloride	$MgCl_2$	800	+35.92	18
Magnesium chloride	$MgCl_2 \cdot 6H_2O$	400	+2.95	18
Magnesium dithionate	$MgS_2O_6 \cdot 6H_2O$	400	−2.96	18
Magnesium fluoride	MgF_2	....	+2.778	15
Magnesium hydroxide	$Mg(OH)_2$	....	−0.0	18
Magnesium iodide	MgI_2	....	+49.8	15
Magnesium nitrate	$Mg(NO_3)_2 \cdot 6H_2O$	400	−4.22	18
Magnesium potassium sulfate	$MgSO_4 \cdot K_2SO_4$	600	+10.60	18
Magnesium potassium sulfate	$MgSO_4 \cdot K_2SO_4 \cdot 6H_2O$	600	−10.02	18
Magnesium sodium sulfate	$MgSO_4 \cdot Na_2SO_4$	....	+16.7	19
Magnesium sulfate	$MgSO_4$	400	+20.28	18
Magnesium sulfate	$MgSO_4 \cdot H_2O$	400	+13.30	18
Magnesium sulfate	$MgSO_4 \cdot 7H_2O$	400	−3.80	18
Manganese chloride	$MnCl_2$	350	+16.01	18
Manganese chloride	$MnCl_2 \cdot 4H_2O$	400	+1.54	18
Manganese dithionate	$MnS_2O_6 \cdot 6H_2O$	400	−1.93	18
Manganese nitrate	$Mn(NO_3)_2$	280	+12.39	14
Manganese nitrate	$Mn(NO_3)_2 \cdot 6H_2O$	400	−6.15	18
Manganese potassium sulfate	$MnSO_4 \cdot K_2SO_4$	600	+6.38	18
Manganese potassium sulfate	$MnSO_4\ K_2SO_4 \cdot 4H_2O$	600	−6.44	18
Manganese sodium sulfate	$MnSO_4 \cdot Na_2SO_4$	....	+13.0	15
Manganese sodium sulfate	$MnSO_4 \cdot Na_2SO_4 \cdot 2H_2O$	....	+3.2	15
Manganese sodium sulfate	$MnSO_4 \cdot Na_2SO_4 \cdot 6H_2O$	....	−9.7	15
Manganese sulfate	$MnSO_4$	400	+13.79	18
Manganese sulfate	$MnSO_4 \cdot H_2O$	400	+7.82	18
Manganese sulfate	$MnSO_4 \cdot 5H_2O$	400	+0.04	18
Mercurous acetate	$HgC_2H_3O_2$	222	−3.8	13.7
Mercuric bromide	$HgBr_2$	....	−3.4	12
Mercuric chloride	$HgCl_2$	300	−3.30	18

HEATS OF SOLUTION

Name	Formula	Dilution in moles of water	Heat of solution in kg-cal.	Temp. °C.
Mercuric cyanide	$Hg(CN)_2$	....	−2.97	18
Mercuric potassium bromide	HgK_2Br_4	600	−9.75	18
Mercuric potassium chloride	$HgKCl_3$	770	−9.5	14
Mercuric potassium chloride	$HgKCl_3 \cdot H_2O$	800	−11.3	14
Mercuric potassium chloride	HgK_2Cl_4	930	−15.0	14
Mercuric potassium chloride	$HgK_2Cl_4 \cdot H_2O$	970	−16.66	14
Mercuric potassium iodide	HgK_2I_4	800	−9.81	18
Neodymium chloride	$NdCl_3$	....	+35.4	17
Neodymium chloride	$NdCl_3 \cdot 6H_2O$	....	+7.6	15
Neodymium iodide	NdI_3	....	+48.9	19
Neodymium sulfate	$Nd_2(SO_4)_3$	....	+36.5	14
Nickel chloride	$NiCl_2$	400	+19.17	18
Nickel chloride	$NiCl_2 \cdot 6H_2O$	400	−1.16	18
Nickel dithionate	$NiS_2O_6 \cdot 6H_2O$	400	−2.42	18
Nickel nitrate	$Ni(NO_3)_2$	280	+11.88	18
Nickel nitrate	$Ni(NO_3)_2 \cdot 6H_2O$	400	−7.47	18
Nickel sulfate	$NiSO_4 \cdot 7H_2O$	800	−4.25	18
Oxalic acid	$H_2C_2O_4 \cdot 2H_2O$	530	−8.59	15
Perchloric acid	$HClO_4$	....	+20.3	15
Phosphoric acid, meta	HPO_3	....	+10.1	15
Phosphoric acid, ortho	H_3PO_4	120	+2.69	15
Phosphoric acid, pyro	$H_4P_2O_7$	....	+7.9	15
Phosphorous acid, hypo	H_3PO_2	....	−0.17	15
Phosphorous acid, ortho	H_3PO_3 (solid)	120	−0.13	15
Phosphorous acid, pyro	$H_4P_2O_5$	550	+35.6	15
Phosphorus trichloride	PCl_3	1000	+65.14	15
Phosphorus pentoxide	P_2O_5	550	+35.6	15
Platinum brom acid	$H_2PtBr_6 \cdot 9H_2O$	....	−2.9	15
Platinum bromide	$PtBr_4$	....	+9.86	15
Platinum chlor acid	$H_2PtCl_6 \cdot 6H_2O$	450	+4.34	15
Platinum chloride	$PtCl_4$	....	+19.6	17
Potassium acetate	$KC_2H_3O_2$	200	+3.34	18
Potassium acid arsenate	KH_2AsO_4	....	−4.9	18
Potassium acid carbonate	$KHCO_3$	....	−5.3	10–15
Potassium acid fluoride	$KF \cdot HF$	400	−6.0	15
Potassium acid flouride	$KF \cdot 2HF$	....	−8.0	15
Potassium acid fluoride	$KF \cdot 3HF$	....	−8.6	15
Potassium acid iodate	$KH(IO_3)_2$	865	−11.8	15
Potassium acid oxalate	KHC_2O_4	....	−9.6	15
Potassium acid sulfate	$KHSO_4$	200	−3.80	18
Potassium aluminum sulfate	$KAl(SO_4)_2 \cdot 12H_2O$	1200	−10.1	18
Potassium bromate	$KBrO_3$	200	−9.76	18
Potassium bromide	KBr	200	−5.08	18
Potassium bromoplatinate	K_2PtBr_6	2000	−12.26	18
Potassium carbonate	K_2CO_3	400	+6.49	18
Potassium carbonate	$K_2CO_3 \cdot \frac{1}{2}H_2O$	400	+4.28	18
Potassium carbonate	$K_2CO_3 \cdot 1\frac{1}{2}H_2O$	400	−0.38	18
Potassium chlorate	$KClO_3$	400	−10.04	18
Potassium chloride	KCl	100	−4.19	21
Potassium chloropalladate	K_2PdCl_6	....	−15.00	18
Potassium chloroplatinate	K_2PtCl_4	600	−12.22	18
Potassium chloroplatinate	K_2PtCl_6	....	−13.76	18
Potassium chromate	K_2CrO_4	543	−5.25	15
Potassium cyanate	$KCNO$	540	−5.2	20

HEATS OF SOLUTION

Name	Formula	Dilution in moles of water	Heat of solution in kg-cal.	Temp. °C.
Potassium cyanide	KCN	175	−3.01	18
Potassium dichromate	$K_2Cr_2O_7$	400	−16.70	18
Potassium dithionate	$K_2S_2O_6$	500	−13.01	18
Potassium ferricyanide	$K_3Fe(CN)_6$	400	−14.4	12
Potassium ferrisulfate	$KFe(SO_4)_2 \cdot 12H_2O$	1000	−16.0	15
Potassium ferrocyanide	$K_4Fe(CN)_6$	820	−12.0	12
Potassium ferrocyanide	$K_4Fe(CN)_6 \cdot 3H_2O$	940	−16.9	11
Potassium fluoride	KF	....	+3.6	20
Potassium fluoride	$KF \cdot 2H_2O$	....	−1.0	20
Potassium hydroxide	KOH	250	+13.29	18
Potassium hydroxide	$KOH \cdot 2H_2O$	170	−0.03	15
Potassium iodate	KIO_3	500	−6.78	18
Potassium iodide	KI	200	−5.11	18
Potassium nitrate	KNO_3	200	−8.52	18
Potassium oxalate	$K_2C_2O_4$	465–930	−4.74	10–15
Potassium oxalate	$K_2C_2O_4 \cdot H_2O$	800	−7.41	18
Potassium oxide	K_2O	....	+75.0	15
Potassium pentathionate	$K_2S_5O_6 \cdot 1\frac{1}{2}H_2O$	2030	−13.1	9.5
Potassium perchlorate	$KClO_4$	460	−12.13	20
Potassium permanganate	$KMnO_4$	700	−10.2	16
Potassium persulfate	$K_2S_2O_8$	3300	−14.55	9
Potassium phosphate dihydrogen	KH_2PO_4	....	−4.85	15
Potassium selenide	KSe	1762–1965	+8.5	13
Potassium selenide	$KSe \cdot 9H_2O$	921–4844	−19.2	14
Potassium selenide	$KSe \cdot 14H_2O$	2145–5914	−20.4	13
Potassium selenide	$KSe \cdot 19H_2O$	....	−29.3	14
Potassium silver cyanide	$KAg(CN)_2$	440	−8.55	11
Potassium stannichloride	K_2SnCl_6	800	−3.38	18
Potassium stannochloride	$K_2SnCl_4 \cdot H_2O$	600	−13.42	18
Potassium sulfate	K_2SO_4	400	−6.38	18
Potassium sulfide	K_2S	....	+22.7	
Potassium tetrasulfide	K_2S_4	600	+1.4	10
Potassium tetrasulfide	$K_2S_4 \cdot \frac{1}{2}H_2O$	....	−1.212	15.7
Potassium tetroxalate	$KHC_2O_4 \cdot H_2C_2O_4$	....	−15.7	15
Potassium tetrathionate	$K_2S_4O_6$	500	−13.15	18
Potassium thiosulfate	$K_2S_2O_3$	950	−5.0	10
Potassium thiosulfate	$K_2S_2O_3 \cdot H_2O$	....	−6.2	14
Potassium thrithionate	$K_2S_3O_6$	500	−12.46	18
Rubidium bicarbonate	$RbHCO_3$	....	+4.731	15
Rubidium bisulfate	$RbHSO_4$	....	−3.73	15
Rubidium bromide	$RbBr$	....	−5.96	15
Rubidium chloride	$RbCl$	....	−4.50	15
Rubidium fluoride	RbF	....	+5.80	15
Rubidium hydroxide	$RbOH$	....	+14.264	15
Rubidium hydroxide	$RbOH \cdot H_2O$	....	+3.70	15
Rubidium hydroxide	$RbOH \cdot 2H_2O$	....	−0.65	15
Rubidium iodide	RbI	....	−6.50	15
Rubidium oxide	Rb_2O	....	+80.0	15
Rubidium sulfate	Rb_2SO_4	....	- 6.66	15
Rubidium sulfide	Rb_2S	....	+24.6	15
Selenic acid	H_2SeO_4	....	+16.8	15
Selenium dioxide	SeO_2	....	−0.74	15
Silver acetate	$AgC_2H_3O_2$	120	−4.3	10
Silver chloride	$AgCl$	....	−15.75	15

HEATS OF SOLUTION

Name	Formula	Dilution in moles of water	Heat of solution in kg-cal.	Temp. °C.
Silver dithionate	$Ag_2S_2O_6 \cdot 2H_2O$	400	−10.36	18
Silver fluoride	AgF	....	+3.4	10
Silver fluoride	$AgF \cdot 2H_2O$	....	−1.5	10
Silver nitrate	$AgNO_3$	200	−5.44	18
Silver nitrite	$AgNO_2$	....	−8.8	15
Silver sulfate	Ag_2SO_4	1400	−4.48	18
Sodium acetate	$NaC_2H_3O_2$	250	+4.1	5.7
Sodium acetate	$NaC_2H_3O_2$	200	+3.87	18
Sodium acetate	$NaC_2H_3O_2 \cdot 3H_2O$	400	−4.81	18
Sodium ammonium phosphate	$NaNH_4HPO_4 \cdot 4H_2O$	800	−10.75	18
Sodium arsenate	$Na_3AsO_4 \cdot 12H_2O$	670	−12.6	18–20
Sodium bicarbonate	$NaHCO_3$	....	−4.3	15
Sodium bifluoride	$NaF \cdot HF$	400	−6.2	12
Sodium bisulfate	$NaHSO_4$	200	+1.19	18
Sodium bisulfide	NaHS	....	+4.4	10–16
Sodium bisulfide	$NaHS \cdot 2H_2O$	....	−1.5	17.5
Sodium borate (tetra)	$Na_2B_4O_7$	....	+10.2	15
Sodium borate (tetra)	$Na_2B_4O_7 \cdot 10H_2O$	1600	−25.86	18
Sodium bromide	NaBr	200	−0.19	18
Sodium bromide	$NaBr \cdot 2H_2O$	300	−4.71	18
Sodium bromoplatinate	Na_2PtBr_6	600	+9.99	18
Sodium bromoplatinate	$Na_2PtBr_6 \cdot 6H_2O$	800	−8.55	18
Sodium carbonate	Na_2CO_3	400	+5.64	18
Sodium chlorate	$NaClO_3$	180–360	−5.6	10
Sodium chloride	NaCl	100	−1.18	18
Sodium chloroplatinate	Na_2PtCl_6	800	+8.54	18
Sodium chloroplatinate	$Na_2PtCl_6 \cdot 6H_2O$	900	−10.63	18
Sodium chromate	Na_2CrO_4	360–720	+2.2	10.5
Sodium chromate	$Na_2CrO_4 \cdot 4H_2O$	650	−7.6	11
Sodium chromate	$Na_2CrO_4 \cdot 10H_2O$	760	−15.8	10.5
Sodium cyanate	NaCNO	....	−4.8	12.8
Sodium cyanide	NaCN	100	−0.5	9
Sodium cyanide	$NaCN \cdot \frac{1}{2}H_2O$	100	−1.0	6
Sodium cyanide	$NaCN \cdot 2H_2O$	....	−4.4	9
Sodium dithionate	$Na_2S_2O_6$	400	−5.37	18
Sodium dithionate	$Na_2S_2O_6 \cdot 2H_2O$	400	−11.65	18
Sodium fluoride	NaF	400	−0.6	12
Sodium formate	$NaCHO_2$	150	−0.52	11.5
Sodium hydroxide	NaOH	200	+9.94	18
Sodium iodide	NaI	200	+1.22	18
Sodium iodide	$NaI \cdot 2H_2O$	300	−4.01	18
Sodium nitrate	$NaNO_3$	200	−5.03	18
Sodium oxide	Na_2O	....	+55.0	15
Sodium perchlorate	$NaClO_4$	200–400	−3.5	10
Sodium phosphate (tri)	$Na_3PO_4 \cdot 12H_2O$	670	−14.5	18–20
Sodium phosphate (di)	Na_2HPO_4	400	+5.64	18
Sodium phosphate (di)	$Na_2HPO_4 \cdot 2H_2O$	400	−0.39	18
Sodium phosphate (di)	$Na_2HPO_4 \cdot 7H_2O$	....	−11.3	15
Sodium phosphate (di)	$Na_2HPO_4 \cdot 12H_2O$	400	−22.83	18
Sodium phosphate (pyro)	$Na_4P_2O_7$	800	+11.85	18
Sodium phosphate (pyro)	$Na_4P_2O_7 \cdot 10H_2O$	800	−11.67	18
Sodium phosphite (dl)	Na_2HPO_3	555	+9.15	13.5
Sodium phosphite (di)	$Na_2HPO_3 \cdot 5H_2O$	555	−4.6	13.5
Sodium phosphite (mono)	NaH_2PO_3	555	+0.75	13

HEATS OF SOLUTION

Name	Formula	Dilution in moles of water	Heat of solution in kg-cal.	Temp. °C.
Sodium phosphite (mono)	$NaH_2PO_3 \cdot 2\frac{1}{2}H_2O$	555	−5.3	15
Sodium selenide	Na_2Se	789–2587	+18.6	14
Sodium selenide	$Na_2Se \cdot 4\frac{1}{2}H_2O$	1030–2125	−7.9	13
Sodium selenide	$Na_2Se \cdot 9H_2O$	723–1352	−10.6	12
Sodium selenide	$Na_2Se \cdot 16H_2O$	1476–3572	−22.0	14
Sodium sulfate	Na_2SO_4	400	+0.46	18
Sodium sulfate	$Na_2SO_4 \cdot H_2O$	400	−1.90	18
Sodium sulfate	$Na_2SO_4 \cdot 10H_2O$	400	−18.76	18
Sodium sulfide	Na_2S	584–1027	+15.0	14.5
Sodium sulfide	$Na_2S \cdot 4\frac{1}{2}H_2O$	589–1059	−5.0	17
Sodium sulfide	$Na_2S \cdot 5H_2O$	513–1167	−6.6	17
Sodium sulfide	$Na_2S \cdot 9H_2O$	774–1495	−16.72	13
Sodium sulfite	Na_2SO_3	....	+2.5	10
Sodium sulfite	$Na_2SO_3 \cdot 7H_2O$	490	−11.2	10
Sodium tetra sulfide	Na_2S_4	....	+9.8	16.5
Sodium tetrathionate	$Na_2S_4O_6 \cdot 2H_2O$	620	−9.7	9.6
Sodium thiosulfate	$Na_2S_2O_3$	440	+1.7	15
Sodium thiosulfate	$Na_2S_2O_3 \cdot 5H_2O$	400	−11.37	18
Sodium trithionate	$Na_2S_3O_6 \cdot 3H_2O$	675	−10.1	10
Strontium acetate	$Sr(C_2H_3O_2)_2$	300	+5.6	11.5
Strontium acetate	$Sr(C_2H_3O_2)_2 \cdot \frac{1}{2}H_2O$	440	+5.3	12
Strontium bromide	$SrBr_2$	400	+16.11	18
Strontium bromide	$SrBr_2 \cdot 6H_2O$	400	−7.22	18
Strontium chloride	$SrCl_2$	400	+11.14	18
Strontium chloride	$SrCl_2 \cdot 6H_2O$	400	−7.50	18
Strontium cyanide	$Sr(CN)_2 \cdot 4H_2O$	100	−4.15	8
Strontium dithionate	$SrS_2O_6 \cdot 4H_2O$	400	−9.25	18
Strontium fluoride	SrF_2	....	−2.10	15
Strontium hydroxide	$Sr(OH)_2$	....	+11.64	18
Strontium hydroxide	$Sr(OH)_2 \cdot 8H_2O$	....	−14.64	18
Strontium iodide	SrI_2	....	+20.5	12
Strontium iodide	$SrI_2 \cdot 7H_2O$	....	−4.47	15
Strontium nitrate	$Sr(NO_3)_2$	400	−4.62	18
Strontium nitrate	$Sr(NO_3)_2 \cdot 4H_2O$	400	−12.30	18
Strontium oxide	SrO	....	+29.34	18
Strontium oxide	$SrO \cdot 0.14H_2O$	1111	+26.10	15
Strontium oxide	$SrO \cdot H_2O$	1111	+10.33	15
Strontium oxide	$SrO \cdot 2H_2O$	1111	+5.26	15
Strontium oxide	$SrO \cdot 9H_2O$	1111	−14.27	15
Strontium selenide	$SrSe$	....	+7.4	15
Sulfur dioxide	SO_2	300	+1.50	15
Sulfur trioxide	SO_3	1600	+39.17	15
Sulfur heptoxide	S_4O_7	....	+37.29	15
Sulfuric acid	H_2SO_4	1600	+17.85	15
Thallium chloride	$TlCl$	4500	−10.10	18
Thallium hydroxide	$TlOH$	235	−3.15	18
Thallium nitrate	$TlNO_3$	300	−9.97	18
Thallium oxide	Tl_2O	570	−3.08	18
Thallium sulfate	Tl_2SO_4	1600	−8.28	18
Tin bromide(ic)	$SnBr_4$	970	+16.6	10.5
Tin bromide (ous)	$SnBr_2$	1080	−1.6	15
Tin chloride (ic)	$SnCl_4$	720	+28.5	10.5
Tin chloride (ous)	$SnCl_2$	300	+0.35	18
Tin chloride (ous)	$SnCl_2 \cdot 2H_2O$	200	−5.37	18
Uranyl acetate	$UO_2(C_2H_3O_2)_2 \cdot 2H_2O$	1000–2500	−4.3	18–20

HEATS OF SOLUTION

Name	Formula	Dilution in moles of water	Heat of solution in kg-cal.	Temp. °C.
Uranyl chloride	$UO_2Cl_2 \cdot H_2O$	1000–2500	+2.0	18–20
Uranyl chromate	$UO_2CrO_4 \cdot 5\frac{1}{2}H_2O$	1000–2500	−6.3	18–20
Uranyl nitrate	$UO_2(NO_3)_2 \cdot 3H_2O$	1000–2500	−3.7	18–20
Uranyl potassium chloride	$UO_2Cl_2 \cdot 2KCl \cdot 2H_2O$	1000–2500	+2.0	18–20
Uranyl sulfate	$UO_2SO_4 \cdot 3H_2O$	1000–2500	+5.1	18–20
Ytterbium sulfate	$Y_2(SO_4)_3 \cdot 8H_2O$	1200	+10.7	18
Zinc acetate	$Zn(C_2H_3O_2)_2$	720	+9.8	22.5
Zinc acetate	$Zn(C_2H_3O_2)_2 \cdot H_2O$	800	+7.0	22.5
Zinc acetate	$Zn(C_2H_3O_2)_2 \cdot 2H_2O$	500	+4.2	10.2
Zinc ammonium chloride	$3ZnCl_2 \cdot 6NH_4Cl \cdot H_2O$	....	+3.23	13
Zinc bromide	$ZnBr_2$	400	+15.03	18
Zinc chloride	$ZnCl_2$	300	+15.63	18
Zinc dithionate	$ZnS_2O_6 \cdot 6H_2O$	400	−2.42	1
Zinc formate	$Zn(CHO_2)_2$	500	+4.0	15
Zinc iodide	ZnI_2	400	+11.31	18
Zinc nitrate	$Zn(NO_3)_2 \cdot 6H_2O$	400	−5.84	18
Zinc potassium sulfate	$ZnSO_4 \cdot K_2SO_4$	600	+7.91	18
Zinc potassium sulfate	$ZnSO_4 \cdot K_2SO_4 \cdot 6H_2O$	600	−11.90	18
Zinc sulfate	$ZnSO_4$	400	+18.43	18
Zinc sulfate	$ZnSO_4 \cdot H_2O$	400	+9.95	18
Zinc sulfate	$ZnSO_4 \cdot 7H_2O$	400	−4.26	18
Zirconyl nitrate	$ZrO(NO_3)_2 \cdot 2H_2O$	....	+2.17	15
Zirconyl nitrate	$ZrO(NO_3)_2 \cdot 3\frac{1}{2}H_2O$	....	−1.92	15

VAN DER WAALS' CONSTANTS FOR GASES

Calculated from the values given in *Landolt-Bornstein Phys.-Chem. Tab.*, 5th Ed., p. 254 (1923); published by J. Springer, Berlin.

$$\left(P + \frac{a}{V^2}\right)\left(V - b\right) = RT \text{ for } one \text{ mole}$$

To use the values of a and b in the table below, P must be expressed in atmospheres and V in liters per mole; then $R = 0.08207$ liter atmospheres per mole per degree; T is degrees absolute.

$$\left(P + \frac{n^2a}{V^2}\right)\left(V - nb\right) = nRT \text{ for } n \text{ moles}$$

Name	Formula	a $\frac{(\text{liters})^2 \times \text{atm.}}{(\text{mole})^2}$	b $\frac{\text{liters}}{\text{mole}}$
Acetic acid	CH_3CO_2H	17.59	0.1068
Acetic anhydride	$(CH_3CO)_2O$	19.90	0.1263
Acetone	$(CH_3)_2CO$	13.91	0.0994
Acetonitrile	CH_3CN	17.58	0.1168
Acetylene	$HCCH$	4.390	0.05136
Ammonia	NH_3	4.170	0.03707
Amyl formate	$HCO_2C_5H_{11}$	27.58	0.1730
Amylene	C_5H_{10}	15.90	0.1207
Aniline	$C_6H_5NH_2$	26.50	0.1369
Argon	A	1.345	0.03219
Benzene	C_6H_6	18.00	0.1154
Benzonitrile	C_6H_5CN	33.39	0.1724
Bromobenzene	C_6H_5Br	28.56	0.1539
Butane *n*	C_4H_{10}	14.47	0.1226

VAN DER WAALS' CONSTANTS FOR GASES

Name	Formula	a $\frac{(\text{liters})^2 \times \text{atm.}}{(\text{mole})^2}$	b $\frac{\text{liters}}{\text{mole}}$
Butyronitrile	C_3H_7CN	25.72	0.1596
Capronitrile	$C_5H_{11}CN$	34.16	0.1984
Carbon dioxide	CO_2	3.592	0.04267
Carbon disulfide	CS_2	11.62	0.07685
Carbon monoxide	CO	1.485	0.03985
Carbon oxysulfide	COS	3.933	0.05817
Carbon tetrachloride	CCl_4	20.39	0.1383
Chlorine	Cl_2	6.493	0.05622
Chlorobenzene	C_6H_5Cl	25.43	0.1453
Chloroform	$CHCl_3$	15.17	0.1022
Cresol *m*	$CH_3C_6H_4OH$	31.38	0.1607
Cyanogen	$(CN)_2$	7.667	0.06901
Cyclohexane	C_6H_{12}	22.81	0.1424
Cymene	$CH_3C_6H_4C_3H_7$	42.16	0.2336
Decane	$C_{10}H_{12}$	48.55	0.2905
Di-isobutyl	C_8H_{18}	34.97	0.2296
Diethylamine	$(C_2H_5)_2NH$	19.15	0.1392
Dimethylamine	$(CH_3)_2NH$	10.38	0.08570
Dimethylaniline	$C_6H_5N(CH_3)_2$	37.49	0.1970
Diphenyl	$(C_6H_5)_2$	52.79	0.2480
Diphenyl methane	$(C_6H_5)_2CH_2$	38.20	0.2240
Dipropylamine	$(C_3H_7)_2NH$	27.72	0.1820
Di-isopropyl	$(C_3H_7)_2$	23.13	0.1669
Durene	$C_{10}H_{14}$	45.32	0.2424
Ethane	C_2H_6	5.489	0.06380
Ethyl acetate	$CH_3CO_2C_2H_5$	20.45	0.1412
Ethyl alcohol	C_2H_5OH	12.02	0.08407
Ethylamine	$C_2H_5NH_2$	10.60	0.08409
Ethyl benzene	$C_2H_5C_6H_5$	28.60	0.1667
Ethyl butyrate	$C_3H_7CO_2C_2H_5$	30.07	0.1919
Ethyl isobutyrate	$C_3H_7CO_2C_2H_5$	28.87	0.1994
Ethyl chloride	C_2H_5Cl	10.91	0.08651
Ethyl ether	$(C_2H_5)_2O$	17.38	0.1344
Ethyl formate	$HCO_2C_2H_5$	14.80	0.1056
Ethyl mercaptan	C_2H_5SH	11.24	0.08098
Ethyl propionate	$C_2H_5CO_2C_2H_5$	24.39	0.1615
Ethyl sulfide	$(C_2H_5)_2S$	18.75	0.1214
Ethylene	C_2H_4	4.471	0.05714
Ethylene bromide	$(CH_2Br)_2$	13.98	0.08664
Ethylene chloride	$(CH_2Cl)_2$	16.91	0.1086
Ethylidene chloride	CH_3CHCl_2	15.50	0.1073
Fluorobenzene	C_6H_5F	19.93	0.1286
Germanium tetrachloride	$GeCl_4$	22.60	0.1485
Helium	He	0.03412	0.02370
Heptane *n*	C_7H_{16}	31.51	0.2654
Hexane *n*	C_6H_{14}	24.39	0.1735
Hydrogen	H_2	0.2444	0.02661
Hydrogen bromide	HBr	4.451	0.04431
Hydrogen chloride	HCl	3.667	0.4081
Hydrogen selenide	H_2Se	5.268	0.04637
Hydrogen sulfide	H_2S	4.431	0.04287
Iodobenzene	C_6H_5I	33.08	0.1656
Isoamylene	C_5H_{10}	18.08	0.1405
Isobutane	C_4H_{10}	12.87	0.1142
Isobutyl acetate	$CH_3CO_2C_4H_9$	28.50	0.1833

VAN DER WAALS' CONSTANTS FOR GASES

Name	Formula	a $\frac{(\text{liters})^2 \times \text{atm.}}{(\text{mole})^2}$	b $\frac{\text{liters}}{\text{mole}}$
Isobutyl alcohol	C_4H_9OH	17.03	0.1143
Isobutylbenzene	$C_6H_5C_4H_9$	38.59	0.2144
Isobutyl formate	$HCO_2C_4H_9$	22.54	0.1476
Isopentane	C_5H_{12}	18.05	0.1417
Isopropyl alcohol	C_3H_7OH	13.78	0.09804
Isopropylbenzene	$C_6H_5C_3H_7$	35.64	0.2025
Krypton	Kr	2.318	0.03978
Mercury	Hg	8.093	0.01696
Mesitylene	$(CH_3)_3C_6H_3$	34.32	0.1979
Methane	CH_4	2.253	0.04278
Methyl acetate	$CH_3CO_2CH_3$	15.29	0.1091
Methyl alcohol	CH_3OH	9.523	0.06702
Methylamine	CH_3NH_2	7.130	0.05992
Methyl butyrate	$C_3H_7CO_2CH_3$	23.94	0.1569
Methyl isobutyrate	$C_3H_7CO_2CH_3$	24.50	0.1637
Methyl chloride	CH_3Cl	7.471	0.06483
Methyl ether	$(CH_3)_2O$	8.073	0.07246
Methyl ethyl ether	$CH_3OC_2H_5$	11.95	0.09775
Methyl ethyl sulfide	$CH_3SC_2H_5$	19.23	0.1304
Methyl fluoride	CH_3F	4.631	0.05264
Methyl formate	HCO_2CH_3	10.84	0.08068
Methyl propionate	$C_2H_5CO_2CH_3$	19.91	0.1360
Methyl sulfide	$(CH_3)_2S$	12.87	0.09213
Methyl valerate	$C_4H_9CO_2CH_3$	28.96	0.1845
Naphthalene	$C_{10}H_8$	39.74	0.1937
Neon	Ne	0.2107	0.01709
Nitric oxide	NO	1.340	0.02789
Nitrogen	N_2	1.390	0.03913
Nitrogen dioxide	NO_2	5.284	0.04424
Nitrous oxide	N_2O	3.782	0.04415
Octane *n*	C_8H_{18}	37.32	0.2368
Oxygen	O_2	1.360	0.03183
Pentane *n*	C_5H_{12}	19.01	0.1460
Phenetole	$C_6H_5OC_2H_5$	35.16	0.1963
Phosphine	PH_3	4.631	0.05156
Phosphonium chloride	PH_4Cl	4.054	0.04545
Phosphorus	P	52.94	0.1566
Propane	C_3H_8	0.8664	0.08445
Propionic acid	$C_2H_5CO_2H$	20.11	0.1187
Propionitrile	C_2H_5CN	16.44	0.1064
Propyl acetate	$CH_3CO_2C_3H_7$	24.63	0.1619
Propyl alcohol	C_3H_7OH	14.92	0.1019
Propylamine	$C_3H_7NH_2$	14.99	0.1090
Propyl benzene	$C_6H_5C_3H_7$	35.85	0.2028
Propyl chloride	C_3H_7Cl	15.91	0.1141
Propyl formate	$HCO_2C_3H_7$	18.95	0.1280
Propylene	C_3H_6	8.379	0.08272
Pseudo-cumene	$C_6H_3(CH_3)_3$	36.61	0.2021
Silicon fluoride	SiF_4	4.195	0.05571
Silicon tetrahydride	SiH_4	4.320	0.05786
Stannic chloride	$SnCl_4$	26.91	0.1642
Sulfur dioxide	SO_2	6.714	0.05636
Thiophene	C_4H_4S	20.72	0.1270
Toluene	$C_6H_5CH_3$	24.06	0.1463
Triethylamine	$(C_2H_5)_3N$	27.17	0.1831

VAN DER WAALS' CONSTANTS FOR GASES

Name	Formula	a $\frac{(\text{liters})^2 \times \text{atm.}}{(\text{mole})^2}$	b $\frac{\text{liters}}{\text{mole}}$
Trimethylamine	$(CH_3)_3N$	13.02	0.1084
Xenon	Xe	4.194	0.05105
Xylene *m*	$C_6H_4(CH_3)_2$	30.36	0.1772
Xylene *o*	$C_6H_4(CH_3)_2$	29.98	0.1755
Xylene *p*	$C_6H_4(CH_3)_2$	30.93	0.1809
Water	H_2O	5.464	0.03049

SPECIFIC HEAT OF GASES AND VAPORS

The values of γ in the table below are the ratios of the specific heat at constant pressure (Cp) to that at constant volume (Cv). To convert the values below into joules per gram per degree C., multiply by 4.186.

Gas or Vapor	Temp. °C.	Press. atm.	Specific Heat in cal. 15° per gram per °C. Const. press.	Const. vol.	$\gamma = Cp/Cv$
Acetaldehyde, C_2H_4O	30	1	.....	.....	1.14
Acetic acid, $C_2H_4O_2$	118–140	1	1.50	.....	$1.15^{136°}$
" "	140–180	1	1.27	.....	.....
" "	180–220	1	0.951	.....	.....
Acetone, C_3H_6O	26–110	1	0.347	.....	.....
"	130–230	1	0.412	.....	.....
Acetylene, C_2H_2	15	1	0.3830	0.3039	1.26
"	−71	1	0.3513	0.2676	1.31
Air	0	1	0.2399	0.1710	1.403
"	100	1	0.2404	0.1715	1.401
"	200	1	0.2413	0.1726	1.398
"	400	1	0.2430	0.1744	1.393
"	600	1	0.2471	0.1785	1.385
"	800	1	0.2521	0.1835	1.376
"	1000	1	0.2571	0.1885	1.365
"	1400	1	0.2700	0.2014	1.341
"	2000	1	0.2949	0.2263	1.088
"	0	20	0.2490	.....	.....
"	0	100	0.2800	.....	.....
"	50	220	0.2961	.....	.....
"	−50	10	0.2440	.....	.....
"	−100	10	0.2581	.....	.....
"	−140	10	0.4079	.....	.....
Allyl chloride, C_3H_5Cl	14	0.2	.....	.....	1.137
Ammonia, NH_3	15	1	0.5232	0.3995	1.310
"	15	3.5	.....	.....	1.41
Argon, A	−180	1	1.33	0.0754	1.76
"	15	1	0.1252	0.07531	1.668
Arsenic trichloride, $AsCl_3$	160–270	1	0.112	.....	.....
Benzene, C_6H_6	90	1	0.3254	0.2958	1.10
"	34–115	1	0.301	.....	.....
"	120–220	1	0.370	.....	.....
Bromine, Br_2	20–350	0.3–1.5	.....	.....	1.32
"	19–388	1	0.0550	.....	.....
iso-Butane, C_4H_{10}	15	1	.....	.....	1.11
Carbon dioxide, CO_2	0	1	0.1973	0.1506	1.310
" "	15	1	0.1988	0.1525	1.304
" "	100	1	0.2064	0.1626	1.281
" "	400	1	0.2379	0.1927	1.235
" "	1000	1	0.2763	0.2312	1.195

SPECIFIC HEAT OF GASES AND VAPORS

Gas or Vapor	Temp. °C.	Press. atm.	Specific Heat in cal. 15° per gram per °C. Const. press.	Const. vol.	$\gamma = Cp/Cv$
Carbon dioxide, CO_2	2000	1	0.3091	0.2640	1.171
" "	38	24.25	0.2879	.....	.....
" "	38	54.1	0.3259	.....	.....
" "	38	85.4	0.9950	.....	.....
" "	−75	1	0.184	0.144	1.37
Carbon disulfide, CS_2	99.7	sat. vap.	.....	.....	1.63
" "	80–190	1	0.157	.....	.....
" "	17	0.3	0.157	.....	.....
Carbon monoxide, CO	−180	1	0.259	0.176	1.41
" "	15	1	0.2478	0.1766	1.404
Carbon tetrachloride, CCl_4	0	1	0.140	.....	.....
" "	30	1	0.132	.....	.....
" "	70	1	0.115	.....	.....
" "	20	0.1	.....	.....	1.13
Chlorine, Cl_2	15	1	0.1150	0.08486	1.355
"	16	0.5	.....	.....	1.34
Chloroform, $CHCl_3$	27–118	1	0.145	.....	.....
"	120–230	1	0.157	.....	.....
"	20	0.15	.....	.....	1.15
"	100	1	.....	.....	1.15
Cyanogen, $(CN)_2$	15	1	0.4095	0.3260	1.256
Cyclohexane, C_6H_{12}	80	1	.....	.....	1.08
"	100	1	0.413	.....	.....
Ethane, C_2H_6	−82	1	0.347	0.271	1.28
"	15	1	0.3860	0.3136	1.22
"	50	1	.....	.....	1.21
"	100	1	.....	.....	1.19
Ethyl acetate, $C_4H_8O_2$	35–113	1	0.2369	.....	.....
" "	110–220	1	0.4010	.....	.....
Ethyl alcohol, C_2H_6O	90	1	0.406	0.359	1.13
" "	100–223	1	0.454	.....	.....
Ethyl bromide, C_2H_5Br	14	0.3	.....	.....	1.19
" "	28–116	1	0.161	.....	.....
" "	80–200	1	0.190	.....	.....
Ethyl chloride, C_2H_5Cl	−30	0.137	0.21	.....	.....
" "	0	0.137	0.22	.....	.....
" "	40	0.137	0.239	.....	.....
" "	40	1.37	0.244	.....	.....
" "	16	0.3–0.5	.....	.....	1.19
Ethyl cyanide, C_3H_5N	114–223	1	0.4260	.....	.....
Ethyl ether, $C_4H_{10}O$	35	1	0.4449	0.4119	1.08
" "	27–189	1	0.4619	.....	$1.086^{80°}$
" "	200–300	1	0.5331	.....	.....
" "	16	0.28	0.459	.....	.....
Ethyl sulfide, $C_4H_{10}S$	120–223	1	0.399	.....	.....
Ethylene, C_2H_4	−91	1	0.3086	0.2285	1.35
"	15	1	0.3592	0.2858	1.255
"	15–100	1	0.399	.....	$1.18^{100°}$
"	25–200	1	0.430	.....	.....
Ethylene chloride, $C_2H_4Cl_2$	19	0.06	.....	.....	1.137
" "	23	0.2	.....	.....	1.134
" "	111–221	1	0.229	.....	.....
Ethylidene chloride, $C_2H_4Cl_2$	110–220	1	0.230	.....	.....
Helium, He	−180	1	1.248	0.752	1.660
n-Hexane, C_6H_{14}	80	1	0.3646	.....	1.08

SPECIFIC HEAT OF GASES AND VAPORS

Gas or Vapor	Temp. °C.	Press. atm.	Specific Heat in cal. 15° per gram per °C. Const. press.	Const. vol.	$\gamma = Cp/Cv$
Hydrogen, H_2	−181	1	2.64	1.66	1.597
"	−76	1	3.15	2.17	1.453
"	0	....	3.39	2.40	1.410
"	15	1	3.388	2.402	1.410
"	100	....	3.428	2.442	1.404
"	400	....	3.533	2.547	1.387
"	1000	....	3.740	2.754	1.358
"	2000	....	4.088	3.102	1.318
Hydrogen bromide, HBr	30	0.3–1.5	.....	.....	1.42
" "	11–100	1	0.0820	.....	.....
Hydrogen chloride, HCl	15	1	0.1939	0.1375	1.41
" "	100	1	.....	.....	1.40
" "	10–190	1	0.185	.....	.....
Hydrogen cyanide, HCN	65	1	.....	.....	1.31
" "	140	1	.....	.....	1.28
" "	210	1	.....	.....	1.24
Hydrogen iodide, HI	20–100	1	.....	.....	1.40
Hydrogen sulfide, H_2S	−57	1	0.292	0.227	1.29
" "	−45	1	0.279	0.215	1.30
" "	15	1	0.2532	0.1918	1.32
" "	18	0.5	.....	.....	1.32
" "	10–190	1	0.2430	.....	.....
Iodine, I_2	185	1	.....	.....	1.30
"	206–377	1	0.0337	.....	.....
Krypton, Kr	19	1	.....	.....	1.68
Mercury, Hg	360	0.5–1	.....	.....	1.67
Methane, CH_4	−115	1	0.450	0.319	1.41
"	−74	1	0.498	0.370	1.35
"	15	1	0.5282	0.4032	1.31
"	10–200	1	0.5931	.....	.....
Methyl acetate, $C_3H_6O_2$	15	1	.....	.....	1.14
Methyl alcohol, CH_4O	77	1	0.390	0.324	1.203
" "	100–223	1	0.4581	.....	.....
Methyl bromide, CH_3Br	18	0.3–0.6	.....	.....	1.27
Methyl chloride, CH_3Cl	16	0.8	.....	.....	1.28
Methyl ether, C_2H_6O	6–30	1	.....	.....	1.11
Methyl iodide, CH_3I	20	0.3	.....	.....	1.286
Neon, Ne	19	1	.....	.....	1.64
Nitric oxide, NO	−80	1	0.244	0.177	1.38
" "	−45	1	0.239	0.172	1.39
" "	15	1	0.2328	0.1664	1.400
" "	10–180	1	0.232	.....	.....
Nitrogen, N_2	−181	1	0.256	0.174	1.47
"	15	1	0.2477	0.1765	1.404
Nitrogen dioxide, NO_2	27–67	1	1.62	.....	.....
" "	27–100	1	1.70	.....	.....
" "	27–200	1	0.851	.....	.....
" "	27–300	1	0.630	.....	.....
Nitrous oxide, N_2O	−70	1	0.190	0.142	1.34
" "	−30	1	0.200	0.153	1.31
" "	15	1	0.2004	0.1538	1.303
" "	100	1	.....	.....	1.28
" "	25–200	1	0.224	.....	.....
Oxygen, O_2	−181	1	0.2284	0.1575	1.45
"	−76	1	0.214	0.152	1.415

SPECIFIC HEAT OF GASES AND VAPORS

Gas or Vapor	Temp. °C.	Press. atm.	Specific Heat in cal. 15° per gram per°C. Const. press.	Const. vol.	$\gamma = Cp/Cv$
Oxygen O_2	15	1	0.2177	0.1554	1.401
"	100	....	0.2187	0.1563	1.399
"	200	....	0.2194	0.1570	1.397
"	400	....	0.2209	0.1585	1.394
n-Pentane, C_5H_{12}	86	1	0.4093	0.3769	1.086
iso-Pentane, C_5H_{12}	58	1	0.449	.....	.....
"	100	1	0.471	.....	.....
Phosphorus, P	300	1	.....	.....	1.17
Phosphorus trichloride, PCl_3	110–250	1	0.135	.....	.....
Potassium, K	850	1	.....	.....	1.77
Propane, C_3H_8	16	0.5	.....	.....	1.13
n- or *iso*-Propyl chloride, C_3H_7Cl	21	0.1	.....	.....	1.13
Silicon tetrachloride, $SiCl_4$	14	0.15	.....	.....	1.13
" "	90–230	1	0.132	.....	.....
Sodium, Na	750–920	1	.....	.....	1.68
Stannic chloride, $SnCl_4$	149–273	1	0.0939	.....	.....
Sulfonyl chloride, SO_2Cl_2	19–98	1	0.114	.....	.....
Sulfur dioxide, SO_2	15	1	0.1516	0.1175	1.29
" "	20	0.5	.....	.....	1.27
" "	20	2.5	.....	.....	1.35
" "	10–190	1	0.134	.....	.....
Titanium tetrachloride, $TiCl_4$	160–270	1	0.129	.....	.....
Water, H_2O	100	1	0.4836	0.3652	1.324
"	200	1	0.4791	0.3657	1.310
"	400	1	0.4801	0.3690	1.301
"	700	1	0.5024	0.3918	1.282
"	1000	1	0.5488	0.4384	1.252
"	1400	1	0.6470	0.5366	1.206
"	2000	1	0.8290	0.7187	1.155
"	2300	1	0.8634	0.7530	1.146
"	200	2	0.4769	.....	.....
"	200	4	0.4939	.....	.....
"	200	6	0.5150	.....	.....
"	200	10	0.5689	.....	.....
"	200	14	0.6710	.....	.....
Xenon, Xe	19	1	.....	.....	1.66

CRITICAL CONSTANTS OF GASES

Name	Formula	t_c, °C.	p_c, atm.	d_c, g/cc
Acetaldehyde	CH_3CHO	188	.....	.....
Acetic acid	CH_3CO_2H	321.6	57.2	0.351
Acetic anhydride	$(CH_3CO)_2O$	296	46	.....
Acetone	$(CH_3)_2CO$	235.0	47	0.268
Acetonitrile	CH_3CN	274.7	47.7	0.240
Acetylene	C_2H_2	36	62	0.231
Air	.....	−140.7	37.2	0.35* 0.31**
Allyl alcohol	C_3H_5OH	272	.....	.....
Allyl sulfide	$(C_3H_5)_2S$	380	.....	.....
Allylene	CH_3CCH	128	.....	.....
Ammonia	NH_3	132.4	111.5	0.235
iso-Amyl acetate	$CH_3CO_2C_5H_{11}$	326	.....	.....
iso-Amyl alcohol	$C_5H_{11}OH$	307	.....	.....
tert-Amyl alcohol	$C_5H_{11}OH$	272	.....	.....
iso-Amyl *n*-butyrate	$C_3H_7CO_2C_5H_{11}$	346	.....	.....
iso-Amyl formate	$HCO_2C_5H_{11}$	303	34	0.282
iso-Amyl mercaptan	$C_5H_{11}SH$	321	.....	.....
iso-Amyl propionate	$C_2H_5CO_2C_5H_{11}$	338	.....	.....
iso-Amyl sulfide	$(C_5H_{11})_2S$	391	.....	.....
Aniline	$C_6H_5NH_2$	426	52.4	.....
Anisole	$C_6H_5OCH_3$	369	41.3	.....
Argon	A	−122	48	0.531
Benzene	C_6H_6	288.5	47.7	0.304
Benzonitrile	C_6H_5CN	426	41.6	.....
Bromine	Br_2	302	.....	.....
Bromobenzene	C_6H_5Br	397	44.6	0.486
n-Butane	C_4H_{10}	153	36	.....
iso-Butane	C_4H_{10}	134	37	.....
n-Butyl acetate	$CH_3CO_2C_4H_9$	306	.....	.....
iso-Butyl acetate	$CH_3CO_2C_4H_9$	288	31	0.281
n-Butyl alcohol	C_4H_9OH	287	48.4	.....
iso-Butyl alcohol	C_4H_9OH	265	48	.....
sec-Butyl alcohol	C_4H_9OH	265	.....	.....
tert-Butyl alcohol	C_4H_9OH	235	.....	.....
iso-Butyl *n*-butyrate	$C_3H_7CO_2C_4H_9$	338	.....	.....
iso-Butyl *iso*-butyrate	$C_3H_7CO_2C_4H_9$	329	.....	.....
iso-Butyl formate	$HCO_2C_4H_9$	278	38	0.288
iso-Butyl propionate	$C_2H_5CO_2C_4H_9$	319	.....	.....
iso-Butyl *iso*-valerate	$C_4H_9CO_2C_4H_9$	348	.....	.....
n-Butyric acid	$C_3H_7CO_2H$	355	.....	0.302
iso-Butyric acid	$C_3H_7CO_2H$	336	.....	0.304
Butyronitrile	C_3H_7CN	309	37.4	.....
Capronitrile	$C_5H_{11}CN$	349	32.2	.....
Carbon dioxide	CO_2	31.1	73.0	0.460
Carbon disulfide	CS_2	273	76	.....
Carbon monoxide	CO	−139	35	0.311
Carbon oxysulfide	COS	105	61	.....
Carbon tetrachloride	CCl_4	283.1	45.0	0.558
Chlorine	Cl_2	144.0	76.1	0.573
Chlorobenzene	C_6H_5Cl	359	44.6	0.365
Chloroform	$CHCl_3$	263	.....	0.516
o-Cresol	C_7H_7OH	422	49.4	.....
m-Cresol	C_7H_7OH	432	45.0	.....
p-Cresol	C_7H_7OH	426	50.8	.....
Cyanogen	C_2N_2	128	59	.....
Cyclohexane	C_6H_{12}	281.0	40.4	0.270

*Plait point **Critical point of contact

CRITICAL CONSTANTS OF GASES

Name	Formula	t_c, °C.	p_c, atm.	d_c, g/cc
Diethylamine	$(C_2H_5)_2NH$	223.5	36.2	0.246
Di-*iso*-butyl	C_8H_{18}	277	24.5	0.237
Dimethylamine	$(CH_3)_2NH$	164.6	51.7	.....
Dimethylaniline	$C_6H_5N(CH_3)_2$	415	35.8	.....
Dimethyl-*o*-toluidine	$C_7H_7N(CH_3)_2$	395	30.8	.....
Di-*iso*-propyl	C_6H_{14}	227.4	30.6	0.241
Dipropylamine	$(C_3H_7)_2NH$	277	31	.....
Ethane	C_2H_6	32.1	48.8	0.21
Ethyl acetate	$CH_3CO_2C_2H_5$	250.1	37.8	0.308
Ethyl alcohol	C_2H_5OH	243.1	63.1	0.2755
Ethyl allyl ether	$C_2H_5OC_3H_5$	245	.....	.....
Ethyl bromide	C_2H_5Br	231	.....	0.513
Ethyl *n*-butyrate	$C_3H_7CO_2C_2H_5$	293	30	0.276
Ethyl *iso*-butyrate	$C_3H_7CO_2C_2H_5$	280	30	0.276
Ethyl caprylate	$C_7H_{15}CO_2C_2H_5$	386	.....	.....
Ethyl chloride	C_2H_5Cl	187.2	52	0.33
Ethyl chloroformate	$ClCO_2C_2H_5$	<235	.....	.....
Ethyl crotonate	$C_3H_5CO_2C_2H_5$	326	.....	.....
Ethyl disulfide	$(C_2H_5)_2S_2$	369	.....	.....
Ethyl ether	$(C_2H_5)_2O$	193.8	35.5	0.2625
Ethyl formate	$HCO_2C_2H_5$	235.3	46.65	0.323
Ethyl mercaptan	C_2H_5SH	225.5	54.2	0.301
Ethyl pelargonate	$CH_3(CH_2)_7CO_2C_2H_5$	400	.....	.....
Ethyl propionate	$C_2H_5CO_2C_2H_5$	272.9	33.0	0.2965
Ethyl propyl ether	$C_2H_5OC_3H_7$	227.4	32.1	0.258
Ethyl sulfide	$(C_2H_5)_2S$	283.8	39.1	0.279
Ethyl *n*-valerate	$C_4H_9CO_2C_2H_5$	297	.....	.....
Ethyl *iso*-valerate	$C_4H_9CO_2C_2H_5$	315	.....	.....
Ethylal	$CH_2(OC_2H_5)_2$	254	.....	.....
Ethylamine	$C_2H_5NH_2$	183.2	55.5	.....
Ethylene	C_2H_4	9.7	50.9	0.22
Ethylene oxide	$(CH_2)_2O$	192.0	.....	.....
Fluorobenzene	C_6H_5F	286	44.6	0.354
Germanium tetrachloride	$GeCl_4$	277	38	.....
Helium	He	−267.9	2.26	0.0693
n-Heptane	C_7H_{16}	266.8	26.8	0.234
n-Heptyl alcohol	$C_7H_{15}OH$	365	.....	.....
n-Hexane	C_6H_{14}	234.8	29.5	0.234
Hydrazine	N_2H_4	380	145	.....
Hydrogen	H_2	−239.9	12.8	0.0310
Hydrogen bromide	HBr	90	84	.....
Hydrogen chloride	HCl	51.4	81.6	0.42
Hydrogen cyanide	HCN	183.5	50	0.20
Hydrogen iodide	HI	151	82	.....
Hydrogen selenide	H_2Se	138	88	.....
Hydrogen sulfide	H_2S	100.4	88.9	.....
Iodine	I_2	553	.....	.....
Iodobenzene	C_6H_5I	448	44.6	0.581
Krypton	Kr	−63	54	0.78
Mercury	Hg	>1550	>200	4−5
Methane	CH_4	−82.5	45.8	0.162
Methyl acetate	$CH_3CO_2CH_3$	233.7	46.3	0.325
Methyl alcohol	CH_3OH	240.0	78.7	0.272
Methyl *n*-butyrate	$C_3H_7CO_2CH_3$	281.3	34.2	0.300
Methyl *iso*-butyrate	$C_3H_7CO_2CH_3$	267.55	33.7	0.301
Methyl chloride	CH_3Cl	143.1	65.8	0.37
Methyl ether	$(CH_3)_2O$	126.9	52.0	0.271

CRITICAL CONSTANTS OF GASES

Name	Formula	t_c, °C.	p_c, atm.	d_c, g/cc
Methyl ethyl ether	$CH_3OC_2H_5$	164.7	43.4	0.270
Methyl ethyl sulfide	$CH_3SC_2H_5$	260	42	.....
Methyl fluoride	CH_3F	44.9	62.0	.....
Methyl formate	HCO_2CH_3	214.0	59.15	0.349
Methyl mercaptan	CH_3SH	196.8	71.4	0.323
Methyl oxalate	$(CO_2CH_3)_2$	260	9.48	.....
Methyl propionate	$C_2H_5CO_2CH_3$	257.4	39.3	0.312
Methyl sulfide	$(CH_3)_2S$	229.9	54.6	0.306
Methyl valerate	$C_4H_9CO_2CH_3$	294d	32	0.279
Methylamine	CH_3NH_2	156.9	73.6	.....
Methylaniline	$C_6H_5NHCH_3$	429	51.3	.....
Neon	Ne	−228.7	25.9	0.484
Nitric oxide	NO	−94	65	0.52
Nitrogen	N_2	−147.1	33.5	0.3110
Nitrogen tetroxide	N_2O_4	158	99	.....
Nitrous oxide	N_2O	36.5	71.7	0.45
n-Octane	C_8H_{18}	296	24.6	0.234
Oxygen	O_2	−118.8	49.7	0.430
Paraldehyde	$C_6H_{12}O_3$	290	.....	.....
n-Pentane	C_5H_{12}	197.2	33.0	0.232
iso-Pentane	C_5H_{12}	187.8	32.8	0.234
Phenetole	$C_6H_5OC_2H_5$	374	33.8	.....
Phenol	C_6H_5OH	419	60.5	.....
Phosgene	$COCl_2$	182	56	0.52
Phosphine	PH_3	51	64	0.30
Phosphonium chloride	PH_4Cl	49	73	.....
Propane	C_3H_8	96.81	42.01	0.226
Propionic acid	$C_2H_5CO_2H$	339.5	53.0	0.315
Propionitrile	C_2H_5CN	291.2	41.3	0.241
Propyl acetate	$CH_3CO_2C_3H_7$	276.2	32.9	0.296
n-Propyl alcohol	C_3H_7OH	263.7	49.95	0.273
iso-Propyl alcohol	C_3H_7OH	235	53	.....
Propyl *n*-butyrate	$C_3H_7CO_2C_3H_7$	327	.....	.....
n-Propyl chloride	C_3H_7Cl	230	45.2	.....
Propyl formate	$HCO_2C_3H_7$	264.85	40.1	0.309
Propyl propionate	$C_2H_5CO_2C_3H_7$	305	.....	.....
Propyl *iso*-valerate	$C_4H_9CO_2C_3H_7$	336	.....	.....
Propylamine	$C_3H_7NH_2$	223.8	46.3	.....
Propylene	C_3H_6	92.3	45.0	.....
Pyridine	C_5H_5N	344	60.0	.....
Radon	Rn	104	62	.....
Silicon tetrafluoride	SiF_4	−1.5	50	.....
Silicon tetrahydride	SiH_4	−3.5	48	.....
Stannic chloride	$SnCl_4$	318.7	37.0	0.742
Sulfur	S	1040	.....	.....
Sulfur dioxide	SO_2	157.2	77.7	0.52
Sulfur trioxide	SO_3	218.3	83.6	0.630
Thiophene	C_4H_4S	317	48	.....
Thymol	$C_{10}H_{13}OH$	425	.....	.....
Toluene	$C_6H_5CH_3$	320.6	41.6	0.292
Tolunitrile	C_7H_7CN	450	.....	.....
Triethylamine	$(C_2H_5)_3N$	262	30	0.251
Trimethylamine	$(CH_3)_3N$	161	41	.....
n-Valeric acid	$C_4H_9CO_2H$	379	.....	.....
iso-Valeric acid	$C_4H_9CO_2H$	361	.....	.....
Water	H_2O	374.0	217.72	0.4
Xenon	Xe	16.6	58.2	1.155

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES*

The values are given in gram-calories (15°) per gram per degree Centigrade. To convert to joules per gram per degree Centigrade multiply by 4.185.

Name	Formula	State	Specific Heat g-cal/g (15°)	Temp. °C.
Acetal	$CH_3CH(OC_2H_5)_2$	L	0.4669	0
.....	.....	L	0.5198	19 to 99
Acetic acid	CH_3COOH	S	0.487	0
.....	.....	L	0.468	0
Acetone	$(CH_3)_2CO$	S	0.540	−210
.....	.....	L	0.506	0
.....	.....	L	0.528	20
Acetonitrile	CH_3CN	L	0.541	21 to 76
Acetophenone	$C_6H_5COCH_3$	L	0.474	20 to 196
Acetyl chloride	CH_3COCl	L	0.339	0
Albite	$Na_2O{\cdot}Al_2O_3{\cdot}6SiO_2$	S	0.212	100
Allyl acetate	$CH_3COOC_3H_5$	L	0.431	0
alcohol	CH_2CHCH_2OH	L	0.665	21 to 96
benzoate	$C_6H_5COOC_3H_5$	L	0.388	20
butyrate	$C_3H_7COOC_3H_5$	L	0.451	20
chloride	CH_2CHCH_2Cl	L	0.313	0
chloroacetate	$ClCH_2COOC_3H_5$	L	0.3959	20
dichloroacetate	$Cl_2CHCOOC_3H_5$	L	0.3319	20
isobutyrate	$C_3H_7COOC_3H_5$	L	0.448	20
propionate	$C_2H_5COOC_3H_5$	L	0.451	20
trichloroacetate	$Cl_3CCOOC_3H_5$	L	0.2879	20
valerate	$C_4H_9COOC_3H_5$	L	0.451	20
Aluminum	Al	S	0.0092	−240.6
.....	.....	S	0.0165	−233
.....	.....	S	0.0889	−190
.....	.....	S	0.1466	−192 to −82
.....	.....	S	0.1962	−76 to −1
.....	.....	S	0.217	17 to 100
.....	.....	S	0.236	15 to 435
.....	.....	S	0.274	500
Aluminum chloride	$AlCl_3(\alpha)$	S	0.468	93
.....	$AlCl_3(\beta)$	S	0.196	0
.....	$AlCl_3{\cdot}6H_2O$	S	0.313	35
fluoride	AlF_3	S	0.229	35
.....	$2AlF_3{\cdot}7H_2O$	S	0.342	35
hydroxide	$Al(OH)_3$	S	0.103	−100
.....	$Al(OH)_3$	S	0.177	0
.....	$Al(OH)_3$	S	0.202	50
.....	$Al(OH)_3$	S	0.215	100
oxide	Al_2O_3	S	0.0992	−100
.....	Al_2O_3	S	0.174	0
.....	Al_2O_3	S	0.198	50
.....	Al_2O_3	S	0.21	100
sulfate	$Al_2(SO_4)_3$	S	0.184	50
.....	$Al_2(SO_4)_3{\cdot}18H_2O$	S	0.354	34
o-Aminobenzoic acid	$NH_2C_6H_4COOH$	S	0.254	85
.....	$NH_2C_6H_4COOH$	L	0.435	145
m-Aminobenzoic acid	$NH_2C_6H_4COOH$	S	0.253	120
.....	$NH_2C_6H_4COOH$	L	0.435	174
p-Aminobenzoic acid	$NH_2C_6H_4COOH$	S	0.287	128
.....	$NH_2C_6H_4COOH$	L	0.444	186

*See also the table: Specific Heat of Gases and Vapors.

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g(15°)	Temp.°C.
Ammonia	NH_3	S	0.502	−103 to −188
.....	.....	L	1.047	−60
.....	.....	L	1.098	0
.....	.....	L	1.125	20
.....	.....	L	1.48	100
Ammonium bromide	NH_4Br	S	0.210	20
chloride	NH_4Cl	S	0.121	−200
.....	.....	S	0.263	−100
.....	.....	S	0.357	0
.....	.....	S	0.389	50
iodide	NH_4I	S	0.111	0
.....	.....	S	0.118	50
nitrate	NH_4NO_3	S	0.306	−100
.....	.....	S	0.397	0
.....	.....	S	0.4146	50
.....	.....	S	0.428	100
sulfate	$(NH_4)_2SO_4$	S	0.283	−100
.....	.....	S	0.337	0
.....	.....	S	0.345	50
prim-Amyl alcohol (d)	$C_5H_{11}OH$	L	0.712	22 to 125
tert-Amyl alcohol	$C_5H_{11}OH$	L	0.753	20 to 99
Amylene	C_5H_{10}	L	0.282	0
Andalusite	Al_2SiO_5	S	0.228	100
Anethole	$C_9H_9OCH_3$	L	0.551	22.5
Aniline	$C_6H_5NH_2$	S	0.741	?
.....	.....	L	0.478	0
.....	.....	L	0.521	50
.....	.....	L	0.547	100
Anisole	$CH_3OC_6H_5$	L	0.483	20 to 152
Anorthite	$CaO{\cdot}Al_2O_3{\cdot}(SiO_2)_2$	S	0.205	100
Anthracene	$C_{14}H_{10}$	S	0.308	50
.....	.....	S	0.350	100
Anthraquinone	$C_6H_4(CO)_2C_6H_4$	S	0.258	0
Antimony	Sb	S	0.0462	−186 to −79
.....	.....	S	0.0468	−188 to +20
.....	.....	S	0.0503	20
.....	.....	S	0.0513	100
.....	.....	S	0.0520	200
.....	.....	S	0.0537	300
Antimony trioxide	Sb_2O_3	S	0.934	60
trisulfide	Sb_2S_3	S	0.0829	0
.....	.....	S	0.884	100
Apiol	$C_{12}H_{14}O_4$	S	0.299	10
Arsenic	As	S	0.0704	−188 to +20
Arsenic, gray cryst.	As	S	0.0822	0 to 100
Arsenic, black amorph.	As	S	0.0861	0 to 100
Arsenic trichloride	$AsCl_3$	L	0.177	56
Arsenous oxide	As_2O_3	S	0.117	0
Asbestos	.....	S	0.195	20 to 98
Azobenzene	$(C_6H_5N)_2$	S	0.330	28
Barium	Ba	S	0.068	−185 to +20
Barium carbonate	$BaCO_3$	S	0.0999	0
.....	.....	S	0.110	100
chlorate	$Ba(ClO_3)_2{\cdot}H_2O$	S	0.158	32

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g(15°)	Temp.°C.
Barium chloride	$BaCl_2$	S	0.08523	0
.....	$BaCl_2 \cdot 2H_2O$	S	0.140	0
formate	$Ba(CHO_2)_2$	S	0.137	0
molybdate	$BaMoO_4$	S	0.11	15
nitrate	$Ba(NO_3)_2$	S	0.148	47
sulfate	$BaSO_4$	S	0.111	0
thiosulfate	BaS_2O_3	S	0.162	58
Basalt	.....	S	0.20	20 to 100
Benzaldehyde	C_6H_5CHO	L	0.428	22 to 172
Benzene	C_6H_6	S	0.0399	−250
.....	.....	S	0.124	−200
.....	.....	S	0.227	−100
.....	.....	S	0.299	−50
.....	.....	L	0.389	5
.....	.....	L	0.406	20
.....	.....	L	0.444	60
.....	.....	L	0.473	90
Benzoic acid	C_6H_5COOH	S	0.287	20
Benzonitrile	C_6H_5CN	L	0.441	22 to 186
Benzophenone	$(C_6H_5)_2CO$	S	0.115	−150
.....	.....	S	0.220	−50
.....	.....	S	0.275	0
.....	.....	S	0.303	20
.....	.....	L	0.383	3 to 40
Benzyl alcohol	$C_6H_5CH_2OH$	L	0.511	20 to 100
chloride	$C_6H_5CH_2Cl$	L	0.323	0
Beryl	$3BeO \cdot Al_2O_3 \cdot 6SiO_2$	S	0.20	57
Beryllium	Be	S	0.397	0 to 46
.....	.....	S	0.425	0 to 100
.....	.....	S	0.505	0 to 300
Beryllium oxide	BeO	S	0.260	50
sulfate	$BeSO_4$	S	0.198	50
Betol	$HOC_6H_4COOC_{10}H_7$	S	0.129	−150
.....	.....	S	0.167	−100
.....	.....	L	0.356	19 to 63
Bismuth	Bi	S	0.0218	−253 to −196
.....	.....	S	0.0284	−188 to +20
.....	.....	S	0.0285	−79 to +17
.....	.....	S	0.0303	17 to 100
.....	.....	S	0.0303	18
.....	.....	S	0.0338	271
.....	.....	L	0.0363	280 to 360
Bismuth oxide	Bi_2O_3	S	0.0569	50
.....	.....	S	0.0593	100
sulfide	Bi_2S_3	S	0.0600	50
Borax	$Na_2B_4O_7 \cdot 10H_2O$	S	0.385	35
Boron, amorph.	B	S	0.071	−191 to −78
Boron, cryst.	B	S	0.2518	0 to 100
.....	.....	S	0.165	−78 to 0
.....	.....	S	0.307	0 to 100
.....	.....	S	0.357	0 to 234
Boron nitride	BN	S	0.349	200
Bromine	Br	S	0.070	−191 to −81
.....	.....	S	0.084	−78 to −20

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g(15°)	Temp.°C.
Bromine	Br	L	0.107	1 to 32
Bromobenzene	C_6H_5Br	L	0.231	20
o-Bromochlorobenzene	BrC_6H_4Cl	S	0.192	−34
.....	.....	L	0.215	0
m-Bromochlorobenzene	BrC_6H_4Cl	S	0.150	−52
.....	.....	L	0.212	0
p-Bromochlorobenzene	BrC_6H_4Cl	S	0.150	−40
.....	.....	S	0.170	0
o-Bromoiodobenzene	BrC_6H_4I	S	0.143	−50
.....	.....	L	0.160	5 to 100
m-Bromoiodobenzene	BrC_6H_4I	S	0.143	−75 to −15
.....	.....	L	0.158	5 to 100
p-Bromoiodobenzene	BrC_6H_4I	S	0.150	−40
α-Bromonaphthalene	$C_{10}H_7Br$	S	0.260	41
Bromophenol	HOC_6H_4Br	L	0.316	18 to 77
Brucite	$MgO·H_2O$	S	0.311	35
n-Butane	C_4H_{10}	L	0.550	0
n-Butyl alcohol	C_4H_9OH	L	0.526	2.3
.....	.....	L	0.563	19.2
butyrate	$C_3H_7COOC_4H_9$	L	0.459	20
chloride	C_4H_9Cl	L	0.451	20
formate	$HCOOC_4H_9$	L	0.459	20
propionate	$C_2H_5COOC_4H_9$	L	0.459	20
valerate	$C_4H_9COOC_4H_9$	L	0.459	20
n-Butyric acid	C_3H_7COOH	L	0.515	20 to 100
n-Butyronitrile	C_3H_7CN	L	0.547	21 to 113
Cadmium	Cd	S	0.0308	−253 to −196
.....	.....	S	0.0498	−186 to −79
.....	.....	S	0.0537	−79 to +18
.....	.....	S	0.0549	20
.....	.....	S	0.0566	100
.....	.....	S	0.0594	200
.....	.....	S	0.0617	300
Cadmium chloride	$2CdCl_2·5H_2O$	S	0.243	0
nitrate	$Cd(NO_3)_2·4H_2O$	S	0.260	40
sulfate	$CdSO_4·8H_2O$	S	0.195	0
.....	.....	S	0.200	20
sulfide	CdS	S	0.0882	0
.....	.....	S	0.0922	50
Calcium	Ca	S	0.0714	−253 to −196
.....	.....	S	0.157	−185 to +20
.....	.....	S	0.145	0 to 20
.....	.....	S	0.149	0 to 100
.....	.....	S	0.152	0 to 157
.....	.....	S	0.168	20.4
Calcium carbide	CaC_2	S	0.239	20 to 500
carbonate	$CaCO_3$	S	0.203	0
.....	.....	S	0.214	100
chloride	$CaCl_2$	S	0.164	61
.....	$CaCl_2·6H_2O$	S	0.320	0
.....	.....	S	0.552	33 to 99
fluoride	CaF_2	S	0.204	0
.....	.....	S	0.212	40
formate	$Ca(HCO_2)_2$	S	0.238	0

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g(15°)	Temp. °C.
Calcium hydride	CaH_2	S	0.0466	−200
hydroxide	$Ca(OH)_2$	S	0.260	0
.....	.....	S	0.288	50
molybdate	$CaMoO_4$	S	0.165	15
oxide	CaO	S	0.177	0
.....	.....	S	0.197	100
silicate	$CaSiO_3$	S	0.195	100
sulfate	$CaSO_4 \cdot 2H_2O$	S	0.265	36
sulfite	$CaSO_3 \cdot 2H_2O$	S	0.272	9
tungstate	$CaWO_4$	S	0.104	15
Calcspar	.....	S	0.2005	0 to 100
Camphene	$C_{10}H_{16}$	S	0.380	35
Capric acid	$CH_3(CH_2)_8COOH$	S	0.695	8
Caproic acid	$CH_3(CH_2)_4COOH$	L	0.533	29 to 105
Capronitrile	$C_5H_{11}CN$	L	0.542	18 to 156
Caprylic acid	$CH_3(CH_2)_6COOH$	S	0.628	−2
Carbon, charcoal	C	S	0.165	0 to 24
gas carbon	C	S	0.204	24 to 68
graphite	C	S	0.005	−243
.....	.....	S	0.0175	−203
.....	.....	S	0.060	−188 to −78
.....	.....	S	0.160	11
.....	.....	S	0.254	138
.....	.....	S	0.445	642
diamond	C	S	0.0005	−233
.....	.....	S	0.0025	−185
.....	.....	S	0.019	−188 to −78
.....	.....	S	0.079	−78 to +18
.....	.....	S	0.113	11
.....	.....	S	0.222	140
.....	.....	S	0.303	247
.....	.....	S	0.441	606
Carbon dioxide	CO_2	S	0.124	−225
monoxide	CO	S	0.417	−220
.....	.....	S	0.457	206
tetrachloride	CCl_4	S	0.0812	−200
.....	.....	S	0.182	−80
.....	.....	S	0.201	−40
.....	.....	L	0.198	0
.....	.....	L	0.201	20
Carborundum	.....	S	0.162	3 to 44
Carvacrol	$C_{10}H_{13}OH$	L	0.577	24 to 233
Catechol	$C_6H_4(OH)_2$	L	0.462	0
Cellulose, dry	.....	S	0.37	.....
Cement, powder	.....	S	0.20	20 to 100
Cerium	Ce	S	0.033	−253 to −196
.....	.....	S	0.0448	0 to 100
.....	.....	S	0.0511	20 to 100
Ceric oxide	CeO_2	S	0.0870	0
.....	.....	S	0.0946	50
Cerous sulfate	$CeSO_4$	S	0.117	50
.....	$CeSO_4 \cdot 5H_2O$	S	0.201	50
Cesium	Cs	S	0.048	0 to 26
.....	.....		0.0587	50

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g (15°)	Temp.°C.
Cesium bromide	$CsBr$	S	0.0581	10
chloride	$CsCl$	S	0.0746	10
fluoride	CsF	S	0.0796	10
iodide	CsI	S	0.0478	10
Chalcopyrite	$FeCuS_2$	S	0.129	48
Chalk	.....	S	0.214	20 to 99
Charcoal	.....	S	0.16	10
Chloral	CCl_3CHO	L	0.250	17 to 53
Chloral alcoholate	$CCl_3CH(OH)OC_2H_5$	S	0.509	78
hydrate	$CCl_3CH(OH)_2$	S	0.213	32
.....	.....	L	0.470	55 to 88
Chlorine	Cl	L	0.226	0 to 24
Chloro-acetic acid	$ClCH_2COOH$	S	0.363	60
benzene	C_6H_5Cl	L	0.309	20
benzoic acid (*o*)	ClC_6H_4COOH	L	0.392	0
benzoic acid (*m*)	ClC_6H_4COOH	S	0.232	94
benzoic acid (*p*)	ClC_6H_4COOH	S	0.228	80
.....	.....	S	0.242	180
.....	.....	L	0.547	226
phenol (*o*)	ClC_6H_4OH	L	0.401	0 to 20
toluene	$ClC_6H_4CH_3$	L	0.316	0
Chloroform	$CHCl_3$	L	0.232	0
.....	.....	L	0.226	15
.....	.....	L	0.234	20
Chromic oxide	Cr_2O_3	S	0.168	0
.....	.....	S	0.189	50
sulfate	$Cr_2(SO_4)_3$	S	0.172	50
.....	$Cr_2(SO_4)_3 \cdot 5H_2O$	S	0.200	50
Chromium	Cr	S	0.0142	−253 to −196
.....	.....	S	0.0793	−188 to +20
.....	.....	S	0.098	−79 to +17
.....	.....	S	0.1039	0
.....	.....	S	0.110	17 to 100
.....	.....	S	0.1202	18 to 500
.....	.....	S	0.112	100
.....	.....	S	0.133	400
Chrysoberyl	Al_2BeO_4	S	0.20	50
Clay, dry	.....	S	0.22	20 to 100
Cobalt	Co	S	0.0207	−253 to −196
.....	.....	S	0.0827	−188 to +20
.....	.....	S	0.1041	0 to 100
.....	.....	S	0.1035	15 to 100
.....	.....	S	0.1047	15 to 185
.....	.....	S	0.121	300
.....	(at transformation temp.)	S	0.145	508
		S	0.125	
.....	.....	S	0.160	800
.....	.....	S	0.184	1000
.....	(at transformation temp.)	S	0.270	1112
.....		S	0.170	
Cobaltite	$CoAsS$	S	0.098	58
Cobaltous nitrate	$Co(NO_3)_2 \cdot 6H_2O$	S	0.373	32
sulfate	$CoSO_4 \cdot 7H_2O$	S	0.342	48
Columbium pentoxide	Cb_2O_5	S	0.101	50

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g(15°)	Temp.°C.
Copper	Cu	S	0.0031	−253
.....	.....	S	0.0245	−253 to −196
.....	.....	S	0.029	−213
.....	.....	S	0.047	−193
.....	.....	S	0.0788	−188 to +20
.....	.....	S	0.0883	−79 to +18
.....	.....	S	0.0909	0
.....	.....	S	0.0912	20
.....	.....	S	0.09305	15 to 100
.....	.....	S	0.0928	50
.....	.....	S	0.0942	100
.....	.....	S	0.0963	200
.....	.....	S	0.1259	900
Copper ammonium sulfate	$CuSO_4(NH_4)_2SO_4 \cdot 6H_2O$	S	0.256	0
Copper carbonate	$2CuO \cdot CO_2 \cdot H_2O$	S	0.177	57
sulfate	$CuSO_4$	S	0.166	50
sulfate	$CuSO_4 \cdot H_2O$	S	0.172	0
.....	.....	S	0.191	50
.....	$CuSO_4 \cdot 3H_2O$	S	0.228	9
.....	$CuSO_4 \cdot 5H_2O$	S	0.253	0
.....	.....	S	0.287	50
o-Cresol	$CH_3C_6H_4OH$	L	0.499	0 to 20
m-Cresol	$CH_3C_6H_4OH$	L	0.479	0 to 20
p-Cresyl methyl ether	$CH_3OC_6H_4CH_3$	L	0.405	0
Crotonic acid	$CH_3CHCHCOOH$	S	0.520	38
.....	.....	L	0.500	71.4
Cryolite	$3NaF \cdot AlF_3$	S	0.2519	43
Cupric chloride	$CuCl_2$	S	0.139	58
oxide	CuO	S	0.125	0
.....	.....	S	0.144	100
sulfide	CuS	S	0.129	0
.....	.....	S	0.151	100
Cuprous iodide	CuI	S	0.0658	0
.....	.....	S	0.0671	50
oxide	Cu_2O	S	0.110	0
.....	.....	S	0.116	100
selenide	Cu_2Se	S	0.104	60
sulfide	Cu_2S	S	0.148	0
.....	.....	S	0.166	50
Cyamelide	$(CNOH)_3$	S	0.263	40
Cyanamide	NH_2CN	S	0.547	20
Cyanogen	$(CN)_2$	S	0.167	−188 to +78
Cyanuric acid	$(HNCO)_3$	S	0.318	40
Cyclo-hexanol	$C_6H_{11}OH$	L	0.417	15 to 18
hexanone	$C_6H_{10}O$	L	0.433	15 to 18
Decylene-2	$C_{10}H_{20}$	L	0.469	0 to 50
Dextrose	$C_6H_{12}O_6$	S	0.0155	−250
.....	.....	S	0.277	0
.....	.....	S	0.275	20
Dextrin	$(C_6H_{10}O_5)_x$	S	0.292	0 to 90
Diallyl oxalate	$(COOC_3H_5)_2$	L	0.426	20
succinate	$(CH_2COOC_3H_5)_2$	L	0.425	20
Diamylene	$C_{10}H_{20}$	L	0.545	20 to 130
Dibenzyl	$(C_6H_5CH_2)_2$	S	0.363	28

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g (15°)	Temp. °C.
o-Dibromobenzene	$C_6H_4Br_2$	S	0.249	−36
.....	.....	L	0.180	0
m-Dibromobenzene	$C_6H_4Br_2$	S	0.134	−25
.....	.....	L	0.175	0
p-Dibromobenzene	$C_6H_4Br_2$	S	0.139	−50
Dibutyl oxalate	$(COOC_4H_9)_2$	L	0.441	20
Dichloroacetic acid	$Cl_2CHCOOH$	S	0.406	.....
.....	.....	L	0.350	21 to 106
o-Dichlorobenzene	$C_6H_4Cl_2$	S	0.185	−48.5
.....	.....	L	0.270	0
m-Dichlorobenzene	$C_6H_4Cl_2$	S	0.186	−52
.....	.....	L	0.270	0
p-Dichlorobenzene	$C_6H_4Cl_2$	S	0.219	−50
.....	.....	L	0.298	53 to 99
Dicyandiamide	$C_2H_4N_4$	S	0.456	0 to 204
Diethylamine	$(C_2H_5)_2NH$	L	0.518	22.5
Diethylaniline	$C_6H_5N(C_2H_5)_2$	L	0.452	20
Diethyl carbonate	$CO(OC_2H_5)_2$	L	0.464	20 to 100
ketone	$(C_2H_5)_2CO$	L	0.557	20 to 98.5
malate	$C_2H_4O(COOC_2H_5)_2$	L	0.475	24 to 186
malonate	$CH_2(COOC_2H_5)_2$	L	0.433	20
oxalate	$(COOC_2H_5)_2$	L	0.433	20
succinate	$C_2H_4(COOC_2H_5)_2$	L	0.452	20
Dihydronaphthalene	$C_{10}H_{10}$	L	0.346	18 to 28
o-Diiodobenzene	$C_6H_4I_2$	S	0.109	0
.....	.....	L	0.136	0
m-Diiodobenzene	$C_6H_4I_2$	S	0.100	−52
.....	.....	L	0.140	34.2 to 99.6
p-Diiodobenzene	$C_6H_4I_2$	S	0.101	−50
Diisoamyl	$C_{10}H_{22}$	L	0.590	21.5 to 155
Diisoamyl oxalate	$(COOC_5H_{11})_2$	L	0.449	20
Diisobutylamine	$(C_4H_9)_2NH$	L	0.571	22 to 130
Dimethylaniline	$C_6H_5N(CH_3)_2$	L	0.418	0 to 20
Dimethyl carbonate	$CO(OCH_3)_2$	L	0.452	19.8 to 88
Dimethyl oxalate	$(COOCH_3)_2$	S	0.212	10
Dimethylpyrone	$(CH_3)_2C_5H_2O_2$	S	0.368	50
.....	.....	L	0.55	166
o-Dinitrobenzene	$C_6H_4(NO_2)_2$	S	0.252	−160
.....	.....	L	0.349	0
m-Dinitrobenzene	$C_6H_4(NO_2)_2$	S	0.248	−160
.....	.....	L	0.405	90
p-Dinitrobenzene	$C_6H_4(NO_2)_2$	S	0.259	119
Diopside	$CaMg(SiO_3)_2$	S	0.193	50
Diphenyl	$(C_6H_5)_2$	S	0.385	40
Diphenylamine	$(C_6H_5)_2NH$	S	0.337	26
.....	.....	L	0.464	53
Diphenyl oxide	$(C_6H_5)_2O$	L	0.399	30
Dipropylamine	$(C_3H_7)_2NH$	L	0.464	53
Dipropyl ketone	$(C_3H_7)_2CO$	L	0.552	20 to 140
malonate	$CH_2(COOC_3H_7)_2$	L	0.433	20
oxalate	$(COOC_3H_7)_2$	L	0.433	20
succinate	$(CH_2COOC_3H_7)_2$	L	0.452	20
Dodecane	$C_{12}H_{26}$	L	0.500	0 to 50
Dodecylene	$C_{12}H_{24}$	L	0.457	0 to 50

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g (15°)	Temp. °C.
Dulcitol	$C_6H_8(OH)_6$	S	0.282	20
Ebonite	.....	S	0.40	20 to 100
Erbium oxide	Er_2O_3	S	0.065	50
Erythritol	$C_4H_6(OH)_4$	S	0.351	60
Ethyl acetate	$CH_3COOC_2H_5$	L	0.459	20
acetoacetate	$CH_3COCH_2COOC_2H_5$	L	0.477	20 to 100
alcohol (cryst.)	C_2H_5OH	S	0.232	−190
alcohol (vitreous)	C_2H_5OH	S	0.260	−190
.....	.....	L	0.456	−100
.....	.....	L	0.535	0
.....	.....	L	0.581	25
.....	.....	L	0.824	100
benzene	$C_6H_5C_2H_5$	L	0.409	30
benzoate	$C_6H_5COOC_2H_5$	L	0.389	20
bromide	C_2H_5Br	L	0.216	5 to 10
.....	.....	L	0.215	15 to 20
butyrate	$C_3H_7COOC_2H_5$	L	0.459	20
chloride	C_2H_5Cl	L	0.368	0
chloroacetate	$ClCH_2COOC_2H_5$	L	0.418	9 to 138
dichloroacetate	$Cl_2CHCOOC_2H_5$	L	0.329	20
ether	$(C_2H_5)_2O$	L	0.517	−50
.....	.....	L	0.529	0
.....	.....	L	0.547	30
.....	.....	L	0.803	120
.....	.....	L	1.041	180
formate	$HCOOC_2H_5$	L	0.510	14 to 49
iodide	C_2H_5I	L	0.162	0
.....	.....	L	0.172	60
isobutyrate	$C_3H_7COOC_2H_5$	L	0.459	20
propionate	$C_2H_5COOC_2H_5$	L	0.459	20
sulfide	$(C_2H_5)_2S$	L	0.470	0
.....	.....	L	0.477	15 to 20
trichloroacetate	$Cl_3CCOOC_2H_5$	L	0.295	10 to 81
valerate	$C_4H_9COOC_2H_5$	L	0.459	20
Ethylene bromide	$C_2H_4Br_2$	L	0.174	20
chloride	$C_2H_4Cl_2$	L	0.2791	−30
.....	.....	L	0.301	20
.....	.....	L	0.319	60
Ferric oxide	Fe_2O_3	S	0.148	0
.....	.....	S	0.182	100
.....	.....	S	0.263	400
Ferrosoferric oxide (magnetite)	Fe_3O_4	S	0.151	0
.....	.....	S	0.179	100
Ferrous carbonate	$FeCO_3$	S	0.194	54
sulfate	$FeSO_4$	S	0.167	45
.....	$FeSO_4 \cdot 4H_2O$	S	0.284	9
.....	$FeSO_4 \cdot 7H_2O$	S	0.325	0
.....	.....	S	0.337	10
sulfide	FeS	S	0.135	0
Formamide	$HCONH_2$	L	0.551	19
Formic acid	$HCOOH$	S	0.387	−22
.....	.....	S	0.430	0
.....	.....	L	0.437	0
.....	.....	L	0.511	15.5

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g (15°)	Temp. °C.
Formic acid	HCOOH	L	0.526	20 to 100
Furfural	$(C_4H_3O)CHO$	L	0.418	20 to 100
Gallium	Ga	L	0.080	13 to 110
.....	.....	S	0.079	12 to 23
Gallium sesqui-oxide	Ga_2O_3	S	0.105	50
Germanium	Ge	S	0.074	0 to 100
.....	.....	S	0.0773	0 to 211
Germanium oxide	GeO_2	S	0.129	50
Glass, normal thermometer	.....	S	0.1988	19 to 100
Glass, crown	.....	S	0.161	10 to 50
Glass, flint	.....	S	0.117	10 to 50
Glutaric acid	$(CH_2)_3(COOH)_2$	S	0.299	20
Glycerol	$C_3H_5(OH)_3$	S	0.0471	−250
.....	.....	S	0.115	−200
.....	.....	S	0.217	−100
.....	.....	S	0.330	0
.....	.....	L	0.540	0
.....	.....	L	0.600	50
.....	.....	L	0.669	100
Glycol	$(CH_2OH)_2$	S	0.323	−40
.....	.....	L	0.544	0
.....	.....	L	0.571	14.9
Gold	Au	S	0.016	−253 to −196
.....	.....	S	0.0297	−188 to +20
.....	.....	S	0.0297	−79 to +17
.....	.....	S	0.0316	0 to 100
.....	.....	S	0.0312	18
.....	.....	S	0.031	17 to 100
.....	.....	S	0.0345	0 to 900
Gold iodide	AuI	S	0.0404	0
.....	.....	S	0.0432	50
Granite	.....	S	0.192	12 to 100
Heptaldehyde	$C_6H_{13}CHO$	L	0.365	0
n-Heptane	C_7H_{16}	L	0.365	0
Heptylene (B. P. 98°)	C_7H_{14}	L	0.488	0 to 50
Heptylic acid	$C_6H_{13}COOH$	L	0.558	9
Hexachloroethane	C_2Cl_6	S	0.174	25
Hexadecane	$C_{16}H_{34}$	S	0.495	19
n-Hexadecane (B. P. 275°)	$C_{16}H_{34}$	L	0.496	0 to 50
Hexadiene (1, 5)	C_6H_{10}	L	0.407	0
o-Hexahydrocresol	$CH_3C_6H_{10}OH$	L	0.418	15 to 18
m-Hexahydrocresol	$CH_3C_6H_{10}OH$	L	0.422	15 to 18
p-Hexahydrocresol	$CH_3C_6H_{10}OH$	L	0.423	15 to 18
n-Hexane	C_6H_{14}	L	0.600	20 to 100
Hexylene	C_6H_{12}	L	0.506	0 to 50
Hydrogen	H	L	6.0	−253
Hydrogen peroxide	H_2O_2	S	0.471	−25
.....	.....	L	0.578	0
Ice see water	.....	....	.....	.....
India rubber (Para)	.....	S	0.481	? to 100
Indium	In	S	0.0263	−186 to −79
.....	.....	S	0.0303	−79 to +18
.....	.....	S	0.0323	18 to 100
Indium sesqui-oxide	In_2O_3	S	0.0808	50

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal./g(15°)	Temp. °C.
Iodine	I	S	0.0361	−253 to −196
.....	.....	S	0.031	−243
.....	.....	S	0.043	−193
.....	.....	S	0.0467	−189 to −76
.....	.....	S	0.0516	−76 to 0
.....	.....	S	0.054	9 to 98
.....	.....	L	0.108	107 to 180
Iodine chloride	ICl	L	0.158	15 to 77
Iodobenzene	C_6H_5I	S	0.191	40
Iridium	Ir	S	0.0099	−253 to −196
.....	.....	S	0.0263	−186 to −79
.....	.....	S	0.0302	−79 to +18
.....	.....	S	0.0323	18 to 100
.....	.....	S	0.0371	0 to 900
.....	.....	S	0.0401	0 to 1400
Iron	Fe	S	0.0175	−253 to −196
.....	.....	S	0.0721	−186 to −79
.....	.....	S	0.1000	−79 to +18
.....	.....	S	0.1045	0
.....	.....	S	0.113	18 to 100
.....	.....	S	0.1137	97
.....	.....	S	0.138	300
.....	.....	S	0.138	0 to 650
.....	.....	S	0.195	650
.....	.....	S	0.23	850
Iron, cast	Fe	S	0.1189	20 to 100
Iron, electrolytic	Fe	S	0.1939	0 to 160C
Iron, hard drawn	Fe	S	0.1146	20 to 100
Iron, wrought	Fe	S	0.1152	15 to 100
Iron, diarsenide	$FeAs_2$	S	0.0860	50
Iron disulfide	FeS_2	S	0.128	50
Iron, see also ferrous and ferric	.....	....	.....	.....
Isoamyl acetate	$CH_3COOC_5H_{11}$	L	0.459	20
alcohol	$C_5H_{11}OH$	L	0.502	0
.....	.....	L	0.535	20
.....	.....	L	0.688	75.5
amine	$C_5H_{11}NH_2$	L	0.614	22 to 91
butyrate	$C_3H_7COOC_5H_{11}$	L	0.459	20
formate	$HCOOC_5H_{11}$	L	0.459	20
isobutyrate	$C_3H_7COOC_5H_{11}$	L	0.459	20
propionate	$C_2H_5COOC_5H_{11}$	L	0.459	20
succinate	$C_2H_4(COOC_5H_{11})_2$	L	0.449	0
valerate	$C_4H_9COOC_5H_{11}$	L	0.459	20
Isobutane	C_4H_{10}	L	0.550	0
Isobutyl acetate	$CH_3COOC_4H_9$	L	0.459	20
alcohol	C_4H_9OH	L	0.716	21 to 109
butyrate	$C_3H_7COOC_4H_9$	L	0.459	20
succinate	$C_2H_4(COOC_4H_9)_2$	L	0.442	0
Isobutyric acid	C_3H_7COOH	L	0.450	20
Isoheptane	C_7H_{16}	L	0.501	0 to 50
Isopentane	C_5H_{12}	L	0.527	8
Isopropyl alcohol	C_3H_7OH	S	0.0507	−200
Isovaleric acid	C_4H_9COOH	L	0.590	23 to 93
Lactose	$C_{12}H_{22}O_{11}$	S	0.287	20

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g(15°)	Temp. °C.
Lactose	$C_{12}H_{22}O_{11}\cdot H_2O$	S	0.299	20
Lanthanum	La	S	0.0322	−253 to −196
.....	.....	S	0.0448	0 to 100
Lanthanum molybdate	$La_2(MoO_4)_3$	S	0.115	15
Lanthanum sesqui-oxide	La_2O_3	S	0.0750	50
Lauric acid	$C_{11}H_{23}COOH$	S	0.430	−30
.....	.....	L	0.515	57
Lead	Pb	S	0.0120	−253
.....	.....	S	0.0220	−233
.....	.....	S	0.0275	−173
.....	.....	S	0.0293	−192 to +20
.....	.....	S	0.0291	−186 to −79
.....	.....	S	0.0292	−100
.....	.....	S	0.0300	−79 to +18
.....	.....	S	0.0305	0
.....	.....	S	0.0305	20 to 100
.....	.....	S	0.0313	100
.....	.....	S	0.0338	300
.....	.....	L	0.0410	360
Lead ammonium chloride	$2PbCl_2\cdot NH_4Cl$	S	0.0865	10
Lead arsenate	$Pb_3As_2O_8$	S	0.0729	55
borate	PbB_2O_4	S	0.0903	57
bromide	$PbBr_2$	S	0.0502	0
.....	.....	S	0.0530	50
.....	.....	L	0.0779	550
carbonate	$PbCO_3$	S	0.0800	32
chloride	$PbCl_2$	S	0.0649	0
.....	.....	S	0.0681	100
.....	.....	S	0.0741	300
.....	.....	L	0.121	540
chromate	$PbCrO_4$	S	0.0908	35
dioxide	PbO_2	S	0.0619	0
.....	.....	S	0.0650	50
fluoride	PbF_2	S	0.0719	9
iodide	PbI_2	S	0.0417	0
.....	.....	S	0.0437	100
molybdate	$PbMoO_4$	S	0.100	15
monoxide	PbO	S	0.0483	0
.....	.....	S	0.0509	50
.....	.....	S	0.0521	100
nitrate	$Pb(NO_3)_2$	S	0.115	45
pyrophosphate	$Pb_2P_2O_7$	S	0.0820	55
silicate	$PbSiO_3$	S	0.0779	60
sulfate	$PbSO_4$	S	0.0839	45
sulfide	PbS	S	0.0502	0
.....	.....	S	0.0511	100
tetraborate	PbB_4O_7	S	0.10	57
thiosulfate	PbS_2O_3	S	0.0918	58
tungstate	$PbWO_4$	S	0.0769	15
Leather, dry	.....	S	0.36	.....
Levulose	$C_6H_{12}O_6$	S	0.275	20
Limonite	$2Fe_2O_3\cdot 3H_2O$	S	0.22	60
Lithium	Li	S	0.1924	−253 to −196
.....	.....	S	0.52	−190 to −80

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g (15°)	Temp. °C.
Lithium	Li	S	0.5997	−100
.....	.....	S	0.7951	0
.....	.....	S	0.9063	50
.....	.....	S	1.09	0 to 100
.....	.....	S	1.0407	100
.....	.....	L	1.3745	190
Lithium chloride	LiCl	S	0.282	55
fluoride	LiF	S	0.373	10
hydride	LiH	S	0.980	0
.....	.....	S	1.07	50
hydroxide	LiOH	S	0.327	0
.....	.....	S	0.356	50
nitrate	$LiNO_3$	S	0.387	210
.....	.....	L	0.390	280
thiosulfate	$Li_2S_2O_3$	S	0.0920	58
Magnesium	Mg	S	0.0713	−253 to −196
.....	.....	S	0.189	−186 to −79
.....	.....	S	0.222	−185 to +20
.....	.....	S	0.233	−79 to +18
.....	.....	S	0.248	17 to 100
.....	.....	S	0.2421	28
.....	.....	S	0.3235	325
.....	.....	L	0.4352	625
Magnesium carbonate	$MgCO_3$	S	0.200	25
chloride	$MgCl_2$	S	0.194	48
.....	$MgCl_2 \cdot 6H_2O$	S	0.378	44
nitrate	$Mg(NO_3)_2 \cdot 6H_2O$	S	0.887	55
oxide	MgO	S	0.209	0
.....	.....	S	0.232	50
sulfate	$MgSO_4$	S	0.222	61
.....	$MgSO_4 \cdot H_2O$	S	0.239	9
.....	$MgSO_4 \cdot 6H_2O$	S	0.349	9
.....	$MgSO_4 \cdot 7H_2O$	S	0.361	12
Malachite	$2CuO \cdot CO_2 \cdot H_2O$	S	0.177	57
Malonic acid	$CH_2(COOH)_2$	S	0.275	20
Maltose	$C_{12}H_{22}O_{11}$	S	0.320	20
Manganese	Mn	S	0.0229	−253 to −196
.....	.....	S	0.093	−188 to +20
.....	.....	S	0.0979	−100
.....	.....	S	0.1072	0
.....	.....	S	0.1143	100
.....	.....	S	0.1652	500
Manganese dioxide	MnO_2	S	0.152	0
.....	.....	S	0.163	50
Manganic oxide	Mn_2O_3	S	0.162	58
.....	$Mn_2O_3 \cdot 3H_2O$	S	0.177	38
Manganous nitrate	$Mn(NO_3)_2 \cdot 6H_2O$	S	0.373	47
oxide	MnO	S	0.158	58
sulfate	$MnSO_4$	S	0.182	61
sulfide	MnS	S	0.14	60
sulfate	$MnSO_4 \cdot 5H_2O$	S	0.323	32
Mannitol	$C_6H_8(OH)_6$	S	0.313	0
Marble	.....	S	0.21	0 to 100
Melamine	$C_3H_6N_6$	S	0.351	40

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g(15°)	Temp. °C.
Mercuric bromide	$HgBr_2$	S	0.0519	100
chloride	$HgCl_2$	S	0.0640	0
.....	.....	S	0.0669	100
cyanide	$Hg(CN)_2$	S	0.100	29
iodide (red)	HgI_2	S	0.0404	0
.....	.....	S	0.0413	50
oxide	HgO	S	0.0485	0
.....	.....	S	0.0521	50
sulfide	HgS	S	0.0506	0
.....	.....	S	0.0520	50
Mercurous chloride	HgCl	S	0.0499	0
.....	....	S	0.0512	50
sulfate	Hg_2SO_4	S	0.0616	0
.....	.....	S	0.0680	50
Mercury	Hg	S	0.0232	−253 to −196
See also special table				
.....	.....	S	0.0266	−213
.....	.....	S	0.0285	−183
.....	.....	S	0.0315	−78 to −40
.....	.....	SL	0.032	−185 to +20
.....	.....	L	0.0334	−35.6 to −3.4
.....	.....	L	0.03346	0
.....	.....	L	0.03325	20
.....	.....	L	0.03308	40
.....	.....	L	0.03294	60
.....	.....	L	0.03267	100
.....	.....	L	0.03196	200
.....	.....	L	0.0322	250
Mesitylene	$(CH_3)_3C_6H_3$	L	0.393	0
Mesityl oxide	$C_6H_{10}O$	L	0.521	21 to 121
Methyl acetate	CH_3COOCH_3	L	0.468	15
Methylal	$C_3H_8O_2$	L	0.521	15 to 41
Methyl alcohol	CH_3OH	L	0.566	0
.....	.....	L	0.600	20
aniline	$C_6H_5NHCH_3$	L	0.513	20 to 197
benzoate	$C_6H_5COOCH_3$	L	0.363	0
butyl ketone	$CH_3COC_4H_9$	L	0.553	21 to 127
n-butyrate	$C_3H_7COOCH_3$	L	0.459	20
chloroacetate	$ClCH_2COOCH_3$	L	0.382	20
cyclohexanone (*o*)	$C_7H_{12}O$	L	0.463	15 to 18
cyclohexanone (*m*)	$C_7H_{12}O$	L	0.441	15 to 18
cyclohexanone (*p*)	$C_7H_{12}O$	L	0.441	15 to 18
dichloroacetate	$Cl_2CHCOOCH_3$	L	0.311	20
ethyl ketone	$CH_3COC_2H_5$	L	0.549	20 to 78
ethyl ketoxime	$(CH_3)(C_2H_5)NOH$	L	0.650	22 to 152
formate	$HCOOCH_3$	L	0.516	13 to 29
hexyl ketone	$CH_3COC_6H_{13}$	L	0.552	22 to 168
isobutyl ketone	$CH_3COC_4H_9$	L	0.459	20
isopropyl ketone	$CH_3COC_3H_7$	L	0.525	20 to 91
trichloroacetate	$Cl_3CCOOCH_3$	L	0.267	20
valerate	$C_4H_9COOCH_3$	L	0.459	20
Methylene chloride	CH_2Cl_2	L	0.288	15 to 40
Mica (Mg)	.....	S	0.2061	20 to 98
Molybdenum	Mo	S	0.0141	−253 to −196

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g(15°)	Temp. °C.
Molybdenum	Mo	S	0.062	−185 to +20
.....	.....	S	0.072	15 to 93
.....	.....	S	0.0722	20 to 550
.....	.....	S	0.0647	60
.....	.....	S	0.0750	475
Molybdenum trioxide	MoO_3	S	0.134	54
Myristic acid	$C_{13}H_{27}COOH$	S	0.381	0
.....	.....	L	0.539	56 to 100
Naphthalene	$C_{10}H_8$	S	0.281	−130
.....	.....	L	0.402	87.5
α-Naphthol	$C_{10}H_7OH$	S	0.240	50
β-Naphthol	$C_{10}H_7OH$	S	0.252	61
α-Naphthylamine	$C_{10}H_7NH_2$	S	0.270	0
.....	.....	L	0.475	53.2
Nickel	Ni	S	0.0208	−253 to −196
.....	.....	S	0.092	−185 to +20
.....	.....	S	0.0743	−186 to −79
.....	.....	S	0.0983	−79 to +18
.....	.....	S	0.1034	0 to 20
.....	.....	S	0.1089	15 to 100
.....	.....	S	0.1128	100
.....	.....	S	0.1140	0 to 200
.....	.....	S	0.1256	0 to 400
.....	.....	S	0.131	0 to 800
.....	.....	S	0.1607	1000
Nickel carbonyl	$Ni(CO)_4$	S	0.165	−188 to −78
nitrate	$Ni(NO_3)_2 \cdot 6H_2O$	S	0.473	80
sulfate	$NiSO_4$	S	0.225	58
.....	$NiSO_4 \cdot 6H_2O$	S	0.313	35
sulfide	NiS	S	0.116	0
.....	.....	S	0.128	100
Nitro-aniline (*o*)	$NO_2C_6H_4NH_2$	S	0.269	−160
.....	.....	L	0.400	0
aniline (*m*)	$NO_2C_6H_4NH_2$	S	0.275	−160
.....	.....	L	0.392	0
aniline (*p*)	$NO_2C_6H_4NH_2$	S	0.276	−160
.....	.....	L	0.427	0
benzene	$C_6H_5NO_2$	L	0.339	30
.....	.....	L	0.3429	90
.....	.....	L	0.394	120
benzoic acid (*o*)	$NO_2C_6H_4COOH$	S	0.256	−163
.....	.....	L	0.314	0
benzoic acid (*m*)	$NO_2C_6H_4COOH$	S	0.247	−160
.....	.....	L	0.405	0
benzoic acid (*p*)	$NO_2C_6H_4COOH$	S	0.247	−160
.....	.....	L	0.449	238
methane	CH_3NO_2	L	0.412	17
naphthalene (α)	$C_{10}H_7NO_2$	S	0.236	0
.....	.....	L	0.365	58.6
Nitrogen	N	L	0.0284	−208 to −196
Nitrogen pentoxide	N_2O_5	S	0.239	−80 to −5
Nonane	C_9H_{20}	L	0.503	0 to 50
Nonylene	C_9H_{18}	L	0.485	0 to 50
n-Octane	C_8H_{18}	L	0.578	20 to 123

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g(15°)	Temp. °C.
Octylene	C_8H_{16}	L	0.486	0 to 50
Olive oil	.....	L	0.471	6.6
Orthoclase	$K_2O \cdot Al_2O_3 \cdot 6SiO_2$	S	0.205	100
Osmium	Os	S	0.0078	−253 to −196
.....	.....	S	0.0311	19 to 98
Oxalic acid	$(COOH)_2$	S	0.259	−200 to +50
.....	$(COOH)_2 \cdot 2H_2O$	S	0.338	0
.....	.....	S	0.385	50
Oxygen	O	L	0.35	−200 to −183
Palladium	Pd	S	0.0190	−253 to −196
.....	.....	S	0.0528	−186 to +18
.....	.....	S	0.0567	−79 to +18
.....	.....	S	0.0586	18
.....	.....	S	0.0592	0 to 100
.....	.....	S	0.0632	0 to 500
.....	.....	S	0.0672	0 to 900
Palmitic acid	$C_{15}H_{31}COOH$	S	0.167	−180
.....	.....	S	0.251	−100
.....	.....	S	0.306	−50
.....	.....	S	0.382	0
.....	.....	S	0.430	20
.....	.....	L	0.653	65 to 104
Paraffin	.....	S	0.694	0 to 20
Paraldehyde	$(CH_3CHO)_3$	L	0.436	0
Pentadecane	$C_{15}H_{32}$	L	0.497	0 to 50
Pentadecylene	$C_{15}H_{30}$	L	0.471	0 to 50
Petroleum	.....	L	0.511	21 to 58
Phenetole	$C_2H_5OC_6H_5$	L	0.446	20
Phenol	C_6H_5OH	L	0.561	14 to 26
Phosphorus (yellow)	P	S	0.0774	−253 to −196
.....	.....	S	0.169	−188 to +20
.....	.....	S	0.178	−186 to +20
.....	.....	S	0.190	7 to 30
Phosphorus (red)	P	S	0.0431	−253 to −196
.....	.....	S	0.1829	0 to 51
Phosphorus (liquid)	P	L	0.2045	49 to 98
Phosphorus trichloride	PCl_3	S	0.203	33
Phthalic acid	$C_6H_4(COOH)_2$	S	0.232	20
α-Picoline	C_6H_7N	L	0.4339	22 to 124
Picric acid	$HOC_6H_2(NO_2)_3$	S	0.165	−100
.....	.....	S	0.240	0
.....	.....	S	0.263	50
.....	.....	S	0.297	100
Piperidine	$C_5H_{11}N$	L	0.523	20 to 98
Platinum	Pt	S	0.0135	−253 to −196
.....	.....	S	0.0293	−180 to +18
.....	.....	S	0.0307	0 to 10
.....	.....	S	0.03224	15 to 100
.....	.....	S	0.0347	0 to 500
.....	.....	S	0.0275	100
.....	.....	S	0.0356	500
.....	.....	S	0.0344	600
.....	.....	S	0.0369	800
.....	.....	S	0.0382	1000

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g (15°)	Temp. °C.
Platinum	Pt	S	0.0398	1200
.....	.....	S	0.0368	1500
Porcelain	.....	S	0.26	19 to 950
Potassium	K	S	0.1280	−253 to −196
.....	.....	S	0.170	−185 to +20
.....	.....	S	0.1728	0
.....	.....	S	0.188	0 to 22
.....	.....	S	0.192	22 to 56
.....	.....	L	0.217	78 to 100
.....	.....	L	0.224	100 to 157
Potassium acetate	$KC_2H_3O_2$	S	0.272	20
acid arsenate	KH_2AsO_4	S	0.174	31
acid sulfate	$KHSO_4$	S	0.244	35
aluminum sulfate (alum)	$K_2SO_4 \cdot Al_2(SO_4)_3 \cdot 24H_2O$	S	0.324	0
bromide	KBr	S	0.104	0
.....	.....	S	0.108	100
carbonate	K_2CO_3	S	0.210	47
chlorate	$KClO_3$	S	0.191	0
.....	.....	S	0.205	50
choride	KCl	S	0.162	0
.....	.....	S	0.168	100
chloroplatinate	K_2PtCl_6	S	0.112	30
chromate	K_2CrO_4	S	0.186	46
dichromate	$K_2Cr_2O_7$	S	0.178	0
.....	.....	L	0.0335	297
ferricyanide	$K_3Fe(CN)_6$	S	0.232	26
ferrocyanide	$K_4Fe(CN)_6$	S	0.210	0
.....	.....	S	0.225	50
.....	$K_4Fe(CN)_6 \cdot 3H_2O$	S	0.267	0
.....	.....	S	0.285	50
fluoride	KF	S	0.199	0
.....	.....	S	0.204	50
metaborate	KBO_2	S	0.225	57
nitrate	KNO_3	S	0.214	0
.....	.....	S	0.240	100
.....	.....	L	0.0332	380
perchlorate	$KClO_4$	S	0.189	30
phosphate	KH_2PO_4	S	0.208	33
pyrophosphate	$K_4P_2O_7$	S	0.191	58
sulfate	K_2SO_4	S	0.176	0
.....	.....	S	0.191	100
thiosulfate	$K_2S_2O_3$	S	0.196	60
tetraborate	$K_2B_4O_7$	S	0.22	57
Propane	C_3H_8	L	0.576	0
Propionaldehyde	C_2H_5CHO	L	0.522	0
Propionic acid	C_2H_5COOH	S	0.726	−33
.....	.....	L	0.560	20 to 137
Propionitrile	C_2H_5CN	L	0.538	19 to 95
n-Propyl-acetate	$CH_3COOC_3H_7$	L	0.459	20
alcohol	C_3H_7OH	S	0.170	−200
.....	.....	S	0.497	−130
.....	.....	L	0.435	−100
.....	.....	L	0.526	0
.....	.....	L	0.586	25

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g(15°)	Temp. °C.
n-Propyl benzene	$C_3H_7C_6H_5$	L	0.400	0
benzoate	$C_6H_5COOC_3H_7$	L	0.398	20
butyrate	$C_3H_7COOC_3H_7$	L	0.459	20
chloroacetate	$ClCH_2COOC_3H_7$	L	0.414	20
formate	$HCOOC_3H_7$	L	0.459	20
isobutyrate	$C_3H_7COOC_3H_7$	L	0.459	20
phenyl ether	$C_3H_7OC_6H_5$	L	0.429	0
propionate	$C_2H_5COOC_3H_7$	L	0.459	20
valerate	$C_4H_9COOC_3H_7$	L	0.459	20
Proustite	Ag_3AsS_3	S	0.081	50
Pseudocumene	$(CH_3)_3C_6H_3$	L	0.414	20
Pyrargyrite	Ag_3SbS_3	S	0.076	50
Pyridine	C_5H_5N	L	0.431	21 to 108
Pyrosulfuric acid	$H_2S_2O_7$	L	0.334	35
Pyrotartaric acid	$C_5H_8O_4$	S	0.301	20
Quartz	.....	S	0.188	12 to 100
Quinhydrone	$C_{12}H_{10}O_4$	S	0.0165	−250
.....	.....	S	0.0980	−200
.....	.....	S	0.256	0
Quinol	$C_6H_4(OH)_2$	S	0.0246	−250
.....	.....	S	0.268	−150
Quinoline	C_9H_7N	L	0.352	0 to 20
Quinone	$C_6H_4O_2$	S	0.0311	−250
.....	.....	S	0.113	−200
.....	.....	S	0.282	−150
Resorcinol	$C_6H_4(OH)_2$	S	0.269	−160
.....	.....	L	0.452	0
Rhodium	Rh	S	0.0134	−253 to −196
.....	.....	S	0.0580	10 to 97
Rock salt	.....	S	0.219	13 to 45
Rubidium	Rb	S	0.0711	−253 to −196
.....	.....	S	0.0802	0
.....	.....	L	0.0908	50
Rubidium bromide	RbBr	S	0.0743	10
carbonate	Rb_2CO_3	S	0.122	33
chloride	RbCl	S	0.101	10
fluoride	RbF	S	0.115	10
iodide	RbI	S	0.0581	10
Ruthenium	Ru	S	0.0109	−253 to −196
.....	.....	S	0.061	0 to 100
Salicylaldehyde	HOC_6H_4CHO	L	0.382	18
Salol	$HOC_6H_4COOC_6H_5$	S	0.289	32
.....	.....	L	0.391	44.1
Scandium oxide	Sc_2O_3	S	0.168	−150 to +40
Selenium	Se	S	0.0361	−253 to −196
.....	.....	S	0.068	−188 to +18
(amorph.)	Se	S	0.095	18 to 38
(cryst.)	Se	S	0.084	22 to 63
Silicon (melted)	Si	S	0.0303	−253 to −196
(cryst.)	Si	S	0.0271	−253 to −196
.....	.....	S	0.123	−185 to +20
(amorph.)	Si	S	0.091	−190 to −80
.....	.....	S	0.147	−79 to +17
.....	.....	S	0.179	3 to 50

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g (15°)	Temp. °C.
Silicon (cryst.)	Si	S	0.136	−40
.....	.....	S	0.170	21
.....	.....	S	0.196	129
Silicon carbide	SiC	S	0.143	0
.....	.....	S	0.194	100
.....	.....	S	0.280	600
chloride	$SiCl_4$	S	0.237	−200 to −80
Silver	Ag	S	0.0242	−253 to −196
.....	.....	S	0.0175	−233
.....	.....	S	0.040	−193
.....	.....	S	0.0496	−186 to −70
.....	.....	S	0.0544	−79 to +18
.....	.....	S	0.0556	0
.....	.....	S	0.05625	15 to 100
.....	.....	S	0.0557	58
.....	.....	S	0.0581	500
.....	.....	S	0.076	800
.....	.....	L	0.0748	907 to 1100
Silver bromide	AgBr	S	0.0695	0
.....	.....	S	0.0734	100
.....	.....	L	0.0760	500
chloride	AgCl	S	0.0848	0
.....	.....	S	0.0906	50
.....	.....	L	0.129	490
cyanate	AgCNO	S	0.124	40
iodide	AgI	S	0.0548	0
.....	.....	S	0.0593	100
nitrate	$AgNO_3$	S	0.146	50
.....	.....	L	0.187	250
selenide	Ag_2Se	S	0.0693	37 to 187
sulfide	Ag_2S	S	0.0719	0
.....	.....	S	0.0748	50
Sodium	Na	S	0.1519	−253 to −196
.....	.....	S	0.229	−186
.....	.....	S	0.253	−185 to +20
.....	.....	S	0.266	−80
.....	.....	S	0.279	−40
.....	.....	S	0.293	0
.....	.....	S	0.290	27
.....	.....	L	0.323	100
.....	.....	L	0.319	140
Sodium acetate	$NaC_2H_3O_2$	S	0.339	38
.....	$NaC_2H_3O_2 \cdot 3H_2O$	S	0.344	0
.....	$NaC_2H_3O_2 \cdot 3H_2O$	L	0.846	61.8
.....	.....	S	0.602	40
borate	$Na_2B_2O_4$	S	0.253	57
bromide	NaBr	S	0.118	0
.....	.....	S	0.124	100
carbonate	Na_2CO_3	S	0.256	45
chlorate	$NaClO_3$	L	0.325	280
chloride	NaCl	S	0.204	0
.....	.....	S	0.217	100
fluoride	NaF	S	0.258	0
.....	.....	S	0.279	100

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g(15°)	Temp. °C.
Sodium formate	$NaCHO_2$	S	0.306	46
iodide	NaI	S	0.0829	0
.....	.....	S	0.0848	50
nitrate	$NaNO_3$	S	0.247	0
.....	.....	S	0.270	50
.....	.....	L	0.430	350
phosphate	$Na_2HPO_4 \cdot 7H_2O$	S	0.351	0
.....	.....	S	0.406	50
.....	$Na_2HPO_4 \cdot 12H_2O$	S	0.404	0
.....	.....	S	0.464	50
phosphite	$NaPO_3$	S	0.217	30
pyrophosphate	$Na_4P_2O_7$	S	0.227	50
sulfate	Na_2SO_4	S	0.202	0
.....	.....	S	0.220	100
tetraborate	$Na_2B_4O_7$	S	0.234	45
(borax)	$Na_2B_4O_7 \cdot 10H_2O$	S	0.385	35
thiosulfate	$Na_2S_2O_3$	S	0.220	9
.....	$Na_2S_2O_3 \cdot 5H_2O$	S	0.346	21
.....	.....	L	0.570	13 to 98
Stannic chloride	$SnCl_4$	S	0.115	−100
.....	.....	L	0.148	14 to 98
oxide	SnO_2	S	0.0898	45
sulfide	SnS_2	S	0.119	54
Stannous chloride	$SnCl_2$	S	0.102	60
sulfide	SnS	S	0.0839	56
Stearic acid	$C_{17}H_{35}COOH$	S	0.399	15
.....	.....	L	0.550	74 to 137
Strontium (impure)	Sr	S	0.0550	−253 to −196
Strontium carbonate	$SrCO_3$	S	0.146	54
chloride	$SrCl_2$	S	0.119	58
molybdate	$SrMoO_4$	S	0.148	15
nitrate	$Sr(NO_3)_2$	S	0.182	32
sulfate	$SrSO_4$	S	0.143	48
Succinic acid	$(CH_2COOH)_2$	S	0.248	0
Sucrose	$C_{12}H_{22}O_{11}$	S	0.299	20
Sulfur	S	S	0.0546	−253 to −196
(rhombic)	S	S	0.1520	−71
.....	.....	S	0.1728	0 to 54
(monoclinic)	S	S	0.1498	−72
.....	.....	S	0.1809	0 to 52
.....	.....	L	0.235	119 to 147
.....	.....	L	0.331	201 to 233
Sulfur chloride	S_2Cl_2	L	0.220	12 to 70
dioxide	SO_2	S	0.229	−185 to −103
.....	.....	L	0.313	−20
.....	.....	L	0.318	0
.....	.....	L	0.327	20
.....	.....	L	0.418	100
Sulfuric acid	H_2SO_4	S	0.239	−30
.....	.....	S	0.270	0
.....	.....	L	0.339	10
Talc	$Mg_3Si_4O_{11} \cdot H_2O$	S	0.208	57
Tantalum	Ta	S	0.033	−185 to +20
.....	.....	S	0.036	58

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g(15°)	Temp. °C.
Tantalum	Ta	S	0.043	1400
Tartaric acid	$(CHOHCOOH)_2$	S	0.287	36
.....	$(CHOHCOOH)_2 \cdot H_2O$	S	0.308	0
.....	.....	S	0.366	50
Tellurium	Te	S	0.0288	−253 to −196
.....	.....	S	0.047	−188 to +18
(cryst.)	Te	S	0.0483	15 to 100
.....	.....	S	0.0490	15 to 300
Tetrachloroethylene	C_2Cl_4	S	0.198	0
.....	.....	L	0.211	20
Tetradecane	$C_{14}H_{30}$	L	0.497	0 to 50
Tetradecylene	$C_{14}H_{28}$	L	0.453	0 to 50
Tetryl	$C_7H_5N_5O_8$	S	0.212	0
.....	.....	S	0.236	100
Thallium	Tl	S	0.0235	−253 to −196
.....	.....	S	0.038	−185 to +20
.....	.....	S	0.0326	20 to 100
.....	.....	S	0.0311	28
Thallium bromide	TlBr	L	0.080	500
bromide	TlBr	S	0.0526	390
chloride	TlCl	L	0.059	480
.....	.....	S	0.0520	0
.....	.....	S	0.0542	100
Thorium	Th	S	0.0197	−253 to −196
.....	.....	S	0.0276	0 to 100
Thorium chloride	ThCl	S	0.406	30
dioxide	ThO_2	S	0 0571	0
.....	.....	S	0.0589	50
sulfate	$Th(SO_4)_2$	S	0.0980	50
Thymol	$C_{10}H_{14}O$	S	0.315	0
m-Thymol	$C_{10}H_{14}O$	S	0.0567	50
Tin	Sn	S	0.0286	−253 to −196
.....	.....	S	0.0486	−186 to −79
.....	.....	S	0.0518	−79 to +18
.....	.....	S	0.0536	0
.....	.....	S	0.0541	20
.....	.....	S	0.0565	100
.....	.....	L	0.0608	250 to 350
.....	.....	L	0.0758	1100
(gray)	Sn	S	0.0589	0 to 18
Titanium	Ti	S	0.0205	−253 to −196
.....	.....	S	0.036	−185 to +20
.....	.....	S	0.142	20
.....	.....	S	0.1125	0 to 100
.....	.....	S	0.1563	0 to 333
Titanium chloride	$TiCl_4$	S	0.177	−25
.....	.....	L	0.192	13 to 99
oxide	TiO_2	S	0.168	0
Toluene	$C_6H_5CH_3$	L	0.386	0
.....	.....	L	0.421	50
.....	.....	L	0.470	100
o-Toluic acid	$CH_3C_6H_4COOH$	S	0.277	54
m-Toluic acid	$CH_3C_6H_4COOH$	S	0.239	54
p-Toluic acid	$CH_3C_6H_4COOH$	S	0.271	130

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g(15°)	Temp. °C.
p-Toluidine	$CH_3C_6H_4NH_2$	S	0.337	0
.....	.....	S	0.387	20
Topaz	$2(AlF)O{\cdot}SiO_2$	S	0.205	52
Trichloroacetic acid	Cl_3CCOOH	S	0.459	.....
Trichloroethane	$C_2H_3Cl_3$	L	0.2660	20
Trichloroethylene	C_2HCl_3	L	0.223	20
Tridecane	$C_{13}H_{28}$	L	0.499	0 to 50
Tridecylene	$C_{13}H_{26}$	L	0.457	0 to 50
Trimethyl carbinol	$(CH_3)_3COH$	S	0.559	−4
Trinitrotoluene	$CH_3C_6H_2(NO_2)_3$	S	0.170	−100
.....	.....	S	0.311	0
.....	.....	S	0.385	100
.....	.....	L	0.335	?
Trinitroxylene	$(CH_3)_2C_6H(NO_2)_3$	S	0.423	20 to 50
Triphenylmethane	$(C_6H_5)_3CH$	S	0.189	0
Tungsten	W	S	0.0095	−253 to −196
.....	.....	S	0.036	−185 to +20
.....	.....	S	0.034	15 to 93
.....	.....	S	0.034	20 to 100
.....	.....	S	0.041	1350
Tungsten trioxide	WO_3	S	0.0743	0
.....	.....	S	0.0832	50
Turpentine, oil	.....	L	0.411	0
Undecane	$C_{11}H_{24}$	L	0.501	0 to 50
Undecylene	$C_{11}H_{22}$	L	0.482	0 to 50
Uranium	U	S	0.0138	−253 to −196
.....	.....	S	0.028	0 to 98
.....	.....	S	0.062	11 to 98
Uranium oxide	U_3O_8	S	0.0671	0
.....	.....	S	0.0750	50
Urea	$(NH_2)_2CO$	S	0.320	20
Valeronitrile	C_4H_9CN	L	0.520	23 to 121
Vanadium	V	S	0.1153	0 to 100
Vulcanite	.....	S	0.3312	20 to 100
Water	H_2O	S	0.0361	−250
See also special table				
.....	.....	S	0.156	−200
.....	.....	S	0.246	−150
.....	.....	S	0.332	−100
.....	.....	S	0.435	−40
.....	.....	S	0.492	0
.....	.....	L	1.0000	15
Wood	.....	S	0.42	.....
o-Xylene	$(CH_3)_2C_6H_4$	L	0.411	30
m-Xylene	$(CH_3)_2C_6H_4$	L	0.387	16 to 35
p-Xylene	$(CH_3)_2C_6H_4$	L	0.397	30
o-Xylene dibromide	$C_8H_8Br_2$	L	0.183	15 to 40
dichloride	$C_8H_8Cl_2$	L	0.2829	15 to 40
tetrachloride	$C_8H_6Cl_4$	L	0.2399	15 to 40
Xylyl ethyl ether (2, 4)	$C_{10}H_{14}O$	L	0.4170	0
Ytterbium oxide	Yb_2O_3	S	0.0650	50
Yttrium oxide	Y_2O_3	S	0.112	57
Zinc	Zn	S	0.0384	−253 to −196
.....	.....	S	0.0268	−233

SPECIFIC HEAT OF ELEMENTS, COMPOUNDS AND VARIOUS SUBSTANCES

Name	Formula	State	Specific Heat g-cal/g(15°)	Temp. °C.
Zinc	Zn	S	0.063	−193
.....	.....	S	0.0836	−192 to +20
.....	.....	S	0.080	−186 to −79
.....	.....	S	0.0895	−79 to +18
.....	.....	S	0.0903	1
.....	.....	S	0.0924	20
.....	.....	S	0.0951	100
.....	.....	S	0.1040	300
.....	.....	S	0.110	419
.....	.....	L	0.121	419
Zinc acetate	$Zn(C_2H_3O_2)_2$	S	0.270	45
.....	$Zn(C_2H_3O_2)_2 \cdot 3H_2O$	S	0.410	85
carbonate	$ZnCO_3$	S	0.142	0
chloride	$ZnCl_2$	S	0.136	60
nitrate	$Zn(NO_3)_2 \cdot 6H_2O$	S	0.318	30
oxide	ZnO	S	0.114	0
.....	.....	S	0.129	100
.....	.....	S	0.15	600
sulfate	$ZnSO_4$	S	0.174	50
.....	$ZnSO_4 \cdot H_2O$	S	0.194	9
.....	$ZnSO_4 \cdot 6H_2O$	S	0.299	9
.....	$ZnSO_4 \cdot 7H_2O$	S	0.322	0
sulfide	ZnS	S	0.116	0
.....	.....	S	0.118	100
Zircon	$ZrO_2 \cdot SiO_2$	S	0.131	36
Zirconium	Zr	S	0.0262	−253 to −196
.....	.....	S	0.068	0 to 100
Zirconium dioxide	ZrO_2	S	0.103	0

SPECIFIC HEAT OF MERCURY AND WATER

The values are given in gram calories at 15° C. per gram.

Temp. °C.	Mercury	Water
−10	.....	0.48*
−6	.....	1.0119
−4	.....	1.0105
−2	.....	1.0097
0	0.03346	1.00874
5	0.03340	1.00477
10	0.03335	1.00184
15	0.03330	1.00000
20	0.03325	0.99859
25	0.03320	0.99765
30	0.03316	0.99745
35	0.03312	0.99743
40	0.03308	0.99761
45	.....	0.99790
50	0.03300	0.99829
55	.....	0.99873
60	0.03294	0.99934
65	.....	1.00001
70	0.03290	1.00077
75	.....	1.00158

Temp. °C.	Mercury	Water
80	0.03283	1.00239
85	.....	1.00329
90	0.03274	1.00433
95	.....	1.00534
100	0.03267	1.00645
110	0.03260	1.0116
120	0.03253	1.0144
130	0.03246	1.0174
140	0.03239	1.0206
150	0.03232	1.0240
160	0.03225	1.0275
170	0.03218	1.0313
180	0.03211	1.0353
190	0.03203	1.0395
200	0.03196	1.0439
220	0.03185	1.0769
240	0.03217	1.0939
260	0.03320	1.1126
280	.....	1.1329
300	.....	1.1549

* Value for solid state at −10°C.

HEAT CONDUCTIVITY

In the following tables dealing with heat conductivity, the coefficient λ is given in calories/cm. sec. degree C. This value expresses the quantity of heat in gram calories, transmitted per second through a plate of the material one centimeter thick and one square centimeter in area when the temperature difference between the two sides of the plate is one degree Centigrade. To express λ in English units (B.T.U./inch sec. degree F) multiply the values given below by 0.00560.

HEAT CONDUCTIVITY OF VARIOUS METALS AND ALLOYS

Metal or Alloy	Temp. °C.	λ
Aluminum, commercial	−188.2	0.454
" "	0	0.461
" 99%	18	0.504
" "	100	0.49
" "	400	0.76
" "	600	1.01
Antimony	−77	0.0628
	0	0.0538
	100	0.0515
20Sb+80Bi	0	0.0152
	100	0.0205
50Sb+50Bi	0	0.0196
	100	0.0229
70Sb+30Bi	0	0.0234
	100	0.0281
33.3Sb+66.7Cd	0	0.0267
50Sb+50Cd	0	0.00519
66.7Sb+33.3Cd	0	0.00299
Bismuth	−77	0.0257
	0	0.0177
	100	0.0164
25Bi+75Pb (Vol.)	44	0.0468
96.5Bi+3.5Pb (Vol.)	44	0.0129
90Bi+10Sn (Vol.)	44	0.0126
50Bi+50Sn	12.5	0.056
25Bi+75Sn	12.5	0.102
Brass, red	0	0.246
" "	100	0.2827
Brass, yellow	0	0.2041
" "	100	0.254
Cadmium	0	0.2213
"	100	0.2045
Constantin, see 60 Cu+40 Ni		
Cobalt, with 0.24%C, + 1.4Fe+1.1 Ni+0.14Si	30	0.1653
Chromium steel, 5%Cr	30	0.073
" " 10%Cr	30	0.052
" " 15%Cr	30	0.044
Copper	−183	1.111
"	0	0.920
"	100	0.92
60Cu+40Ni	18	0.05401
	100	0.06405
54Cu+46Ni	18	0.0484
99.37Cu+0.63P	30	0.250
98.02Cu+1.98P	30	0.125

Metal or Alloy	Temp. °C.	λ
89Cu+11Zn	18	0.275
87Cu+13Zn	18	0.301
82Cu+18Zn	18	0.313
68Cu+32Zn	18	0.260
German silver (52Cu, 26Zn, 22Ni)	0	0.0700
	100	0.0887
62Cu+15Ni+22Zn	18	0.0595
Gold	0	0.744
"	97	0.7464
90Au+10Pd	25	0.234
50Au+50Pd	25	0.086
10Au+90Pd	25	0.124
40Au+60Pt	25	0.062
10Au+90Pt	25	0.182
Iridium	17	0.141
Iron, with 0.1%C+ 0.1%Mn+0.2%Si	18	0.1436
	100	0.1420
99Fe+1C	18	0.1085
	100	0.1076
Fe+1.5C+0.19Mn+ 0.05Si+0.03Cu+ 0.01P+0.025S	18	0.119
Bessemer steel	8	0.0985
Lead	18	0.0827
"	100	0.0815
Lithium	0	0.17
"	101.3	0.18
Magnesium	0−100	0.376
Manganin (84Cu+4Ni +12Mn)	18	0.05186
	100	0.0631
Mercury, solid	−269.3	0.40
" "	−44.2	0.0664
" liquid	−37.2	0.0218
" "	0	0.0248
" "	50.4	0.0298
" "	149.4	0.0385
Molybdenum	17	0.346
Nickel, 99%	−160	0.129
	18	0.140
Nickel +2 or 3% Co	300	0.126
	500	0.104
	950	0.065
	1200	0.058
Nickel steel, (30.4Ni+ 0.14Si+0.84Mn+ 0.26C)	29	0.029
	71	0.031
Palladium	18	0.1683

HEAT CONDUCTIVITY OF VARIOUS METALS AND ALLOYS

Metal or Alloy	Temp. °C.	λ
Palladium	100	0.1817
90Pd+10Pt	25	0.134
50Pd+50Pt	25	0.088
10Pd+90Pt	25	0.103
90Pd+10Ag	25	0.114
50Pd+50Ag	25	0.076
10Pd+90Ag	25	0.337
Platinum	−252.8	0.93
"	−183	0.182
"	0−200	0.167
90Pt+10Ir	17	0.074
90Pt+10Rh	17	0.072
30Pt+70Ag	25	0.074
10Pt+90Ag	25	0.234
Potassium	5.0	0.234
"	20.7	0.232
"	57.6	0.217
62.9K+37.1Na	6.0	0.0549
	42.9	0.0619
Rhodium	17	0.210

Metal or Alloy	Temp. °C.	λ
Silver, 99.9%	−160	0.998
" "	0	1.096
" "	10−97	0.9628
" 99.98%	18	1.006
" "	100	0.9919
Sodium	5.7	0.321
"	21.2	0.317
"	88.1	0.288
Tantalum	17	0.130
"	1827	0.198
Tin	−170	0.195
"	0	0.1528
"	100	0.1423
30Sn+70Zn (Vol.)	44	0.224
91.1Sn+8.9Zn (Vol.)	44	0.157
Tungsten	0	0.383
"	2227	0.354
Wood's metal	7	0.0319
Zinc	−170	0.280
	18	0.2653
	100	0.2619

HEAT CONDUCTIVITY OF VARIOUS SOLIDS

Substance	Temp. °C.	λ×10³
Aluminum oxide (pressed powder)	46.8	1.62
Asbestos board	20	1.78
Asbestos fabric	20	0.666
Asbestos fiber	0	0.267
" "	100	0.284
Asbestos paper	20	0.345
Asphalt	20	1.78
Basalt	20	5.2
Bauxite	600	1.33
Boiler scale	65.5	3.13
Brick, common	20	1.5
Blotting paper	20	0.15
Cadmium oxide (pressed powder)	46.5	1.63
Carborundum	600	9.3
Cardboard	20	0.5
Cement, Portland	89.5	0.71
Chalk	20	2.2
Clay (fire-hardened)	360 to	2.09 to
	600	2.21
Coal	<0	0.405
"	1427	20.1
Cobalt oxide (pressed powder)	48.5	1.00
Concrete	20	2.2
Copper oxide (pressed powder)	45.6	2.42
Copper sulfide (pure)	0	1.06

Substance	Temp. °C.	λ×10³
Cork, Sp.G. =0.204	30	0.128
Cork meal	100	0.133
Cotton, Sp.G. =0.081	0	0.136
Diatomaceous earth	20	0.13
Earth's crust, average	20	4.0
Ebonite	0	0.378
Eiderdown	20	0.011
Feathers (with air)	9	0.0574
Feldspar	20	5.6
Felt (dark gray)	40	0.149
Ferric oxide (pressed powder)	200	1.41
Ferrous oxide (pressed powder)	49.8	1.33
Fiber, vegetable (with air)	9	0.0645
" , " (without air)	9	1.42
Fire brick	20	1.1
Flannel	50	0.0355
Flint	20	2.4
Fluorite	0	24.68
"	100	19.10
Gas carbon	20	8.5
" "	100	9.5
Glass, crown	12.5	1.63
" , flint	12.5	1.43
" , Jena	22	2.27
" , soda	20	1.7

HEAT CONDUCTIVITY OF VARIOUS SOLIDS

Substance	Temp. °C.	$\lambda \times 10^3$
Glass, soda	100	1.8
Granite	20	8.17
Graphite, Sp.G. =1.58	50	105.5
" ⊥ to axis	142	42.6
" " " "	555	279
Graphite powder, Sp.G. =0.7	40	2.85
Gutta percha	20	0.48
Gypsum	0	3.1
Hair-cloth	<0	0.0402
Horn	<0	0.087
Horse hair, Sp.G. =0.172	20	0.122
Ice	....	5.7
Infusorial earth	100	0.34
" "	300	0.40
Lampblack, Sp.G. =0.165	40	0.156
Lava	16 to 99	2.01
Leather, cowhide	84	0.42
" sole, Sp.G. =1.00	30	0.38
Lime, clayey	20	7.8
Linen	20	0.21
Linoleum, Sp.G. =1.183	20	0.445
Magnesia (MgO) (pressed powder), Sp.G. =0.797	47.6	1.45
Magnesia brick	50 to 1130	2.7 to 7.2
Magnesite	1000	3.98
Marble, white	....	7.8
" black	30	6.85
Mica	41.3	0.860
Mica, pressed plates	60	0.627
Naphthalene	0	0.90
α-Naphthol	35	0.76
β-Naphthol	35	0.80
Nickel oxide (pressed powder, Sp.G. =1.445)	46.2	2.24
Onyx	30	5.56
Paper	20	0.3
Paraffin	0	0.688
Plaster of Paris	20	0.70
Porcelain	95	2.48
Potassium chloride	0	16.6
Potassium iodide	0	12
Quartz, || to axis	0	32.5
" " " "	100	21.5
" ⊥ to axis	0	17.31
" " " "	100	13.33

Substance	Temp. °C.	$\lambda \times 10^3$
Quartz glass	0	3.32
" "	100	4.57
Rock salt	0	16.67
" "	100	11.59
Roofing paper	<0	0.453
Rubber, hard, gray	49	0.55
" soft, "	49	0.44
" " red	49	0.34
Sand, dry	20	0.93
Sandstone, Sp.G. =2.259	40	4.39
Sawdust, Sp.G. =0.19	30	0.14
Serpentine	20	2.4
Silica, see Quartz		
Silk, Sp.G. =0.101	0	0.122
" " "	50	0.136
Silver bromide	0	2.46
Silver chloride	0	2.6
Slate	20	4.70
Snow, fresh, Sp.G. =0.111	....	2.56
" , old, Sp.G. =0.450	....	0.115
Sodium chlorate	0	2.665
Soil, dry	20	0.33
Sugar, cane	0	1.39
Sulfur, rhombic	0	0.70
" plastic	20 to 100	0.63
Sylvite	0	16.65
"	100	11.76
Thymol	12	0.359
Wadding, Sp.G. =0.01	18	0.93
Wax, bees'	20	0.207
Wood, maple || to face	20	1.015
Wood, maple, ⊥ to face	50	0.434
Wood, oak, ⊥ to face Sp.G. =0.825	15	0.500
Wood, oak, || to face Sp.G. =0.819	15	0.834
Wood, pine, || to face Sp.G. =0.551	20	0.834
Wood, pine, ⊥ to face Sp.G. =0.546	15	0.361
Wood, teak, || to face Sp. G. =0.604	15	0.903
Wood, teak, ⊥ to face Sp.G. =0.642	15	0.417
Zinc oxide (pressed powder, Sp.G. =2.886)	49.7	1.42

HEAT CONDUCTIVITY OF VARIOUS LIQUIDS AND SOLUTIONS

Liquid or Solution	Temp. °C.	$\lambda \times 10^3$
Acetic acid	25	0.43
" " , 50%	25	0.85
Acetone	0	0.4228

Liquid or Solution	Temp. °C.	$\lambda \times 10^3$
Ammonia, 26%	18	1.09
Amyl acetate	12	0.302
Amyl alcohol	12	0.328

HEAT CONDUCTIVITY OF VARIOUS LIQUIDS AND SOLUTIONS

Liquid or Solution	Temp. °C.	$\lambda \times 10^3$
Amyl chloride	12	0.283
Amyl iodide	12	0.203
Aniline	12	0.408
Barium chloride, 21%	32	1.396
Benzene	12	0.333
Bromobenzene	12	0.265
iso-Butyl alcohol	12	0.340
iso-Butyl bromide	12	0.278
iso-Butyl chloride	12	0.278
iso-Butyl iodide	12	0.208
n-Butyric acid	12	0.360
iso-Butyric acid	12	0.340
Calcium chloride, 15%	32	1.383
" " , 30%	32	1.315
iso-Caproic acid	12	0.298
Carbon disulfide	12	34.3
Carbon tetrachloride	12	0.252
Castor oil	....	0.425
Chlorobenzene	12	0.302
Chloroform	12	0.288
Copper sulfate, 18%	32	1.379
Cylinder oil	81	0.290
Cymene	12	0.272
Ethyl acetate	12	0.348
Ethyl alcohol	5.2	0.487
" "	51	0.369
" " , 90%	15	0.4391
" " , 70%	14.1	0.5711
" " , 50%	12.9	0.7461
" " , 30%	12.3	1.002
" " , 10%	11.9	1.247
Ethyl bromide	12	0.247
Ethyl ether	12	0.303
Ethyl formate	12	0.378
Ethyl iodide	12	0.222
Ethyl sulfide	12	0.328
Ethylene glycol	0	0.6353
Formic acid	12	0.648
Glycerol	12	0.670
"	48	0.613
Heptane	4	0.337
Hexane	4	0.364
Hydrochloric acid, 12.5%	32	1.262
" " , 25%	32	1.151
" " , 38%	32	1.052
Magnesium chloride, 11%	32	1.376
" " , 29%	32	1.238
Magnesium sulfate, 22%	32	1.414
Methyl acetate	12	0.385
Methyl alcohol	12	0.495
Methyl butyrate	12	0.335
Methyl valerate	12	0.315
Nitrobenzene	12.5	0.3801
Octane	4	0.375
Olive oil, Sp.G. =0.911	15.7	0.4515
Paraffin oil	17	0.346

Liquid or Solution	Temp. °C.	$\lambda \times 10^3$
Pentane	−185	0.3955
"	14	0.2856
Petroleum	13	0.355
Potassium bromide, 40%	32	1.176
Potassium carbonate, 20%	32	1.373
Potassium chlorate, Sp.G. =1.026	13	1.16
Potassium chloride, 20%	32	1.334
Potassium hydroxide, 21%	32	1.385
" " , 42%	32	1.313
Potassium nitrate, 10%	32	1.409
" " , 20%	32	1.337
Potassium sulfate, 10%	32	1.440
Propionic acid	12	0.390
Propyl acetate	12	0.327
n-Propyl alcohol	12	0.373
iso-Propyl alcohol	0	0.3683
Propyl bromide	12	0.257
Propyl chloride	12	0.283
Propyl formate	12	0.357
Propyl iodide	12	0.220
Sodium bromide, 20%	32	1.348
" " , 40%	32	1.289
Sodium carbonate, 10%	32	1.403
Sodium chloride, 12.5%	32	1.403
" " , 25%	32	1.141
Sodium nitrate, 20%	32	1.376
" " , 44%	32	1.311
Sodium sulfate, 10%	32	1.447
Strontium nitrate, 20%	32	1.398
" " , 40%	32	1.346
Sulfuric acid, 30%	32	1.244
" " , 60%	32	1.047
" " , 90%	32	0.846
" " , Sp.G. =1.054	20.5	1.26
" " , Sp.G. =1.18	21	1.30
Thymol	13	0.313
Toluene	0	0.3492
"	12	0.307
Turpentine oil	12	0.260
n-Valeric acid	12	0.325
iso-Valeric acid	12	0.312
Vaseline	20	0.222
Water	4.1	1.29
"	12	1.36
"	40.8	1.555
Wood tar	79.5	0.324
o-Xylene	0	0.3443
" "	33	0.2519
m-Xylene	0	0.3429
Zinc chloride, 17.5%	32	1.327
" " , 35%	32	1.213
Zinc sulfate, 16%	32	1.382
" sulfate, 32%	32	1.327
" " , Sp.G. =1.134	4.5	1.18
" " , Sp.G. =1.382	45.2	1.44

HEAT CONDUCTIVITY OF VARIOUS GASES AND VAPORS

Gas or Vapor	Temp. °C.	$\lambda \times 10^5$
Acetone	0	2.301
"	100	3.96
"	184	5.90
Acetylene	0	4.40
Air	−191.1	1.80
"	−78.4	4.256
"	0	5.572
"	100	7.197
"	531	15.95
Ammonia	−57.6	3.82
"	0	5.135
"	100	7.09
Argon	−182.6	1.42
"	0	3.88
"	100	5.087
Benzene	0	2.094
"	100	4.144
"	212.5	7.08
Butylamine	6.5	3.003
Carbon dioxide	−78.5	2.546
" "	0	3.393
" "	100	5.06
" "	546	14.20
Carbon disulfide	0	1.615
Carbon monoxide	−191	1.650
" "	0	5.425
Carbon tetrachloride	46	1.666
" "	100	2.048
" "	184	2.599
Chlorine	0	1.829
Chloroform	0	1.523
"	100	2.333
"	184	3.103
Ethane	−70.4	2.727
"	0	4.306
"	100	7.673
Ethyl acetate	46	2.88
" "	100	3.862
" "	184	5.69
Ethyl alcohol	20	3.583
" "	100	4.98
Ethyl ether	0	3.101
" "	100	5.278
" "	212.5	8.400
Ethylene	−71.1	2.572
"	0	4.02
"	100	6.36
Helium	−252.2	5.18
"	−191.7	14.84
"	0	33.60

Gas or Vapor	Temp. °C.	$\lambda \times 10^5$
Helium	100	39.85
n-Heptane	100	4.136
n-Hexane	20	2.854
Hexylene	100	4.396
Hydrogen	−252.2	3.22
"	−78.4	30.65
"	0	39.60
"	100	49.94
Hydrogen sulfide	0	3.045
Mercury vapor	203	1.846
Methane	−181.6	2.248
"	−75.6	4.940
"	0	7.200
Methyl alcohol	0	3.357
" "	100	5.161
Methyl bromide	4.6	1.74
Methyl chloride	0	2.216
" "	100	3.841
" "	212.5	6.113
Methyl dichloride	0	1.562
" "	100	2.524
" "	212.5	3.804
Methyl iodide	0	1.098
" "	100	1.804
Neon	−181.4	4.99
"	−74.4	8.79
"	0	10.87
"	105.8	13.44
Nitric oxide, NO	−71.4	4.160
" "	0	5.55
Nitrogen	−191.4	1.829
"	−78.4	4.305
"	0	5.68
"	100	7.18
Nitrogen dioxide	55	8.88
Nitrous oxide, N_2O	−71.8	2.710
" "	0	3.515
" "	100	5.06
Oxygen	−191.4	1.721
"	−78.4	4.292
"	0	5.70
"	100	7.427
n-Pentane	20	3.267
iso-Pentane	0	2.912
" "	100	5.105
" "	184	7.52
Sulfur dioxide	0	1.950
Water vapor	46	4.580
" "	100	5.510

HEAT CONDUCTIVITY OF COMMERCIAL INSULATORS

(Calculated from the values in Bu. of Standards Letter Circular No. 227.)

In the table below, the materials are divided into eight classes,* as follows:
Class 1—Soft flexible materials in sheet form.
Class 2—Loose materials.
Class 3—Semi-flexible materials in sheet form.
Class 4—Semi-rigid materials in board form.
Class 5—Stiff fibrous materials in board form.
Class 6—Cellular gypsum.
Class 7—Woods, across grain.
Class 8—Miscellaneous building materials.

To convert the specific gravities to pounds per cubic foot, multiply by 62.43. To convert the values for λ, which are given in calories/cm. sec. degree C to B.T.U./hour, square foot, degree F per inch thickness, multiply by 3303.

Material	Composition	Class	Sp. Gr.	$\lambda \times 10^4$
Balsa	Wood, across grain	7	0.1168	1.0
"		7	0.1408	1.15
"		7	0.32	1.76
Balsam Wool	Chemically treated wood fibre	1	0.0352	0.818
Building brick	.....	8	.....	9 to 18
Building gypsum	.....	8	.....	about 9
Cabots Quilt	Eel grass between kraft paper	1	0.054	0.76
" "		1	0.074	0.79
Celotex	Sugar cane fiber	5	0.211	1.03
"		5	0.237	1.03
Charcoal	From maple, beech and birch; coarse	2	0.211	1.09
"	6 mesh	2	0.243	1.12
"	20 mesh	2	0.307	1.18
Cinder concrete	.....	8	.....	6 to 9
Concrete	.....	8	.....	18 to 27
Corkboard	No added binder; very low density	4	0.0864	0.76
"	No added binder; low density	4	0.112	0.82
"	No added binder; medium density	4	0.170	0.91
"	No added binder; high density	4	0.224	1.03
Cornstalk Pith Board	.....	5	.....	0.73 to 0.91
Cypress	Wood, across grain	7	0.464	2.03
Dry Zero	Kopak between burlap or paper	1	0.016	0.73
" "		1	0.032	0.76
Eureka	Corkboard with asphaltic binder	4	0.232	0.97
Fibrofelt	Flax and rye fibre	3	0.218	0.97
Flaxlinum	Flax fibre	3	0.208	0.94
Glass	.....	8	.....	15 to 18
Glass Wool	Pyrex glass, curled	2	0.064	0.88
" "		2	0.160	0.88
Granite	.....	8	.....	39 to 85
Hair Felt	Felted cattle hair	1	0.176	0.79
" "		1	0.208	0.79
Hairinsul	75% hair, 25% jute	1	0.101	0.82
"	50% hair, 50% jute	1	0.098	0.79
Inso-board	.....	5	.....	1.0
Insulex or Pyrocell	Cellular Gypsum	6	0.128	1.06
" " "		6	0.192	1.33
" " "		6	0.288	1.79
" " "		6	0.384	2.33
" " "		6	0.480	3.03
Insulite	Wood pulp	5	0.259	1.03
"		5	0.270	1.03
Limestone	.....	8	.....	12 to 27

*See also another table in the section on Materials of Construction.

HEAT CONDUCTIVITY OF COMMERCIAL INSULATORS

Material	Composition	Class	Sp. Gr	$\lambda \times 10^4$
Linofelt	Flax fibres between paper	1	0.0784	0.85
Lith	Board containing rock wool, flax and straw pulp	4	0.229	1.21
Maftex	.....	5	.....	1.03
Mahogany	Wood, across grain	7	0.544	2.73
Maizewood	.....	5	.....	1.0 to 1.18
Maple	Wood, across grain	7	0.704	3.3
Marble	.....	8	.....	43 to 61
Masonite	.....	5	.....	1.0
Oak	Wood, across grain	7	0.608	3.09
Pine, Virginia	Wood, across grain	7	0.544	2.97
Pine, White	Wood, across grain	7	0.512	2.36
Plaster	.....	8	.....	6 to 15
Regranulated Cork	Fine particles	2	0.150	0.91
" "	About 3/16 inch particles	2	0.130	0.94
Rock Cork	Rock wool block with binder	4	0.267	1.12
Rock Wool	Fibrous material made from rock, also made	2	0.096	0.79
" "	in sheet form, felted and confined with	2	0.160	0.82
" "	wire netting	2	0.224	0.85
" "		2	0.288	0.88
Sandstone	.....	8	.....	24 to 48
Sawdust	Various	2	0.192	1.24
"	Redwood	2	0.174	1.27
Shavings	Various, from planer	2	0.141	1.24
Sil-O-Cel	Powdered diatomaceous earth	2	0.170	0.94
Thermofelt	Jute and asbestos fibers, felted	1	0.160	1.12
"	Hair and asbestos fibers, felted	1	0.125	0.85
Thermofill	Gypsum in powdered form	2	0.416	1.58
"		2	0.544	1.82
Tucork, see Rock Cork				

HEAT OF FUSION OF INORGANIC COMPOUNDS AND ELEMENTS

To convert the values from gram calories per gram into joules per gram, multiply by 4.186; to convert gram calories per gram into BTU per pound multiply by 1.800.

Name	Formula	Melting Point, °C.	Heat of Fusion g. cal. 15°/g.
Aluminum	Al	660	94.55
Aluminum bromide	$AlBr_3$	97.5	10.47
Ammonia	NH_3	−77.7	83.9
Antimony	Sb	630.5	39.2
Antimony tribromide	$SbBr_3$	96.6	9.759
Antimony trichloride	$SbCl_3$	73.4	13.29
Antimony trisulfide	Sb_2S_3	550	17.6
Argon	A	−189.2	6.713
Arsenic tribromide	$AsBr_3$	31	8.93
Barium chloride	$BaCl_2$	962	27.8
Beryllium	Be	1300	318
Bismuth	Bi	271	11.98
Bromine	Br	−7.2	16.2
Cadmium	Cd	320.9	12.9
Cadmium nitrate	$Cd(NO_3)_2 \cdot 4H_2O$	59.4	25.3
Calcium chloride	$CaCl_2$	772	54.2
Calcium chloride	$CaCl_2 \cdot 6H_2O$	29.92	40.7
Calcium nitrate	$Ca(NO_3)_2 \cdot 4H_2O$	42.7	33.9
Carbon dioxide	CO_2	−56.2	45.30
Carbon monoxide	CO	−207	8.00
Cesium	Cs	28.5	3.8
Cesium hydroxide	CsOH	272	10.8
Chlorine	Cl	−101.6	23.0
Chromium	Cr	1615	75.6
Cobalt	Co	1480	62.23
Copper	Cu	1083	48.92
Cupric nitrate	$Cu(NO_3)_2 \cdot 6H_2O$	24.4	29.4
Fluorine	F	−223	10.06
Gallium	Ga	30	19.0
Gold	Au	1063	15.36
Hydrogen	H	−259.1	14.0
Hydrogen bromide	HBr	−86	7.67
Hydrogen chloride	HCl	−111	13.9
Hydrogen peroxide	H_2O_2	−1.7	74
Iodine	I	113.5	15.8
Iodine chloride	ICl (α)	27.2	16.5
Iron	Fe	1535	48.0
Krypton	Kr	−169	4.3
Lead	Pb	327.5	5.97
Lead chloride	$PbCl_2$	501	18.5
Lead iodide	PbI_2	402	11.5
Lithium	Li	186	158.5
Lithium nitrate	$LiNO_3$	261	88.51
Magnesium	Mg	651	88.81
Magnesium chloride	$MgCl_2 \cdot 6H_2O$	118	41.21
Magnesium nitrate	$Mg(NO_3)_2 \cdot 6H_2O$	95	38.2
Manganese	Mn	1260	62.81
Manganese nitrate	$Mn(NO_3)_2 \cdot 6H_2O$	25.8	28.79
Mercuric bromide	$HgBr_2$	237	12.8
Mercuric iodide	HgI_2	259	9.8
Mercury	Hg	−38.87	2.78
Neon	Ne	−248.67	2.6
Nickel	Ni	1452	71.56
Nickel nitrate	$Ni(NO_3)_2 \cdot 6H_2O$	56.7	36.43

HEAT OF FUSION OF INORGANIC COMPOUNDS AND ELEMENTS

Name	Formula	Melting Point, °C.	Heat of Fusion g. cal. 15°/g.
Nitric acid	HNO_3	−42	9.544
Nitric oxide	NO	−163	18.4
Nitrogen	N	−210	6.09
Nitrogen pentoxide	N_2O_5	29.5	76.7
Nitrogen tetroxide	N_2O_4	−9.3	32.3 to 37.1
Osmium tetroxide	OsO_4	40.1	13.5
Oxygen	O	−218.4	3.30
Palladium	Pd	1555	38.61
Phosphorus	P	44.1	5.034
Phosphorus oxychloride	$POCl_3$	2	19.8
Platinum	Pt	1755	24.07
Potassium	K	62.3	14.68
Potassium chloride	KCl	790	74.1
Potassium dichromate	$K_2Cr_2O_7$	398	29.74
Potassium fluoride	KF	880	108
Potassium hydroxide	KOH	380	28.55
Potassium nitrate	KNO_3	333	25.44
Pyrosulfuric acid	$H_2S_2O_7$	35	18
Radon	Rn	−71	3.50
Rubidium	Rb	38.5	6.10
Rubidium hydroxide	RbOH	300	15.8
Selenium, gray	Se	220	6.7
Silicon tetrachloride	$SiCl_4$	−70	10.85
Silver	Ag	960.5	25.02
Silver bromide	AgBr	434	12.5
Silver chloride	AgCl	455	21.3
Silver nitrate	$AgNO_3$	212	16.7
Sodium	Na	97.5	27.40
Sodium chlorate	$NaClO_3$	248	49.0
Sodium chloride	NaCl	804.3	123.5
Sodium chromate	$Na_2CrO_4 \cdot 10H_2O$	20	39.2
Sodium fluoride	NaF	992.2	186
Sodium hydrogen phosphate	$Na_2HPO_4 \cdot 12H_2O$	34.6	66.77
Sodium hydroxide	NaOH	318.4	40.02
Sodium nitrate	$NaNO_3$	308	45.27
Sodium sulfate	$Na_2SO_4 \cdot 10H_2O$	32.4	57.1
Stannic bromide	$SnBr_4$	31	6.49
Stannic chloride	$SnCl_4$	−30.2	8.41
Strontium chloride	$SrCl_2$	873	25.6
Sulfur (rhombic)	S	112.8	9.370
Sulfur (monoclinic)	S	118.95	10.4
Sulfuric acid	H_2SO_4	10.49	24.03
Sulfuric acid	$H_2SO_4 \cdot H_2O$	8.62	39.2
Thallium	Tl	303.5	5.04
Thallous bromide	TlBr	460	12.7
Thallous chloride	TlCl	430	16.6
Tin	Sn	231.8	14.99
Titanium tetrachloride	$TiCl_4$	−30	11.8
Water	H_2O	0	79.67
Xenon	Xe	−140	3.77
Zinc	Zn	419.4	24.40
Zinc nitrate	$Zn(NO_3)_2 \cdot 6H_2O$	36.4	31.1

HEAT OF FUSION OF ORGANIC COMPOUNDS

Name	Formula	Melting Point, °C.	Heat of Fusion g.cal.15°/g.
Acetic acid	CH_3COOH	16.7	43.2
Acetone	CH_3COCH_3	−94.6	23.4
Acrylic acid	C_2H_3COOH	13	37.0
Allocinnamic acid	C_8H_7COOH	68	27.4
o-Aminobenzoic acid	$C_6H_4(NH_2)COOH$	145	35.5
m-Aminobenzoic acid	$C_6H_4(NH_2)COOH$	174	38.0
p-Aminobenzoic acid	$C_6H_4(NH_2)COOH$	188.5	36.5
tert-Amyl alcohol	$C_5H_{11}OH$	−12	12.5
Anethole	$CH_3OC_6H_4C_3H_5$	22.5	25.8
Aniline	$C_6H_5NH_2$	−6.2	21.0
Anthracene	$C_{14}H_{10}$	216.5	38.7
Anthraquinone	$C_{14}H_8O_2$	286	37.5
Azobenzene	$C_6H_5N{:}NC_6H_5$	68	32.4
Azoxybenzene	$(C_6H_5)_2N_2O$	36	21.6
Benzene	C_6H_6	5.5	30.1
Benzil	$(C_6H_5CO)_2$	94.9	22.2
Benzoic acid	C_6H_5COOH	121.7	33.9
Benzophenone	$(C_6H_5)_2CO$	48.5	23.5
Benzylaniline	$C_6H_5CH_2NHC_6H_5$	37	21.9
Bromal hydrate	$CBr_3CH(OH)_2$	53.5	16.9
Bromocamphor	$C_{10}H_{15}OBr$	77	41.6
o-Bromochlorobenzene	BrC_6H_4Cl	−12.6	15.4
m-Bromochlorobenzene	BrC_6H_4Cl	−21.2	15.3
p-Bromochlorobenzene	BrC_6H_4Cl	67.4	23.4
Bromoform	Br_3CH	7.8	10.9
o-Bromoiodobenzene	BrC_6H_4I	5	12.2
m-Bromoiodobenzene	BrC_6H_4I	−9.3	10.3
p-Bromoiodobenzene	BrC_6H_4I	91	16.6
p-Bromophenol	BrC_6H_4OH	64	20.5
p-Bromotoluene	$BrC_6H_4CH_3$	28.5	20.9
n-Butane	$(C_2H_5)_2$	−135	18.0
n-Butyl alcohol	C_4H_9OH	−79	29.9
tert-Butyl alcohol	$(CH_3)_3COH$	25.5	21.0
n-Butylbenzene	$C_4H_9{\cdot}C_6H_5$	−88.5	19.5
tert-Butylbenzene	$(CH_3)_3C{\cdot}C_6H_5$	58.1	14.9
n-Butyric acid	C_3H_7COOH	−4.7	30.1
Camphene	$C_{10}H_{12}$	50	57
Camphor	$C_{10}H_{16}O$	178.4	10.7
n-Capric acid	$CH_3(CH_2)_8COOH$	31.5	38.9
n-Caprylic acid	$CH_3(CH_2)_6COOH$	16.3	35.4
Carbazole	$C_{12}H_9N$	245	42.1
Carbon tetrachloride	CCl_4	−23	4.16
Catechol	$C_6H_4(OH)_2$ (1, 2)	104.3	49.4
Cetyl alcohol	$C_{16}H_{33}OH$	49	33.8
Chloral alcoholate	$CCl_3CHO{\cdot}C_2H_5OH$	56	24.0
Chloral hydrate	$CCl_3CH(OH)_2$	52	33.2
Chloroacetic acid (α)	$ClCH_2COOH$	61.2	31.1
Chloroacetic acid (β)	$ClCH_2COOH$	56	35.1
p-Chloroaniline	$ClC_6H_4NH_2$	71	37.2
o-Chlorobenzoic acid	ClC_6H_4COOH	140.2	39.3
m-Chlorobenzoic acid	ClC_6H_4COOH	158	36.4
p-Chlorobenzoic acid	ClC_6H_4COOH	242	49.2
m-Chloronitrobenzene	$ClC_6H_4NO_2$	44	29.4
p-Chloronitrobenzene	$ClC_6H_4NO_2$	83	21.4
Cinnamic acid	$C_6H_5{\cdot}CH{:}CH{\cdot}COOH$	133	36.5

HEAT OF FUSION OF ORGANIC COMPOUNDS

Name	Formula	Melting Point, °C.	Heat of Fusion g.cal.15°/g.
Cinnamic anhydride	$(C_8H_7CO)_2O$	136	28.1
p-Cresol	$HOC_6H_4CH_3$	35	26.3
Cyanamide	H_2NCN	44	49.8
Cyclohexane	C_6H_{12}	6.5	7.4
Cyclohexanol	$C_6H_{11}(OH)$	23.9	4.9
Cyclohexene	C_6H_{10}	−104	9.6
p-Cymene	$(CH_3)_2CHC_6H_4CH_3$	−73.5	17.2
n-Decane	$C_{10}H_{22}$	−32	48.3
Dibenzyl	$(C_6H_5CH_2)_2$	51.4	30.7
o-Dibromobenzene	$C_6H_4Br_2$	1.8	12.8
m-Dibromobenzene	$C_6H_4Br_2$	−6.9	13.4
p-Dibromobenzene	$C_6H_4Br_2$	87	20.5
Dibromophenol	$HOC_6H_3Br_2$ (2, 4)	40	14.0
Dichloroacetic acid	$Cl_2CH{\cdot}COOH$	9.7	14.2
o-Dichlorobenzene	$C_6H_4Cl_2$	−17.5	21.0
m-Dichlorobenzene	$C_6H_4Cl_2$	−24.8	20.5
p-Dichlorobenzene	$C_6H_4Cl_2$	52.7	29.7
Δ_2-Dihydronaphthalene	$C_{10}H_{10}$	23.9	22.4
Dihydrophenanthrene	$(C_6H_4CH_2)_2$	94	17.6
o-Diiodobenzene	$C_6H_4I_2$	27	10.2
m-Diiodobenzene	$C_6H_4I_2$	40	11.6
p-Diiodobenzene	$C_6H_4I_2$	129	16.2
Diisobutylene	C_8H_{16}	−101	16.8
Dimethylcyclopentane (1, 2)	C_7H_{14}	−119.0	15.7
Dimethylpentane (2, 2)	C_7H_{16}	−125.0	14.0
Dimethylpentane (2, 4)	C_7H_{16}	−120.6	16.0
Dimethylpentane (3, 3)	C_7H_{16}	−134.9	16.9
d-Dimethyltartrate	$(CH_3)_2C_4H_4O_6$	48	21.5
dl-Dimethyltartrate	$(CH_3)_2C_4H_4O_6$	89	35.1
o-Dinitrobenzene	$C_6H_4(NO_2)_2$	116.9	32.3
m-Dinitrobenzene	$C_6H_4(NO_2)_2$	89.8	24.7
p-Dinitrobenzene	$C_6H_4(NO_2)_2$	173.5	40.0
Dinitrotoluene (2, 4)	$CH_3C_6H_3(NO_2)_2$	70	26.4
Diphenyl	$(C_6H_5)_2$	70	28.8
Diphenylamine	$(C_6H_5)_2NH$	52.9	25.2
Diphenylmethane	$(C_6H_5)_2CH_2$	26	26.4
n-Dodecane	$C_{12}H_{26}$	−12	51.3
Durene	$C_{10}H_{14}$	79.3	37.4
Eicosane	$C_{20}H_{42}$	38	52.0
Elaidic acid	$C_{17}H_{33}COOH$	51	52.1
Ethane	C_2H_6	−172	22.2
Ethyl alcohol	C_2H_5OH	−112	24.9
Ethylbenzene	$C_2H_5{\cdot}C_6H_5$	−92.8	20.6
Ethylpentane (3)	C_7H_{16}	−118.8	22.6
Ethylene	C_2H_4	−169.5	25.0
Ethylene bromide	$(CH_2Br)_2$	10	13.5
Formic acid	$HCOOH$	8.6	58.9
Glutaric acid	$(CH_2)_3(COOH)_2$	97.5	37.4
Glycerol	$C_3H_5(OH)_3$	18	47.5
Glycol	$C_2H_4(OH)_2$	−15	43.3
n-Heptane	C_7H_{16}	−90.6	33.7
Hexamethylbenzene	$(CH_3)_6C_6$	165.5	30.4
Hexamethylethane	$(CH_3)_6C_2$	104	14.9
n-Hexane	C_6H_{14}	−94	36.7
Hydrazobenzene	$(C_6H_5NH)_2$	131	22.9

HEAT OF FUSION OF ORGANIC COMPOUNDS

Name	Formula	Melting Point, °C.	Heat of Fusion g. cal.15°/g.
Hydrocinnamic acid	C_8H_9COOH	48	28.1
p-Iodotoluene	$CH_3C_6H_4I$	35	18.8
Isodurene	$C_{10}H_{14}$	−24.0	23.0
n-Lauric acid	$C_{11}H_{23}COOH$	47	43.7
Levulinic acid	$CH_3CO{\cdot}C_2H_4COOH$	33	19.0
α-Menthol (l)	$C_{10}H_{19}OH$	42	18.6
Methane	CH_4	−184	14.0
Methyl alcohol	CH_3OH	−98	16.4
Methylbutane (2)	$CH_3C_4H_9$	−159	16.9
Methyl cinnamate	$CH_3C_9H_7O_2$	33.4	26.5
Methylcyclohexane	C_7H_{14}	−126.3	16.2
Methylcyclopentane	C_6H_{12}	−140.5	19.5
Methyl fumarate	$(CH_3)_2C_4H_2O_4$	102	57.9
Methylhexane (2)	$CH_3C_6H_{13}$	−119.1	21.2
Methylnaphthalene (2)	$CH_3C_{10}H_7$	35	20.1
Methyl oxalate	$(CH_3)_2C_2O_4$	54	42.7
Methyl phenylpropiolate	$C_6H_5C{:}CCOOCH_3$	18	22.9
Methyl succinate	$(CH_3)_2C_4H_4O_4$	19.5	35.7
Myristic acid	$C_{13}H_{27}COOH$	57	47.5
Naphthalene	$C_{10}H_8$	80.2	36.0
Naphthol (1)	$C_{10}H_7OH$	96	38.9
Naphthol (2)	$C_{10}H_7OH$	122.5	31.3
Naphthylamine (1)	$C_{10}H_7NH_2$	50	24.9
o-Nitroaniline	$NH_2C_6H_4NO_2$	71.5	27.9
m-Nitroaniline	$NH_2C_6H_4NO_2$	114	41.0
p-Nitroaniline	$NH_2C_6H_4NO_2$	147	36.5
Nitrobenzene	$C_6H_5NO_2$	5.7	22.5
o-Nitrobenzoic acid	$NO_2C_6H_4COOH$	147.5	40.1
m-Nitrobenzoic acid	$NO_2C_6H_4COOH$	141.1	27.6
p-Nitrobenzoic acid	$NO_2C_6H_4COOH$	240	52.8
Nitronaphthalene (1)	$C_{10}H_7NO_2$	59	25.4
o-Nitrophenol	$NO_2C_6H_4OH$	44.5	30.9
n-Octane	C_8H_{18}	−56.5	43.2
Palmitic acid	$C_{15}H_{31}COOH$	63	39.2
Paraffin	C_nH_{2n+2} (?)	52	35
Paraldehyde	$(CH_3CHO)_3$	12.6	25.0
Pentacosane	$C_{25}H_{52}$	54	53.6
n-Pentane	C_5H_{12}	−131.5	27.7
Phenanthrene	$C_{14}H_{10}$	99.3	25.0
Phenol	C_6H_5OH	42	29.0
Phenylacetic acid	$C_6H_5CH_2COOH$	76.6	30.0
Phenyl hydrazine	$C_6H_5N_2H_3$	19.6	36.3
Prehnitene	$C_{10}H_{14}$	−4	20.0
iso-Propyl alcohol	C_3H_7OH	−85.8	21.0
Propylene	C_3H_6	−184.9	16.7
Pseudocumene	C_9H_{12}	−57	25.2
Quinol	$C_6H_4(OH)_2$ (1, 4)	170.3	58.8
Quinone	$C_6H_4O_2$	115.7	40.9
Resorcinol	$C_6H_4(OH)_2$ (1, 3)	110.7	46.2
Salol	$C_{13}H_{10}O_3$	43	16.1
Stearic acid	$C_{17}H_{35}COOH$	69	47.6
Stilbene	$(C_6H_5CH)_2$	124	40.0
Succinic anhydride	$(CH_2CO)_2O$	119.6	48.7
Succinic nitrile	$(CH_2CN)_2$	54.5	11.7
Thymol	$C_{10}H_{13}OH$	51.5	27.5

HEAT OF FUSION OF ORGANIC COMPOUNDS

Name	Formula	Melting Point, °C.	Heat of Fusion g.cal.15°/g.
Tolane	$(C_6H_5C)_2$	60	28.7
Trimethylbutane	$C_4H_7(CH_3)_3$ (2, 2, 3,)	−25.4	5.3
o-Toluic acid	$CH_3C_6H_4COOH$	103.7	35.4
m-Toluic acid	$CH_3C_6H_4COOH$	110	27.6
p-Toluic acid	$CH_3C_6H_4COOH$	179.6	39.9
p-Toluidine	$CH_3C_6H_4NH_2$	44.5	39.9
Tribromoaniline	$NH_2C_6H_2Br_3$ (2, 4, 6)	120	16.8
Tribromophenol	$HOC_6H_2Br_3$ (2, 4, 6)	96	13.4
Trichloroacetic acid	Cl_3CCOOH	58	8.6
Trimethylethylene	$(CH_3)_2C{:}CHCH_3$	−134.2	25.7
Trimethylpentane	$C_5H_9(CH_3)_3$ (2, 2, 4)	−107.8	18.9
Trinitroglycerol (α)	$C_3H_5(ONO_2)_3$	13.3	5.2
Trinitroglycerol (β)	$C_3H_5(ONO_2)_3$	2.0	33.2
Trinitrotoluene	$CH_3C_6H_2(NO_2)_3$ (2, 4, 6)	81	22.3
Triphenylmethane	$(C_6H_5)_3CH$	93	21.1
Triphenyl phosphate	$(C_6H_5)_3PO_4$	49.9	17.6
Tristearin	$(C_{17}H_{35}COO)_3C_3H_5$	56	45.6
n-Undecane	$C_{11}H_{24}$	−26.5	34.1
n-Undecylic acid (α)	$C_{10}H_{21}COOH$	29	32.2
n-Undecylic acid (β)	$C_{10}H_{21}COOH$	....	42.9
Urethane	$NH_2COOC_2H_5$	49.7	40.9
Veratrole	$C_6H_4(OCH_3)_2$ (1, 2)	22.5	27.5
o-Xylene	$C_6H_4(CH_3)_2$	−27	29.3
m-Xylene	$C_6H_4(CH_3)_2$	−53.5	25.8
p-Xylene	$C_6H_4(CH_3)_2$	13.2	38.1

HEAT OF VAPORIZATION OF ELEMENTS AND COMPOUNDS

The heat of vaporization is given in gram-calories (15°) per gram. To convert to joules per gram multiply by 4.185.

Name	Formula	Temp. Deg. C.	Heat of vaporization g-cal/g (15°)
Acetaldehyde	CH_3CHO	21	136
Acetic acid	CH_3COOH	118.3	96.8
anhydride	$(CH_3CO)_2O$	137	66.2
Acetone	$(CH_3)_2CO$	56.1	124.5
Acetonitrile	CH_3CN	80	174
Acetyl chloride	CH_3COCl	51	78.9
Air	.....	.....	50.97
Allyl alcohol	C_3H_5OH	96	163
Aluminum	Al	1800	1994
Ammonia	NH_3	−33.4	327.1
.....	.....	−20	317.6
.....	.....	−10	309.7
.....	.....	0	301.6
Ammonium chloride	NH_4Cl (solid)	350	78.9
n-Amyl alcohol	$C_5H_{11}OH$	131	120.2
amine	$C_5H_{11}NH_2$	95	98.7
bromide	$C_5H_{11}Br$	129	48.3
ether	$(C_5H_{11})_2O$	170	69.5
iodide	$C_5H_{11}I$	155	47.6
Amylene	C_5H_{10}	12.5	75.0
p-Anethole	$C_3H_5C_6H_4OCH_3$	232	71.4
Aniline	$C_6H_5NH_2$	183	103.7
Antimony	Sb	1380	372.8
Argon	A	−186	37.6
Barium	Ba	1140	628.3
Benzaldehyde	C_6H_5CHO	179	86.5
Benzene	C_6H_6	0	107.0
.....	.....	20	103.8
.....	.....	40	100.7
.....	.....	60	97.5
.....	.....	80.2	94.3
.....	.....	100	90.6
.....	.....	120	86.5
Benzyl alcohol	$C_6H_5CH_2OH$	204.3	112.3
Bismuth	Bi	1450	220.6
Boron chloride	BCl_3	10	38.2
Bromine	Br	58.78	44.8
Bromobenzene	C_6H_5Br	155.9	57.6
n-Butane	C_4H_{10}	0	91.5
.....	.....	20	87.5
n-Butyl acetate	$CH_3COOC_4H_9$	124.0	73.8
alcohol	C_4H_9OH	116.8	141
formate	$HCOOC_4H_9$	105.1	86.8
iodide	C_4H_9I	129.5	45.9
sec-Butyl alcohol	C_4H_9OH	98.1	134
tert-Butyl alcohol	C_4H_9OH	83	130.5
n-Butyric acid	C_3H_7COOH	163.5	114.0
n-Butyronitrile	C_3H_7CN	117.4	114.9
Cadmium	Cd	767	227.7
Calcium	Ca	1170	2378.3
Carbon	C	4200 *	11917
Carbon dioxide	CO_2	−60	87.2
.....	.....	−50	83.4
.....	.....	−40	79.6

HEAT OF VAPORIZATION OF ELEMENTS AND COMPOUNDS

Name	Formula	Temp. Deg. C.	Heat of vaporization g-cal/g (15°)
Carbon dioxide	CO_2	−30	71.4
.....	.....	−20	66.9
.....	.....	−10	61.4
.....	.....	0	55.0
.....	.....	10	46.6
.....	.....	20	35.1
.....	.....	30	11.9
disulfide	CS_2	46.25	84.1
monoxide	CO	−192	50.4
tetrachloride	CCl_4	76.75	46.4
Carvacrol	$C_3H_7C_6H_3(OH)CH_3$	237	68.1
Cesium	Cs	670	128.0
Chloral	CCl_3CHO	.....	54.0
hydrate	$CCl_3CH(OH)_2$	96	132
Chlorine	Cl	−34.6	67.4
Chlorobenzene	C_6H_5Cl	130.6	77.6
β-Chloroethyl acetate	$CH_3CO_2C_2H_4Cl$	141.5	80.8
Chloroform	$CHCl_3$	61.5	59.0
Chlorosulfonic acid	$ClSO_3H$	151	110.2
o-Chlorotoluene	$ClC_6H_4CH_3$	158.1	72.6
p-Chlorotoluene	$ClC_6H_4CH_3$	160.4	73.1
Chromium	Cr	2200	1471
Cobalt	Co	2900	1541
Copper	Cu	2300	1762
m-Cresol	$CH_3C_6H_4OH$	202	100.6
Cyanogen	$(CN)_2$	0	10.3
chloride	CNCl	13	135
Cyclo-hexane	C_6H_{12}	80.0	85.6
hexanol	$C_6H_{11}OH$	161.6	108.2
p-Cymene	$C_3H_7C_6H_4CH_3$	176	67.6
n-Decane	$C_{10}H_{22}$	160	60.2
Dichloroacetic acid	$Cl_2CHCOOH$	194.4	77.2
Diethyl amine	$(C_2H_5)_2NH$	58	91.0
carbonate	$(C_2H_5)_2CO_3$	126	73.1
ketone	$(C_2H_5)_2CO$	101	90.8
oxalate	$(COOC_2H_5)_2$	185	67.6
Dimethyl aniline	$C_6H_5N(CH_3)_2$	193	80.8
carbonate	$(CH_3)_2CO_3$	90	88.2
Ethane	C_2H_6	−90	258
.....	.....	−40	97.5
.....	.....	−20	87.0
.....	.....	0	75.0
Ethyl acetate	$CH_3COOC_2H_5$	0	102.0
alcohol	C_2H_5OH	78.3	204
amine	$C_2H_5NH_2$	15	14.6
benzene	$C_6H_5C_2H_5$	135.2	81.2
benzoate	$C_6H_5COOC_2H_5$	213	64.5
bromide	C_2H_5Br	38.4	59.9
n-butyrate	$C_3H_7COOC_2H_5$	118.9	74.7
caprylate	$C_7H_{15}COOC_2H_5$	207	60.5
chloride	C_2H_5Cl	4.7	92.95
.....	.....	15.0	92.5
.....	.....	20.0	92.2
.....	.....	25.0	92.0
ether	$(C_2H_5)_2O$	34.6	83.9
formate	$HCOOC_2H_5$	53.3	97.2

HEAT OF VAPORIZATION OF ELEMENTS AND COMPOUNDS

Name	Formula	Temp. Deg. C.	Heat of vaporization g-cal/g (15°)
Ethyl iodide	C_2H_5I	71.2	45.6
isobutyl ether	$C_2H_5OC_4H_9$	79.0	74.8
isobutyrate	$C_3H_7COOC_2H_5$	109.2	72.1
nonylate	$C_8H_{17}COOC_2H_5$	227	58.1
propionate	$C_2H_5COOC_2H_5$	97.6	80.1
n-propyl ether	$C_2H_5OC_3H_7$	60.0	82.7
Ethylene bromide	$(CH_2Br)_2$	130.8	46.2
chloride	$(CH_2Cl)_2$	0	85.3
.....	.....	82.3	77.5
chlorohydrin	$ClCH_2CH_2OH$	126.5	123.9
oxide	$(CH_2)_2O$	13	139
Ethylidene chloride	CH_3CHCl_2	0	76.7
.....	.....	60	67.1
Fluorine	F	−187	73.7
Formic acid	HCOOH	101	120.0
Furane	$(CH)_4O$	31	95.3
Furfural	C_4H_3OCHO	160.5	107.5
Germanium	Ge	2700	1639
Gold	Au	2600	445.7
Glycol	$(CH_2OH)_2$	197	191
Helium	He	−268.9	6
n-Heptane	C_7H_{16}	97.5	76.3
n-Hexane	C_6H_{14}	0	89.1
.....	.....	66.9	81.7
.....	.....	68	79.3
Hydrogen	H	−252.7	108
Hydrogen bromide	HBr	−66.7	52.0
chloride	HCl	−85	105.9
cyanide	HCN	20	210
fluoride	HF	19.4	97
iodide	HI	−37.2	33.9
sulfide	H_2S	−61.4	131.9
Iodine	I	184.4	41.4
Iron	Fe	3000	1626
Isoamyl acetate	$CH_3COOC_5H_{11}$	143.6	69.1
alcohol	$C_5H_{11}OH$	130.2	119.8
formate	$HCOOC_5H_{11}$	123	73.6
isobutyrate	$C_3H_7COOC_5H_{11}$	168	57.6
n-valerate	$C_4H_9COOC_5H_{11}$	187	56.2
Isobutane	C_4H_{10}	−10	87.5
.....	.....	10	82.4
Isobutyl acetate	$CH_3COOC_4H_9$	115.5	73.8
alcohol	C_4H_9OH	106.9	138
formate	$HCOOC_4H_9$	97	78.5
isovalerate	$C_4H_9COOC_4H_9$	169	60.5
n-valerate	$C_4H_9COOC_4H_9$	169	57.8
Isobutyric acid	C_3H_7COOH	154	111.6
Isopentane	C_5H_{12}	13	88.7
Isopropyl alcohol	C_3H_7OH	82.3	159
Isovaleric acid	C_4H_9COOH	176.3	101.1
Krypton	Kr	−151.8	26.5
Lead	Pb	1620	222.6
Lithium	Li	1200	5850
Magnesium	Mg	1110	2574
Manganese	Mn	1900	1043
Mercury	Hg	357	70.8
Methane	CH_4	−159	138

HEAT OF VAPORIZATION OF ELEMENTS AND COMPOUNDS

Name	Formula	Temp. Deg. C.	Heat of vaporization g-cal/g (15°)
Methyl acetate	CH_3COOCH_3	0	114.0
.....	.....	56.3	98.1
alcohol	CH_3OH	64.7	262.8
aniline	$C_6H_5NHCH_3$	194	95.6
n-butyl ketone	$CH_3COC_4H_9$	127	82.4
n-butyrate	$C_3H_7COOCH_3$	102.6	79.8
chloride	CH_3Cl	−23.8	102.3
.....	.....	20.0	95.3
ethyl ketone	$CH_3COC_2H_5$	78.2	106.0
ethyl ketoxime	C_4H_8NOH	182	115.9
formate	$HCOOCH_3$	31.3	112.4
iodide	CH_3I	42	45.9
isobutyrate	$C_3H_7COOCH_3$	91.1	78.1
isopropyl ketone	$CH_3COC_3H_7$	92	89.8
isovalerate	$C_4H_9COOCH_3$	116	72.4
propionate	$C_2H_5COOCH_3$	79.0	87.6
n-valerate	$C_4H_9COOCH_3$	116	70.0
Methylene chloride	CH_2Cl_2	40.5	78.6
Molybdenum	Mo	3700	1771
Naphthalene	$C_{10}H_8$	218	75.5
Neon	Ne	−245.9	20.6
Nickel	Ni	2900	1564
Nitric acid	HNO_3	86.0	114.9
Nitro-benzene	$C_6H_5NO_2$	210	79.1
methane	CH_3NO_2	99.9	135
Nitrogen	N	−195.6	47.8
Nitrogen tetroxide	N_2O_4	18	93.4
n-Octane	C_8H_{18}	125	70.9
Oxygen	O	−183.0	51.0
Phosphorus	P	287	130
Phosphorus trichloride	PCl_3	78	51.4
Piperidine	$C_5H_{11}N$	106	89.4
Platinum	Pt	4300	635.1
Potassium	K	760	511.5
Propane	C_3H_8	−30	98.0
.....	.....	−20	95.3
.....	.....	0	89.6
.....	.....	20	83.4
Propionic acid	C_2H_5COOH	139.3	98.8
Propionitrile	C_2H_5CN	97	134
n-Propyl acetate	$CH_3COOC_3H_7$	100.4	80.3
alcohol	C_3H_7OH	97.2	164
benzene	$C_6H_5C_3H_7$	157	71.9
formate	$HCOOC_3H_7$	80.0	88.1
propionate	$C_2H_5COOC_3H_7$	120.6	74.9
Pyridine	C_5H_5N	114.1	107.4
Radon	Rn	−61.8	19.5
Rubidium	Rb	700	210.7
Selenium	Se	688	93.4
Silicon	Si	2600	144.7
Silicon tetrachloride	$SiCl_4$	57	36.1
Silver	Ag	1950	551.5
Sodium	Na	880	1091
Stannic chloride	$SnCl_4$	112	30.3
Strontium	Sr	1150	1044
Sulfur	S	316	362

HEAT OF VAPORIZATION OF ELEMENTS AND COMPOUNDS

Name	Formula	Temp. Deg. C.	Heat of vaporization g-cal/g (15°)
Sulfur chloride	S_2Cl_2	138	49.5
dioxide	SO_2	−10.8	94.9
.....	.....	0	91.3
.....	.....	10	87.7
.....	.....	20	84.1
.....	.....	30	80.8
.....	.....	40	71.2
.....	.....	50	73.8
.....	.....	60	70.3
pentoxy dichloride	$SO_3 \cdot SO_2Cl_2$	140	61.2
trioxide	SO_3	53	118.5
Sulfuric acid	H_2SO_4	326	122.1
Sulfuryl chloride	SO_2Cl_2	69.1	49.4
Tellurium	Te	1390	156.9
Tetrachloro-ethane	$(CHCl_2)_2$	145.0	55.1
ethylene	$(CCl_2)_2$	120.7	50.1
Thionyl chloride	$SOCl_2$	82	54.5
Tin	Sn	2260	654.6
Toluene	$C_6H_5CH_3$	109.6	86.5
Trichloroethylene	C_2HCl_3	85.7	57.3
Tungsten	W	5900	1179
Turpentine	$C_{10}H_{16}$	156	68.6
n-Valeric acid	C_4H_9COOH	184.6	103.2
n-Valeronitrile	C_4H_9CN	129	96.3
Water	H_2O	0	595.9
.....	.....	10	590.4
.....	.....	20	584 9
.....	.....	30	579.5
.....	.....	40	574.0
.....	.....	50	568.5
.....	.....	60	563.2
.....	.....	70	557.5
.....	.....	80	551.7
.....	.....	90	545.8
.....	.....	100	539.55
.....	.....	110	532.9
.....	.....	120	525.7
.....	.....	130	518.5
.....	.....	140	511.1
.....	.....	150	503.5
.....	.....	160	495.6
.....	.....	170	487.2
.....	.....	180	478.6
o-Xylene	$(CH_3)_2C_6H_4$	141.4	82.9
m-Xylene	$(CH_3)_2C_6H_4$	138.5	81.8
p-Xylene	$(CH_3)_2C_6H_4$	137.1	81.0
Zinc	Zn	907	362.5

HEAT OF COMBUSTION OF VARIOUS SUBSTANCES

In the table below, gaseous products of combustion are to be assumed unless otherwise stated. See special tables for foods, coals, gases, and organic compounds. To convert gram-calories per gram to B.T.U. per pound, multiply the values below by 1800.

Substance	kg.-cal. per gram
Asphalt	9.532
Castor oil	8.850
Cod liver oil	9.40
Cottonseed oil	9.40
Dynamite (75%)	1.29
Graphite	α 7.840; β 7.856
Guncotton	1.0563
Hemoglobin	5.89
Hydrogen (to H_2O, liq.)	34.18
Hydrogen (to H_2O, steam)	29.15
Linseed oil	9.41
Mining powder	0.5088
Paraffin	10.34
Paraffin oil	9.80

Substance	kg.-cal. per gram
Petroleum	10.30 to 10.33
Pitch	8.4
Rape-seed oil	9.45
Sawdust, pressed	4.065
Spermaceti	9.95
Sulfur, monoclinic (to SO_2)	2.241
Sulfur, rhombic (to SO_2)	2.221
Whale oil	9.47
Wood, beech (13% H_2O)	4.168
Wood, birch (11.8% H_2O)	4.207
Wood, oak (13.3% H_2O)	3.990
Wood, pine (12.2% H_2O)	4.422

HEAT OF COMBUSTION OF ORGANIC COMPOUNDS

(Kharasch, *Bu. Stand. Jour. Research*, Vol. 2, p. 359 (1929))

The heat of combustion is expressed in kilogram calories per gram formula weight of the compound as given in the table; the values are based upon a combustion at atmospheric pressure and at 20°C, the final combustion products consisting of liquid water, gaseous carbon dioxide and gaseous nitrogen. To convert to British Thermal Units (B.T.U.) multiply the value in kg-cal. by 3.9685.

Name	Formula	Physical state	Heat of combustion in kg. cal.
Acetaldehyde	CH_3CHO	liq.	279.0
Acetamide	CH_3CONH_2	solid	282.6
Acetanilide	$C_6H_5NHCOCH_3$	solid	1010.4
Acetic acid	CH_3COOH	liq.	209.4
Acetic anhydride	$(CH_3CO)_2O$	liq.	431.9
Acetone	CH_3COCH_3	liq.	426.8
Acetonitrile	CH_3CN	liq.	302.4
Acetophenone	$CH_3COC_6H_5$	solid	988.9
Acetylacetone	$CH_3COCH_2COCH_3$	liq.	615.9
Acetylene	C_2H_2	gas	312.0
Acrolein	$CH_2{:}CHCHO$	liq.	389.6
Acrylic acid	$CH_2{:}CHCOOH$	liq.	327.5
Adipic acid	$HOOC.(CH_2)_4.COOH$	solid	669.0
Alanine	$CH_3CH(NH_2)COOH$	solid	387.7
Aldol	$CH_3CHOHCH_2CHO$	liq.	546.6
Alizarin	$C_{14}H_6O_2(OH)_2$-(1, 2)	solid	1448.9
Allylacetic acid	$C_3H_5.CH_2COOH$	liq.	641.6
Allyl alcohol	$CH_2{:}CHCH_2OH$	liq.	442.4
Allylamine	$CH_2{:}CHCH_2NH_2$	gas	528.1
Allyldiethyl carbinol	$C_3H_5(C_2H_5)_2COH$	liq.	1207
Allyldimethyl carbinol	$C_3H_5(CH_3)_2COH$	liq.	886.5
Allylene	$CH_3C{:}CH$	gas	465.1
p-Aminoazobenzene	$C_6H_5N_2C_6H_4NH_2$	solid	1574.0
p-Aminophenol	$HOC_6H_4NH_2$	solid	760.0
Amygdalin	$C_{20}H_{27}O_{11}N$	solid	2348.4

HEAT OF COMBUSTION OF ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion in kg. cal.
Amylacetate	$C_4H_9COOC_2H_5$	liq.	1042.5
Amyl alcohol (ferm.)	$C_4H_9.CH_2OH$	liq.	793.7
Amylpropargyl alcohol	$C_8H_{13}OH$	liq.	1192
Amylene	C_5H_{10}	liq.	803.4
Anethole	$C_{10}H_{12}O$	solid	1324.4
Angelic acid	$C_4H_7.COOH$	solid	634.8
Aniline	$C_6H_5NH_2$	liq.	811.7
p-Anisidine	$CH_3OC_6H_4NH_2$	solid	924.0
Anisole	$CH_3OC_6H_5$	liq.	905.1
Anthracene	$C_6H_4:(CH)_2:C_6H_4$	solid	1700.4
Anthraquinone	$C_6H_4:(CO)_2:C_6H_4$	solid	1544.5
Arabinose	$C_5H_{10}O_5$	solid	559.9
Arabitol	$C_5H_{12}O_5$	solid	661.2
Arachidic acid	$C_{20}H_{40}O_2$	solid	3025.9
Asparagine	$C_4H_8N_2O_3$	solid	463.3
Atropic acid	$CH_2:C(C_6H_5).COOH$	solid	1044
Azelaic acid	$(CH_2)_7(COOH)_2$	solid	1141.7
Azobenzene	$C_6H_5N:NC_6H_5$	solid	1555.2
Azoxybenzene	$(C_6H_5N)_2O$	solid	1534.5
Behenic acid	$C_{22}H_{44}O_2$	solid	3338.4
Benzalacetone	$CH_3COCH:CHC_6H_5$	solid	1257.4
Benzaldehyde	C_6H_5CHO	liq.	841.3
Benzamide	$C_6H_5CONH_2$	solid	847.6
Benzanilide	$C_6H_5CONHC_6H_5$	solid	1575.5
Benzene	C_6H_6	liq.	782.3
Benzenediazonium nitrate	$C_6H_5N_2NO_3$	solid	782.6
Benzidine	$NH_2C_6H_4.C_6H_4NH_2$	solid	1560.9
Benzil	$C_6H_5CO.COC_6H_5$	solid	1624.6
Benzilic acid	$C_{14}H_{12}O_3$	solid	1618
*Benzoic acid	C_6H_5COOH	solid	771.2
Benzoic anhydride	$(C_6H_5CO)_2O$	solid	1555.1
Benzoin	$C_6H_5COCHOHC_6H_5$	solid	1671.4
Benzonitrile	C_6H_5CN	liq.	865.5
Benzophenone	$C_6H_5COC_6H_5$	solid	1556.5
Benzoyl chloride	C_6H_5COCl	liq.	782.8
Benzoyl peroxide	$(C_6H_5CO)_2O_2$	solid	1551.7
Benzyl alcohol	$C_6H_5CH_2OH$	liq.	894.3
Benzyl amine	$C_6H_5CH_2NH_2$	liq.	969.4
Benzyl carbylamine	$C_6H_5CH_2NC$	liq.	1046.5
Benzyl chloride	$C_6H_5CH_2Cl$	liq.	886.4
Benzyl cyanide	$C_6H_5CH_2CN$	liq.	1023.5
Benzylethylamine	$C_6H_5CH_2NHC_2H_5$	liq.	1290
Bicyclohexane (0, 1, 3)	C_6H_{10}	liq.	912.5
Borneo camphene	$C_{10}H_{16}$	liq.	1470.2
Borneol	$C_{10}H_{18}O$	liq.	1469.6
Brucine	$C_{23}H_{26}O_4N_2$	solid	2933.0
n-Butyl alcohol	C_4H_9OH	liq	638.6
tert.-Butyl alcohol	$(CH_3)_3COH$	liq.	629.3
n-Butylamine	$C_4H_9NH_2$	liq.	710.6
sec.-Butylamine	$(C_2H_5)(CH_3):CHNH_2$	liq.	713.0
tert.-Butylamine	$(CH_3)_3CNH_2$	liq.	716.0
tert.-Butyl benzene	$(CH_3)_3C.C_6H_5$	liq.	1400.4
n-Butyramide	$C_2H_5.CH_2CONH_2$	solid	596.0
n-Butyric acid	$C_2H_5.CH_2COOH$	liq.	524.3
n-Butyronitrile	$C_2H_5.CH_2CN$	liq.	613.3

* Accepted value by International Union of Pure and Applied Chemistry, Lyons, 1923.

HEAT OF COMBUSTION OF ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion in kg. cal.
Caffeine	$C_8H_{10}O_2N_4$	solid	1014.2
Camphene	$C_{10}H_{16}$	solid	1468.8
Camphor	$C_{10}H_{16}O$	solid	1411.0
Cane sugar	$C_{12}H_{22}O_{11}$	solid	1349.6
Capric acid	$C_{10}H_{20}O_2$	solid	1458.1
Caproic acid	$CH_3(CH_2)_4COOH$	liq.	831.0
Carbon disulfide	CS_2	liq.	246.6
Carbon tetrachloride	CCl_4	liq.	37.3
Carbonyl sulfide	COS	gas	130.5
Carvacrol	$C_{10}H_{13}OH$	liq.	1354.5
Cetyl alcohol	$C_{16}H_{33}OH$	solid	2504.5
Cetyl palmitate	$C_{15}H_{31}CO_2C_{16}H_{33}$	solid	4872.8
Chloroacetic acid	$CH_2Cl.COOH$	solid	171.0
o-Chlorobenzoic acid	$ClC_6H_4 \cdot COOH$	solid	734.5
Chloroform	$CHCl_3$	liq.	89.2
Chrysene	$C_{18}H_{12}$	solid	2139.1
Cinnamic acid (*trans*)	$C_6H_5CH:CHCOOH$	solid	1040.2
Cinnamic aldehyde	$C_6H_5CH:CHCHO$	liq.	1112.3
Cinnamic anhydride	$(C_6H_5CH:CHCO)_2O$	solid	2091.3
d-Citrene	$C_{10}H_{16}$	liq.	1473.0
Citric acid (anhydrous)	$H_3C_6H_5O_7$	solid	474.5
Codeine	$C_{18}H_{21}O_3N \cdot H_2O$	solid	2327.6
Coniine	$C_8H_{17}N$	liq.	1275.5
Creatine (anhydrous)	$C_4H_9O_2N_3$	solid	559.8
Creatinine	$C_4H_7ON_3$	solid	563.4
o-Cresol	$CH_3.C_6H_4OH$	solid	879.5
o-Cresol	$CH_3.C_6H_4OH$	liq.	882.6
m-Cresol	$CH_3.C_6H_4OH$	liq.	880.5
p-Cresol	$CH_3.C_6H_4OH$	solid	880.0
p-Cresol	$CH_3.C_6H_4OH$	liq.	882.5
m-Cresol methylether	$CH_3.C_6H_4OCH_3$	liq.	1057.0
Crotonaldehyde	$CH_3.CH:CHCHO$	liq.	542.1
Crotonic acid	$CH_3.CH:CHCOOH$	solid	477.7
Cyanacetic acid	$CH_2(CN).COOH$	solid	298.8
Cyanogen	$(CN)_2$	gas	258.3
Cyclobutyl carbinol	$C_4H_7.CH_2OH$	liq.	748
Cycloheptanol	$CH_2(CH_2)_5CHOH$	liq.	1050.2
Cyclohexanol	$CH_2(CH_2)_4CHOH$	liq.	890.7
Cycloheptene	C_7H_{12}	liq.	1049.9
Cycloheptane	$(CH_2)_7$	liq.	1087.3
Cyclohexane	$(CH_2)_6$	liq.	937.8
Cyclohexene	C_6H_{10}	liq.	891.9
Cyclopentane	$(CH_2)_5$	liq.	783.6
Cyclopropane	$(CH_2)_3$	gas	496.8
Cymene (*p*)	$CH_3.C_6H_4.C_3H_7$	liq.	1402.8
Decahydronaphthalene (*cis*)	$C_{10}H_{18}$	liq.	1502.5
Decahydronaphthalene (*trans*)	$C_{10}H_{18}$	liq.	1499.5
Decane	$C_{10}H_{22}$	liq.	1610.2
Dextrose	$C_6H_{12}O_6$	solid	673.0
Diallyl	$(CH_3CH:CH_2)_2$	vapor	903.4
Diamyl ether	$(C_5H_{11})_2O$	liq.	1609.3
Diamylene	$C_{10}H_{20}$	liq.	1582.2
Dibenzyl	$(C_6H_5CH_2)_2$	solid	1810.6

HEAT OF COMBUSTION OF ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion in kg. cal.
Dibenzylamine	$(C_6H_5CH_2)_2NH$	solid	1853.0
o-Dichlorobenzene	$C_6H_4Cl_2$	liq.	671.8
Diethylacetic acid	$(C_2H_5)_2CH.COOH$	liq.	830.8
Diethylamine	$(C_2H_5)_2NH$	liq.	716.9
Diethyl aniline	$C_6H_5N(C_2H_5)_2$	liq.	1451.6
Diethyl carbonate	$(C_2H_5O)_2CO$	liq.	647.9
Diethyl ether	$(C_2H_5)_2O$	liq.	651.7
Diethyl ketone	$(C_2H_5)_2CO$	liq.	735.6
Diethyl malonate	$CH_2(COOC_2H_5)_2$	liq.	860.4
Diethyl oxalate	$(COOC_2H_5)_2$	liq.	716.0
Diethyl succinate	$(CH_2COOC_2H_5)_2$	liq.	1007.3
Dihydrobenzene	C_6H_8	liq.	847.8
Δ_1-Dihydronaphthalene	$C_{10}H_{10}$	liq.	1296.3
Δ_1-Dihydronaphthalene	$C_{10}H_{10}$	solid	1298.3
Dihydroxyanthraquinone (1, 2)	$(HO)_2C_{14}H_6O_2$	solid	1448.9
Diisoamyl	$(C_5H_{11})_2$	liq.	1615.8
Diisobutylene	$(C_4H_8)_2$	liq.	1252.4
Diisopropyl	$(C_3H_7)_2$	vapor	993.9
Diisopropyl ketone	$(C_3H_7)_2CO$	liq.	1045.5
Dimethylamine	$(CH_3)_2NH$	liq.	416.7
Dimethyl aniline	$C_6H_5N(CH_3)_2$	liq.	1142.7
Dimethyl carbonate	$(CH_3O)_2CO$	liq.	340.8
Dimethyl ether	$(CH_3)_2O$	gas	347.6
Dimethylethyl carbinol	$(CH_3)_2C_2H_5COH$	liq.	784.6
Dimethyl fumarate	$(CHCOOCH_3)_2$	solid	664.3
Dimethyl hexane (2, 5)	C_6H_{18}	liq.	1303.3
Dimethyl hexane (3, 4)	C_6H_{18}	liq.	1303.7
Dimethyl maleate	$(CHCOOCH_3)_2$	solid	669.2
Dimethyl malonic acid	$(CH_3)_2C(COOH)_2$	solid	515.1
Dimethyl oxalate	$(COOCH_3)_2$	solid	401.9
Dimethyl pentane (2, 2)	C_7H_{16}	liq.	1148.9
Dimethyl pentane (2, 3)	C_7H_{16}	liq.	1148.9
Dimethyl pentane (2, 4)	C_7H_{16}	liq.	1148.9
Dimethyl pentane (3, 3)	C_7H_{16}	liq.	1147.9
Dimethyl phthalate	$C_6H_4(COOCH_3)_2$	liq.	1119.7
α, β-Dimethyl styrene	$C_{20}H_{16}$	solid	1357.2
Dimethyl succinate	$(CH_2COOCH_3)_2$	solid	703.3
m-Dinitrobenzene	$C_6H_4(NO_2)_2$	solid	696.8
Dinitrophenol (2, 4)	$(HO)C_6H_3(NO_2)_2$	solid	648.0
Dinitrotoluene (2, 4)	$CH_3.C_6H_3(NO_2)_2$	solid	852.8
Diphenyl	$C_6H_5.C_6H_5$	solid	1493.6
Diphenylamine	$(C_6H_5)_2NH$	solid	1536.2
Diphenyl carbinol	$(C_6H_5)_2CHOH$	solid	1615.4
Diphenyl methane	$(C_6H_5)_2CH_2$	solid	1655.0
Diphenylnitrosamine	$(C_6H_5)_2N.NO$	solid	1532.6
Diphenylstyrene	$C_{20}H_{16}$	solid	2496
Dipropargyl	$(CH{:}C.CH_2)_2$	vapor	882.9
Dipropyl ketone	$(C_3H_7)_2CO$	liq.	1050.5
Dulcitol	$C_6H_{14}O_6$	solid	729.1
Durene (1, 2, 4, 5)	$(CH_3)_4C_6H_2$	solid	1393.6
Eicosane	$C_{20}H_{42}$	solid	3183.1
Erythritol	$C_4H_{10}O_4$	solid	504.1
Ethane	$CH_3.CH_3$	gas	368.4
Ethyl acetate	$CH_3COOC_2H_5$	liq.	536.9
Ethyl acetoacetate	$CH_3COCH_2COOC_2H_5$	liq.	690.8

HEAT OF COMBUSTION OF ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion in kg. cal.
Ethyl alcohol	C_2H_5OH	liq.	327.6
Ethylamine	$C_2H_5NH_2$	liq.	408.5
Ethyl aniline	$C_6H_5NHC_2H_5$	liq.	1121.5
Ethylbenzene	$C_2H_5.C_6H_5$	liq.	1091.2
Ethyl benzoate	$C_6H_5COOC_2H_5$	liq.	1098.7
Ethyl bromide	C_2H_5Br	vapor	340.5
Ethyl *n*-butyrate	$C_2H_5.CH_2COOC_2H_5$	liq.	851.2
Ethyl carbylamine	C_2H_5NC	liq.	477.1
Ethyl chloride	C_2H_5Cl	vapor	316.7
Ethyl cycloheptane	$C_7H_{13}.C_2H_5$	liq.	1406.8
Ethyl formate	$HCOOC_2H_5$	liq.	391.7
Ethyl hexane (3)	$C_3H_7.CH(C_2H_5)_2$	liq.	1302.3
Ethyl iodide	C_2H_5I	liq.	356.0
Ethyl isobutyrate	$(CH_3)_2CH.COOC_2H_5$	liq.	845.7
Ethyl isocyanate	C_2H_5NCO	liq.	424.5
Ethyl mercaptan	C_2H_5SH	gas	452.0
Ethyl mercaptan	C_2H_5SH	liq.	517.2
Ethyl nitrate	$C_2H_5ONO_2$	vapor	322.4
Ethyl nitrite	C_2H_5ONO	vapor	332.6
Ethylpentane (3)	$(C_2H_5)_3CH$	liq.	1149.9
Ethyl propionate	$C_2H_5COOC_2H_5$	liq.	690.8
Ethyl salicylate	$HOC_6H_4COOC_2H_5$	liq.	1051.2
Ethylsuccinic anhydride	$C_6H_8O_3$	liq.	684.8
Ethyl thiocyanate	C_2H_5CNS	liq.	613.8
Ethylurea	$C_2H_5NHCONH_2$	solid	472
Ethyl valerate	$C_4H_9COOC_2H_5$	liq.	1017.5
Ethylene	C_2H_4	gas	331.6
Ethylene chloride	$ClCH_2.CH_2Cl$	vapor	271.0
Ethylene diamine	$(CH_2NH_2)_2$	liq.	452.6
Ethylene glycol	$HOCH_2.CH_2OH$	liq.	281.9
Ethylene iodide	$ICH_2.CH_2I$	solid	324.8
Ethylene oxide	$O.CH_2.CH_2$	liq.	302.1
Ethylidene chloride	$CH_3.CHCl_2$	liq.	267.1
Eugenol	$C_{10}H_{12}O_2$	liq.	1286.6
Fenchane	$C_{10}H_{18}$	liq.	1502.6
Fluorene	$CH_2:(C_6H_4)_2$	solid	1584.9
Fluorobenzene	C_6H_5F	liq.	747.2
Formaldehyde	CH_2O	gas	134.1
Formamide	$HCONH_2$	solid	134.9
Formanilide	$HCONHC_6H_5$	solid	861.0
Formic acid	HCOOH	liq.	62.8
l-Fructose	$C_6H_{12}O_6$	solid	675.6
Fucose	$C_6H_{12}O_5$	solid	712.0
Fumaric acid (*trans*)	$(CHCOOH)_2$	solid	320.0
Furfural	$C_4H_3O.CHO$	liq.	559.5
Galactose	$C_6H_{12}O_6$	solid	670.7
Gallic acid	$(HO)_3C_6H_2COOH$	solid	633.7
Geranic acid	$C_{10}H_{16}O_2$	liq.	1379
l-Glucosan	$C_6H_{10}O_5$	solid	678
d-Glucose	$C_6H_{12}O_6$	solid	673.0
Glutamic acid	$C_5H_9O_4N$	solid	542.4
Glutaric acid	$(CH_2)_3(COOH)_2$	solid	514.9
Glutaric anhydride	$C_5H_6O_3$	solid	528.0
Glycerol	$C_3H_5(OH)_3$	liq.	397.0

HEAT OF COMBUSTION OF ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion in kg. cal.
Glyceryl tributyrate	$C_{15}H_{26}O_6$	liq.	1941.1
Glycine	$H_2N.CH_2COOH$	solid	234.5
Glycogen	$1/x(C_6H_{10}O_5)_x$	solid	4186.8
Glycol	$(CH_2OH)_2$	liq.	281.9
Glycolic acid	$HOCH_2COOH$	solid	166.6
Glycolic nitrile	$HOCH_2CN$	liq.	256.7
Glycylglycine	$C_4H_8O_3N_2$	solid	470.7
Guanine	$C_5H_5ON_5$	solid	586
n-Heptaldehyde	$C_6H_{13}CHO$	liq.	1062.4
n-Heptane	C_7H_{16}	liq.	1149.9
Heptine (1)	$CH:C(CH_2)_4CH_3$	liq.	1091.2
n-Heptyl alcohol	$C_6H_{13}CH_2OH$	liq.	1104.9
Heptylamine	$C_7H_{15}NH_2$	liq.	1178.9
Heptylic acid	$C_6H_{13}COOH$	liq.	986.1
n-Hexane	C_6H_{14}	liq.	989.8
Hexachlorobenzene	C_6Cl_6	solid	509.0
Hexachloroethane	C_2Cl_6	solid	110.0
Hexadecane	$C_{16}H_{34}$	solid	2559.1
Hexahydrobenzoic acid	$C_6H_{11}COOH$	liq.	934
Hexahydronaphthalene	$C_{10}H_{14}$	liq.	1419.3
Hexamethylbenzene	$C_6(CH_3)_6$	solid	1711.9
Hexamethylenetetramine	$(CH_2)_6N_4$	solid	1006.7
Hexamethylethane	$(CH_3)_3C.C(CH_3)_3$	solid	1301.8
Hexylamine	$C_6H_{13}NH_2$	liq.	1022.2
Hexylene	C_6H_{12}	liq.	952.6
Hippuric acid	$C_6H_5CONHCH_2COOH$	solid	1012.4
Hydantoic acid	$C_3H_6O_3N_2$	solid	308.6
Hydrazobenzene	$C_6H_5NH.NHC_6H_5$	solid	1597.3
Hydrobenzoin	$C_{14}H_{14}O_2$	solid	1723
α, β-Hydromuconic acid	$C_6H_8O_4$	solid	628.8
Hydrosorbic acid	$C_6H_{10}O_2$	liq.	795
Hydroquinol	$C_6H_4(OH)_2$ (1, 4)	solid	683.7
Hydroquinoldimethyl ether	$C_6H_4(OCH_3)_2$	solid	1014.7
p-Hydroxyazobenzene	$C_6H_5N_2C_6H_4OH$	solid	1502.0
o-Hydroxybenzaldehyde	$(HO)C_6H_4.CHO$	liq.	796.0
m-Hydroxybenzaldehyde	$(HO)C_6H_4.CHO$	solid	788.7
p-Hydroxybenzaldehyde	$(HO)C_6H_4.CHO$	solid	792.7
m-Hydroxybenzoic acid	$(HO)C_6H_4.COOH$	solid	726.1
p-Hydroxybenzoic acid	$(HO)C_6H_4.COOH$	solid	725.4
β-Hydroxybutyraldehyde	$CH_3CHOHCH_2CHO$	liq.	546.6
Indigo	$C_{16}H_{10}O_2N_2$	solid	1815.0
Indole	C_8H_7N	solid	1022.2
Inositol	$C_6H_6(OH)_6$	solid	662.1
Iodoform	CHI_3	solid	161.9
Isatin	$C_8H_5O_2N$	solid	868
Isoamylamine	$C_5H_{11}NH_2$	liq.	866.8
Isobutane	$(CH_3)_3CH$	gas	683.4
Isobutyl alcohol	$C_3H_7.CH_2OH$	liq.	638.2
Isobutylamine	$C_3H_7.CH_2NH_2$	liq.	713.6
Isobutyl chloride	$C_3H_7.CH_2Cl$	solid	635.5
Isobutylene	$CH_2:C(CH_3)_2$	gas	647.2
Isobutyraldehyde	$(CH_3)_2CH.CHO$	vapor	596.8
Isobutyramide	$(CH_3)_2CHCONH_2$	solid	595.9
Isobutyric acid	$(CH_3)_2CH.COOH$	liq.	517.4
Isoeugenol	$C_{10}H_{12}O_2$	liq.	1277.6

HEAT OF COMBUSTION OF ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion in kg. cal.
Isopentane	C_5H_{12}	gas	843.5(?)
Isopentane	C_5H_{12}	liq.	838.3(?)
Isophthalic acid	$C_6H_4(COOH)_2$ (1, 3)	solid	768.3
Isopropyl alcohol	$(CH_3)_2CHOH$	liq.	474.8
Isopropylbenzene	$C_6H_5.CH(CH_3)_2$	liq.	1247.3
Isopropyl iodide	$(CH_3)_2CHI$	liq.	509.1
Isopropyltoluene	$CH_3.C_6H_4.CH(CH_3)_2$ (1, 3)	liq.	1409.5
Isopropyltoluene	$CH_3.C_6H_4.CH(CH_3)_2$ (1, 4)	liq.	1402.8
Isosafrole	$C_{10}H_{10}O_2$	liq.	1233.9
Isostilbene	$C_{14}H_{12}$	liq.	1770.9
Lactic acid	$CH_3CHOH.COOH$	liq.	326.0
Lactose (anhydrous)	$C_{12}H_{22}O_{11}$	solid	1350.8
Lactose octoacetate	$C_{28}H_{38}O_{19}$	solid	3029.3
Lauric acid	$C_{12}H_{24}O_2$	solid	1771.7
Laurolene	C_8H_{14}	liq.	1192.7
Leucine	$C_6H_{13}O_2N$	solid	855.6
d-Limonene	$C_{10}H_{16}$	liq.	1471.2
l-Limonene	$C_{10}H_{16}$	liq.	1457.2
Maleic acid (*cis*)	$(CHCOOH)_2$	solid	326.1
Maleic anhydride	$(CHCO)_2O$	solid	333.9
l-Malic acid	$C_2H_3OH:(COOH)_2$	solid	320.1
Malonamide	$CH_2(CONH_2)_2$	solid	359
Malonic acid	$CH_2(COOH)_2$	solid	207.2
Malononitrile	$CH_2(CN)_2$	solid	394.8
Maltose	$C_{12}H_{22}O_{11}$	solid	1350.2
Mandelic acid	$C_6H_5CHOHCOOH$	solid	890.3
d-Mannitol	$C_6H_{14}O_6$	solid	727.6
Menthene	$C_{10}H_{18}$	liq.	1523.2
Menthol	$C_{10}H_{20}O$	solid	1508.8
Mesitylene	$C_6H_3(CH_3)_3$ (1, 3, 5)	liq.	1243.6
Mesityl oxide	$CH_3COCH:C(CH_3)_2$	liq.	846.7
Mesotartaric acid	$(CHOH)_2(COOH)_2$	solid	276.0
Methane	CH_4	gas	210.8
Methyl acetate	CH_3COOCH_3	liq.	381.2
Methylal	$C_3H_8O_2$	liq.	462.8
Methyl alcohol	CH_3OH	liq.	170.9
Methylamine	CH_3NH_2	liq.	256.1
Methyl aniline	$C_6H_5NHCH_3$	liq.	973.5
Methyl benzoate	$C_6H_5COOCH_3$	liq.	943.5
Methyl bromide	CH_3Br	vapor	184.0
Methylbutyl ketone	$CH_3COC_4H_9$	liq.	895.2
Methyl *tert*-butyl ketone	$CH_3COC(CH_3)_3$	solid	891.8
Methyl butyrate	$C_3H_7COOCH_3$	liq.	692.8
Methyl carbylamine	CH_3NC	liq.	320.1
Methyl chloride	CH_3Cl	gas	164.2
Methyl cinnamate	$C_6H_5CH:CHCOOCH_3$	solid	1213.0
Methylcyclobutane	$CH_3CHCH_2CH_2CH_2$	liq.	784.2
Methylcycloheptane	$C_7H_{13}.CH_3$	liq.	1244.5
Methylcyclohexane	$C_6H_{11}.CH_3$	liq.	1091.8
Methylcyclopentane	$CH_3CHCH_2CH_2CH_2CH_2$	liq.	937.9
Methyldiethyl carbinol	$(CH_3)(C_2H_5)_2COH$	liq.	927.0
Methylene chloride	CH_2Cl_2	vapor	106.8
Methylene iodide	CH_2I_2	liq.	178.4

HEAT OF COMBUSTION OF ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion in kg. cal.
Methylethyl ether	$CH_3OC_2H_5$	vapor	503.4
Methylethyl ketone	$CH_3COC_2H_5$	liq.	582.3
Methyl formate	$HCOOCH_3$	liq.	233.1
Methylheptane (2)	$CH_3.C_7H_{18}$	liq.	1306.1
Methylhexane (2)	$CH_3.C_6H_{13}$	liq.	1148.9
Methylhexane (3)	$CH_3.C_6H_{13}$	liq.	1148.9
Methylhexyl ketone	$CH_3COC_6H_{13}$	liq.	1205.1
Methyl iodide	CH_3I	liq.	194.7
Methyl isobutyrate	$(CH_3)_2CHCOOCH_3$	liq.	694.2
Methyl isocyanate	CH_3NCO	liq.	269.4
Methylisopropyl ketone	$CH_3COCH(CH_3)_2$	liq.	733.9
Methyl lactate	$CH_3CHOHCOOCH_3$	liq.	497.2
Methyl mercaptan	CH_3SH	gas	297.6
Methyl propionate	$C_2H_5COOCH_3$	vapor	552.3
Methylpropyl ketone	$CH_3COC_3H_7$	liq.	735.6
Methyl salicylate	$HOC_6H_4COOCH_3$	liq.	898.3
Milk sugar	$C_{12}H_{22}O_{11}$	solid	1350.8
Methyl tetryl	$C_8H_7O_8N_5$	solid	1009
Methyl thiocyanate	CH_3CNS	liq.	453.1
Morphine	$C_{17}H_{19}O_3N.H_2O$	solid	2146.3
Mucic acid	$C_6H_{10}O_8$	solid	483.6
Myristic acid	$C_{14}H_{28}O_2$	solid	2085.8
Naphthalene	$C_{10}H_8$	solid	1232.5
Naphthalic acid	$C_{10}H_6(COOH)_2$	solid	1244
α-Naphthoic acid	$C_{10}H_7COOH$	solid	1231.8
β-Naphthoic acid	$C_{10}H_7COOH$	solid	1227.6
α-Naphthol	$C_{10}H_7OH$	solid	1185.4
β-Naphthol	$C_{10}H_7OH$	solid	1187.2
α-Naphthonitrile	$C_{10}H_7CN$	solid	1326.2
β-Naphthonitrile	$C_{10}H_7CN$	solid	1321.0
α-Naphthoquinone	$C_{10}H_6O_2$	solid	1100.8
β-Naphthoquinone	$C_{10}H_6O_2$	solid	1106.4
α-Naphthylamine	$C_{10}H_7NH_2$	solid	1263.5
β-Naphthylamine	$C_{10}H_7NH_2$	solid	1261.0
Narceine	$C_{23}H_{27}O_8N.2H_2O$	solid	2802.9
Narcotine	$C_{22}H_{23}O_7N$	solid	2644.5
Nicotine	$C_{10}H_{14}N_2$	liq.	1427.7
m-Nitroacetanilide	$NO_2.C_6H_4NHCOCH_3$	solid	970
o-Nitroaniline	$NO_2.C_6H_4NH_2$	solid	765.8
p-Nitroaniline	$NO_2.C_6H_4NH_2$	solid	761.0
m-Nitroaniline	$NO_2.C_6H_4NH_2$	solid	765.2
m-Nitrobenzaldehyde	$NO_2.C_6H_4CHO$	solid	800.4
Nitrobenzene	$C_6H_5NO_2$	liq.	739.2
m-Nitrobenzoic acid	$NO_2.C_6H_4COOH$	solid	729.1
Nitroethane	$CH_3.CH_2NO_2$	liq.	322.2
Nitroglycerine	$C_3H_5(NO_3)_3$	liq.	432.4
Nitromethane	CH_3NO_2	liq.	169.4
p-Nitromethylaniline	$NO_2.C_6H_4NHCH_3$	solid	924
p-Nitrophenetole	$NO_2.C_6H_4OC_2H_5$	liq.	1006
o-Nitrophenol	$NO_2.C_6H_4OH$	solid	689.1
m-Nitrophenol	$NO_2.C_6H_4OH$	solid	684.4
p-Nitrophenol	$NO_2.C_6H_4OH$	solid	688.8
Nitropropane	$C_2H_5.CH_2NO_2$	liq.	477.9
o-Nitrotoluene	$NO_2.C_6H_4CH_3$	liq.	897.0
p-Nitrotoluene	$NO_2C_6H_4CH_3$	solid	888.6

HEAT OF COMBUSTION OF ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion in kg. cal.
Octahydronaphthalene	$C_{10}H_{16}$	liq.	1461.7
n-Octane	C_8H_{18}	liq.	1302.7
Octyl alcohol	$C_8H_{17}OH$	liq.	1262.0
Oleic acid	$C_{17}H_{33}COOH$	liq.	2657.0
Opianic acid	$C_{10}H_{10}O_5$	solid	1090
Oxamic acid	$H_2NCO.COOH$	solid	130
Oxalic acid	$(COOH)_2$	solid	60.2
Oxamide	$(CONH_2)_2$	solid	203.2
Palmitic acid	$C_{15}H_{31}COOH$	solid	2398.4
Papaverine	$C_{20}H_{21}O_4N$	solid	2478.1
Paraformaldehyde	$1/n(CH_2O)n$	solid	122
Pentamethylbenzene	$(CH_3)_5C_6H$	solid	1554.0
n-Pentane	C_5H_{12}	gas	838.3
n-Pentane	C_5H_{12}	liq.	833.4
Phenacetin	$C_2H_5OC_6H_4NHCOCH_3$	solid	1285.2
Phenanthraquinone	$C_{14}H_8O_2$	solid	1544.0
Phenanthrene	$C_{14}H_{10}$	solid	1692.5
Phenetole	$C_2H_5OC_6H_5$	liq.	1060.3
Phenol	C_6H_5OH	solid	732.2
Phenylacetic acid	$C_6H_5CH_2COOH$	solid	930.2
Phenylacetylene	$C_6H_5C{:}CH$	liq.	1024.2
Phenylalanine	$C_9H_{11}O_2N$	solid	1111.3
Phenylbutene	$C_6H_5CH_2CH{:}CHCH_3$	liq.	1361.2
p-Phenylenediamine	$C_6H_4(NH_2)_2$	solid	843.4
Phenylglycine	$C_6H_5NHCH_2COOH$	solid	955.1
Phenylhydrazine	$C_6H_5NH.NH_2$	solid	875.4
Phenylhydroxylamine	C_6H_5NHOH	liq.	803.7
Phenyl iodide	C_6H_5I	liq.	770.7
Phloroglucinol	$C_6H_3(OH)_3$	solid	635.7
Phthalic acid	$C_6H_4(COOH)_2$	solid	771.0
Phthalide	$C_8H_6O_2$	solid	884
Phthalic anhydride	$C_6H_4(CO)_2O$	solid	783.4
Phthalimide	$C_8H_5O_2N$	solid	849.5
Picric acid	$HOC_6H_2(NO_2)_3$ (1, 2, 4, 6)	solid	611.8
Pinacol	$C_6H_{14}O_2$	solid	897.6
Pinacoline	$(CH_3)_3CCOCH_3$	solid	891.8
Piperidine	$C_5H_{11}N$	liq.	826.6
Piperonal	$C_8H_6O_3$	solid	870.7
Piperonylic acid	$C_8H_6O_4$	solid	803.5
Propane	C_3H_8	gas	526.3
Propine	$HC{:}CCH_3$	gas	465.1
Propionaldehyde	C_2H_5CHO	liq.	434.2
Propionamide	$C_2H_5CONH_2$	solid	439.9
Propionic acid	C_2H_5COOH	liq.	367.2
Propionic anhydride	$(C_2H_5CO)_2O$	liq.	746.6
Propionitrile	C_2H_5CN	liq.	456.4
n-Propyl alcohol	$C_2H_5CH_2OH$	liq.	480.5
Propylamine	$C_3H_7NH_2$	liq.	558.3
n-Propylbenzene	$C_6H_5.C_3H_7$	liq.	1246.4
Propyl bromide	C_3H_7Br	vapor	497.3
Propyl carbylamine	C_3H_7NC	liq.	639.6
Propyl chloride	C_3H_7Cl	vapor	478.3
Propylene	$CH_2{:}CHCH_3$	gas	490.2
Propylene glycol	$CH_3CHOHCH_2OH$	liq.	431.0
n-Propyl iodide	C_3H_7I	liq.	514.3

HEAT OF COMBUSTION OF ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion in kg. cal.
o-Propyltoluene (1, 3)	$CH_3.C_6H_4.C_3H_7$	liq.	1405.4
Pseudocumene (1, 2, 4)	$(CH_3)_3C_6H_3$	liq.	1241.7
Pyridine	C_5H_5N	liq.	658.5
Pyrocatechol (1, 2)	$C_6H_4(OH)_2$	solid	684.8
Pyrogallol (1, 2, 3)	$C_6H_3(OH)_3$	solid	638.7
Pyromellitic acid	$C_{10}H_6O_8$	solid	776.8
Pyrrole	C_4H_5N	liq.	567.7
Quercitol	$C_6H_7(OH)_5$	solid	704.2
Quinoline	C_9H_7N	liq.	1123.5
Quinone	$O:C_6H_4:O$	solid	656.6
Raffinose	$C_{18}H_{32}O_6$	solid	2025.5
Retene	$C_{18}H_{18}$	solid	2306.8
Resorcinol (1, 3)	$C_6H_4(OH)_2$	solid	683.0
Resorcinol dimethylether	$C_6H_4(OCH_3)_2$	liq.	1022.6
Rhamnose	$C_6H_{12}O_5$	solid	718.3
Rhamnose triacetate	$C_{12}H_{18}O_8$	solid	1351
Saccharic acid lactone	$C_6H_{10}O_5$	solid	656.6
Safrole	$C_{10}H_{10}O_2$	liq.	1244.1
Salicylaldehyde	HOC_6H_4CHO	liq.	796.0
*Salicylic acid	HOC_6H_4COOH	solid	723.1
Sarcosine	CH_3NHCH_2COOH	solid	401.1
Sebacic acid	$HOOC.(CH_2)_8COOH$	solid	1297.3
Skatole	$CH_3.C_8H_6N$	liq.	1170.5
d-Sorbose	$C_6H_{12}O_6$	solid	668.3
Starch	$1/x(C_6H_{10}O_5)_x$	solid	4178.8
Stearic acid	$C_{17}H_{35}COOH$	solid	2711.8
Stearolic acid	$C_{18}H_{32}O_2$	solid	2629
Stilbene	$C_{14}H_{12}$	solid	1765
Strychnine	$C_{21}H_{22}O_2N_2$	solid	2685.7
Styrene	$C_6H_5CH:CHC_6H_5$	liq.	1047.1
Suberic acid	$HOOC.(CH_2)_6COOH$	solid	985.2
Succinamide	$(CH_2CONH_2)_2$	solid	509.2
Succinic acid	$(CH_2COOH)_2$	solid	357.1
Succinic acid nitrile	$(CH_2CN)_2$	liq.	545.7
Succinic anhydride	$(CH_2CO)_2O$	solid	369.6
Succinimide	$(CH_2CO)_2NH$	solid	437.9
Sucrose	$C_{12}H_{22}O_{11}$	solid	1349.6
Sylvestrene	$C_{10}H_{16}$	liq.	1464.7
d-Tartaric acid	$(CHOH)_2(COOH)_2$	solid	275.1
dl-Tartaric acid (anhydrous)	$(CHOH)_2(COOH)_2$	solid	278.4
Taurine	$C_2H_7O_3NS$	solid	382.9
Terephthalic acid (1, 4)	$C_6H_4(COOH)_2$	solid	770.4
Terpin hydrate	$C_{10}H_{22}O_2$	solid	1451.0
Terpineol	$C_{10}H_{18}O_2$	solid	1469.5
Tetrachloroquinone	$O:C_6Cl_4:O$	solid	517.7
Tetrahydrobenzene	C_6H_{10}	liq.	891.9
Tetrahydronaphthalene	$C_{10}H_{12}$	liq.	1352.4
Tetrahydroquinaldine	$C_{10}H_{13}N$	liq.	1382
Tetramethylmethane	$(CH_3)_4C$	gas	842.6
Tetrolic acid	$C_4H_4O_2$	solid	452.4
Tetryl	$C_7H_5N_5O_8$	solid	842.3
Thebaine	$C_{19}H_{21}O_3N$	solid	2441.3
Thialdine	$C_6H_{13}NS_2$	solid	1264
Thiophene	C_4H_4S	liq.	670.5
Thiourea	$CS(NH_2)_2$	solid	342.8

*Recommended as a secondary thermochemical standard.

HEAT OF COMBUSTION OF ORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of combustion in kg. cal.
Thujane	$C_{10}H_{18}$	liq.	1506.4
Thymol	$C_{10}H_{14}O$	liq.	1353.4
Thymol	$C_{10}H_{14}O$	solid	1349.7
Thymoquinone	$C_{10}H_{12}O_2$	solid	1271.3
Toluene	$C_6H_5.CH_3$	liq.	934.2
o-Toluic acid	$CH_3.C_6H_4.COOH$	solid	928.9
m-Toluic acid	$CH_3.C_6H_4.COOH$	solid	928.6
p-Toluic acid	$CH_3.C_6H_4.COOH$	solid	926.9
o-Toluidine	$CH_3.C_6H_4.NH_2$	liq.	964.3
m-Toluidine	$CH_3.C_6H_4.NH_2$	liq.	965.3
p-Toluidine	$CH_3.C_6H_4.NH_2$	solid	958.4
o-Tolunitrile	$CH_3.C_6H_4CN$	liq.	1030.3
Toluquinone	$C_7H_6O_2$	solid	803.2
Triaminotriphenyl carbinol	$(H_2NC_6H_4)_3COH$	solid	2483.5
Tribenzylamine	$(C_6H_5CH_2)_3N$	solid	2762.1
Trichloroacetic acid	$Cl_3C.COOH$	solid	92.8
Triethylamine	$(C_2H_5)_3N$	liq.	1036.8
Triethyl carbinol	$(C_2H_5)_3COH$	liq.	1080.0
Triisoamylamine	$(C_5H_{11})_3N$	liq.	2459.3
Triisobutylamine	$(C_4H_9)_3N$	liq.	1973.6
Trimesic acid	$C_9H_6O_6$	solid	767
Trimethylamine	$(CH_3)_3N$	liq.	578.6
Trimethylbutane (2, 2, 3)	$(CH_3)_3C_4H_7$	liq.	1147.9
Trimethyl carbinol	$(CH_3)_3COH$	liq.	629.3
Trimethylene	$CH_2CH_2CH_2$ (ring)	gas	496.8
Trimethylene nitrile	C_4H_5N	liq.	581
Trimethylethylene	$(CH_3)_2C{:}CH.CH_3$	liq.	796.0
Trimethylethylene	$(CH_3)_2C{:}CH.CH_3$	vapor	803.6
Trimethylpentane (2, 2, 4)	$(CH_3)_3C_5H_9$	liq.	1303.9
Trimethyl succinic acid	$C_7H_{12}O_4$	solid	829.9
Trinitrobenzene (1, 3, 5)	$C_6H_3(NO_2)_3$	solid	663.7
Trinitroglycerol	$C_3H_5(NO_3)_3$	liq.	432.4
Trinitrotoluene (1, 2, 4, 6)	$CH_3.C_6H_2(NO_2)_3$	solid	820.7
Triphenylamine	$(C_6H_5)_3N$	solid	2267.8
Triphenylbenzene (1, 3, 5)	$(C_6H_5)_3C_6H_3$	solid	2936.7
Triphenyl carbinol	$(C_6H_5)_3COH$	solid	2340.8
Triphenylmethane	$(C_6H_5)_3CH$	solid	2388.7
Triphenyl methyl	$(C_6H_5)_3C$	solid	2378.5
Tyrosine	$C_9H_{11}O_3N$	solid	1070.2
Undecolic acid	$C_{11}H_{18}O_2$	solid	1538
Undecylenic acid	$C_{11}H_{20}O_2$	solid	1580
Undecylic acid	$C_{11}H_{22}O_2$	solid	1615.9
Urea	$CO(NH_2)_2$	solid	128.6
Urethane	$NH_2COOC_2H_5$	solid	397.2
Uric acid	$C_5H_4O_3N_4$	solid	460.2
Uvitic acid	$C_9H_8O_4$	solid	928.3
n-Valeric acid	C_4H_9COOH	liq.	681.6
Vanillin (1, 2, 4)	$HOC_6H_3(OCH_3).CHO$	solid	914.1
Veronal	$C_8H_{12}N_2O_3$	solid	983
o-Xylene	$C_6H_4(CH_3)_2$	liq.	1091.7
m-Xylene	$C_6H_4(CH_3)_2$	liq.	1088.4
p-Xylene	$C_6H_4(CH_3)_2$	liq.	1089.1
Xylose	$C_5H_{10}O_5$	solid	561.5

HEAT OF FORMATION OF ORGANIC COMPOUNDS

The heat of formation of an organic compound can be calculated since this value is equal to the sum of the heats of formation of the products of combustion less the heat of combustion (see table: Heat of Combustion of Organic Compounds) of the compound. A positive value indicates an evolution of heat during formation.

The heat of formation of the usual products of combustion of an organic compound are:

Free elements		0 kg-cal.
CO_2	(gas)	94.38 kg-cal.
$\frac{1}{2}H_2O$	(liquid; from one atom of hydrogen)	34.19 kg-cal.
SO_2	(gas)	69.3 kg-cal.
H_2SO_4	(in dilute aqueous solution)	207.5 kg-cal.
HBr	(in dilute aqueous solution)	28.54 kg-cal.
HCl	(in dilute aqueous solution)	39.46 kg-cal.
HF	(in dilute aqueous solution)	75.6 kg-cal.
HNO_3	(in dilute aqueous solution)	49.80 kg-cal.

EXAMPLES

Thus, to calculate the heat of formation of acetaldehyde and where the combustion is represented by the following equation:

$CH_3CHO + 2\frac{1}{2}O_2 = 2CO_2 + 2H_2O$

Heat of combustion of acetaldehyde . . 279.0
Heat of formation of CO_2 . . . . . 94.38
Heat of formation of $\frac{1}{2}H_2O$ 34.19

then, the heat of formation of acetaldehyde = $2(94.38) + 4(34.19) - 279 = +46.52$ kg-cal. for 44 grams (the gram formula weight) of acetaldehyde.

To calculate the heat of formation of acetylene from its heat of combustion where the combustion is represented by the equation:

$C_2H_2 + 2\frac{1}{2}O_2 = 2CO_2 + H_2O$

Heat of combustion of acetylene 312.0
Heat of formation of CO_2 . . . . . 94.38
Heat of formation of $\frac{1}{2}H_2O$ 34.19

then, the heat of formation of acetylene = $2(94.38) + 2(34.19) - 312 = -54.86$ kg-cal. for 26 grams (the gram formula weight) of acetylene.

To calculate the heat of formation of methylamine from the heat of combustion of methylamine when the combustion is represented by the equation:

$CH_3NH_2 + 4\frac{1}{2}O = CO_2 + 2\frac{1}{2}H_2O + \frac{1}{2}N_2$

Heat of combustion of methylamine . . . 256.1
Heat of formation of CO_2 . . . . . 94.38
Heat of formation of $\frac{1}{2}H_2O$ 34.19

then, the heat of formation of methylamine = $94.38 + 5(34.19) + 0(\text{nitrogen}) - 256.1 = +9.23$ kg-cal. for 31 grams (the gram formula weight) of methylamine.

HEATS OF FORMATION OF INORGANIC COMPOUNDS

This table gives the heat of formation expressed in kilogram-calories per gram formula weight; to convert to British Thermal Units (B.T.U.) multiply the value in kg-cal. by 3.9685. A positive value in the table indicates an evolution of heat during formation.

Name	Formula	Physical state	Heat of formation in kg.-calories
Aluminum bromide	Al, Br_3	solid	126.7
Aluminum carbide	Al_4, C_3	solid	60.
Aluminum chloride	Al, Cl_3	solid	166.8
Aluminum chloride	Al, Cl_3	dil. sol.	238.1
Aluminum fluoride	Al, F_3	dil. sol.	360.1
Aluminum hydroxide	Al, O_3, H_3	solid	304.9
Aluminum hydroxide	$Al_2O_3 \cdot 3H_2O$	solid	388.92
Aluminum iodide	Al, I_3	solid	77.2
Aluminum nitride	Al, N	solid	80.0
Aluminum oxide	Al_2, O_3	solid	380.0
Aluminum silicate	Al_2, Si_2, O_7	solid	767.5
Aluminum silicate	Al_2, Si_2, O_9, H_4	solid	927.42
Aluminum sulfate	Al_2, S_3, O_{12}	dil. sol.	879.7
Aluminum sulfide	Al_2, S_3	solid	344.8
Ammonia	N, H_3	gas	11.0
Ammonia	N, H_3	liq.	16.07
Ammonium acetate	N, H_7, C_2, O_2	solid	150.25
Ammonium acid carbonate	N, H_5, C, O_3	solid	208.6
Ammonium acid sulfate	N, H_5, S, O_4	solid	244.6
Ammonium acid sulfate	N, H_5, S, O_4	dil. sol.	245.1
Ammonium acid sulfide	N, H_5, S	solid	40.0
Ammonium acid sulfide	NH_3, H_2S	solid	22.4
Ammonium bromide	N, H_4, Br	solid	64.58
Ammonium bromide	NH_3, HBr	solid	45.0

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Ammonium carbonate	N_2, H_8, C, O_3	dil. sol.	221.6
Ammonium chloride	N, H_4, Cl	solid	74.95
Ammonium chloride	N, H_4, Cl	dil. sol.	71.0
Ammonium chloride	NH_3, HCl	solid	41.9
Ammonium cyanate	N_2, H_4, C, O	dil. sol.	68.9
Ammonium cyanide	N_2, H_4, C	solid	0.956
Ammonium cyanide	NH_3, HCN	solid	20.6
Ammonium fluoride	N, H_4, F	solid	111.6
Ammonium fluoride	N, H_4, F	dil. sol.	110.1
Ammonium fluoride	NH_3, HF	solid	37.3
Ammonium fluosilicate	N_2, H_8, Si, F_6	solid	621.6
Ammonium hydroxide	N, H_5, O	solid	88.8
Ammonium hydroxide	N, H_5, O	dil. sol.	90.0
Ammonium iodide	N, H_4, I	solid	48.39
Ammonium iodide	NH_3, HI	solid	43.5
Ammonium nitrate	N_2, H_4, O_3	solid	87.13
Ammonium nitrate	NH_3, HNO_3	.....	34.8
Ammonium nitrite	N_2, H_4, O_2	solid	61.5
Ammonium oxalate	N_2, H_8, C_2O_4	solid	270.1
Ammonium persulfate	N_2, H_8, S_2, O_8	solid	395.4
Ammonium phosphate	N_3, H_{12}, P, O_4	dil. sol.	397.5
Ammonium phosphate (di-basic)	N_2, H_9, P, O_4	dil. sol.	360.
Ammonium phosphate (mono-basic)	N, H_6, P, O_4	dil. sol.	338.9
Ammonium sulfate	N_2, H_8, S, O_4	solid	281.46
Ammonium sulfate	N_2, H_8, S, O_4	dil. sol.	281.1
Ammonium sulfide	N_2, H_8, S	solid	66.2
Ammonium sulfite	N_2, H_8, S, O_3	solid	213.3
Ammonium thiocyanate	N_2, H_4, C, S	solid	20.7
Antimony acid (ic)	$3H_2O$, Sb_2, O_5	solid	228.78
Antimony acid (ous)	$3H_2O$, Sb_2, O_3	solid	167.42
Antimony bromide	Sb, Br_3	solid	60.0
Antimony chloride (tri)	Sb, Cl_3	liq.	88.4
Antimony chloride (penta)	Sb, Cl_5	liq.	104.87
Antimony fluoride	Sb, F_3	solid	216.5
Antimony fluoride	Sb, F_3	dil. sol.	214.8
Antimony hydride (stibine)	Sb, H_3	g.const.vol.	−34.27
Antimony hydride (stibine)	Sb, H_3	g.const.press	−33.96
Antimony iodide	Sb, I_3	solid	+22.8
Antimony oxide (tri)	Sb_2, O_3	solid	166.9
Antimony oxide (penta)	Sb_2, O_5	solid	230.83
Antimony oxychloride	Sb_2, O_2, Cl_2	solid	179.6
Antimony sulfide	Sb_2, S_3	solid	34.4
Arsenic acid	H_3, As, O_4	solid	215.0
Arsenic bromide	As, Br_3	gas	33.
Arsenic bromide	As, Br_3	liq.	43.50
Arsenic chloride	As, Cl_3	gas	64.0
Arsenic chloride	As, Cl_3	liq.	71.5
Arsenic hydride (arsine)	As, H_3	gas	−43.50
Arsenic iodide	As, I_3	solid	13.6
Arsenic oxide (tri)	As_2, O_3	solid	154.67
Arsenic oxide (tri)	As_2, O_3	dil. sol.	146.6
Arsenic oxide (penta)	As_2, O_5	solid	217.90
Arsenic oxide (penta)	As_2, O_5	dil. sol.	223.90
Auric-see Gold			
Barium acetate	Ba, C_4, H_6, O_4	solid	358.5

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Barium arsenate	Ba_3, As_2, O_8	precip.	817.7
Barium bromide	Ba, Br_2	solid	180.4
Barium carbonate	Ba, C, O_3	amorph.	282.5
Barium carbonate	Ba, C, O_3	cryst.	290.9
Barium carbonate	BaO, CO_2	solid	63.44
Barium chlorate	Ba, Cl_2, O_6	solid	176.6
Barium chloride	Ba, Cl_2	solid	205.33
Barium cyanide	Ba, C_2, N_2	solid	57.4
Barium dithionate	Ba, S_2, $O_6 \cdot 2H_2O$	solid	406.7
Barium fluoride	Ba, F_2	precip.	287.7
Barium hydride	Ba, H_2	solid	40.8
Barium hydroxide	Ba, O_2, H_2	solid	225.9
Barium hypobromite	Ba, Br_2, O_2	dil. sol.	168.4
Barium hypochlorite	Ba, Cl_2, O_2	dil. sol.	180.
Barium hypophosphite	Ba, H_4, P_2O_4	dil. sol.	403.6
Barium iodide	Ba, I_2	solid	144.8
Barium nitrate	Ba, N_2, O_6	solid	236.9
Barium nitride	Ba_3, N_2	solid	90.7
Barium nitrite	Ba, N_2, O_4	solid	184.6
Barium oxide	Ba, O	solid	133.1
Barium perchlorate	Ba, Cl_2, O_8	solid	210.3
Barium peroxide	Ba, O_2	solid	152.4
Barium peroxide	BaO, O	solid	18.6
Barium persulfate	Ba, S_2, O_8	dil. sol.	451.7
Barium phosphate (tri)	Ba_3, P_2, O_8	cryst.	991.6
Barium phosphate (di)	Ba, H, P, O_4	ppt.	424.6
Barium phosphate (mono)	Ba, H_4, P_2, O_8	solid	735.9
Barium selenide	Ba, Se	solid	81.3
Barium silicate	Ba, Si, O_3	solid	363.
Barium sulfate	Ba, S, O_4	solid	349.4
Barium sulfide	Ba, S (rhomb)	solid	111.2
Barium sulfide	Ba, S	dil. sol.	118.4
Barium sulfite	Ba, S, O_3	ppt.	282.5
Beryllium chloride	Be, Cl_2	solid	112.5
Beryllium chloride	Be, Cl_2	dil. sol.	163.7
Beryllium oxide	Be, O	solid	135.0
Bismuth chloride	Bi, Cl_3	solid	90.63
Bismuth hydroxide	Bi_2, $O_3 + 3H_2O = 2Bi(OH)_3$	solid	137.74
Bismuth oxide	Bi_2, O_3	solid	137.8
Bismuth oxychloride	Bi, O, Cl	solid	89.8
Boric acid	H_3, B, O_3	solid	251.6
Boric acid	B_2O_3, $3H_2O$	solid	16.4
Boron bromide	B, Br_3	liq.	42.8
Boron chloride	B, Cl_3	gas	88.3
Boron chloride	B, Cl_3	liq.	94.6
Boron fluoride	B, F_3	gas	256.9
Boron oxide	B_2, O_3	solid	279.9
Boron oxide	B_2, O_3	dil. sol.	287.2
Boron sulfide	B_2, S_3	solid	75.8
Bromic acid	H, Br, O_3	dil. sol.	12.50
Bromine chloride	Br, Cl	liq.	0.70
Cadmium bromide	Cd, Br_2	solid	75.8
Cadmium bromide	Cd, $Br_2 \cdot 4H_2O$	solid	82.93
Cadmium carbonate	Cd, C, O_3	solid	178.6
Cadmium chloride	Cd, Cl_2	solid	93.0

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Cadmium cyanide	Cd, C_2, N_2	solid	−35.2
Cadmium cyanide	$Cd, 2CN$	dil. sol.	33.96
Cadmium fluoride	Cd, F_2	dil. sol.	172.5
Cadmium hydroxide	Cd, O, H_2O	solid	65.68
Cadmium iodide	Cd, I_2	solid	48.33
Cadmium nitrate	$Cd, N_2, O_6 \cdot H_2O$	solid	113.3
Cadmium nitrate	$Cd, N_2, O_6 \cdot 4H_2O$	solid	121.16
Cadmium oxide	Cd, O	solid	65.23
Cadmium selenide	Cd, Se	cryst.	24.2
Cadmium selenide	Cd, Se	ppt.	23.7
Cadmium sulfate	Cd, S, O_4	solid	222.2
Cadmium sulfate	Cd, SO_2, O_2	solid	150.47
Cadmium sulfide	Cd, S	solid	34.6
Cadmium sulfide	Cd, S, xH_2O	solid	34.35
Cadmium telluride	Cd, Te	cryst.	16.60
Calcium acetate	Ca, C_4, H_6, O_4	solid	358.0
Calcium acid sulfide	Ca, H_2, S_2	dil. sol.	125.3
Calcium aluminate (mono)	Ca, Al_2, O_4	solid	620.
Calcium aluminate (di)	Ca_2, Al_2, O_5	solid	857.
Calcium aluminate (tri)	Ca_3, Al_2, O_6	solid	1098.
Calcium aluminum silicate	Ca_3, Al_2, Si_2, O_{10}	solid	1,486.3
Calcium arsenate	Ca_3, As_2, O_8	solid	794.0
Calcium borate	$CaO, 2B_2O_3$	solid	39.8
Calcium borate	CaO, B_2O_3	solid	30.9
Calcium borate	$2CaO, B_2O_3$	solid	48.5
Calcium borate	$3CaO, B_2O_3$	solid	62.2
Calcium bromide	Ca, Br_2	solid	162.2
Calcium carbide	Ca, C_2	solid	14.5
Calcium carbonate	Ca, C, O_3	solid	289.5
Calcium carbonate	CaO, CO_2	ppt.	43.3
Calcium carbonate	CaO, CO_2	calcite	42.0
Calcium chloride	Ca, Cl_2	solid	190.3
Calcium chloride	Ca, Cl_2	dil. sol.	209.
Calcium cyanide	Ca, C_2, N_2	solid	58.7
Calcium dithionate	$Ca, S_2, O_6 \cdot 4H_2O$	solid	410.03
Calcium fluoride	Ca, F_2	solid	290.2
Calcium hydride	Ca, H_2	solid	46.
Calcium hydroxide	Ca, O_2, H_2	solid	236.0
Calcium hydroxide	Ca, O, H_2O	solid	160.54
Calcium iodide	Ca, I_2	solid	128.6
Calcium nitrate	Ca, N_2, O_6	solid	223.7
Calcium nitride	Ca_3, N_2	solid	109.5
Calcium oxalate	Ca, C_2, O_4	ppt.	332.9
Calcium oxide	Ca, O	solid	151.9
Calcium peroxide	Ca, O_2	solid	156.4
Calcium peroxide	CaO, O	solid	5.40
Calcium phosphate	Ca_3, P_2, O_8	solid	983.
Calcium selenide	Ca, Se	solid	81.8
Calcium silicate	CaO, SiO_2	solid	17.4
Calcium sulfate	Ca, S, O_4	solid	340.
Calcium sulfate	Ca, SO_2, O_2	solid	231.36
Calcium sulfide	Ca, S (rhomb)	solid	111.2
Carbon dichloride	C_2, Cl_4	gas	−1.15
Carbon dichloride	C_2, Cl_4	liq.	6.0
Carbon dioxide	C, O_2	gas	94.45

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Carbon dioxide	C (diamond), O_2	gas	94.38
Carbon dioxide	CO, O	gas	68.28
Carbon disulfide	C, S_2	gas	−25.4
Carbon disulfide	C, S_2	liq.	−19.0
Carbon monoxide	C, O	gas	26.84
Carbon monoxide	C (diamond), O	gas	26.1
Carbon oxychloride	C, O, Cl_2	gas	52.09
Carbon oxysulfide	C, O, S	solid	37.03
Carbon tetrachloride	C, Cl_4	gas	25.4
Carbon tetrachloride	C, Cl_4	liq.	33.19
Carbon tetrachloride	C (diamond), Cl_4	gas	68.5
Carbon tetrachloride	C (diamond), Cl_4	liq.	75.7
Carbon trichloride	C_2 (diamond), Cl_6	solid	107.4
Cerium oxide	Ce, O_2	solid	233.4
Cesium bicarbonate	Cs, H, C, O_3	solid	231.0
Cesium bicarbonate	CsOH, CO_2	solid	11.25
Cesium bisulfate	Cs, H, S, O_4	solid	279.7
Cesium bromide	Cs, Br	solid	97.65
Cesium carbonate	Cs_2, C, O_3	solid	272.76
Cesium carbonate	Cs_2O, CO_2	solid	97.53
Cesium chloride	Cs, Cl	solid	106.32
Cesium fluoride	Cs, F	solid	131.68
Cesium hydroxide	Cs, O, H	solid	100.2
Cesium hydroxide	Cs_2O, H_2O = 2CsOH	dil. sol.	80.6
Cesium iodide	Cs, I	solid	83.90
Cesium oxide (mon)	Cs_2, O	solid	82.1
Cesium oxide (di)	Cs_2O, O	solid	−28.26
Cesium oxide (tri)	Cs_2O_2, O	solid	−18.0
Cesium oxide (tetr)	Cs_2O_3, O	solid	−12.5
Cesium oxide (tetr)	Cs_2, O_4	solid	163.5
Cesium sulfate	Cs_2, S, O_4	solid	344.85
Chloric acid	H, Cl, O_3	dil. sol.	20.8
Chlorine monoxide	Cl_2, O	gas	−18.25
Chlorosulfonic acid	H, Cl, S, O_3	liq.	140.2
Chromium chloride (ic)	$CrCl_2$, Cl (violet)	dil. sol.	56.7
Chromium oxide (ic)	Cr_2, O_3	cryst.	273.
Chromium oxide (ic)	Cr_2, O_3	amorph.	243.8
Chromium oxide (tri)	Cr, O_3	solid	140.0
Chromium sulfate (violet)	Cr_2, S_3, O_{12}	dil. sol.	753.9
Cobalt bromide (ous)	Co, Br_2	dil. sol.	72.94
Cobalt chloride (ous)	Co, Cl_2	solid	76.9
Cobalt chloride (ous)	Co, Cl_2	dil. sol.	95.0
Cobalt fluoride (ous)	Co, F_2	dil. sol.	172.8
Cobalt hydroxide (ic)	Co_2, O_3, $3H_2O$	solid	149.38
Cobalt hydroxide (ic)	$2Co(OH)_2$, O, H_2O	solid	22.58
Cobalt hydroxide (ous)	Co, O, H_2O	solid	63.4
Cobalt iodide (ous)	Co, I_2	dil. sol.	42.97
Cobalt nitrate (ous)	CoO, N_2O_5	dil. sol.	85.54
Cobalt nitrate (ous)	Co, N_2, $O_6 \cdot 6H_2O$	solid	219.32
Cobalt oxide (ous)	Co, O	cryst.	57.5
Cobalt oxide (ous)	Co, O	amorph.	50.5
Cobalt oxide (ous, ic)	Co_3, O_4	solid	196.5
Cobalt selenide (ous)	Co, Se	cryst.	12.
Cobalt selenide (ous)	Co, Se	ppt.	11.5
Cobalt sulfate (ous)	Co, O, SO_3	dil. sol.	88.07

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Cobalt sulfate (ous)	Co, O_2, $SO_2 \cdot 7H_2O$	solid	162.97
Cobalt sulfide (ous)	Co, S, xH_2O	ppt.	19.73
Cobalt telluride (ous)	Co, Te	solid	11.
Copper acetate (ic)	Cu, C_4, H_6, O_4	solid	216.4
Copper bromide (ic)	Cu, Br_2	solid	34.0
Copper bromide (ous)	Cu, Br	solid	26.7
Copper carbonate (ic)	Cu, C, O_3	ppt.	142.8
Copper chlorate (ic)	Cu, Cl_2, O_6	dil. sol.	24.3
Copper chloride (ic)	Cu, Cl_2	solid	53.4
Copper chloride (ic)	Cu, Cl_2	dil. sol.	62.5
Copper chloride (ous)	Cu, Cl	solid	34.3
Copper cyanide (ous)	Cu, C, N	solid	−28.0
Copper dithionate (ic)	Cu, $2SO_2$, $O_2 \cdot 5H_2O$	solid	126.25
Copper fluoride (ic)	Cu, F_2	dil. sol.	141.7
Copper iodide (ic)	Cu, I_2	solid	4.08
Copper iodide (ous)	Cu, I	solid	17.8
Copper nitrate (ic)	Cu, N_2, O_6	solid	73.1
Copper nitrate (ic)	Cu, N_2, $O_6 \cdot 6H_2O$	solid	92.94
Copper oxide (ic)	Cu, O	solid	38.5
Copper oxide (ic)	Cu_2O, O	solid	35.0
Copper oxide (ous)	Cu_2, O	solid	42.5
Copper selenide (ic)	Cu, Se	solid	19.0
Copper selenide (ous)	Cu_2, Se	cryst.	14.5
Copper sulfate (ic)	Cu, S, O_4	solid	184.7
Copper sulfate (ic)	Cu, S, O_4	dil. sol.	200.
Copper sulfate (ic)	Cu, SO_2, O_2	solid	111.49
Copper sulfate (ic)	Cu, SO_2, $O_2 \cdot 5H_2O$	solid	130.04
Copper sulfide (ic)	Cu, S	solid	11.6
Copper sulfide (ous)	Cu_2, S	solid	18.97
Copper telluride (ous)	Cu_2, Te	solid	6.0
Cyanic acid	H, C, N, O	dil. sol.	36.6
Cyanogen	C_2, N_2	gas	−65.7
Cyanogen	C_2 (diamond), N_2	gas	−73.9
Cyanogen	C_2 (diamond), N_2	liq.	−68.5
Cyanogen chloride	C (diamond), N, Cl	gas	−35.2
Cyanogen chloride	C (diamond), N, Cl	liq.	−26.8
Cyanogen iodide	C (diamond), N, I	solid	−39.2
Ferric, see Iron			
Fluosilicic acid	H_2, Si, F_6	dil. sol.	545.0
Gold bromic acid (ic)	H, Au, Br_4	dil. sol.	47.1
Gold bromide (ic)	Au, Br_3	solid	14.5
Gold bromide (ous)	Au, Br	solid	3.4
Gold chloric acid (ic)	H, Au, $Cl_4 \cdot 4H_2O$	solid	76.95
Gold chloride (ic)	Au, Cl_3	solid	28.3
Gold chloride (ous)	Au, Cl	solid	8.3
Gold hydroxide (ic)	Au_2, O_3, $3H_2O$	solid	−13.19
Gold iodide (ous)	Au, I	solid	−0.2
Gold oxide (ic)	Au_2, O_3	solid	−11.0
Hydrazine	N_2, H_4	dil. sol.	−4.5
Hydrazoic acid	H, N_3	dil. sol.	−54.48
Hydriodic acid	H, I	gas	−5.91
Hydrobromic acid	H, Br	gas	+8.6
Hydrobromic acid	H, Br	dil. sol.	28.54
Hydrochloric acid	H, Cl	gas	22.0
Hydrochloric acid	H, Cl	dil. sol.	39.46

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Hydrocyanic acid	H, C (diamond), N	gas	−30.5
Hydrocyanic acid	H, C (diamond), N	liq.	−24.8
Hydrocyanic acid	H, C (diamond), N	dil. sol.	−24.4
Hydroferricyanic acid	H_3, Fe, C_6, N_6	solid	−147.5
Hydroferrocyanic acid	H_4, Fe, C_6, N_6	solid	−122.0
Hydrofluoric acid	H, F	dil. sol.	75.6
Hydrogen	H, H	gas	76.0
Hydrogen oxide (water)	H_2, O	liq.	68.39
Hydrogen oxide	H_2, O	solid	69.83
Hydrogen oxide	H_2, O	gas	57.83
Hydrogen peroxide	H_2, O_2	dil. sol.	45.3
Hydrogen peroxide	H_2O, O	dil. sol.	−23.06
Hydrogen peroxide	H_2, O_2	liq.	45.2
Hydrogen selenide	H_2, Se	gas	−18.5
Hydrogen sulfide	H_2, S	gas	5.26
Hydrogen telluride	H_2, Te	gas	−33.93
Hydrosulfurous acid	H_2, S_2, O_4	dil. sol.	161.1
Hydroxylamine	N, H_3, O	solid	27.6
Hydroxylamine	N, H_3, O	dil. sol.	21.7
Iodic acid	H, I, O_3	solid	56.77
Iodine bromide	I, Br	solid	2.5
Iodine chloride (mono)	I, Cl	solid	8.2
Iodine chloride (mono)	I, Cl	liq.	6.06
Iodine chloride (tri)	I, Cl_3	solid	20.0
Iodine oxide (pent)	I_2, O_5	solid	42.06
Iron acetate (ic)	Fe, C_6, H_9, O_6	dil. sol.	359.4
Iron ammonium sulfate (ic)	Fe_2, S_4, N_2, H_8, O_{16}	dil. sol.	458.5
Iron bromide (ic)	Fe, Br_3	dil. sol.	95.45
Iron bromide (ous)	Fe, Br_2	dil. sol.	78.07
Iron carbide	Fe_3, C	solid	−5.2
Iron carbonate (ous)	Fe, C, O_3	ppt.	178.8
Iron carbonate (ous)	Fe, C, O_3	cryst.	184.5
Iron carbonate (ous)	FeO, CO_2	solid	24.5
Iron chlorate (ic)	Fe, Cl_3, O_9	dil. sol.	67.38
Iron chloride (ic)	Fe, Cl_3	solid	96.4
Iron chloride (ic)	$FeCl_2$, Cl	solid	13.99
Iron chloride (ous)	Fe, Cl_2	solid	82.05
Iron chloride (ous)	Fe, Cl_2	dil. sol.	99.95
Iron ferrocyanide (ic)	Fe_7, C_{18}, N_{18}	ppt.	−319.0
Iron fluoride (ic)	Fe, F_3	dil. sol.	243.3
Iron fluoride (ous)	Fe, F_2	dil. sol.	177.1
Iron hydroxide (ic)	Fe_2, O_3, $3H_2O$	solid	2x95.57
Iron hydroxide (ic)	$2Fe(OH)_2$, O, H_2O	solid	2x27.29
Iron hydroxide (ous)	Fe, O, H_2O	solid	68.28
Iron hydroxide (ous)	FeO, H_2O	solid	4.0
Iron iodide (ic)	Fe, I_3	dil. sol.	49.46
Iron iodide (ous)	Fe, I_2	dil. sol.	47.55
Iron nitrate (ic)	Fe, N_3, O_9	dil. sol.	159.4
Iron nitrate (ous)	Fe, N_2, O_6	dil. sol.	119.0
Iron oxide (ic)	Fe_2, O_3	solid	198.5
Iron oxide (ous)	Fe, O	solid	64.3
Iron oxide (ous, ic)	Fe_3O_4	solid	266.9
Iron phosphide	Fe, P	solid	0
Iron selenide (ous)	Fe, Se	cryst.	13.2
Iron selenide (ous)	Fe, Se	ppt.	14.3

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Iron silicate (ous)	Fe, Si, O_3	solid	264.5
Iron silicate (ous)	FeO, SiO_2	solid	9.3
Iron sulfate (ic)	Fe_2, S_3, O_{12}	dil. sol.	641.77
Iron sulfate (ic)	Fe_2, O_3, $3SO_3$	dil. sol.	224.9
Iron sulfate (ous)	Fe, S, O_4	dil. sol.	231.95
Iron sulfate (ous)	Fe, SO_2, $O_2 \cdot 7H_2O$	solid	169.04
Iron sulfate (ous)	Fe, SO_3, O	dil. sol.	93.2
Iron sulfide (ous)	Fe, S (*rhomb*)	solid	23.07
Iron sulfide (ous)	Fe, S	amorph.	18.8
Iron sulfide (ous)	Fe, $S \cdot xH_2O$	solid	21.77
Iron telluride (ous)	Fe, Te	cryst.	8.
Lanthanum chloride	La, Cl_3	solid	253.1
Lanthanum oxide	La_2, O_3	solid	456.9
Lanthanum sulfate	La_2 $(SO_4)_3$	dil. sol.	972.
Lanthanum sulfide	La_2S_3	solid	351.4
Lead acetate	Pb, C_4, H_6, O_4	solid	234.3
Lead bromide	Pb, Br_2	solid	66.27
Lead carbonate	Pb, C, O_3	solid	168.0
Lead chloride	Pb, Cl_2	solid	85.7
Lead fluoride	Pb, F_2	solid	159.4
Lead iodide	Pb, I_2	solid	41.77
Lead nitrate	Pb, N_2, O_6	solid	106.89
Lead oxalate	Pb, C_2, O_4	ppt.	205.3
Lead oxide (mon)	Pb, O	solid	52.47
Lead oxide (di)	Pb, O_2	solid	65.0
Lead oxide (di)	PbO, O	solid	12.6
Lead oxide (red)	Pb_3, O_4	solid	172.4
Lead oxide (sub)	Pb_2, O	solid	51.25
Lead oxybromide	$PbBr_2$, PbO	solid	3.3
Lead oxybromide	$PbBr_2$, 2PbO	solid	4.7
Lead oxybromide	$PbBr_2$, 3PbO	solid	6.3
Lead oxychloride	$PbCl_2$, PbO	solid	5.3
Lead oxychloride	$PbCl_2$, 2PbO	solid	6.6
Lead oxychloride	$PbCl_2$, 3PbO	solid	6.7
Lead oxyiodide	PbI_2, PbO	solid	3.6
Lead phosphite	Pb, H, P, O_3	solid	227.7
Lead selenide	Pb, Se	cryst.	12.4
Lead selenide	Pb, Se	ppt.	23.7
Lead sulfate	Pb, S, O_4	solid	218.5
Lead sulfate	Pb, SO_2, O_2	solid	145.1
Lead sulfide	Pb, S	ppt.	22.2
Lead telluride	Pb, Te	solid	6.0
Lead thiocyanate	Pb, C_2, N_2, S_2	solid	−28.7
Lead thiosulfate	Pb, S_2, O_3	solid	145.6
Lithium bromide	Li, Br	solid	83.73
Lithium bromide	Li, Br	dil. sol.	95.43
Lithium carbide	Li_2, C_2	solid	13.9
Lithium carbonate	Li_2O, CO_2	solid	54.23
Lithium chloride	Li, Cl	solid	97.65
Lithium cyanide	Li, C, N	dil. sol.	31.3
Lithium fluoride	Li, F	solid	145.54
Lithium fluoride	Li, F	dil. sol.	144.49
Lithium fluosilicate	2LiF, SiF_4	solid	25.2
Lithium hydride	Li, H	solid	21.6
Lithium hydroxide	Li, O, H	solid	116.55

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Lithium hydroxide	Li, O, H	dil. sol.	121.6
Lithium hydroxide	Li_2, O, H_2O	dil. sol.	174.8
Lithium iodide	Li, I,	solid	64.99
Lithium iodide	Li, I	dil. sol.	79.759
Lithium nitrate	Li, N, O_3	solid	115.7
Lithium nitride	Li_3, N	solid	46.4
Lithium oxide	Li_2, O	solid	142.3
Lithium peroxide	Li_2, O_2	solid	151.9
Lithium selenide	Li_2, Se	solid	84.9
Lithium silicate	Li_2, Si, O_3	solid	434.9
Lithium sulfate	Li_2, S (rhomb), O_4	solid	342.4
Lithium sulfide	Li_2, S (rhomb)	dil. sol.	121.5
Lithium thiohydrate	Li, H, S (rhomb)	dil. sol.	68.2
Magnesium ammonium phosphate	Mg, N, H_4, P, O_4	cryst.	898.8
Magnesium ammonium sulfite	$3(MgSO_3 \cdot 6H_2O)$, $(NH_4)_2SO_3$	solid	−2.1
Magnesium arsenate	Mg_3, As_2, O_8	solid	731.43
Magnesium bromide	Mg, Br_2	solid	124.0
Magnesium carbonate	Mg, C, O_3	ppt.	266.6
Magnesium chloride	Mg, Cl_2	solid	153.2
Magnesium cyanide	Mg, C_2, N_2	dil. sol.	40.38
Magnesium dithionate	Mg, S_2, O_6	dil. sol.	390.57
Magnesium fluoride	Mg, F_2	ppt.	263.8
Magnesium hydroxide	Mg, O_2, H_2	solid	217.32
Magnesium hydroxide	MgO, H_2O	cryst.	9.4
Magnesium iodide	Mg, I_2	solid	86.74
Magnesium nitrate	Mg, N_2, $O_6 \cdot 6H_2O$	solid	210.52
Magnesium nitride	Mg_3, N_2	solid	116.
Magnesium oxide	Mg, O	solid	146.1
Magnesium oxide (bomb)	Mg, O	amorph	145.76
Magnesium phosphate	Mg_3, P_2, O_8	colloid.	910.6
Magnesium potassium chloride	$MgCl_2$, KCl	solid	3.1
Magnesium pot. chloride	$MgCl_2$, 2KCl	solid	5.7
Magnesium pot. chloride	$MgCl_2$, 4KCl	solid	9.8
Magnesium pot. sulfate	$MgSO_4$, K_2SO_4	solid	3.3
Magnesium sodium sulfate	$MgSO_4$, Na_2SO_4	solid	3.7
Magnesium sulfate	Mg, S, O_4	solid	304.95
Magnesium sulfide	Mg, S	solid	82.23
Magnesium sulfite	Mg, S, O_3	solid	240.0
Magnesium thiohydrate	Mg, S_2, H_2	dil. sol.	117.3
Manganese acetate	Mn, C_4, H_6, O_4	solid	272.88
Manganese bromide	Mn, Br_2	dil. sol.	107.0
Manganese carbide	Mn_3, C	solid	23.
Manganese carbonate	Mn, C, O_3	solid	218.
Manganese carbonate	Mn, C, O_3	amorph.	207.0
Manganese carbonate	Mn, C, O_3	cryst.	208.6
Manganese carbonate	MnO, CO_2	solid	27.6
Manganese chloride	Mn, Cl_2	solid	112.7
Manganese dithionate	Mn, $2SO_2$, $O_2 \cdot 6H_2O$	solid	188.6
Manganese fluoride, di	Mn, F_2	dil. sol.	206.0
Manganese fluoride, tri	Mn, F_3	dil. sol.	260.5
Manganese hydroxide	Mn, O_2, H_2	ppt.	163.4
Manganese hydroxide	Mn, O, H_2O	solid	94.77
Manganese iodide	Mn, I_2	dil. sol.	76.2
Manganese nitrate	Mn, N_2, $O_6 \cdot 6H_2O$	solid	153.05
Manganese oxide (ic)	Mn_2, O_3	solid	233.

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Manganese oxide (ous)	Mn, O	solid	96.5
Manganese oxide (di)	Mn, O_2	solid	123.
Manganese oxide (di)	$Mn_3O_4+O_2=3MnO_2$	solid	3×16.0
Manganese oxide (ous, ic)	Mn_3, O_4	solid	345.
Manganese phosphate	Mn_3, P_2, O_8	colloid.	737.5
Manganese potassium sulfate	$MnSO_4$, K_2SO_4	solid	0.99
Manganese selenide	Mn, Se	cryst.	26.3
Manganese selenide	Mn, Se	ppt.	22.4
Manganese silicate	Mn, Si, O_3	solid	299.4
Manganese silicate	MnO, SiO_2	solid	7.7
Manganese sodium sulfate	$MnSO_4$, Na_2SO_4	solid	1.2
Manganese sulfate	Mn, S, O_4	solid	251.2
Manganese sulfate	Mn, SO_2, O_2	solid	178.79
Manganese sulfide	Mn, S	ppt.	47.0
Mercury acetate (ic)	Hg, C_4, H_6, O_4	solid	198.0
Mercury acetate (ous)	Hg, C_2, H_3, O_2	solid	101.05
Mercury bromide (ic)	Hg, Br_2	solid	40.70
Mercury bromide (ous)	Hg, Br	solid	24.5
Mercury chloride (ic)	Hg, Cl_2	solid	53.4
Mercury chloride (ous)	Hg, Cl	solid	31.3
Mercury cyanide (ic)	Hg, $(CN)_2$	solid	11.4
Mercury fulminate (ic)	Hg, O_2, N_2, C_2	solid	−64.1
Mercury iodide (ic)	Hg, I_2	solid	25.2
Mercury iodide (ous)	Hg, I	solid	14.42
Mercury nitrate (ic)	Hg, N_2, O_6	dil. sol.	56.6
Mercury nitrate (ic)	Hg, N_2, $O_6 \cdot \frac{1}{2}H_2O$	solid	57.4
Mercury nitrate (ous)	Hg_2, N_2, O_6	dil. sol.	58.3
Mercury nitrate (ous)	Hg_2, N_2, $O_6 \cdot 2(H_2, O)$	solid	207.9
Mercury nitride	Hg_2, N_6	solid	−100.
Mercury oxide (ic)	Hg, O (red)	solid	21.7
Mercury oxide (ous)	Hg_2, O	solid	21.5
Mercury oxybromide (ic)	$HgBr_2$, HgO	solid	3.3
Mercury oxychloride (ic)	$HgCl_2$, HgO	solid	3.3
Mercury oxychloride (ic)	$HgCl_2$, 2HgO	solid	6.3
Mercury oxychloride (ic)	$HgCl_2$, 3HgO	solid	8.0
Mercury oxychloride (ic)	$HgCl_2$, 4HgO	solid	9.9
Mercury oxycyanide (ic)	$Hg(CN)_2$, HgO	solid	2.6
Mercury potassium bromide (ic)	$HgBr_2$, KBr	solid	3.1
Mercury potassium bromide (ic)	$HgBr_2$, KBr	dil. sol.	1.3
Mercury potassium chloride (ic)	$HgCl_2$, KCl	solid	2.4
Mercury potassium chloride (ic)	$HgCl_2$, 2KCl	solid	3.8
Mercury potassium chloride (ic)	$HgCl_2$, $2KCl \cdot H_2O$	solid	60.62
Mercury potassium iodide (ic)	Hg, I_2, 2KI	solid	28.68
Mercury selenide (ic)	Hg, Se	ppt.	8.0
Mercury sulfate (ic)	Hg, S, O_4	solid	166.6
Mercury sulfate (ous)	Hg_2, S, O_4	solid	176.5
Mercury sulfide (ic)	Hg, S	ppt.	10.6
Mercury thiocyanate (ic)	Hg, C_2, N_2, S_2	solid	−52.0
Molybdenum oxide (di)	Mo, O_2	solid	131.4
Molybdenum oxide (tri)	Mo, O_3	solid	176.5
Molybdic acid	H_2, Mo, O_4	solid	247.07
Neodymium chloride	Nd, Cl_3	solid	246.7
Neodymium iodide	Nd, I_3	solid	155.4
Neodymium oxide	Nd_2, O_3	solid	435.1
Neodymium sulfate	Nd_2, S_3, O_{12}	solid	931.5

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Neodymium sulfide	Nd_2, S_3	solid	262.61
Nickel bromide	Ni, Br_2	dil. sol.	72.4
Nickel carbide	Ni_3, C	solid	−0.394
Nickel chloride	Ni, Cl_2	solid	75.0
Nickel chloride	Ni, Cl_2	dil. sol.	93.9
Nickel cyanide	Ni, C_2, N_2	ppt.	−232.
Nickel dithionate	$Ni, S_2, O_6, 6(H_2, O)$	solid	702.75
Nickel dithionate	$Ni, O_2, 2SO_2 \cdot 6H_2O$	solid	154.79
Nickel fluoride	Ni, F_2	solid	157.5
Nickel fluoride	Ni, F_2	dil. sol.	171.4
Nickel hydroxide (ic)	$Ni_2, O_3, 3H_2O$	solid	120.38
Nickel hydroxide (ic)	$2Ni(OH)_2, O, H_2O$	solid	−1.3
Nickel hydroxide (ous)	Ni, O_2, H_2	ppt.	129.8
Nickel hydroxide (ous)	Ni, O, H_2O	solid	60.84
Nickel iodide	Ni, I_2	dil. sol.	41.8
Nickel nitrate	Ni, N_2, O_6	solid	101.5
Nickel nitrate	$Ni, O, 2HNO_3$	dil. sol.	83.42
Nickel nitrate	$Ni, N_2, O_6 \cdot 6H_2O$	solid	120.71
Nickel oxide	Ni, O	solid	58.4
Nickel selenide	Ni, Se	cryst.	14.
Nickel selenide	Ni, Se	ppt.	14.7
Nickel sulfate	Ni, S, O_4	dil. sol.	228.7
Nickel sulfate	Ni, O, H_2SO_4	dil. sol.	86.95
Nickel sulfate	$Ni, SO_2, O_2 \cdot 7H_2O$	solid	162.53
Nickel sulfide	Ni, S	solid	20.4
Nickel telluride	Ni, Te	cryst.	10.8
Nitric acid	H, N, O_3	gas	34.4
Nitric acid	H, N, O_3	dil. sol.	49.0
Nitric acid	H, N, O_3	liq.	42.366
Nitrogen oxide (ic)	N, O	gas	−21.6
Nitrogen oxide (ous)	N_2, O	gas	−19.65
Nitrogen oxide (ous)	N_2, O	liq.	−18.73
Nitrogen oxide (pent)	N_2, O_5	gas	−0.6
Nitrogen oxide (pent)	N_2, O_5	liq.	3.6
Nitrogen oxide (pent)	N_2, O_5	solid	13.1
Nitrogen oxide (pent)	N_2, O_5	dil. sol.	28.6
Nitrogen oxide (tetr)	N_2, O_4	gas	−3.06
Nitrogen oxide (tetr)	N_2, O_4	liq.	5.2
Nitrogen oxide (tri)	N_2, O_3	gas	−20.0
Nitrogen selenide	N, Se	solid	−42.3
Nitrogen sulfide	N, S	solid	−31.9
Nitrous acid	H, N, O_2	dil. sol.	28.5
Nitrous acid (sub) (hypo)	H_2, N_2, O_2	dil. sol.	8.4
Oxalic acid	H_2, C_2, O_2	solid	197.6
Palladic chlorine acid	$Pd, Cl_4, 2HCl$	dil. sol.	72.94
Palladic hydroxide	$Pd, O_2, 2H_2O$	solid	30.43
Palladic potassium chloride	$Pd, Cl_4, 2KCl$	solid	79.06
Palladium hydride	Pd_2, H	solid	8.86
Palladous ammonium chloride	$PdCl_2, 2NH_3$	solid	40.0
Palladous ammonium chloride	$PdCl_2 \cdot 2NH_3, 2NH_3$	solid	31.0
Palladous ammonium iodide	$PdI_2, 2NH_3$	solid	34.0
Palladous ammonium iodide	$PdI_2 \cdot 2NH_3, 2NH_3$	solid	25.8
Palladous bromide	Pd, Br_2	solid	24.9
Palladous chloride	Pd, Cl_2	solid	44.2
Palladous cyanide	Pd, C_2, N_2	solid	−51.7

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Palladous hydroxide	Pd, O, H_2O	solid	21.0
Palladous iodide	Pd, I_2	solid	15.1
Palladous iodide	Pd, I_2; H_2, O	ppt.	89.37
Palladous potassium bromide	$PdBr_2$, 2KBr	dil. sol.	2.8
Palladous potassium chloride	Pd, Cl_2, 2KCl	solid	52.67
Perchloric acid	H, Cl, O_4	liq.	19.4
Periodic acid	H, I, O_4	dil. sol.	47.68
Permanganic acid	H, Mn, O_4	dil. sol.	123.3
Permanganic acid	Mn_2, O_7, H_2O	dil. sol.	2×93.55
Phosphonium bromide	P(white), H_4, Br	solid	34.2
Phosphonium chloride	P(white), H_4, Cl	solid	67.8
Phosphonium iodide	P(white), H_4, I	solid	20.6
Phosphoric acid (meta)	H, P, O_3	solid	224.8
Phosphoric acid (ortho)	H_3, P, O_4	liq.	300.85
Phosphoric acid (ortho)	H_3, P, O_4	solid	303.37
Phosphoric acid (ortho)	H_3, P, O_4	dil. sol.	305.29
Phosphoric acid (pyro)	H_4, P_2, O_7	liq.	529.4
Phosphoric acid (pyro)	H_4, P_2, O_7	solid	513.7
Phosphorous acid (hypo)	H_3, P, O_2	liq.	139.02
Phosphorous acid (hypo)	H_3, P, O_2	solid	141.36
Phosphorous acid (hypo)	H_3, P, O_2	dil. sol.	141.4
Phosphorous acid (ortho)	H_3, P, O_3	liq.	225.86
Phosphorous acid (ortho)	H_3, P, O_3	solid	228.93
Phosphorous acid (ortho)	H_3, P, O_3	dil. sol.	227.57
Phosphorous acid (pyro)	H_4, P_2, O_5	dil. sol.	384.3
Phosphorus bromide (tri)	P, Br_3	solid	44.8
Phosphorus bromide (penta)	P, Br_5	solid	60.6
Phosphorus chloride (tri)	P, Cl_3	liq.	76.9
Phosphorus chloride (tri)	P, Cl_3	gas	70.0
Phosphorus chloride (penta)	P, Cl_5	solid	106.6
Phosphorus hydride (phosphine)	P(white), H_3	gas	2.3
Phosphorus hydride (solid)	P_{12}(white), H_6	solid	71.7
Phosphorus iodide (tri)	P, I_3	solid	10.9
Phosphorus iodide (tetr)	P_2, I_4	solid	19.8
Phosphorus nitride	P_3(white), N_5	solid	75.03
Phosphorus oxide (pent)	P_2, O_5	solid	365.2
Phosphorus oxybromide	P, O, Br_3	solid	106.9
Phosphorus oxychloride	P, O, Cl_3	liq.	147.1
Phosphorus sesquisulfide	P_4, S_3	solid	77.53
Platinic acid (brom)	H_2, Pt, Br_6	dil. sol.	115.4
Platinic acid (brom)	H_2, Pt, $Br_6 \cdot 9H_2O$	solid	733.8
Platinic acid (chlor)	H_2, Pt, Cl_6	dil. sol.	165.6
Platinic acid (chlor)	H_2, Pt, $Cl_6 \cdot 6H_2O$	solid	571.6
Platinic bromide	Pt, Br_4	solid	40.6
Platinic chloride	Pt, Cl_4	solid	62.6
Platinic iodide	Pt, I_4	solid	18.
Platinous acid (chlor)	H_2, Pt, Cl_4	dil. sol.	121.9
Platinous hydroxide	Pt, O_2, H_2	ppt.	87.69
Platinous hydroxide	Pt, O, H_2O	solid	19.22
Platinous oxide	Pt, O	solid	17.0
Potassium acetate	K, C_2, H_3, O_2	solid	174.67
Potassium acid arsenate	K, H_2, As, O_4	dil. sol.	276.0
Potassium acid arsenate	K, H_2, As, O_4	solid	271.2
Potassium acid arsenate	K_2, H, As, O_4	dil. sol.	335.0
Potassium acid arsenite	K_2, H, As, O_3	dil. sol.	277.18

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Potassium acid carbonate	K, H, C, O_3	solid	230.2
Potassium acid fluoride	KF, HF	solid	21.1
Potassium acid iodate	KIO_3, HIO_3	solid	3.3
Potassium acid oxalate	K, H, C_2, O_4	solid	266.9
Potassium acid sulfate	K, H, S, O_4	solid	276.85
Potassium acid sulfide	K, H, S	solid	63.31
Potassium acid sulfide	K, H, S	dil. sol.	64.4
Potassium acid sulfite	K, H, S, O_3	dil. sol.	209.3
Potassium arsenate	K_3, As, O_4	dil. sol.	389.72
Potassium bromate	K, Br, O_3	solid	81.60
Potassium bromide	K, Br	solid	94.07
Potassium bromoplatinate	K_2, Pt, Br_6	dil. sol.	236.1
Potassium bromoplatinate	Pt, Br_4, 2KBr	solid	59.26
Potassium bromoplatinite	K_2, Pt, Br_4	dil. sol.	210.5
Potassium bromoplatinite	Pt, Br_2, 2KBr	solid	32.31
Potassium carbonate	K_2, C, O_3	solid	274.46
Potassium carbonate	K_2, C, O_3	dil. sol.	281.
Potassium carbonate	K_2O, CO_2	solid	94.26
Potassium chlorate	K, Cl, O_3	solid	91.33
Potassium chlorate	K, Cl, O_3	dil. sol.	81.
Potassium chloride	K, Cl	solid	104.36
Potassium chloride	K, Cl	dil. sol.	99.9
Potassium chloroplatinate	Pt, Cl_4, 2KCl	solid	89.5
Potassium chloroplatinate	K_2, Pt, Cl_6	dil. sol.	286.26
Potassium chloroplatinite	Pt, Cl_2, 2KCl	solid	45.17
Potassium chloroplatinite	K_2, Pt, Cl_4	dil. sol.	242.53
Potassium chlorostannate	$SnCl_4$, 2KCl	solid	24.16
Potassium chlorostannate	K_2, Sn, Cl_6	dil. sol.	356.80
Potassium chromate	K_2, Cr, O_4	solid	333.4
Potassium chromate	K_2, Cr, O_4	dil. sol.	328.5
Potassium cyanate	K, C, N, O	solid	100.1
Potassium cyanate	K, C, N, O	dil. sol.	94.86
Potassium cyanide	K, C, N	solid	28.5
Potassium cyanide	K, C, N	dil. sol.	25.5
Potassium cyanide	K, CN	solid	67.1
Potassium dichromate	K_2, Cr_2, O_7	solid	488.5
Potassium dichromate	K_2, Cr_2O_3, O_4	solid	226.44
Potassium dithionate	K_2, S_2, O_6	solid	413.7
Potassium ferricyanide	K_3, Fe, C_6, N_6	solid	48.5
Potassium ferricyanide	K_3, Fe, C_6, N_6	dil. sol.	34.1
Potassium ferricyanide	K_3, Fe, 6CN	solid	263.3
Potassium ferrocyanide	K_4, Fe, C_6, N_6	solid	131.9
Potassium ferrocyanide	K_4, Fe, C_6, N_6	dil. sol.	119.5
Potassium ferrocyanide	K_4, Fe, 6CN	solid	358.9
Potassium fluoride	K, F	solid	134.51
Potassium fluoride	K, F	dil. sol.	138.4
Potassium fluosilicate	2KF, SiF_4	solid	52.8
Potassium fluosilicate	K_2, Si, F_6	dil. sol.	664.5
Potassium hydroxide	K, O, H	solid	102.01
Potassium hydroxide	K, O, H	dil. sol.	114.808
Potassium hydroxide	2K, O, H_2O = 2KOH	solid	2×68.99
Potassium hydroxide	2K, O, xH_2O = 2KOH + Aq.	dil. sol.	2×82.28
Potassium hypobromite	K, Br, O	dil. sol.	81.6
Potassium hypochlorite	K, Cl, O	dil. sol.	89.35
Potassium hyponitrite	K_2, N_2, O_2	dil. sol.	117.0

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. cal.
Potassium hypophosphite	K, H_2, P, O_2	dil. sol.	202.9
Potassium iodate	K, I, O_3	solid	121.70
Potassium iodate	K, I, O_3	dil. sol.	114.8
Potassium iodide	K, I	solid	78.87
Potassium iodide	K, I	dil. sol.	74.0
Potassium metasulfate	K_2, S_2, O_5	solid	361.1
Potassium nitrate	K, N, O_3	solid	118.093
Potassium nitrate	K, N, O_3	dil. sol.	110.
Potassium nitrite	K, N, O_2	dil. sol.	85.78
Potassium oxalate	K_2, C_2, O_4	solid	320.8
Potassium oxide	K_2, O	solid	86.26
Potassium oxide (tri)	K_2, O_3	solid	126.
Potassium pentathionate	K_2, S_5, O_6	solid	398.09
Potassium perchlorate	K, Cl, O_4	solid	112.71
Potassium periodate	K, I, O_4	dil. sol.	97.73
Potassium permanganate	K, Mn, O_4	solid	192.9
Potassium permanganate	K, Mn, O_4	dil. sol.	182.5
Potassium persulfate	K_2, S_2, O_8	solid	457.5
Potassium persulfate	K_2, S_2, O_8	dil. sol.	443.8
Potassium phosphate (ortho)	K_3, P, O_4	dil. sol.	478.4
Potassium phosphate (hydrogen)	K_2, H, P, O_4	dil. sol.	425.6
Potassium phosphate (dihydrogen)	K, H_2, P, O_4	solid	362.7
Potassium phosphate (dihydrogen)	K, H_2, P, O_4	dil. sol.	367.27
Potassium pyrosulfate	K_2, S_2, O_7	solid	475.4
Potassium pyrosulfate	K_2, S_2, O_7	dil. sol.	471.6
Potassium selenide	K_2, Se	solid	74.4
Potassium sulfate	K_2, S, O_4	solid	342.66
Potassium sulfate	K_2, S, O_4	dil. sol.	336.
Potassium sulfate	K_2, SO_2, O_2	solid	273.56
Potassium sulfide	K_2, S (rhomb)	solid	121.5
Potassium sulfide	K_2, S (rhomb)	dil. sol.	110.6
Potassium sulfite	K_2, S, O_3	solid	267.7
Potassium tetroxide	K_2, O_4	solid	135.
Potassium tetrasulfide	K_2, S_4	solid	114.1
Potassium tetrathionate	K_2, S_4, O_6	solid	406.0
Potassium thiocyanate	K, C, N, S	solid	47.40
Potassium thiosulfate	K_2, S_2, O_3	solid	270.5
Potassium thiosulfate	K_2, S_2, O_3	dil. sol.	261.65
Potassium tri-iodide	KI, I_2	solid	13.6
Potassium trithionate	K_2, S_3, O_6	solid	411.2
Praseodymium dioxide	Pr, O_2	solid	231.5
Praseodymium trichloride	Pr, Cl_3	solid	254.9
Praseodymium trioxide	Pr_2, O_3	solid	439.4
Rubidium acid carbonate	Rb, H, C, O_3	solid	230.44
Rubidium acid fluoride	RbF, HF	solid	22.58
Rubidium acid sulfate	Rb, H, S, O_4	solid	277.6
Rubidium bromide	Rb, Br	solid	95.83
Rubidium carbonate	Rb, C, O_3	solid	273.66
Rubidium carbonate	Rb_2O, CO_2	solid	97.42
Rubidium chloride	Rb, Cl	solid	105.08
Rubidium fluoride	Rb, F	solid	133.24
Rubidium hydroxide	Rb, O, H	solid	101.3
Rubidium hydroxide	$2Rb, O, H_2O = 2RbOH$	dil. sol.	2×82.4
Rubidium iodide	Rb, I	solid	81.03
Rubidium oxide	Rb_2, O	solid	82.9

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg calories
Rubidium sulfate	Rb_2, S, O_4	solid	344.48
Rubidium sulfide	Rb_2, S	solid	87.7
Rubidium thiocyanate	Rb, C, N, S	solid	56.
Selenic acid	H_2, Se, O_4	liq.	126.6
Selenious acid	H_2, Se, O_3	solid	119.69
Selenium chloride	Se_2, Cl_2	liq.	22.15
Selenium hydroxide (ic)	Se, O_3, H_3	dil. sol.	79.3
Selenium hydroxide (ous)	Se, O_2, H_2	solid	52.4
Selenium nitride	Se, N	solid	−42.3
Selenium oxide (di)	Se, O_2	solid	56.36
Selenium tetrachloride	Se, Cl_4	solid	46.165
Silicic acid	H_4, Si, O_4	colloid.	334.3
Silicon bromide	Si, Br_4	liq.	93.6
Silicon carbide	Si, C	solid	28.
Silicon chloride	Si, Cl_4	gas	142.7
Silicon chloride	Si, Cl_4	liq.	150.1
Silicon fluoride	Si, F_4	gas	360.1
Silicon hydride	Si, H_4	gas	8.7
Silicon iodide	Si, I_4	solid	29.8
Silicon oxide	Si, O_2	solid	201.4
Silicon sulfide	Si, S_2	solid	32.02
Silver acetate	Ag, C_2, H_3, O_2	solid	96.8
Silver acid fluoride	AgF, HF	solid	2.0
Silver ammonia chloride	AgCl, $3NH_3$	solid	31.6
Silver bromide	AgBr	solid	23.85
Silver carbide	Ag, C	solid	−41.8
Silver carbonate	Ag_2, C, O_3	solid	119.9
Silver carbonate	Ag_2, CO_2, O	solid	25.96
Silver chlorate	Ag, Cl, O_3	solid	1.8
Silver chloride	Ag, Cl	solid	30.30
Silver chloride (sub)	AgCl, $Ag = Ag_2Cl$	solid	0.5
Silver cyanate	Ag, C, N, O	solid	23.66
Silver cyanide	Ag, C, N	solid	−33.45
Silver dithionate	Ag_2, S_2, $O_6 \cdot 2H_2O$	solid	231.06
Silver fluoride	Ag, F	solid	48.7
Silver fluoride	Ag, F	dil. sol.	53.0
Silver fluoride (sub)	AgF, $Ag = Ag_2F$	solid	−0.7
Silver fulminate	Ag, O, N, C	solid	−42.8
Silver hyponitrite	Ag_2, N_2, O_2	solid	−34.4
Silver iodide	Ag, I	cryst.	15.15
Silver iodide	Ag, I	ppt.	14.93
Silver nitrate	Ag, N, O_3	solid	29.4
Silver nitrate	Ag, N, O_3	dil. sol.	24.66
Silver nitride	Ag, N_3	solid	−67.3
Silver nitrite	Ag, N, O_2	solid	11.6
Silver oxalate	Ag_2, C_2, O_4	solid	159.6
Silver oxide	Ag_2, O	solid	6.953
Silver peroxide	Ag_2, O_2	solid	5.95
Silver potassium bromide	AgBr, KBr	solid	−0.4
Silver potassium cyanide	AgCN, KCN	solid	11.9
Silver potassium iodide	AgI, KI	solid	−1.8
Silver potassium iodide	AgI, 3KI	solid	−0.9
Silver selenide	Ag_2, Se	solid	0.96
Silver sulfate	Ag_2, S, O_4	solid	170.1
Silver sulfate	Ag_2, SO_2, O_2	solid	96.20

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Silver sulfide	Ag_2, S	solid	5.5
Silver thiocyanate	Ag, C, N, S	solid	−21.90
Sodium acetate	Na, C_2, H_3, O_2	solid	171.34
Sodium acid arsenate	Na, H_2, As, O_4	dil. sol.	273.7
Sodium acid arsenate	Na_2, H, As, O_4	dil. sol.	329.7
Sodium acid carbonate	Na, H, C, O_3	solid	226.4
Sodium acid carbonate	Na, H, C, O_3	dil. sol.	222.3
Sodium acid fluoride	Na, H, F_2	solid	216.75
Sodium acid fluoride	NaF, HF	solid	17.1
Sodium acid oxalate	Na, H, C_2, O_4	solid	257.7
Sodium acid phosphite	Na, H_2, P, O_3	dil. sol.	285.9
Sodium acid selenate	Na, H, Se, O_4	dil. sol.	201.84
Sodium acid selenide	Na, H, Se	dil. sol.	31.0
Sodium acid sulfate	Na, H, S, O_4	solid	269.04
Sodium acid sulfide	Na, H, S	solid	56.76
Sodium acid sulfide	Na, H, S	dil. sol.	61.3
Sodium acid sulfite	Na, H, S, O_3	dil. sol.	206.5
Sodium aluminate	Na, Al, O_2	solid	271.7
Sodium amide	Na, N, H_2	solid	32.0
Sodium antimonate	Na_3, Sb, O_4	solid	349.
Sodium antimonate	$3Na_2O$, Sb_2O_5	solid	2×81.85
Sodium arsenate	Na_3, As, O_4	solid	366.
Sodium arsenate	Na_3, As, O_4	dil. sol.	381.5
Sodium arsenite	Na_2, H, As, O_3	dil. sol.	271.7
Sodium bismuthate	Na_3, Bi, O_4	solid	284.
Sodium borate	$3Na_2O$, $B_2O_3 = 2Na_3BO_3$	solid	2×52.1
Sodium bromide	Na, Br(liq)	solid	86.73
Sodium bromide	Na, Br	dil. sol.	87.
Sodium bromide	Na, Br (gas)	solid	90.45
Sodium bromoplatinate	Na_2, Pt, Br_6	solid	221.3
Sodium bromoplatinate	2NaBr, Pt, Br_4	solid	46.79
Sodium carbide	Na_2, C_2 (diamond)	solid	−8.8
Sodium carbonate	Na_2, C, O_3	solid	269.89
Sodium carbonate	Na_2, C, O_3	dil. sol.	276.
Sodium carbonate	Na_2O, CO_2	solid	76.88
Sodium chlorate	Na, Cl, O_3	solid	83.60
Sodium chlorate	Na, Cl, O_3	dil. sol.	78.2
Sodium chloride	Na, Cl	solid	98.330
Sodium chloride	Na, Cl	dil. sol.	97.1
Sodium chloropalladite	Na_2, Pd, Cl_4	dil. sol.	242.3
Sodium chloroplatinate	Na_2, Pt, Cl_6	solid	272.1
Sodium chloroplatinate	Na_2, Pt, Cl_6	dil. sol.	280.29
Sodium chloroplatinate	2NaCl, Pt, Cl_4	solid	73.72
Sodium chloroplatinite	Na_2, Pt, Cl_4	solid	227.0
Sodium chromate	Na_2, Cr, O_4	solid	319.8
Sodium chromate	Na_2O, CrO_3	solid	77.0
Sodium cyanate	Na, C, N, O	solid	97.01
Sodium cyanate	Na, C, N, O	dil. sol.	92.23
Sodium cyanide	Na, C, N	solid	22.9
Sodium cyanide	Na, C, N	dil. sol.	22.5
Sodium dichromate	Na_2, Cr_2, O_7	dil. sol.	465.6
Sodium disulfide	Na_2, S_2	dil. sol	105.2
Sodium dithionate	Na_2, S_2, O_6	solid	401.0
Sodium fluoride	Na, F	solid	135.95
Sodium fluoride	Na, F	dil. sol.	135.70

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Sodium fluosilicate	Na_2, Si, F_6	solid	669.
Sodium fluosilicate	Na_2, Si, F_6	dil. sol.	658.31
Sodium formate	Na, C, H, O_2	solid	157.7
Soldium hydride	Na, H	solid	14.
Sodium hydroxide	Na, O, H	solid	101.96
Sodium hydroxide	Na, O, H	dil. sol.	112.
Sodium hydroxide	2Na, O, H_2O	solid	135.38
Sodium hypobromite	Na, Br, O	dil. sol.	78.8
Sodium hypochlorite	Na, Cl, O	dil. sol.	83.36
Sodium hypophosphite	Na_2, H, P, O_2	dil. sol.	198.4
Sodium iodide	Na, I	solid	69.28
Sodium iodide	Na, I	dil. sol.	70.8
Sodium iodide	Na, I (gas)	solid	76.50
Sodium iodoplatinate	Na_2, Pt, I_6	dil. sol.	167.0
Sodium manganate	Na_2, Mn, O_4	solid	270.0
Sodium manganate	Na_2O, Mn, O_3	solid	169.0
Sodium manganate	Na_2O, MnO_2, O	solid	49.4
Sodium metaborate	Na, B, O_2	dil. sol.	231.5
Sodium molybdate	Na_2, Mo, O_4	solid	364.
Sodium molybdate	Na_2O, MoO_3	solid	181.5
Sodium molybdate	Na_2O_2, MoO_2	solid	101.2
Sodium nitrate	Na, N, O_3	solid	111.72
Sodium nitrate	Na, N, O_3	dil. sol.	106.6
Sodium nitrite	Na, N, O_2	solid	86.5
Sodium nitrite	Na, N, O_2	dil. sol.	83.15
Sodium oxalate	Na_2, C_2, O_4	solid	314.7
Sodium oxalate	Na_2, C_2, O_4	dil. sol.	310.444
Sodium oxide	Na_2, O	solid	99.45
Sodium perchlorate	Na, Cl, O_4	solid	101.3
Sodium perchlorate	Na, Cl, O_4	dil. sol.	97.25
Sodium peroxide	Na_2, O_2	solid	119.2
Sodium phosphate (tri)	Na_3, P, O_4	solid	457.
Sodium phosphate (tri)	Na_3, P, O_4	dil. sol.	471.305
Sodium phosphate (di)	Na_2, H, P, O_4	solid	414.85
Sodium phosphate (mono)	Na, H_2, P, O_4	dil. sol.	364.6
Sodium phosphate (pyro)	Na_4, P_2, O_7	solid	755.08
Sodium phosphite	Na_2, H, P, O_3	dil. sol.	344.6
Sodium selenate	Na_2, Se, O_4	dil. sol.	261.3
Sodium selenate	Na_2O, Se, O_3	solid	154.1
Sodium selenate	Na_2O_2, SeO_2	solid	71.2
Sodium selenide	Na_2, Se	solid	59.1
Sodium selenite	Na_2, Se, O_3	dil. sol.	238.4
Sodium silicate	Na_2, Si, O_3	solid	371.2
Sodium stannate	Na_4, Sn, O_4	solid	370.1
Sodium stannate	Na_2O, Sn, O_2	solid	172.6
Sodium stannite	Na_2, Sn, O_2	dil. sol.	224.0
Sodium sulfate	Na_2, S, O_4	solid	330.48
Sodium sulfate	Na_2, S, O_4·10(H_2, O)	solid	1033.20
Sodium sulfide	Na_2, S	solid	89.8
Sodium sulfide	Na_2, S	dil. sol.	105.
Sodium sulfite	Na_2, S, O_3	solid	261.2
Sodium sulfite	Na_2, S, O_3	dil. sol.	264.
Sodium tetraborate	Na_2, B_4, O_7	solid	742.6
Sodium tetraborate (borax)	Na_2, B_4, O_7·10(H_2, O)	solid	1453.1
Sodium tetrasulfide	Na_2, S_4	solid	99.8

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Sodium tetrathionate	Na_2, S_4, O_6	dil. sol.	387.3
Sodium thiocyanate	Na, C, N, S	dil. sol.	40.36
Sodium thiosulfate	Na_2, S_2, O_3	solid	258.5
Sodium thiosulfate	$Na_2, S_2, O_3 \cdot 5(H_2, O)$	solid	613.
Sodium trisulfide	Na_2, S_3	dil. sol.	107.2
Sodium trithionate	Na_2, S_3, O_6	dil. sol.	392.
Sodium trithionate	$Na_2, S_3, O_6 \cdot 3(H_2, O)$	solid	606.7
Sodium tungstate	Na_2, W, O_4	solid	391.
Sodium tungstate	Na_2, W, O_4	dil. sol.	381.3
Sodium tungstate	Na_2O, WO_3	solid	94.7
Sodium uranate	Na_2, U, O_4	solid	500.
Sodium vanadate	Na_3, V, O_4	solid	450.
Sodium zincate	Na_2, Zn, O_2	solid	185.9
Stannic acid	H_4, Sn, O_4	colloid.	324.3
Stannic acid	$H_2O, SnO_2 = H_2SnO_3$	solid	133.5
Strontium acetate	Sr, C_4, H_6, O_4	solid	359.62
Strontium amide	Sr, N_2, H_4	solid	82.68
Strontium arsenate	Sr_3, As_2, O_8	ppt.	795.7
Strontium bromide	Sr, Br_2	solid	171.09
Strontium bromide	Sr, Br_2	dil. sol.	187.3
Strontium carbonate	Sr, C, O_3	amorph.	278.1
Strontium carbonate	Sr, C, O_3	cryst.	279.2
Strontium carbonate	Sr, C, O_3	ppt.	291.3
Strontium carbonate	SrO, CO_2	solid	57.3
Strontium chloride	Sr, Cl_2	solid	197.85
Strontium chloride	Sr, Cl_2	dil. sol.	209.13
Strontium cyanide	Sr, C_2, N_2	dil. sol.	60.69
Strontium dithionate	$Sr, S_2, O_6 \cdot 4(H_2, O)$	solid	693.0
Strontium dithionate	$Sr, 2SO_2, O_2 \cdot 4H_2O$	solid	274.56
Strontium fluoride	Sr, F_2	ppt.	288.89
Strontium formate	Sr, C_2, H_2, O_4	solid	327.4
Strontium hydride	Sr, H_2	solid	42.06
Strontium hydroxide	Sr, O_2, H_2	solid	228.7
Strontium hydroxide	Sr, O_2, H_2	dil. sol.	239.3
Strontium hydroxide	$Sr, O_2, H_2 \cdot 8(H_2, O)$	solid	800.48
Strontium hydroxide	Sr, O, H_2O	solid	146.14
Strontium hydroxide	SrO, H_2O	solid	19.84
Strontium iodide	Sr, I_2 (solid)	solid	136.2
Strontium iodide	Sr, I_2	dil. sol.	156.8
Strontium iodide	Sr, I_2, (gas)	solid	142.5
Strontium nitrate	Sr, N_2, O_6	solid	233.2
Strontium nitrate	$Sr, N_2, O_6 \cdot 4(H_2, O)$	solid	514.3
Strontium nitride	Sr, N_6	solid	−48.98
Strontium nitride	Sr_3, N_2	solid	92.23
Strontium oxalate	$Sr, C_2, O_4; 2\frac{1}{2}H_2O$	solid	503.5
Strontium oxide	Sr, O	solid	140.7
Strontium peroxide	Sr, O_2	solid	153.2
Strontium phosphate	Sr_3, P_2, O_8	solid	980.
Strontium selenide	Sr, Se	solid	83.4
Strontium silicate	Sr, Si, O_3	fused	363.2
Strontium sulfate	Sr, S, O_4	solid	345.3
Strontium sulfide	Sr, S	solid	113.1
Strontium sulfide	Sr, S	dil. sol.	120.3
Strontium thiohydrate	Sr, H_2, S_2	dil. sol.	137.9
Sulfur bromide	S_2, Br_2	liq.	4.0

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Sulfur chloride	S_2, Cl_2	liq.	14.34
Sulfur chloride	S_2, Cl_2	gas	5.64
Sulfur chloride	S_2, Cl_4	liq.	24.1
Sulfur dioxide	S, O_2	gas	70.92
Sulfur dioxide	S, O_2	liq.	77.0
Sulfur dioxide	S, O_2	dil. sol.	79.0
Sulfur heptoxide	S_2, O_7	solid	193.4
Sulfur heptoxide	$2SO_3$, O	solid	−9.71
Sulfur iodide	S_2, I_2	solid	0.0
Sulfur oxychloride (ic)	S, O_2, Cl_2	liq.	92.9
Sulfur oxychloride (ic)	SO_2, Cl_2	liq.	18.7
Sulfur oxychloride (ous)	S, O, Cl_2	gas	42.7
Sulfur oxychloride (ous)	S, O, Cl_2	liq.	50.2
Sulfur pentoxy dichloride	S_2, O_5, Cl_2	liq.	166.5
Sulfur trioxide	S, O_3	solid	105.2
Sulfuric acid	H_2, S, O_4	liq.	193.75
Sulfuric acid	H_2, S, O_4	dil. sol.	214.0
Sulfuric acid	H_2, S, O_4	solid	196.3
Sulfuric acid	H_2O, SO_3	liq.	21.3
Sulfuric acid (per)	H_2, S_2, O_8	dil. sol.	318.5
Sulfuric acid (pyro)	H_2, S_2, O_7	liq.	299.6
Sulfuric acid (thio)	H_2, S_2, O_3	dil. sol.	141.7
Sulfurous acid	H_2, S, O_3	dil. sol.	146.7
Tantalum oxide	Ta_2, O_5	solid	499.
Telluric acid	H_2, Te, O_4	dil. sol.	165.3
Telluric acid	H_2, Te, O_4·2(H_2, O)	solid	305.4
Tellurium bromide	Te, Br_4	solid	49.3
Tellurium chloride	Te, Cl_4	solid	77.42
Tellurium hydride	Te, H_2	gas	−33.93
Tellurium oxide (di)	Te, O_2	solid	77.58
Tellurium oxide (tri)	Te, O_3	solid	83.15
Tellurous acid	H_2, Te, O_3	solid	144.8
Thallium acetate	Tl, C_2, H_3, O_2	dil. sol.	116.6
Thallium acid fluoride	Tl, H, F_2	dil. sol.	191.2
Thallium bromide	Tl, Br	solid	41.5
Thallium bromide (ic)	Tl, Br_3	dil. sol.	58.1
Thallium chloride	Tl, Cl	solid	48.70
Thallium chloride	Tl, Cl	dil. sol.	38.47
Thallium chloride (ic)	Tl, Cl_3	solid	82.4
Thallium chloride (ic)	Tl, Cl_3	dil. sol.	89.176
Thallium fluoride	Tl, F	dil. sol.	77.30
Thallium fulminate	Tl, O, N, C	solid	−26.05
Thallium hydroxide	Tl, O, H	solid	56.87
Thallium hydroxide (ic)	Tl, O_3, H_3	solid	145.07
Thallium hydroxide (ic)	Tl_2, O_3, $3H_2O$	solid	2×43.17
Thallium iodide	Tl, I	solid	31.1
Thallium iodide (ic)	Tl, I_3	dil. sol.	10.82
Thallium nitrate	Tl, N, O_3	solid	58.81
Thallium nitrate	Tl, N, O_3	dil. sol.	48.84
Thallium nitride	Tl, N_3	solid	−54.72
Thallium oxide	Tl_2, O	solid	42.3
Thallium selenide	Tl_2, Se	solid	18.
Thallium sulfate	Tl_2, S, O_4	solid	221.8
Thallium sulfate	Tl_2, S, O_4	dil. sol.	214.
Thallium sulfate	Tl_2, SO_2, O_2	solid	149.9

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Thallium sulfide	Tl_2, S	solid	21.98
Thallium telluride	Tl_2, Te	solid	7.17
Thiocyanic acid	H, C, N, S	dil. sol.	−18.4
Thionic acid (di)	H_2, S_2, O_6	dil. sol.	274.31
Thionic acid (penta)	H_2, S_5, O_6	dil. sol.	267.62
Thionic acid (tetra)	H_2, S_4, O_6	dil. sol.	262.37
Thionic acid (tri)	H_2, S_3, O_6	dil. sol.	261.89
Thorium bromide	Th, Br_4	solid	281.0
Thorium bromide	Th, Br_4	dil. sol.	351.7
Thorium carbonate	Th, C_2, O_6	solid	855.2
Thorium chloride	Th, Cl_4	solid	335.0
Thorium chloride	Th, Cl_4	dil. sol.	392.12
Thorium hydride	Th, H_4	solid	−42.77
Thorium hydroxide	Th, O_4, H_4	ppt.	325.1
Thorium iodide	Th, I_4	dil. sol.	291.8
Thorium oxide	Th, O_2	solid	293.
Thorium oxybromide	Th, O, Br_2	solid	318.8
Thorium oxychloride	Th, O, Cl_2	solid	336.9
Thorium oxyiodide	Th, O, I_2	solid	289.6
Thorium sulfate	Th, S_2, O_8	dil. sol.	661.9
Tin bromide (ic)	Sn, Br_4	liq.	91.8
Tin bromide (ic)	Sn, Br_4	solid	94.8
Tin bromide (ic)	Sn, Br_4	dil. sol.	111.6
Tin bromide (ous)	Sn, Br_2	solid	61.41
Tin bromide (ous)	Sn, Br_2	dil. sol.	60.0
Tin chloride (ic)	Sn, Cl_4	liq.	127.4
Tin chloride (ic)	Sn, Cl_4	gas	118.3
Tin chloride (ous)	Sn, Cl_2	solid	81.15
Tin hydroxide (ous)	Sn, O_2, H_2	colloid.	136.4
Tin iodide (ous)	Sn, I_2	solid	38.9
Tin oxide (ic)	Sn, O_2	solid	138.1
Tin oxide (ous)	Sn, O	solid	67.7
Tin sulfide (ous)	Sn, S	solid	22.7
Titanium chloride	Ti, Cl_4	liq.	181.4
Titanium oxide	Ti, O_2	amorph.	215.6
Titanium oxide	Ti, O_2	cryst.	218.4
Tungsten dioxide	W, O_2	solid	130.5
Tungsten pentoxide	W_2, O_5	solid	324.
Tungsten trioxide	W, O_3	solid	195.7
Tungstic acid	H_2, W, O_4	solid	284.5
Tungstic acid	H_2, W, O_4	dil. sol.	284.4
Uranium carbide	U, C_2	solid	28.91
Uranium dioxide	U, O_2	solid	256.6
Uranium octoxide	U_3, O_8	solid	845.2
Uranium tetroxide	U, O_4·2(H_2, O)	solid	426.0
Uranium trioxide	U, O_3	solid	291.6
Uranyl acetate	U, O_2, C_4, H_6, O_4	dil. sol.	476.5
Uranyl acetate	U, O_2, C_4, H_6, O_4·2H_2O	solid	617.7
Uranyl chloride	U, O_2, Cl_2	dil. sol.	320.2
Uranyl chloride	U, O_2, Cl_2·H_2O	solid	382.3
Uranyl chromate	U, O_2, Cr, O_4	dil. sol.	444.9
Uranyl chromate	U, O_2, Cr, O_4·5½H_2O	solid	827.5
Uranyl nitrate	U, O_2, N_2, O_6	solid	322.1
Uranyl nitrate	U, O_2, N_2, O_6	dil. sol.	341.0
Uranyl sulfate	U, O_2, S, O_4	dil. sol.	455.0

HEATS OF FORMATION OF INORGANIC COMPOUNDS

Name	Formula	Physical state	Heat of formation in kg. calories
Uranyl sulfate	$U, O_2, S, O_4 \cdot 3(H_2, O)$	solid	655.6
Vanadium dichloride	V, Cl_2	solid	147.2
Vanadium dioxide	V_2, O_2	solid	195.
Vanadium pentoxide	V_2, O_5	solid	437.3
Vanadium tetrachloride	V, Cl_4	liq.	165.
Vanadium tetroxide	V_2, O_4	solid	383.
Vanadium trichloride	V, Cl_3	liq.	187.1
Vanadium trioxide	V_2, O_3	solid	330.
Vanadyl chloride	V, O, Cl_3	liq.	201.2
Zinc acetate	Zn, C_4, H_6, O_4	solid	261.17
Zinc acetate	$Zn, C_4, H_6, O_4 \cdot 2(H_2O)$	solid	403.59
Zinc bromide	Zn, Br_2	solid	78.4
Zinc bromide	Zn, Br_2	dil. sol.	92.95
Zinc carbonate	Zn, C, O_3	ppt.	194.2
Zinc chloride	Zn, Cl_2	solid	99.547
Zinc chloride	Zn, Cl_2	dil. sol.	115.27
Zinc cyanide	Zn, C_2, N_2	solid	−16.2
Zinc cyanide	$Zn, (CN)_2$	solid	53.4
Zinc dithionate	$Zn, S_2, O_6 \cdot 6(H_2, O)$	solid	723.5
Zinc dithionate	$Zn, 2SO_2, O_2 \cdot 6H_2, O$	solid	173.85
Zinc ethyl	Zn, C_4, H_{10}	liq.	10.0
Zinc fluoride	Zn, F_2	solid	144.0
Zinc fluoride	Zn, F_2	dil. sol.	192.31
Zinc formate	Zn, C_2, H_2, O_4	solid	231.3
Zinc hydroxide	Zn, O_2, H_2	solid	155.
Zinc hydroxide	ZnO, H_2O	solid	2.4
Zinc iodide	Zn, I_2	solid	49.70
Zinc iodide	Zn, I_2	dil. sol.	61.41
Zinc nitrate	Zn, N_2, O_6	dil. sol.	134.7
Zinc nitrate	$Zn, N_2O_4, O_2 \cdot 6H_2O$	solid	140.82
Zinc nitride	Zn, N_6	solid	−50.9
Zinc oxalate	$Zn, C_2, O_4 \cdot 2H_2O$	solid	373.2
Zinc oxide	Zn, O	solid	85.0
Zinc potassium sulfate	$ZnSO_4, K_2SO_4$	solid	4.145
Zinc selenide	Zn, Se	cryst.	29.6
Zinc selenide	Zn, Se	solid	33.45
Zinc selenide	Zn, Se	ppt.	30.3
Zinc silicate	Zn, Si, O_3	solid	282.6
Zinc silicate	ZnO, SiO_2	cryst.	23.74
Zinc silicate	$2ZnO, SiO_2$	glassy	2.49
Zinc sulfate	Zn, S, O_4	solid	233.4
Zinc sulfate	Zn, S, O_4	dil. sol.	252.
Zinc sulfate	Zn, SO_2, O_2	solid	158.99
Zinc sulfate	$Zn, S, O_4 \cdot 7(H_2,O)$	solid	734.8
Zinc sulfide	Zn, S	cryst.	44.0
Zinc sulfide	Zn, S	solid	45.88
Zinc sulfide	Zn, S	ppt.	44.3
Zinc sulfide	$Zn, S \cdot xH_2O$	solid	39.57
Zinc telluride	Zn, Te	cryst.	33.21
Zirconium carbide	Zr, C	solid	44.
Zirconium oxide	Zr, O_2	solid	258.1

FREE ENERGIES AND HEATS OF FORMATION OF COMPOUNDS

In gram-calories per mole at 25°C.

Name and Formula	ΔF°	ΔH
Acetaldehyde, C_2H_4O (g)	-32,000	.....
" C_2H_4O (l)	-31,880	.....
Acetate ion, $CH_3CO_2^-$	-89,720	.....
Acetic acid, $C_2H_4O_2$ (g)	-91,230	.....
" $C_2H_4O_2$ (l)	-94,500	-117,200
" $C_2H_4O_2$ (aq.)	-96,210	.....
anhydride, $C_4H_6O_3$ (l)	-104,200	.....
Acetone, C_3H_6O (g)	-36,500	.....
" C_3H_6O (l)	-37,220	.....
Acetylene, C_2H_2 (g)	50,840	.....
Ammonia, NH_3 (g)	-3,910	-10,950
" NH_3 (l)	-2,620	-16,258
" NH_3 (s)	-1,585	-15,109
" NH_3 (aq.)	-6,300	.....
Ammonium chloride, NH_4Cl (s)	-47,810	.....
hydroxide, NH_4OH (aq.)	-62,860	-87,800
ion, NH_4^+	-18,930	.....
Amyl acetate (*n*), $C_7H_{14}O_2$ (l)	-77,900	.....
alcohol (*tert*), $C_5H_{12}O$ (l)	-47,600	-96,460
" (*n*), $C_5H_{12}O$ (l)	-39,100	-86,060
butyrate (*n*), $C_9H_{18}O_2$ (l)	-74,900	.....
Aniline, C_6H_7N (l)	35,400	7,340
Anthracene, $C_{14}H_{10}$ (s)	64,800	27,600
l-Asparagine, $C_4H_8O_3N_2$ (s)	-125,200	-187,100
" hydrate, $C_4H_{10}O_4N_2$ (s)	-183,300	-259,100
l-Aspartic acid, $C_4H_7O_4N$ (s)	-173,500	-231,340
Auric oxide, Au_2O_3 (s)	19,100	.....
Benzene, C_6H_6 (g)	30,640	.....
" C_6H_6 (l)	29,400	11,630
Benzoate ion, $C_6H_5CO_2^-$	-52,250	.....
Benzoic acid, $C_7H_6O_2$ (l)	-59,160	.....
" acid, $C_7H_6O_2$ (s)	-60,100	-93,210
" acid, $C_7H_6O_2$ (aq.)	-57,950	.....
Benzophenone, $C_{13}H_{10}O_2$ (s)	31,400	-10,000
Benzoquinone, $C_6H_4O_2$ (s)	-21,410	.....
Bicarbonate ion, HCO_3^-	-140,000	.....
Bromate ion, BrO_3^-	2,300	.....
Bromine, Br_2 (aq.)	-977	-1,190
Butane (*n*), C_4H_{10} (g)	-6,200	-32,100
Butyl acetal (*n*), $C_{10}H_{22}O_2$ (l)	-56,400	.....
alcohol (*n*), $C_4H_{10}O$ (l)	-40,400	-79,610
" (*tert*), $C_4H_{10}O$ (l)	-45,000	.....
benzene (*n*), $C_{10}H_{14}$ (l)	27,500	-18,670
" (*tert*), $C_{10}H_{14}$ (l)	29,000	-20,170
bromide (*iso*), C_4H_9Br (l)	-4,600	.....
" (*tert*), C_4H_9Br (l)	-5,600	.....
Butylene (*iso*), C_4H_8 (g)	15,000	.....
Butyric acid (*n*), $C_4H_8O_2$ (l)	-91,500	-128,800
Cadmium chloride, $CdCl_2$ (s)	-82,260	.....
iodide, CdI_2 (s)	-48,169	.....
ion, Cd^{++}	-18,348	.....
Carbon, diamond, C	390	180
dioxide, CO_2 (g)	-94,260	-94,400
" CO_2 (aq.)	-92,250	.....
disulfide, CS_2 (g)	17,600	.....

FREE ENERGIES AND HEATS OF FORMATION OF COMPOUNDS

Name and Formula	ΔF°	ΔH
Carbon, disulfide, CS_2 (l)	17,150	.....
monoxide, CO (g)	-32,510	-26,400
tetrachloride, CCl_4 (l)	-15,600	.....
Carbonate ion, CO_3^{--}	-125,760	.....
Carbonic acid, H_2CO_3 (aq.)	-148,810	-167,500
Carbonyl chloride, $COCl_2$ (g)	-48,960	.....
sulfide, COS (g)	-39,800	.....
Chlorate ion, ClO_3^-	-250	.....
Chlorine, Cl (aq.)	1,650	-5,300
Chlorobenzene, C_6H_5Cl (l)	27,800	.....
Copper, Cu (s)	63,210	66,480
Creatinine, $C_4H_7ON_3$ (s)	-2,900	-52,800
Cupric hydroxide, $Cu(OH)_2$ (s)	-85,090	.....
ion, Cu^{++}	15,912	.....
oxide, CuO (s)	-30,300	37,160
sulfate, $CuSO_4$ (s)	-155,850	-182,600
" $CuSO_4 \cdot 5H_2O$ (s)	-445,960	-542,710
sulfide, CuS (s)	-11,620	-11,610
Cuprous chloride, CuCl (s)	-28,440	.....
oxide, Cu_2O (s)	-35,000	-40,810
sulfide (α), Cu_2S	-19,110	-18,970
" (β), Cu_2S	-18,970	-18,500
Cyanate ion, CNO^-	-23,630	.....
Cyanic acid, HCNO (aq.)	-28,980	.....
Cyanide ion, CN^-	39,140	.....
Cyanogen, C_2N_2 (g)	92,000	70,700
Cyanogen iodide, CNI (s)	42,550	.....
Cyclohexane, C_6H_{12} (g)	8,030	.....
" C_6H_{12} (l)	6,800	-36,700
Cyclohexanol, $C_6H_{12}O$ (l)	-34,300	-85,600
Cyclohexene, C_6H_{10} (l)	18,200	-15,290
p-Cymene, $C_{10}H_{14}$ (l)	24,600	-22,570
n-Decane, $C_{10}H_{22}$ (l)	-2,900	-78,610
Dibenzoyl ethane, $C_{16}H_{14}O_2$ (s)	-2,500	-65,300
ethylene, $C_{16}H_{12}O_2$ (s)	21,500	-32,400
Dibenzyl, $C_{14}H_{14}$ (s)	60,800	9,470
Di-*iso*-butylene, C_8H_{16}	21,800	-34,500
Dimethyl acetal, $C_4H_{10}O_2$ (l)	-55,600	.....
1, 2-Dimethylcyclopentane, C_7H_{14} (l)	1,000	-47,650
Dimethyl ether, C_2H_6O (g)	-26,350	.....
Dinitrobenzene (*o*) $C_6H_4O_4N_2$ (s)	49,400	1,000
" (*m*), $C_6H_4O_4N_2$ (s)	42,900	-5,200
Diphenyl, $C_{12}H_{10}$ (l)	57,900	.....
" $C_{12}H_{10}$ (s)	57,400	20,870
Diphenylmethane, $C_{13}H_{12}$ (s)	63,600	19,720
Diphenyl carbinol, $C_{13}H_{12}O$ (s)	30,700	-20,380
n-Dodecane, $C_{12}H_{26}$ (l)	3,900	-90,450
Dulcitol, $C_6H_{14}O_6$ (s)	-223,100	-317,710
Durene, $C_{10}H_{14}$ (l)	19,700	.....
" $C_{10}H_{14}$ (s)	19,000	-32,570
" (*iso*) $C_{10}H_{14}$ (l)	15,900	-31,070
dl-Erythritol, $C_4H_{10}O_4$ (s)	-149,400	-214,810
Ethane, C_2H_6 (g)	-10,700	.....
Ether, $(C_2H_5)_2O$ (g)	-28,090	.....
" $(C_2H_5)_2O$ (l)	-28,300	.....
Ethyl acetal, $C_6H_{14}O_2$ (l)	-55,800	.....
acetate, $C_2H_8O_2$ (g)	-76,360	.....

FREE ENERGIES AND HEATS OF FORMATION OF COMPOUNDS

Name and Formula	ΔF°	ΔH
Ethyl acetate, $C_2H_8O_2$ (l)	−77,600	.....
alcohol, C_2H_6O, (g)	−38,690	.....
" C_2H_6O (l)	−40,200	−64,710
" C_2H_6O (aq. 1 M)	−41,850	.....
benzene, C_8H_{10} (l)	26,300	−5,070
bromide, C_2H_5Br (l)	−6,180	.....
n-butyrate, $C_6H_{12}O_2$ (l)	−76,000	.....
Ethylene, C_2H_4 (g)	12,300	.....
glycol, $C_2H_6O_2$ (l)	−80,200	−111,610
iodide, C_2H_5I (s)	9,830	.....
Ethyl mercaptan, C_2H_6S (l)	800	.....
sulfide, $C_4H_{10}S$ (l)	5,300	.....
Ferric ion, Fe^{+++}	−3,120	.....
Ferrous ion, Fe^{++}	−20,240	.....
Formaldehyde, CH_2O (g)	−26,100	.....
" CH_2O (aq.)	−31,020	.....
Formic acid, CH_2O_2 (g)	−82,520	.....
" " CH_2O_2 (l)	−85 150	.....
" " CH_2O_2 (aq.)	−88,110	.....
Fumarate ion, $C_4H_2O_4^{--}$	−144,620	.....
Fumaric acid, $C_4H_4O_4$ (s)	−156,700	−194,280
" " $C_4H_4O_4$ (aq.)	−154,800	.....
d-Glucose, $C_6H_{12}O_6$ (aq.)	−217,020	.....
" (α), $C_6H_{12}O_6$ (s)	−215,800	.....
" (β), $C_6H_{12}O_6$ (s)	−215,400	.....
d-Glutamic acid, $C_5H_9O_4N$ (s)	−170,400	−236,600
Glycerol, $C_3H_8O_3$ (l)	−113,600	−159,160
Glycine, $C_2H_5O_2N$ (s)	−87,800	−125,460
Heptane (*n*), C_7H_{16} (l)	−3,000	−56,760
3-Ethyl pentane, C_7H_{16} (l)	−1,800	−56,760
3, 3-Dimethyl pentane, C_7H_{16} (l)	−2,400	−58,760
2, 4-Dimethyl pentane, C_7H_{16} (l)	−1,300	−57,760
2, 2-Dimethyl pentane, C_7H_{16} (l)	−1,800	−58,760
2, 3-Dimethyl pentane, C_7H_{16} (l)	−2,100	−57,760
2-Methyl hexane, C_7H_{16} (l)	−3,000	−57,760
3-Methyl hexane, C_7H_{16} (l)	−2,600	−57,760
2, 2, 3-Trimethyl butane, C_7H_{16} (l)	−800	−58,760
Hexamethylbenzene, $C_{12}H_{18}$ (l)	26,900	.....
" $C_{12}H_{18}$ (s)	25,200	−41,170
Hexamethylethane, C_8H_{18} (l)	−1,500	.....
" C_8H_{18} (s)	1,200	−67,410
n-Hexane, C_6H_{14} (l)	−7,000	−53,410
n-Hexyl alcohol, $C_6H_{14}O$ (l)	−38,100	−92,410
n-Hexylene, C_6H_{12} (l)	14,900	−23,000
Hydrocyanic acid, HCNO (aq.)	−29,100	.....
Hydrogen bromide, HBr (g)	−12,540	−8,650
Hydrogen bromide, HBr (aq.)	−24,595	.....
chloride, HCl (g)	−22,692	$-22{,}000_{291\text{-}1}$
" HCl (aq.)	−31,367	.....
cyanide, HCN (g)	28,670	.....
" HCN (l)	28,870	.....
" HCN (aq.)	27,520	23,890
fluoride, HF (g)	−31,800	.....
" HF (aq.)	1,000	.....
iodide, HI (g)	315	5,920
" HI (aq.)	−12,361	.....
peroxide, H_2O_2 (l)	−28,230	−44,500

FREE ENERGIES AND HEATS OF FORMATION OF COMPOUNDS

Name and Formula	ΔF°	ΔH
Hydrogen peroxide, H_2O_2 (aq.)	−31,470	−45,000
sulfide, H_2S (g)	−7,840	−5,260
" H_2S (aq.)	−6,490	−9,870
Hydroquinone, $C_6H_6O_2$ (s)	−52,700	−87,570
Hydrosulfide ion, HS^-	2,980	.....
Hypobromous acid, HBrO (aq.)	−19,680	.....
Hypochlorite ion, ClO^-	−6,500	.....
Hypochlorous acid, HClO (aq.)	−19,018	−29,800
Hypoiodous acid, HIO (aq.)	−23,170	.....
Iodate ion, IO_3^-	−31,580	.....
Iodic acid, HIO_3 (aq.)	−31,580	.....
Iodine, I_2 (aq.)	3,926	5,500
Lactic acid (*dl*), $C_3H_6O_3$ (l)	−124,400	−161,650
Lead, Pb (g)	41,764	.....
" " (l)	533	.....
bromide, $PbBr_2$ (s)	−62,063	.....
carbonate, $PbCO_3$ (s)	−149,000	.....
chloride, $PbCl_2$ (s)	−74,990	−85,600
hydroxide, $Pb(OH)_2$ (aq.)	−96,888	.....
iodide, PbI_2 (s)	−41,510	.....
ion, Pb^{++}	−5,551	.....
oxide, PbO (s)	−41,000	−52,400
oxide, Pb_3O_4 (s)	−147,342	.....
oxide, di-, PbO_2 (s)	−52,070	.....
sulfate, $PbSO_4$	−176,500	.....
sulfide, PbS (s)	18,000	.....
l-Malate ion, $C_4H_4O_5^{--}$	−201,850	.....
Maleic acid, $C_4H_4O_2$ (s)	−149,400	−187,480
l-Mali acid, $C_4H_6O_5$ (s)	−211,450	.....
" " $C_4H_6O_5$ (aq.)	−213,570	.....
Mannitol, $C_6H_{14}O_6$ (s)	−222,200	−316,510
Mercuric chloride, $HgCl_2$ (g)	−34,569	−36,658
" " $HgCl_2$ (l)	−41,932	−51,938
" " $HgCl_2$ (s)	−43,550	−55,428
oxide, HgO (s)	−13,808	−21,750
Mercurous chloride, Hg_2Cl_2 (s)	−50,274	−63,000
iodide, HgI (s)	−13,290	.....
sulfate, Hg_2SO_4 (s)	−162,100	.....
Mercury, Hg (g)	7,632	14,690
Methane, CH_4 (g)	−12,200	−18,070
Methyl alcohol, CH_4O (g)	−38,890	.....
" " CH_4O (l)	−39,960	.....
cyclohexane, C_7H_{14} (l)	3,600	−46,550
cyclopentane, C_6H_{12} (l)	2,700	−37,800
formate, $C_2H_4O_2$ (g)	−70,850	.....
" $C_2H_4O_2$ (l)	−71,010	.....
nitrite, CH_3O_2N (g)	200	.....
Naphthalene, $C_{10}H_8$ (l)	45,900	.....
" $C_{10}H_8$ (s)	45,200	15,960
Nitrate ion, NO_3^-	−26,500	.....
Nitric acid, HNO_3 (g)	−18,210	.....
" " HNO_3 (aq.)	−26,500	.....
oxide, NO (g)	20,850	21,500
" NO (l)	24,594	20,228
" NO (s)	26.398	17,926
Nitrite ion, NO_2^-	−8,500	.....
Nitroaniline (o), $C_6H_6O_2N_2$ (s)	41,400	−4,600

FREE ENERGIES AND HEATS OF FORMATION OF COMPOUNDS

Name and Formula	ΔF°	ΔH
Nitroaniline (*m*), $C_6H_6O_2N_2$ (s)	40,400	−5,600
" (*p*), $C_6H_6O_2N_2$ (s)	36,400	−9,600
Nitrobenzene, $C_6H_5O_2N$ (l)	36,400	.....
Nitrobenzoic acid (*o*), $C_7H_5O_4N$ (s)	−48,400	−95,600
" acid (*m*), $C_7H_5O_4N$ (s)	−54,200	−101,600
" acid (*p*), $C_7H_5O_4N$ (s)	−55,500	−102,600
Nitrogen, N_2 (aq.)	4,358	.....
dioxide, NO_2 (g)	11,920	8,018
tetroxide, N_2O_4 (g)	23,853	1,870
Nitrosyl chloride, NOCl (g)	16,010	.....
Nitrous acid, HNO_2 (aq.)	−13,070	.....
Octane (*n*), C_8H_{18} (g)	−630	.....
" (*n*), C_8H_{18} (l)	−3,000	−64,210
2, 2, 4-Trimethyl pentane, C_8H_{18} (l)	−800	−65,310
n-Octyl alcohol, $C_8H_{18}O$ (l)	−35,100	.....
Oxalic acid, $H_2C_2O_4$ (s)	−165,900	−196,690
Ozone, O_3 (g)	32,400	34,400
Palmitic acid, $C_{16}H_{32}O_2$ (*l*)	78,560	.....
" " $C_{16}H_{32}O_2$ (s)	−80,000	−215,800
Pentacosane, $C_{25}H_{52}$ (l)	15,000	.....
" $C_{25}H_{52}$ (s)	13,400	−190,560
Pentamethyl benzene, $C_{11}H_{16}$ (s)	21,900	−35,920
Pentane (*n*), C_5H_{12} (l)	−8,600	−47,960
2-Methyl butane, C_5H_{12}, (l)	−3,300	−43,060
Phenanthrene, $C_{14}H_{10}$ (s)	60,000	23,100
Phenol, C_6H_6O (s)	−11,000	−38,370
Picric acid, $C_6H_3O_7N_3$ (s)	10,000	.....
Potassium chlorate, $KClO_3$ (s)	−69,250	−89,800
Prehnitene, $C_{10}H_{14}$ (l)	20,200	−28,170
Propyl acetal (*n*), $C_8H_{18}O_2$ (l)	−57,200	.....
" " (*iso*), $C_8H_{18}O_2$ (l)	−61,900	.....
alcohol (*n*), C_3H_8O (l)	−40,900	−72,860
" (*iso*), C_3H_8O (l)	−44,000	−76,860
Propylene, C_3H_6 (g)	14,800	4,550
Pseudocumene, C_9H_{12} (1)	21,000	−18,220
Pyrocatechol, $C_6H_6O_2$ (s)	−51,400	−85,570
Quinhydrone, $C_{12}H_{10}O_4$ (s)	−77,190	.....
Resorcinol, $C_6H_6O_2$ (s)	−53,200	−87,570
Silicon tetrachloride, $SiCl_4$ (l)	−113,710	−128,100
Silver bromide, AgBr (s)	−22,910	.....
chloride, AgCl (s)	−26,187	−30,600
cyanide, AgCN (s)	38,499	.....
iodide, AgI (s)	−15,820	.....
ion, Ag^+	18,448	.....
nitrite, $AgNO_2$ (s)	4,900	.....
oxide, Ag_2O (s)	−2,395	−6,950
Sodium chloride, NaCl (s)	91,792	−98,300
Stannic chloride, $SnCl_4$ (l)	−113,210	−128,010
Stilbene, $C_{14}H_{12}$ (s)	75,800	32,380
Succinate ion, $C_4H_4O_4^{--}$	−165,090	.....
Succinic acid, $C_4H_6O_4$ (s)	−178,800	−224,990
" " $C_4H_6O_4$ (aq.)	−178,510	.....
Sucrose, $C_{12}H_{22}O_{11}$ (s)	−371,600	.....
Sulfate ion, SO_4^{--}	−176,500	.....
Sulfide ion, S^{--}	23,450	.....
Sulfite ion, SO_3^{--}	−116,680	.....
Sulfur, S (monocl.)	18	69.3

FREE ENERGIES AND HEATS OF FORMATION OF COMPOUNDS

Name and Formula	ΔF°	ΔH
Sulfur dioxide, SO_2 (g)	-69,660	-69,300
" " SO_2 (aq.)	-69,770	.....
trioxide, SO_3 (g)	-85,890	-91,500
Sulfuric acid, H_2SO_4 (aq.)	-176,500	.....
Sulfurous acid, H_2SO_3 (aq.)	-126,330	-145,000
Sulfuryl chloride, SO_2Cl_2 (g)	-71,560	.....
Tetraphenyl methane, $C_{25}H_{20}$ (s)	137,700	62,200
Thallous bromide, TlBr (s)	-39,770	.....
chloride, TlCl (s)	-44,195	.....
hydroxide, TlOH (s)	-45,400	.....
iodide, TlI (s)	-30,020	.....
Thiophene, C_4H_4S (l)	26,300	.....
Thiosulfate ion, $S_2O_3^{--}$	-125,110	.....
Toluene, C_7H_8 (l)	26,500	2,180
Trimethyl ethylene, C_5H_{10} (l)	13,700	-17,050
Triphenyl-amine, $C_{18}H_{15}N$ (s)	120,500	58,700
bromomethane, $C_{19}H_{15}Br$ (s)	107,700	.....
carbinol, $C_{19}H_{16}O$ (s)	69,700	3,960
chloromethane, $C_{19}H_{15}Cl$ (s)	100,600	.....
ethylene, $C_{20}H_{16}$ (s)	123,000	64,220
methane, $C_{19}H_{16}$ (s)	101,400	41,760
Urea, CH_4N_2O (s)	-47,120	.....
" CH_4N_2O (aq.)	-48,720	.....
Water, H_2O (g)	-54,507	-57,800
" H_2O (l)	-56,560	-68,270
Xylene (*o*), C_8H_{10} (l)	27,300	-4,670
" (*m*), C_8H_{10} (l)	27,000	-4,670
" (*p*), C_8H_{10} (l)	23,200	-8,470
Zinc ion, Zn^{++}	-17,492	.....
oxide, ZnO (s)	-75,720	.....

SURFACE TENSIONS OF METALS AND FUSED SALTS

The table below gives the surface tension of various metals and fused salts in contact with an atmosphere as indicated; temperature °C.

Formula	Surface Tension in Dynes per Centimeter		
Ag — air	$800^{970°}$	.....	.....
AgBr — air	$121.4^{434°}$	.....	.....
AgCl — air	$125.5^{452°}$	$121.6^{494°}$	$112.8^{573°}$
Au — air	$(580\text{-}1000)^{1070°}$	.....	.....
$BaCl_2$ — air	$171^{962°}$	.....	.....
Bi — H_2	$388^{300°}$	$354^{583°}$	.....
$BiCl_3$ — N_2	$66.2^{271°}$	$58.1^{331°}$	$52.0^{382°}$
$CaCl_2$ — air	$152^{772°}$	.....	.....
Cd — H_2	$621.5^{450°}$	$618.3^{500°}$	.....
CsBr — N_2	$81.8^{658°}$	$71.6^{808°}$	$62.7^{971°}$
CsCl — N_2	$89.2^{664°}$	$73.7^{881°}$	$56.3^{1080°}$
CsF — N_2	$104.5^{723°}$	$92.3^{877°}$	$78.9^{1100°}$
CsI — N_2	$73.1^{654°}$	$62.5^{821°}$	$51.1^{1030°}$
$CsNO_3$ — N_2	$91.8^{426°}$	$83.7^{511°}$	$72.5^{686°}$
Cs_2SO_4 — N_2	$111.3^{1036°}$	$97.3^{1221°}$	$83.0^{1530°}$
Cu — H_2	$1103^{1131°}$	.....	.....
Ga — CO_2	$358^{300°}$	.....	.....
Hg — Vac.	$480.3^{00°}$	$467.1^{600°}$	.....

SURFACE TENSIONS OF METALS AND FUSED SALTS

Formula	Surface Tension in Dynes per Centimeter		
Hg — air	487^{150}	.....	.....
Hg — H_2	470^{190}	.....	.....
Hg — CO_2	465^{150}	.....	.....
K — CO_2	411^{620}		
KBO_2 — N_2	123.5^{9920}	112.3^{10360}	96.6^{11420}
KBr — N_2	85.7^{7750}	82.0^{8260}	75.4^{9200}
KCN — air	$96.1^{6345.50}$	.....	.....
KCl — N_2	95.8^{8000}	82.2^{9860}	69.6^{11670}
$K_2Cr_2O_7$ — N_2	140.1^{4200}	138.4^{4800}	135.0^{5350}
KF — N_2	138.4^{9130}	119.9^{11470}	104.9^{13100}
KI — N_2	75.2^{7370}	69.2^{8120}	66.5^{8730}
K_2MoO_4 — N_2	150.5^{9310}	135.5^{11890}	112.5^{15220}
KNO_3 — N_2	110.4^{3800}	95.2^{5780}	80.2^{7720}
KPO_3 — N_2	155.5^{8970}	136.8^{11670}	100.3^{15360}
K_2SO_4 — N_2	143.7^{10700}	126.2^{13470}	106.8^{16560}
K_2WO_4 — N_2	161.0^{9250}	124.6^{12840}	105.6^{15200}
$LiBO_2$ — N_2	261.8^{8790}	243.6^{11500}	192.4^{15200}
LiCl — N_2	137.8^{6140}	123.2^{8140}	104.8^{10750}
LiF — N_2	$249.5^{8685.50}$	229.8^{10650}	201.1^{12700}
$LiNO_3$ — N_2	111.5^{3590}	106.0^{4450}	96.2^{5609}
Li_2SO_4 — N_2	223.8^{8600}	211.0^{10570}	200.3^{12140}
Li_2SiO_3 — N_2	374.6^{12540}	356.2^{14210}	346.6^{16010}
Na — CO_2	294^{900}	.....	.....
Na — Vac.	222^{1000}	211^{2500}	.....
$NaBO_2$ — N_2	193.7^{10160}	159.7^{12340}	126.2^{14410}
NaBr — N_2	105.8^{7610}	92.9^{9420}	78.0^{11660}
NaCl — N_2	113.8^{8030}	106.4^{9080}	88.0^{11720}
NaF — N_2	199.5^{10100}	180.5^{11890}	162.9^{13570}
NaI — N_2	85.6^{7060}	80.5^{8160}	77.6^{8610}
Na_2MoO_4 — N_2	214^{6990}	199^{8590}	174.6^{12120}
$NaNO_3$ — N_2	119.7^{3220}	108.9^{5130}	93.7^{7380}
$NaPO_3$ — N_2	197.5^{8270}	181.6^{10990}	147.5^{15170}
Na_2SO_4 — N_2	194.8^{9000}	188.2^{9900}	184.7^{10770}
Na_2WO_4 — N_2	203.3^{7100}	178.3^{10810}	142.6^{15950}
Pb — H_2	453^{3500}	423^{7500}	.....
$PbCl_2$ — air	138^{4900}	131^{5390}	126^{6140}
Pt — air	1819^{20000}	.....	.....
RbBr — N_2	87.7^{7290}	77.2^{8840}	60.6^{11210}
RbCl — N_2	95.7^{7500}	81.1^{9230}	61.4^{11500}
RbF — N_2	127.2^{8030}	113.0^{9360}	102.2^{10850}
RbI — N_2	79.4^{6730}	65.1^{8690}	55.4^{10160}
$RbNO_3$ — N_2	107.5^{3270}	92.5^{5270}	77.7^{7260}
Rb_2SO_4 — N_2	132.5^{10860}	118.9^{12890}	108.9^{15450}
Sb — H_2	350^{6400}	.....	.....
Sn — H_2	526^{2530}	508^{8780}	.....
$SnCl_2$ — N^2	97^{307^0}	89.0^{4050}	81.6^{4800}
$TlNO_3$ — N_2	117.3^{2100}	109.8^{3120}	99.5^{4300}
Zn — H_2	753^{4770}	747^{5430}	.....

SURFACE TENSIONS OF VARIOUS LIQUIDS

The table below gives the surface tension of various liquids in dynes per centimeter. The nature of the gas in contact with the surface of the liquid is given in parenthesis following the name of the compound. The temperature in degrees centigrade is indicated by the superscript which accompanies the value in each case.

The value k_E (Eötvös constant) $= \frac{d\Gamma}{dt} = \frac{d(M/d)^{2/3}\gamma}{dt}$, where d is the density of the substance, M is the gram formula weight, t the temperature and γ is the surface tension in dynes per centimeter.

Name	Surface Tension in Dynes per Centimeter			k_E
Acetal (air)	$23.2^{25°}$	$21.65^{200°}$	$13.5^{100°}$	....
Acetaldehyde	$22.4^{10°}$	$21.2^{200°}$	$17.0^{50°}$	1.8
Acetaldoxime	$30.1^{35°}$	$25.1^{80°}$	$17.8^{145°}$	1.5
Acetamide	$39.3^{85°}$	$37.3^{105°}$	$35.7^{120°}$	1.2
Acetic acid (air)	$28.6^{10°}$	$27.6^{200°}$	$22.2^{75°}$	1.3
Acetic acid (vapor)	$28.8^{10°}$	$27.8^{200°}$	$22.3^{75°}$	....
Acetic anhydride	$33.3^{15°}$	$32.7^{200°}$	$18.6^{140°}$	2.2
Acetone (air or vapor)	$26.2^{20°}$	$23.7^{200°}$	$18.6^{60°}$	1.9
Acetonitrile (air)	$30.6^{10°}$	$29.3^{200°}$	$20.2^{90°}$	1.5
Acetonitrile (vapor)	$30.6^{10°}$	$29.3^{200°}$	$20.2^{90°}$	....
Acetophenone (air or vapor)	$39.8^{200°}$	$33.3^{75°}$	$22.8^{175°}$	2.2
Acetylene (vapor)	$18^{-77.4}$	$16^{-70.5°}$	$14^{-62.4°}$	2.4
Allyl alcohol (air or vapor)	$27.6^{20°}$	$25.8^{200°}$	$19.2^{95°}$	1.5
Anethole (air)	$37.6^{100°}$	$36.5^{200°}$	$19.6^{200°}$	2.3
Aniline (air)	$44.0^{100°}$	$42.9^{200°}$	$24.4^{180°}$	2.1
Anisole (air)	$36.4^{100°}$	$35.2^{200°}$	$28.0^{80°}$	2.3
Ammonia	$23^{11.1°}$	$18^{34.1°}$	$13^{59°}$	1.3
iso-Amyl acetate (air)	$26.6^{20°}$	$24.7^{200°}$	$17.1^{100°}$	2.3
iso-Amyl alcohol (air)	$25.3^{20°}$	$23.8^{200°}$	$17.7^{100°}$	1.90
Argon (vapor)	$13.2^{-188°}$	$11.9^{-183°}$	.....	2.0
Benzene (air)	$31.6^{20°}$	$28.9^{200°}$	$21.3^{80°}$	2.22
Benzene (vapor)	$31.7^{20°}$	$29.02^{200°}$	$18.8^{100°}$	....
Benzonitrile (air or vapor)	$40.2^{10°}$	$39.1^{200°}$	$29.9^{100°}$	2.1
Benzylamine	$39.5^{200°}$	$36.5^{45°}$	$33.1^{75°}$	2.1
Bromine (air or vapor)	$45.0^{20°}$	$41.5^{200°}$	$36.2^{50°}$	2.0
Bromobenzene (air)	$37.7^{100°}$	$36.5^{200°}$	$27.2^{100°}$	2.19
p-Bromotoluene (air)	$32^{43°}$	$26^{100°}$	$20^{164°}$	....
iso-Butyl acetate (air)	$24.7^{5°}$	$23.3^{200°}$	$14.9^{110°}$	2.32
n-Butyl alcohol (air or vapor)	$26.2^{20°}$	$24.6^{200°}$	$17.8^{100°}$	1.91
iso-Butyl alcohol (air)	$24.4^{20°}$	$22.8^{200°}$	$20.5^{50°}$	1.94
n-Butyric acid (air)	$28.8^{20°}$	$26.8^{200°}$	$19.5^{100°}$	1.6
iso-Butyric acid (air or vapor)	$27.1^{20°}$	$25.2^{200°}$	$17.9^{100°}$	1.6
n-Butyronitrile (air)	$28.7^{10°}$	$27.6^{200°}$	$18.2^{110°}$	1.7
Carbon dioxide	$4.5^{20°}$	$1.16^{200°}$	$0.06^{30°}$	....
Carbon disulfide (air or vapor)	$35.3^{20°}$	$32.3^{200°}$	$26.5^{60°}$	2.1
Carbon monoxide (vapor)	$12.1^{-203°}$	$9.8^{-193°}$	$8.7^{-188°}$	2.0
Carbon tetrachloride (air)	$28.0^{10°}$	$26.8^{200°}$	$20.2^{75°}$	2.21
Carbon tetrachloride (vapor)	$28.2^{10°}$	$27.0^{200°}$	$17.3^{100°}$	....
Chloral	$30^{200°}$	$20^{97°}$	.....	2.2
Chlorine	$31^{-60°}$	$18^{200°}$	$13^{50°}$	2.1
Chlorobenzene (air)	$34.4^{10°}$	$33.2^{200°}$	$24.0^{100°}$	2.21
Chlorobenzene (vapor)	$34.8^{10°}$	$33.6^{200°}$	$30.0^{50°}$	....
p-Chlorobromobenzene (air)	$33^{70°}$	$27^{132°}$	$21^{194°}$	....
Chloroform (air)	$28.5^{10°}$	$27.1^{200°}$	$21.7^{60°}$	2.1
p-Chlorotoluene (air or vapor)	$32^{25°}$	$26^{79°}$	$19^{151°}$	....
o-Cresol (air or vapor)	$39.8^{10°}$	$30.4^{100°}$	$22.0^{180°}$	2.0
m-Cresol (air or vapor)	$38.4^{10°}$	$37.4^{200°}$	$22.2^{180°}$	1.8

SURFACE TENSIONS OF VARIOUS LIQUIDS

Name	Surface Tension in Dynes per Centimeter			k_E
p-Cresol	$36.7^{20°}$	$34.0^{50°}$	$29.3^{100°}$	1.7
Cyclohexane (air)	$27^{10°}$	$25.3^{20°}$	$15.7^{80°}$	2.25
Dibenzylamine	$41.1^{20°}$	$38.4^{45°}$	$35.1^{75°}$	2.9
p-Dichlorobenzene (air)	$31^{68°}$	$25^{117°}$	$20^{170°}$	....
Diethyl ketone (air)	$26.9^{0°}$	$25.3^{15°}$	$22.2^{45°}$	....
Diethyl oxalate (air or vapor)	$33.2^{10°}$	$32.0^{20°}$	$26.6^{70°}$	....
Diethyl sulfate (air)	$34.6^{13°}$	$32.5^{32.5°}$	$28.6^{70°}$	....
Diethylaniline	$34.7^{15°}$	$34.2^{20°}$	$24.9^{110°}$	....
Dimethyl sulfate (air)	$40.1^{18°}$	$35.5^{55°}$	$31.0^{93°}$	....
Dimethylamine (N_2)	$25.2^{-78°}$	$20.2^{-23°}$	$17.7^{5°}$	....
Dimethylaniline (air)	$37.7^{10°}$	$36.56^{20°}$	$27.6^{100°}$	2.4
Ethyl acetate (air)	$26.5^{0°}$	$23.9^{20°}$	$17.4^{75°}$	2.3
Ethyl acetate (vapor)	$26.9^{0°}$	$24.3^{20°}$	$14.4^{100°}$	2.3
Ethyl acetoacetate (air or vapor)	$34.8^{0°}$	$32.5^{20°}$	$25.0^{90°}$	....
Ethyl alcohol (air)	$24.05^{0°}$	$22.27^{20°}$	$18.22^{70°}$	1.0
Ethyl alcohol (vapor)	$22.75^{20°}$	$20.14^{50°}$	$15.47^{100°}$	1.3
Ethyl benzoate	$37.5^{0°}$	$35.5^{20°}$	$30.0^{75°}$	....
Ethyl bromide (air or vapor)	$25.5^{10°}$	$24.2^{20°}$	$21.5^{40°}$	2.12
Ethyl *n*-butyrate (air)	$26.1^{5°}$	$24.54^{20°}$	$20.6^{60°}$	2.42
Ethyl *iso*-butyrate (air or vapor)	$24.8^{5°}$	$23.25^{20°}$	$13.85^{110°}$	2.39
Ethyl ether	$17.0^{20°}$	$13.5^{50°}$	$7.97^{100°}$	2.25
Ethyl formate (air or vapor)	$26.2^{0°}$	$23.6^{20°}$	$16.0^{80°}$	2.1
Ethyl iodide (air or vapor)	$30.6^{10°}$	$29.4^{20°}$	$22.4^{75°}$	2.2
Ethyl mercaptan (air or vapor)	$25.4^{0°}$	$24.0^{10°}$	$22.5^{20°}$	2.1
Ethyl propionate (air or vapor)	$25.9^{5°}$	$24.2^{20°}$	$15.5^{100°}$	2.3
Ethylamine (N_2)	$28.9^{-74°}$	$23.2^{-21.5°}$	$20.3^{9.9°}$	1.25
Ethylbenzene (air)	$31.4^{0°}$	$29.2^{20°}$	$24.9^{60°}$	....
Ethylene bromide (air or vapor)	$40.05^{10°}$	$38.75^{20°}$	$28.4^{100°}$	2.2
Ethylene chloride (air)	$33.6^{10°}$	$32.2^{20°}$	$24.0^{80°}$	....
Ethylene oxide (vapor)	$35.8^{-50°}$	$29.2^{-10°}$	$24.3^{20°}$	1.8
Formic acid (air)	$38.7^{10°}$	$37.6^{20°}$	$29.0^{100°}$	0.9
Furfural (air or vapor)	$43.5^{20°}$	$40.9^{40°}$	$25.4^{160°}$	....
Glycerol (air)	$63^{20°}$	$59^{90°}$	$52^{150°}$	....
Glycol (air or vapor)	$49^{0°}$	$47.7^{20°}$	$42.3^{80°}$	....
Guaiacol (air)	$38.66^{19.6°}$	$31.9^{78°}$	$21.3^{201°}$	2.2
Helium (vapor)	$0.353^{-271.6°}$	$0.239^{-270.1°}$	$0.098^{-268.9}$	1.0
n-Hexane (air)	$20.5^{0°}$	$18.4^{20°}$	$13.4^{68°}$	2.26
Hydrogen (vapor)	$2.88^{-258.4°}$	$2.32^{-255.1}$	$1.91^{-252.7}$	1.36
Hydrogen cyanide (air)	$19.1^{10°}$	$18.2^{17°}$	$17.2^{25°}$	1.1
Iodobenzene (air)	$40.3^{15°}$	$39.7^{20°}$	$30.6^{100°}$	2.18
Mesitylene (air)	$30.1^{5°}$	$28.5^{20°}$	$20.6^{100°}$	2.2
Methyl acetate (air or vapor)	$27.4^{0°}$	$24.6^{20°}$	$16.6^{80°}$	2.2
Methyl alcohol (air)	$24.5^{0°}$	$22.6^{20°}$	$15.7^{100°}$	1.0
Methyl *n*-butyrate (air or vapor)	$26.15^{10°}$	$25.0^{20°}$	$16.1^{100°}$	2.3
Methyl *iso*-butyrate (air or vapor)	$24.9^{10°}$	$23.8^{20°}$	$17.6^{75°}$	2.3
Methyl chloride	$19.5^{0°}$	$17.8^{10°}$	$16.2^{20°}$	2.00
Methyl ether (vapor)	$21^{-40°}$	$18^{-20°}$	$16^{-10°}$	2.0
Methyl ethyl ketone (air or vapor)	$26.9^{0°}$	$24.6^{20°}$	$18.4^{75°}$	....
Methyl formate (air)	$28.0^{0°}$	$25.0^{20°}$	$23.5^{30°}$	2.09
Methyl formate (vapor)	$28.3^{0°}$	$25.1^{20°}$	$13.04^{100°}$	2.09
Methyl propionate (air or vapor)	$26.1^{10°}$	$24.9^{20°}$	$17.6^{80°}$	2.2
Methylamine (N_2)	$29.2^{-70°}$	$23.6^{-20°}$	$22.2^{-12°}$	1.2
Naphthalene (air or vapor)	$28.8^{127°}$	$24.0^{170°}$	$21.8^{190°}$	....
Neon (vapor)	$5.90^{-249°}$	$5.15^{-247°}$	$4.45^{-245°}$	2.0
Nitrobenzene (air or vapor)	$46.4^{0°}$	$43.9^{20°}$	$34.4^{100°}$	2.2
Nitroethane (air or vapor)	$33.4^{10°}$	$32.3^{20°}$	$22.5^{100°}$	1.7

SURFACE TENSIONS OF VARIOUS LIQUIDS

Name	Surface Tension in Dynes per Centimeter			k_E
Nitrogen (vapor)	$10.5^{-203°}$	$8.3^{-193°}$	$6.2^{-183°}$	2.0
Nitromethane (air)	$39.8^{0°}$	$36.8^{20°}$	$26.1^{100°}$	....
Nitrosyl chloride (vapor)	$34.5^{-33°}$	$33^{-22°}$	$30^{-5.5°}$	1.46
Nitrous oxide	$10.1^{-25°}$	$3.4^{10°}$	$1.75^{20°}$	....
n-Octane (air or vapor)	$23.8^{0°}$	$21.8^{20°}$	$17.9^{60°}$	2.3
Oxygen (vapor)	$18.3^{-203°}$	$15.7^{-193°}$	$13.2^{-183°}$	1.92
Paraldehyde (air)	$27.5^{5°}$	$25.9^{20°}$	$14.5^{124°}$	2.6
Phenetole (air)	$32.7^{20°}$	$24.2^{100°}$	$16.8^{170°}$	2.4
Phenol (air or vapor)	$40.9^{20°}$	$34.4^{80°}$	$26.8^{150°}$	1.85
Phenyl isothiocyanate (air or vapor)	$42.5^{13°}$	$41.6^{20°}$	$32.4^{100°}$	2.4
Phosphorus oxychloride (air or vapor)	$33.4^{10°}$	$32.2^{20°}$	$24.1^{85°}$	2.2
Piperidine (air)	$32.6^{50°}$	$30.2^{20°}$	$20.4^{105°}$	2.1
Propionic acid (air or vapor)	$27.7^{10°}$	$26.7^{20°}$	$20.8^{80°}$	1.5
Propionitrile (air or vapor)	$28.3^{10°}$	$27.2^{20°}$	$19.4^{90°}$	1.6
n-Propyl acetate (air or vapor)	$26.6^{0°}$	$24.3^{20°}$	$15.6^{100°}$	2.3
n-Propyl alcohol (air)	$25.9^{-5°}$	$23.8^{20°}$	$20.5^{60°}$	1.3
iso-Propyl alcohol (air or vapor)	$22.8^{5°}$	$21.7^{20°}$	$17.0^{80°}$	1.1
n-Propyl formate (air or vapor)	$26.8^{0°}$	$24.5^{20°}$	$15.5^{100°}$	2.2
n-Propylamine (air)	$23.5^{10°}$	$22.4^{20°}$	$19.4^{45°}$	1.9
p-*iso*-Propyltoluene (air)	$29.5^{5°}$	$28.1^{20°}$	$20.7^{100°}$	2.3
Pyridine (air)	$40.8^{0°}$	$38.0^{20°}$	$26.4^{100°}$	2.3
Quinoline (air)	$45.0^{20°}$	$35.8^{100°}$	$25.1^{200°}$	2.4
Thiophene (air)	$36.2^{0°}$	$33.1^{20°}$	$24.3^{80°}$	2.04
Thiophenol (air)	$41.0^{10°}$	$39.8^{20°}$	$31.3^{90°}$	2.0
Toluene (air)	$30.74^{0°}$	$28.43^{20°}$	$19.39^{100°}$	2.2
Toluene (vapor)	$28.5^{20°}$	$25.0^{50°}$	$16.3^{130°}$	2.2
o-Toluidine (air or vapor)	$42.3^{0°}$	$40.0^{20°}$	$31.2^{100°}$	....
Triethylamine (air)	$22.9^{0°}$	$20.9^{20°}$	$13.7^{90°}$	2.37
Trimethylamine (N_2)	$24.8^{-73°}$	$20.2^{-32°}$	$17.4^{-4°}$	1.65
Tripalmitin (air)	$29.5^{55.7°}$	$27.2^{87.6°}$	$25.3^{115.3°}$	5.4
Triphenylmethane	$33.8^{108.7°}$	$24.5^{208.2°}$	$15.4^{335.5°}$	2.1to1.5
iso-Valeric acid (air or vapor)	$26.16^{15°}$	$25.33^{20°}$	$20.4^{80°}$	1.7
Water (see special table)				
m-Xylene (air or vapor)	$29.15^{0°}$	$28.90^{20°}$	$20.46^{100°}$	2.25
p-Xylene (air)	$29.92^{5°}$	$28.37^{20°}$	$24.2^{60°}$	....

SURFACE TENSION OF WATER
Temperature in Degrees C.

Surface Tension in Dynes/cm.		Surface Tension in Dynes/cm.	
$76.96^{-8°}$ (air)	$73.05^{18°}$	$71.18^{30°}$	$52.84^{130°}$
$76.42^{-5°}$	$72.90^{19°}$	$70.38^{35°}$	k_E
$75.64^{0°}$	$72.75^{20°}$	$69.56^{40°}$	$1.03^{25°}$
$74.92^{5°}$	$72.59^{21°}$	$68.74^{45°}$	$1.07^{70°}$
$74.22^{10°}$	$72.44^{22°}$	$67.91^{50°}$	$1.18^{100°}$
$74.07^{11°}$	$72.28^{23°}$	$66.18^{60°}$	$1.27^{120°}$
$73.93^{12°}$	$72.13^{24°}$	$64.42^{70°}$	
$73.78^{13°}$	$71.97^{25°}$	$62.61^{80°}$	
$73.64^{14°}$	$71.82^{26°}$	$60.75^{90°}$	
$73.49^{15°}$	$71.66^{27°}$	$58.85^{100°}$	
$73.34^{16°}$	$71.50^{28°}$	$56.89^{110°}$ (vapor)	
$73.19^{17°}$	$71.35^{29°}$	$54.89^{120°}$	

SURFACE TENSION OF AQUEOUS IN-

The table below gives values for the surface tension of various inorganic aqueous solutions of different concentrations. The concentrations are shown in the super-

	Formula	Surface Tension in Dynes per Centimeter		
1	$AgNO_3$ (20°)	$73.39^{0.5M}$	$73.98^{1.0M}$	$75.06^{2.0M}$
2	$BaCl_2$ (20°)	$72.94^{0.05M}$	$73.08^{0.1M}$	$73.53^{0.25M}$
3	$CaCl_2$ (25°)	$72.32^{0.1M}$	$73.49^{0.5M}$	$75.17^{1.0M}$
4	$CdCl_2$ (20°)	$73.65^{0.5M}$	$74.45^{1.0M}$	$76.85^{2.5M}$
5	$CuSO_4$ (20°)	$73.12^{0.2M}$	$73.67^{0.5M}$	$74.58^{1.0M}$
6	HCl (20°)	$72.59^{0.5M}$	$72.47^{1.0M}$	$72.27^{2.0M}$
7	HNO_3 (20°)	$72.1^{0.7M}$	$71.6^{1.5M}$	$70.9^{2.8M}$
8	H_2O_2 (18°)	$73.37^{4.3M}$	$73.82^{9.5M}$	$74.28^{15.0M}$
9	KBr (20°)	$73.42^{0.5M}$	$74.07^{1.0M}$	$74.74^{1.5M}$
10	K_2CO_3 (20°)	$74.21^{0.5M}$	$75.73^{1.0M}$	$79.07^{2.0M}$
11	KI (20°)	$73.17^{0.5M}$	$73.60^{1.0M}$	$74.01^{1.5M}$
12	KNO_3 (20°)	$72.78^{0.02M}$	$72.86^{0.1M}$	$73.26^{0.5M}$
13	KOH (18°)	$73.94^{0.5M}$	$74.83^{1.0M}$	$75.72^{1.5M}$
14	LiCl (20°)	$73.56^{0.5M}$	$74.38^{1.0M}$	$75.18^{1.5M}$
15	$MgCl_2$ (20°)	$72.92^{0.05M}$	$73.07^{0.1M}$	$73.53^{0.25M}$
16	$MgSO_4$ (20°)	$72.83^{0.025M}$	$72.90^{0.05M}$	$73.01^{0.1M}$
17	$MnCl_2$ (18°)	$74.54^{0.5M}$	$76.02^{1.0M}$	$78.97^{2.0M}$
18	NH_4Cl (20°)	$72.91^{0.1M}$	$73.46^{0.5M}$	$74.14^{1.0M}$
19	NH_4NO_3 (20°)	$73.25^{0.5M}$	$73.75^{1.0M}$	$74.65^{2.0M}$
20	NH_4OH (18°)	$71.8^{0.5M}$	$70.8^{1.0M}$	$67.9^{3.0M}$
21	$(NH_4)_2SO_4$ (20°)	$73.84^{0.5M}$	$74.92^{1.0M}$	$77.10^{2.0M}$
22	Na_2CO_3 (20°)	$73.40^{0.25M}$	$74.03^{0.5M}$	$75.40^{1.0M}$
23	NaCl (20°)	$72.92^{0.1M}$	$73.57^{0.5M}$	$74.39^{1.0M}$
24	Na_2CrO_4 (30°)	$72.6^{0.51M}$	$77.3^{1.95M}$	$82.6^{3.31M}$
25	$NaNO_3$ (20°)	$72.87^{0.1M}$	$73.35^{0.5M}$	$73.95^{1.0M}$
26	NaOH (18°)	$74.4^{0.7M}$	$75.9^{1.5M}$	$83.1^{5.0M}$
27	$Na_2S_2O_3$ (40°)	$71.1^{0.49M}$	$72.4^{1.0M}$	$78.9^{3.04M}$
28	$SrCl_2$ (20°)	$72.93^{0.05M}$	$73.10^{0.1M}$	$73.57^{0.25M}$
29	$Zn(NO_3)_2$ (40°)	$71.1^{0.6M}$	$72.6^{1.1M}$	$77.4^{2.8M}$
30	$ZnSO_4$ (20°)	$73.25^{0.25M}$	$73.73^{0.5M}$	$74.71^{1.0M}$

FORMULAS RELATING SURFACE TENSION

In the following table, γ is the surface
temperature in degrees absolute; T_c is the

Benzene: γ (vapor) $= 71.926\left(1-\frac{T}{561.6}\right)^{1.23} \pm 0.2$, from 0°C. to T_c

p-Bromotoluene: γ (air) $= 66.46\left(1-\frac{T}{694}\right)^{1.2}$

Carbon dioxide: $\gamma = 75\left(1-\frac{T}{T_c}\right)^{1.25}$

Carbon tetrachloride: γ (vapor) $= 67.671\left(1-\frac{T}{556.25}\right)^{1.23} \pm 0.2$, from 10°C. to 270°C.

Chlorine: $\gamma = 72\left(1-\frac{T}{T_c}\right)^{1.18}$

p-Chloroaniline: γ (air) $= 81.37\left(1-\frac{T}{787}\right)^{1.2}$

Chlorobenzene: γ (vapor) $= 72.20\left(1-\frac{T}{632.3}\right)^{1.23} \pm 0.2$, from 10°C. to 333°C.

p-Chlorobromobenzene: γ (air) $= 71.83\left(1-\frac{T}{722}\right)^{1.2}$

p-Chloroiodobenzene: γ (air) $= 74.71\left(1-\frac{T}{767}\right)^{1.2}$

p-Chloronitrobenzene: γ (air) $= 78.68\left(1-\frac{T}{768}\right)^{1.2}$

p-Chlorotoluene: γ (air or vapor) $= 66.65\left(1-\frac{T}{653}\right)^{1.2}$

ORGANIC SOLUTIONS AGAINST AIR

script and are expressed in moles per kilogram of water. The temperature in degrees Centigrade is given in parenthesis after the formula.

Surface Tension in Dynes per Centimeter					
$76.03^{3.0M}$	$77.70^{5.0M}$	$78.60^{6.2M}$	.....	.....	1
$74.26^{0.5M}$	$75.72^{1.0M}$	$77.77^{1.7M}$	.....	.....	2
$78.87^{2.0M}$	$86.92^{4.0M}$	$90.37^{5.0M}$	$97.07^{7.0M}$	$106.97^{11.2M}$	3
$79.15^{4.0M}$	$81.55^{5.8M}$	.....	.....	.....	4
$74.95^{1.2M}$	.....	.....	.....	.....	5
$71.90^{4.0M}$	$71.50^{6.0M}$	$70.55^{9.0M}$	$65.95^{17.7M}$	.....	6
$68.3^{8.5M}$	.....	.....	.....	.....	7
$74.88^{20.5M}$	$75.82^{30.6M}$	.....	.....	.....	8
$76.72^{3.0M}$	$79.06^{4.8°}$	.....	.....	.....	9
$82.85^{3.0M}$	$87.15^{4.0M}$	$96.95^{6.0M}$	$102.55^{7.0M}$	$110.75^{8.3M}$	10
$75.26^{3.0M}$	$76.10^{4.0M}$	$77.95^{6.2M}$	.....	.....	11
$73.78^{1.0M}$	$74.30^{1.5M}$	$74.80^{2.0M}$	$75.25^{2.5M}$	$76.45^{3.9M}$	12
$76.58^{2.0M}$	$79.75^{3.8M}$	.....	.....	.....	13
$76.01^{2.0M}$	$79.45^{4.0M}$	$86.28^{8.0M}$	$93.52^{13.0M}$	$100.76^{19.4M}$	14
$74.27^{0.5M}$	$75.79^{1.0M}$	$79.10^{2.0M}$	$82.98^{3.0M}$	$85.70^{3.65M}$	15
$73.28^{0.25M}$	$73.78^{0.5M}$	$74.85^{1.0M}$	$77.32^{2.0M}$	$79.27^{2.7M}$	16
$81.95^{3.0M}$	$84.89^{4.0M}$	$87.25^{4.8M}$	.....	.....	17
$75.4^{2.0M}$	$76.5^{3.0M}$	$77.6^{4.0M}$	78.65^{0M}	80.46^{7M}	18
$76.33^{4.0M}$	$77.82^{6.0M}$	$79.15^{8.0M}$	$80.30^{10.0M}$	$82.12^{14.0M}$	19
$65.3^{6.0M}$	$63.0^{10.0M}$	$61.1^{15.0M}$	$59.7^{20.0M}$	$57.1^{34.0M}$	20
$79.25^{3.0M}$	$81.42^{4.0M}$	$83.13^{4.8M}$	.....	.....	21
$76.75^{1.5M}$	.....	.....	.....	.....	22
$76.03^{2.0M}$	$77.65^{3.0M}$	$79.29^{4.0M}$	$80.92^{5.0M}$	$82.55^{6.0M}$	23
$90.9^{5.10M}$	$96.5^{6.12M}$	$98.6^{6.99M}$	.....	.....	24
$75.12^{2.0M}$	77.44^{0M}	80.37^{0M}	$82.71^{0.0M}$	$84.11^{2.2M}$	25
$87.8^{7.0M}$	$95.9^{11.0M}$	$100.7^{14.0M}$	.....	.....	26
$85.9^{5.04M}$	$93.5^{8.34M}$	$96.6^{9.73M}$	$98.4^{11.18M}$	.....	27
$74.37^{0.5M}$	$76.00^{1.0M}$	$77.75^{1.5M}$	$79.51^{2.0M}$	$81.62^{2.6M}$	28
$81.1^{4.2M}$	$83.3^{5.2M}$	$84.9^{6.3M}$	.....	.....	29
$77.1^{2.0M}$	$78.1^{2.4M}$	$79.1^{2.75M}$	$84.5^{5.25M}$	.....	30

AND TEMPERATURE OF VARIOUS SUBSTANCES

tension in dynes per centimeter; T is the critical temperature in degrees absolute.

p-Dichlorobenzene: γ (air) $= 71.45 \left(1 - \frac{T}{675}\right)^{1.2}$

Ethyl alcohol: $\gamma = 230.564 \left(1 - \frac{T}{516.2}\right)^{1.45} - 304.339 \left(1 - \frac{T}{516.2}\right)^{2} + 139.756 \left(1 - \frac{T}{516.2}\right)^{3} \pm 0.3$, from 10°C. to 240°C.

Ethyl ether: γ (vapor) $= 57.358 \left(1 - \frac{T}{466.9}\right)^{1.22} \pm 0.2$, from 20°C. to 193°C.

p-Iodotoluene: γ (air) $= 69.28 \left(1 - \frac{T}{734}\right)^{1.2}$

Methyl alcohol: $\gamma = 173.245 \left(1 - \frac{T}{513.1}\right)^{1.33} - 243.042 \left(1 - \frac{T}{513.1}\right)^{2} + 146.344 \left(1 - \frac{T}{513.1}\right)^{3} \pm 0.2$, from 70°C. to 235°C.

Methyl chloride: $\gamma = 72 \left(1 - \frac{T}{Tc}\right)^{1.22}$

Methyl formate: $\gamma = 77.83 \left(1 - \frac{T}{487.1}\right)^{1.23} \pm 0.2$, from 50°C. to 214°C.

p-Nitrotoluene: γ (air) $= 74.06 \left(1 - \frac{T}{754}\right)^{1.2}$

Nitrous oxide: $\gamma = 86 \left(1 - \frac{T}{Tc}\right)^{1.23}$

SURFACE TENSION OF AQUEOUS

The table below gives values for the surface tension of various organic aqueous solutions of different concentrations. The concentration is indicated directly below

	Formula	Surface Tension in Dynes per Centimeter		
1	Acetic acid (30°C)	67.98 1.000%	60.11 5.001%	54.56 10.01%
2	Acetone (25°C)	55.45 5%	48.94 10%	41.11 20%
3	*iso*-Amyl alcohol (15°C)	57.0 0.249%	49.3 0.5%	41.1 0.99%
4	*n*-Butyl alcohol (20°C)	72.8 0.0244%	72.4 0.0487%	67.2 0.1954%
5	*iso*-Butyl alcohol (15°C)	65.6 0.249%	53.0 0.99%	45.4 1.96%
6	*n*-Butyric acid (25°C)	69 0.14%	65 0.31%	60 0.73%
7	*iso*-Butyric acid (25°C)	69.6 0.10%	62.6 0.43%	49.6 1.92%
8	*n*-Caproic acid (19°C)	70 0.00212ML	63 0.0064ML	56 0.0128ML
9	*iso*-Caproic acid (18°C)	71 0.0016ML	67 0.0036ML	60 0.0081ML
10	Chloroacetic acid (25°C)	66.40 3.35%	61.22 7.70%	58.91 10.09%
11	Ethyl alcohol (25°C)	60.79 2.72%	54.87 5.21%	46.03 11.10%
12	Formic acid (30°C)	70.07 1.00%	66.20 5.00%	62.78 10.00%
13	Glycerol (18°C)	72.90 5%	72.85 10%	72.40 20%
14	Glycol (15°C)	73.27 0.125ML	73.02 0.25ML	72.36 0.5ML
15	Maleic acid (20°C)	72.6 0.169%	72.4 0.338%	72.0 0.673%
16	Malic acid (20°C)	72.6 0.154%	72.4 0.320%	72.1 0.645%
17	Methyl alcohol (30°C)	68.44 1.011%	65.32 2.500%	54.60 9.994%
18	Methyl propionate (15°C)	71.72 0.0078ML	70.29 0.0156ML	67.75 0.0313ML
19	Octyl alcohol (20°C)	72.8 1.009%	71.8 1.998%	69.0 2.96%
20	Phenol (20°C)	72.6 0.024%	71.3 0.118%	66.5 0.471%
21	Propionic acid (25°C)	64.5 0.988%	59.8 1.914%	49.1 5.84%
22	*n*-Propyl alcohol (15°C)	70.76 0.0313ML	68.64 0.0625ML	65.08 0.125ML
23	*iso*-Propyl alcohol (15°C)	70.77 0.0313ML	68.56 0.0625ML	65.21 0.125ML
24	Propylamine (15°C)	70.39 0.03125ML	68.43 0.0625ML	64.09 0.125ML
25	Pyrocatechol (20°C)	72.1 0.03ML	71.7 0.05ML	66.8 0.20ML
26	Pyrogallol (20°C)	71.7 0.1ML	70.4 0.2ML	65.7 0.5ML
27	Resorcinol (20°C)	72.1 0.03ML	70.6 0.10ML	66.8 0.40ML
28	Succinic acid (20°C)	72.5 0.0922%	72.4 0.184%	72.2 0.369%
29	Sucrose (20°C)	73.30 10%	73.75 20%	74.15 30%
30	*n*-Valeric acid (25°C)	65.0 0.11%	58.7 0.22%	53.5 0.38%
31	*iso*-Valeric acid (25°C)	63.7 0.15%	56.9 0.34%	45.3 1.03%

ORGANIC SOLUTIONS AGAINST AIR

the corresponding surface tension. These concentrations are expressed in percents when so designated, or in moles per liter of solution in which case they are marked *ML.*

Surface Tension in Dynes per Centimeter				
47.72 20.09%	40.68 40.11%	34.26 69.91%	26.58 100%	1
35.98 30%	30.38 50%	26.75 75%	23.04 100%	2
36.0 1.48%	32.3 1.96%	23.0 100%	....	3
56.0 0.772%	48.1 1.538%	40.4 3.105%	28.6 5.927%	4
40.3 2.91%	34.0 4.76%	28.0 7.41%	22.9 100%	5
42 3.83%	33 8.63%	28 24.96%	27 79.38%	6
37.3 5.65%	29.8 11.69%	27.3 18.95%	26.5 69.93%	7
49 0.0212ML	40 0.0425ML	34 0.068ML	31 0.085ML	8
51 0.0183ML	41 0.0411ML	36 0.0616ML	31 0.0924ML	9
50.34 31.54%	47.68 49.97%	46.81 60.01%	45.09 72.11%	10
37.53 20.50%	29.63 40.00%	23.64 87.92%	22.03 100%	11
57.92 20.00%	51.97 40.00%	42.09 80.01%	36.51 100%	12
69.9 50%	65.8 85%	63.8 98%	63.4 100%	13
70.94 1.0ML	....	....	....	14
71.4 1.338%	70.5 2.641%	69.1 5.13%	66.8 9.67%	15
71.5 1.28%	70.7 2.54%	69.3 4.92%	67.1 9.29%	16
46.05 20.00%	36.09 39.98%	26.03 80.03%	21.76 100%	17
63.87 0.0625ML	58.39 0.125ML	51.28 0.25ML	41.61 0.5ML	18
67.1 3.89%	58.6 7.46%	50.5 13.6%	41.8 21.9%	19
61.1 0.941%	54.0 1.881%	46.0 3.755%	42.3 5.623%	20
43.9 9.82%	36.4 21.71%	29.7 73.92%	25.6 99.99%	21
59.34 0.25ML	51.94 0.5ML	43.59 1.0ML	....	22
60.37 0.25ML	53.66 0.5ML	46.58 1.0ML	....	23
59.55 0.25ML	53.03 0.5ML	46.68 0.1ML	....	24
62.4 0.40ML	59.7 0.60ML	55.7 1.0ML	51.6 2.0ML	25
62.4 0.75ML	60.0 1.00ML	56.1 1.50ML	53.8 2.00ML	26
64.4 0.75ML	61.1 1.5ML	58.6 3.0ML	57.1 6.0ML	27
71.7 0.732%	71.0 1.45%	69.7 2.86%	68.1 5.55%	28
74.85 40%	76.45 55%	....	....	29
42.0 0.83%	32.1 2.34%	25.4 87.04%	26.5 98.91%	30
34.6 2.54%	29.2 4.24%	24.6 89.37%	24.9 99.77%	31

INTERFACIAL TENSIONS

The table below gives values for the interfacial tensions (γ_t) in dynes per centimeter, between various compounds and either water or mercury. The temperature in degrees Centigrade is indicated in each case by a superscript.

Name	γ_t, dynes/cm
iso-Amyl alcohol—H_2O	$5.0^{18°}$
iso-Amyl butyrate—H_2O	$23.0^{20°}$
iso-Amyl chloride—H_2O	$15.44^{20°}$
Aniline—H_2O	$5.77^{20°}$
Aniline—Hg	$341^{20°}$
Anisole—H_2O	$25.82^{20°}$
Benzaldehyde—H_2O	$15.51^{20°}$
Benzene—H_2O	$35.00^{20°}$
Benzene—Hg	$357.2^{20°}$
Benzyl alcohol—H_2O	$4.75^{22.5°}$
Bromobenzene—H_2O	$39.82^{20°}$
o-Bromotoluene—H_2O	$41.15^{20°}$
iso-Butyl alcohol—H_2O	$2.1^{18°}$
iso-Butyl alcohol—Hg	$342.7^{20°}$
iso-Butyl chloride—H_2O	$24.43^{20°}$
tert.-Butyl chloride—H_2O	$23.75^{20°}$
Butyronitrile—H_2O	$10.38^{20°}$
Carbon disulfide—H_2O	$48.36^{20°}$
Carbon disulfide—Hg	$336^{20°}$
Carbon tetrachloride—H_2O	$45^{20°}$
Chlorobenzene—H_2O	$37.41^{20°}$
Chloroform—H_2O	$32.8^{20°}$
α-Chloronaphthalene—H_2O	$40.74^{20°}$
p-Cymene—H_2O	$34.61^{20°}$
Diethyl carbonate—H_2O	$12.86^{20°}$
Dipropylamine—H_2O	$1.66^{20°}$
Ethyl alcohol—Hg	$364^{20°}$
Ethyl bromide—H_2O	$31.20^{20°}$
Ethyl ether—H_2O	$10.7^{20°}$
Ethyl ether—Hg	$379^{20°}$
Ethyl mercaptan—H_2O	$26.12^{20°}$
Ethyl oleate—H_2O	$21.34^{20°}$
Ethyl propyl ketone—H_2O	$13.58^{20°}$
Ethylbenzene—H_2O	$31.35^{17.5°}$

Name	γ_i, dynes/cm
Ethylene bromide—H_2O	$36.54^{20°}$
Ethylene bromide—Hg	$326^{20°}$
n-Hexane—H_2O	$51.1^{20°}$
n-Hexane—Hg	$378^{20°}$
Iodobenzene—H_2O	$41.84^{20°}$
Mercury—H_2O	$375^{20°}$
Mesitylene—H_2O	$38.7^{20°}$
Methyl iodide—Hg	$304^{20°}$
Methylene chloride—H_2O	$28.31^{20°}$
Methylene chloride—Hg	$342.5^{20°}$
Nitrobenzene—H_2O	$25.66^{20°}$
Nitrobenzene—Hg	$350.5^{20°}$
Nitroethane—Hg	$378^{20°}$
Nitromethane—H_2O	$9.66^{20°}$
o-Nitrotoluene—H_2O	$27.19^{20°}$
n-Octane—H_2O	$50.8^{20°}$
n-Octane—Hg	$374.7^{20°}$
n-Octyl alcohol—H_2O	$8.5^{20°}$
sec.-Octyl alcohol—Hg	$359.0^{20°}$
Oleic acid—H_2O	$15.6^{20°}$
Oleic acid—Hg	$322^{20°}$
iso-Pentane—H_2O	$49.64^{20°}$
Phenetole—H_2O	$29.4^{20°}$
n-Propyl alcohol—Hg	$368^{20°}$
Styrene—H_2O	$35.48^{19°}$
Toluene—H_2O	$36.1^{25°}$
Toluene—Hg	$359^{20°}$
iso-Valeric acid—H_2O	$2.73^{20°}$
o-Xylene—H_2O	$36.06^{20°}$
p-Xylene—H_2O	$37.77^{20°}$
o-Xylene—Hg	$359^{20°}$
m-Xylene—Hg	$357^{20°}$
p-Xylene—Hg	$361^{20°}$

VISCOSITY

The viscosity of a substance is the shearing resistance of a liquid film which separates two horizontal plates, one of which is being moved across the other. The absolute viscosity of a substance is the force in dynes which will move one square centimeter of a plane surface with a speed of one centimeter per second relative to another parallel plane surface from which it is separated by a layer of the substance one centimeter thick. This may be expressed by the following formula:

$$\text{viscosity} = \frac{\text{force} \times \text{film thickness}}{\text{area of plate} \times \text{velocity}}.$$

The unit of absolute viscosity is the poise which is equal to one dyne second per square centimeter. That is, when two plates have a shearing area of 1 square centimeter and a film thickness of 1 centimeter, if a force of one dyne is required to maintain a velocity of 1 centimeter per second, the fluid is said to have a viscosity of 1 poise. Since the poise (η) is such a large unit it is generally more convenient to use the millipoise (1/1000 poise) or, in the case of gases, the micropoise (1/1,000,000 poise). Frequently the viscosity of a liquid is expressed in terms of specific viscosity, which is its absolute viscosity compared with that of water at the same temperature. If the temperature in question is 20°C. the specific viscosity equals the viscosity in centipoises (1/100 poise) since the viscosity of water at 20°C. is approximately 1 centipoise.

The kinematic viscosity of a substance is the ratio of the absolute viscosity to the density of the substance at the temperature of measurement. The unit of kinematic viscosity is the stoke and is equal to that possessed by a fluid which has a viscosity of one poise and a density of one gram per cubic centimeter.

Of special importance in the field of lubrication are the so-called kinematic viscosimeters which measure the time in seconds for a given volume of liquid to flow through a definite orifice at some specified temperature. See special table for conversion of kinematic viscosity in centistokes to Saybolt, Redwood, and Engler viscosimeter values.

VISCOSITY OF VARIOUS LIQUIDS

In the table below is given the viscosity of various liquids in millipoises (1000η) at the temperature in degrees Centigrade as indicated by the superscript.

Values in millipoises may be converted to centistokes by dividing by $10d^t$, where d^t is the density of the substance at the same temperature t.

Name	1000η
Acetaldehyde	$2.751^{0°}$
	$2.521^{10°}$
	$2.307^{20°}$
Acetamide	$13.2^{105°}$
	$10.6^{120°}$
Acetanilide	$22.2^{120°}$
	$19.0^{130°}$
Acetic acid	$12.22^{20°}$
	$10.396^{30°}$
	$7.956^{50°}$
	$4.244^{110°}$
Acetic anhydride	$12.448^{0°}$
	$9.065^{20°}$
	$6.991^{40°}$
	$3.079^{130°}$

Name	1000η
Acetone	$4.013^{0°}$
	$3.311^{20°}$
	$2.561^{50°}$
Allyl alcohol	$21.453^{0°}$
	$13.632^{20°}$
	$4.137^{90°}$
Allyl bromide	$6.258^{0°}$
	$5.037^{20°}$
	$4.192^{40°}$
	$3.279^{70°}$
Allyl chloride	$4.127^{0°}$
	$3.374^{20°}$
	$2.825^{40°}$

VISCOSITY OF VARIOUS LIQUIDS

Name	1000η
Allyl iodide	$9.358^{0°}$
	$7.338^{20°}$
	$5.972^{40°}$
	$3.652^{100°}$
Ammonia	$2.66^{-33.5°}$
Amyl acetate	$8.055^{45°}$
Amyl alcohol	$89.22^{0°}$
	$62.34^{10°}$
	$40.04^{23°}$
Aniline	$60.23^{12°}$
	$44.67^{20°}$
	$29.3^{32°}$
	$15.55^{60°}$
Anisole	$10.89^{20°}$
	$7.409^{45°}$
Benzene	$9.00^{0°}$
	$7.57^{10°}$
	$6.47^{20°}$
	$5.61^{30°}$
	$4.36^{50°}$
	$3.502^{70°}$
Benzotrichloride	$30.7^{10°}$
	$25.5^{17°}$
Benzyl acetate	$13.99^{45°}$
Benzyl alcohol	$55.82^{20°}$
	$30.08^{45°}$
Benzyl benzoate	$84.54^{25°}$
Bismuth	$16.20^{283°}$
	$15.25^{330°}$
	$14.55^{365°}$
Bromine	$12.541^{0.56°}$
	$10.466^{16.16°}$
	$9.46^{26°}$
	$7.211^{56.41°}$
Bromobenzene	$15.66^{-0.1°}$
	$11.23^{21.9°}$
	$8.53^{43.6°}$
	$3.85^{142.5°}$
iso-Butyl acetate	$7.04^{20°}$
	$3.667^{8.1°}$
	$2.163^{130.9°}$
	$1.426^{183.8°}$
n-Butyl alcohol	$51.85^{60°}$
	$29.48^{20°}$
	$17.816^{40°}$
	$4.602^{110°}$
iso-Butyl alcohol	$80.38^{40°}$
	$39.068^{20°}$
	$21.223^{40°}$
	$5.270^{100°}$
tert.-Butyl alcohol	$58.88^{22.4°}$
	$23.69^{37.2°}$
	$6.497^{7.1°}$
iso-Butyl bromide	$8.277^{0°}$
	$6.433^{20°}$
	$5.179^{40°}$
	$3.260^{90°}$

Name	1000η
iso-Butyl chloride	$5.878^{0°}$
	$4.617^{20°}$
	$3.729^{40°}$
	$3.090^{60°}$
Butyl formate	$6.91^{20°}$
iso-Butyl iodide	$11.664^{0°}$
	$8.753^{20°}$
	$6.970^{40°}$
	$3.496^{120°}$
n-Butyric acid	$22.855^{0°}$
	$15.402^{20°}$
	$11.205^{40°}$
	$3.230^{160°}$
iso-Butyric acid	$18.868^{0°}$
	$13.175^{20°}$
	$9.804^{40°}$
	$3.258^{150°}$
Caproic acid	$32.01^{20°}$
Carbon dioxide	$0.925^{5°}$
(Under the pressure of its saturated vapor)	$0.852^{10.2°}$
	$0.784^{15°}$
	$0.712^{20°}$
	$0.625^{25°}$
	$0.539^{29°}$
	$0.321^{31.1°}$
	$4.362^{0.4°}$
Carbon disulfide	$3.763^{19.94°}$
	$3.167^{45.96°}$
	$3.367^{0.6°}$
Carbon tetrachloride	$9.578^{21.21°}$
	$7.928^{35.21°}$
	$4.056^{99.6°}$
Castor oil	$329506^{6.5°}$
	$10272^{19.6°}$
	$2245^{40.6°}$
Chlorobenzene	$10.50^{0.3°}$
	$8.03^{20.1°}$
	$6.37^{40.2°}$
	$3.201^{23.6°}$
Chloroform	$7.86^{-10°}$
	$6.99^{0°}$
	$5.63^{20°}$
	$4.64^{40°}$
	$3.89^{60°}$
o-Chlorophenol	$22.50^{45°}$
m-Chlorophenol	$47.22^{45°}$
p-Chlorophenol	$60.18^{45°}$
Copal lac	$4800^{22.2°}$
o-Cresol	$35.06^{45°}$
m-Cresol	$184.23^{20°}$
	$50.57^{45°}$
p-Cresol	$56.07^{45°}$
Cyclohexane	$10.3^{17°}$
	$9.3^{22°}$
	$8.6^{27°}$
	$7.5^{35°}$

VISCOSITY OF VARIOUS LIQUIDS

Name	1000η
Decane	$7.75^{22.3^\circ}$
Diallyl	$3.415^{0.37^\circ}$
	2.75^{20°
	$2.436^{36.06^\circ}$
	$2.059^{56.2^\circ}$
Diethyl ketone	5.990^{0°
	4.705^{20°
	3.854^{40°
	2.349^{100°
Diethylamine	$8.236^{-33.5^\circ}$
	3.67^{25°
Diethylaniline	19.5^{25°
Dimethylamine	$4.368^{-33.5^\circ}$
Dimethylaniline	12.85^{25°
Diphenylamine	46.60^{55°
	10.4^{130°
Dipropyl ether	$5.40^{0.59^\circ}$
	4.25^{20°
	2.241^{88°
Dipropyl ketone	7.36^{20°
Dodecane	$12.57^{23.3^\circ}$
Ethyl acetate	5.825^{0°
	4.546^{20°
	3.668^{40°
	2.786^{70°
Ethyl alcohol	17.716^{0°
	14.510^{10°
	11.943^{20°
	8.309^{40°
	5.098^{70°
Ethyl benzene	8.769^{0°
	6.687^{20°
	5.311^{40°
	2.512^{130°
Ethyl benzoate	22.42^{20°
	20.14^{25°
Ethyl bromide	4.866^{0°
	4.407^{10°
	4.020^{20°
	3.678^{30°
Ethyl butyrate	6.68^{20°
Ethyl ether	2.950^{0°
	2.681^{10°
	2.448^{20°
	2.230^{30°
Ethyl formate	5.103^{0°
	4.085^{20°
	3.356^{40°
	3.077^{50°
Ethyl iodide	7.269^{0°
	5.925^{20°
	4.951^{40°
	3.914^{70°
Ethyl propionate	6.967^{0°
	5.367^{20°
	4.282^{40°
	2.705^{90°

Name	1000η
Ethyl propyl ether	$4.007^{0.35^\circ}$
	$3.231^{20.33^\circ}$
	$2.248^{60.18^\circ}$
Ethyl salicylate	17.72^{45°
Ethyl sulfide	$5.619^{0.21^\circ}$
	$4.292^{24.64^\circ}$
	2.49^{88°
Ethyl valerate	8.47^{20°
Ethylaniline	20.42^{5°
	10.81^{55°
Ethylene bromide	24.38^{0°
	17.21^{20°
	12.86^{40°
	5.309^{130°
Ethylene chloride	11.322^{0°
	8.385^{20°
	6.523^{40°
	4.357^{80°
Ethylidene chloride	6.282^{0°
	4.983^{20°
	3.731^{50°
Eugenol	69.31^{25°
Fluorobenzene	$7.52^{0.2^\circ}$
	$5.85^{19.9^\circ}$
	$3.25^{80.9^\circ}$
Formamide	7.681^{05°
	6.591^{20°
Formanilide	16.51^{23°
Formic acid	22.469^{10°
	17.844^{20°
	12.190^{40°
	5.492^{100°
Glycerol	422002.8°
	10690^{20°
	$7776^{20.9^\circ}$
Glycol	173.3^{25°
Heptane	5.236^{0°
	4.163^{20°
	3.410^{40°
	2.239^{90°
Heptyl alcohol	70.14^{20°
Heptylic acid	43.56^{20°
Hexadecane	$35.91^{22.2^\circ}$
Hexane	4.012^{0°
	3.258^{20°
	2.708^{40°
	2.288^{60°
Iodobenzene	$21.94^{4.6^\circ}$
	$17.74^{17.4^\circ}$
	$4.88^{148.8^\circ}$
Isoprene	$2.664^{0.35^\circ}$
	$2.234^{20.41^\circ}$
	$2.037^{32.02^\circ}$
Lactic acid	403.3^{25°
Lead bromide	101.93^{72°
	69.70^{412°
	40.73^{492°

VISCOSITY OF VARIOUS LIQUIDS

Name	1000η
Lead chloride	55.32^{498°
	40.20^{538°
	29.56^{608°
Lithium nitrate	55.9^{259°
	45.0^{284°
	29.4^{344°
Menthol	$68.9^{34.9^\circ}$
Mercury	$18.68^{-21.4^\circ}$
	16.84^{0°
	15.47^{200°
	14.83^{400°
	$13.60^{62.9^\circ}$
	$12.99^{79.4^\circ}$
	12.60^{98°
	11.71^{124°
	10.92^{154°
	$10.18^{196.7^\circ}$
	$9.86^{237.8^\circ}$
	$9.615^{262.5^\circ}$
	$9.183^{314.7^\circ}$
Methyl acetate	4.837^{0°
	3.880^{20°
	3.202^{40°
	2.929^{50°
Methyl alcohol	8.08^{0°
	6.90^{10°
	5.93^{20°
	4.49^{40°
	3.49^{60°
Methyl benzoate	20.59^{20°
Methyl *n*-butyrate	7.625^{0°
	5.795^{20°
	4.585^{40°
	2.647^{100°
Methyl *iso*-butyrate	6.764^{0°
	5.228^{20°
	4.190^{40°
	2.648^{90°
Methyl ethyl ketone	5.429^{0°
	4.284^{20°
	3.490^{40°
	2.482^{80°
Methyl formate	4.355^{0°
	3.548^{20°
	3.253^{30°
Methyl iodide	6.055^{0°
	5.001^{20°
	4.240^{40°
Methyl propionate	5.866^{0°
	4.597^{20°
	3.748^{40°
	2.861^{70°
Methyl propyl ketone	6.477^{0°
	5.056^{20°
	4.096^{40°
	2.465^{100°

Name	1000η
Methyl sulfide	$3.599^{0.27^\circ}$
	$3.008^{20.19^\circ}$
	$2.649^{35.81^\circ}$
Methyl valerate	7.13^{20°
Methylaniline	20.2^{25°
	10.84^{55°
Methylene chloride	$5.40^{0.46^\circ}$
	$4.414^{20.53^\circ}$
	$3.802^{37.51^\circ}$
Nitric acid	22.75^{0°
	17.70^{10°
Nitrobenzene	28.2^{10°
	19.8^{20°
	15.5^{35°
Nitrogen dioxide	5.349^{0°
	4.766^{10°
	4.275^{20°
o-Nitrophenol	23.43^{45°
Nonane	$6.19^{22.3^\circ}$
Nonylic acid	83.19^{20°
Octane	7.060^{0°
	6.159^{10°
	5.419^{20°
	4.828^{30°
	4.328^{40°
	3.551^{60°
	2.971^{80°
	2.160^{120°
Octyl alcohol	89.47^{20°
Octylic acid	57.49^{20°
Olive oil	$1008^{15.6^\circ}$
	$377^{37.9^\circ}$
	$154^{65.7^\circ}$
	70^{100°
Paraffin oil	1018^{18°
Pentadecane	28.14^{22°
Pentane	2.894^{0°
	2.395^{20°
	2.200^{30°
Phenetole	12.62^{20°
	8.249^{45°
Phenol	$127.44^{18.3^\circ}$
	60.24^{35°
	34.21^{50°
	13.14^{19°
Phenyl acetate	17.99^{45°
Phenyl ethane	6.076^{25°
Potassium dichromate	133.9^{397°
	93.8^{457°
	66.4^{507°
Potassium nitrate	29.70^{333°
	24.42^{373°
	20.07^{413°
Propionic acid	15.21^{40°
	11.022^{20°
	8.451^{40°
	3.308^{140°

VISCOSITY OF VARIOUS LIQUIDS

Name	1000η
Propyl acetate	7.734^{0°
	5.854^{20°
	4.604^{40°
	2.587^{100°
n-Propyl alcohol	38.827^{0°
	22.563^{20°
	14.050^{40°
	5.310^{90°
iso-Propyl alcohol	45.646^{0°
	23.702^{20°
	13.311^{40°
	5.249^{80°
n-Propyl bromide	6.509^{0°
	5.241^{20°
	4.334^{40°
	3.379^{70°
iso-Propyl bromide	6.106^{0°
	4.894^{20°
	4.028^{40°
	3.680^{50°
Propyl *n*-butyrate	8.31^{20°
Propyl *iso*-butyrate	7.41^{20°
n-Propyl chloride	4.416^{0°
	3.589^{20°
	2.990^{40°
iso-Propyl chloride	4.080^{0°
	3.292^{20°
	2.993^{30°
n-Propyl formate	6.720^{0°
	5.210^{20°
	4.171^{40°
	2.883^{80°
iso-Propyl formate	5.12^{20°
n-Propyl iodide	9.435^{0°
	7.438^{20°
	6.067^{40°
	3.714^{100°
iso-Propyl iodide	8.841^{0°
	6.971^{20°
	5.676^{40°
	4.005^{80°
Propyl propionate	6.73^{20°
Propyl valerate	10.53^{20°
n-Propylamine	3.53^{25°
Pyridine	8.775^{25°
Rape oil	$1118^{15.6^\circ}$
	$422^{37.9^\circ}$
	$177^{65.7^\circ}$
	80^{100°
Rosin	$(1.0\times10^{21})^{7.1^\circ}$
	$(6\times10^{18})^{20^\circ}$
Safrol	22.94^{25°
iso-Safrol	39.81^{25°
Salicylaldehyde	16.69^{45°
Silver bromide	18.63^{609°
	14.87^{688°
	11.92^{803°

Name	1000η
Silver chloride	16.066^{03°
	13.726^{69°
	11.867^{34°
Silver iodide	30.266^{05°
	21.237^{30°
	15.568^{27°
Silver nitrate	37.724^{0°
	30.527^{5°
	23.037^{42°
Sodium bromide	14.276^{2°
	13.576^{6°
	12.878^{0°
Sodium chloride	13.084^{1°
	12.085^{8°
	10.189^{6°
	9.792^{4°
Sodium nitrate	29.193^{08°
	26.613^{28°
	24.393^{48°
	22.373^{68°
	20.573^{88°
	18.284^{18°
Sperm oil	$420^{15.6^\circ}$
	$185^{37.9^\circ}$
	$85^{65.7^\circ}$
	46^{100°
Succinonitrile	$27.6^{58.7^\circ}$
	$23.6^{69.4^\circ}$
	$18.1^{83.0^\circ}$
Sulfur	109.4^{123°
	$86.6^{135.5^\circ}$
	$70.9^{149.5^\circ}$
	$71.9^{156.3^\circ}$
	$75.9^{158.2^\circ}$
	$94.8^{159.2^\circ}$
	$144.5^{159.5^\circ}$
	$228.3^{160.0^\circ}$
Sulfur	$773.2^{160.3^\circ}$
	$5000^{165.0^\circ}$
	$45000^{171.0^\circ}$
	215000^{200°
	205000^{210°
	186000^{222°
Sulfuric acid (100%)	618^{0°
	269.4^{15°
	191.5^{25°
	172^{33°
	106^{50°
	63.5^{70°
	42.5^{90°
Tallow	$176^{65.7^\circ}$
	78^{100°
Tetrachloroethylene	$11.384^{0.43^\circ}$
	$8.759^{22.3^\circ}$
	$6.533^{52.68^\circ}$
	$4.034^{117.09^\circ}$

VISCOSITY OF VARIOUS LIQUIDS

Name	1000η
Tetradecane	$21.31^{21.9°}$
Thiophene	$8.712^{0.24°}$
	$6.432^{22.5°}$
	$3.528^{82.53°}$
Tin	$16.78^{280°}$
	$16.64^{296°}$
	$14.21^{357°}$
	$13.11^{389°}$
Toluene	$7.719^{0°}$
	$5.903^{20°}$
	$4.713^{40°}$
	$3.874^{60°}$
	$2.588^{110°}$
Tridecane	$15.50^{23.3°}$
Triethylamine	$7.726^{-33.5°}$
	$3.63^{25°}$
Trimethylamine	$3.208^{-33.5°}$
Turpentine	$22.48^{0°}$
	$17.83^{10°}$
	$14.87^{20°}$
	$12.72^{30°}$
	$10.71^{40°}$
	$8.21^{60°}$
	$6.71^{80°}$

Name	1000η
Undecane	$9.472^{2.7°}$
Urethane	$9.16^{105°}$
	$7.15^{120°}$
n-Valeric acid	$22.36^{20°}$
	$12.5^{50°}$
n-Valeric acid	$9.797^{0°}$
iso-Valeric acid	$24.11^{20°}$
Water (see special table)	.....
Wool fat, neutral	$1672^{65.7°}$
	$314^{100°}$
o-Xylene	$11.049^{0°}$
	$8.102^{20°}$
	$6.270^{40°}$
	$4.168^{80°}$
	$2.626^{140°}$
m-Xylene	$8.059^{0°}$
	$6.200^{20°}$
	$4.970^{40°}$
	$3.455^{80°}$
	$2.418^{130°}$
p-Xylene	$7.385^{10°}$
	$6.475^{20°}$
	$5.134^{40°}$
	$3.519^{80°}$
	$2.424^{130°}$

VISCOSITY OF GASES AND VAPORS

In the table below is given the viscosity of various gases and vapors in micropoises ($\eta \times 10^6$) at the temperature in degrees Centigrade as indicated in each case by the superscript.

Name	$\eta \times 10^6$
Acetone	$72.5^{0°}$
	$78.0^{18°}$
	$94.27^{100°}$
	$125.7^{212.5°}$
Acetylene	$94.3^{0°}$
Air	$24^{-145°}$
	$87^{-98°}$
	$147^{-49.7°}$
	$170.9^{0°}$
	$175.9^{100°}$
	$180.8^{200°}$
	$185.6^{300°}$
	$190.4^{400°}$
	$195.1^{500°}$
	$199.7^{600°}$
	$208.8^{800°}$
	$217.5^{1000°}$
	$238.5^{1500°}$
	$258.2^{2000°}$
	$277.0^{2500°}$
	$294.6^{3000°}$
	$311.3^{3500°}$
	$327.7^{4000°}$

Name	$\eta \times 10^6$
Air	$343.3^{450°}$
	$358.3^{500°}$
Ammonia	$67.2^{-78.5°}$
	$92.6^{0°}$
	$108.0^{20°}$
	$130.3^{100°}$
Argon	$73.56^{-183.2°}$
	$138.0^{-104.4°}$
	$169.7^{-60.2°}$
	$210.4^{0°}$
	$216.8^{12.3°}$
	$221.0^{23°}$
	$270.2^{99.6°}$
	$323.1^{183°}$
Arsine	$145.8^{0°}$
	$198.1^{100°}$
Benzene	$70.9^{0°}$
	$75.9^{16.8°}$
	$100.7^{70.1°}$
	$117.6^{100°}$
	$124.7^{212.5°}$
Bromine	$151.1^{12.8°}$
	$170.5^{65.7°}$

VISCOSITY OF GASES AND VAPORS

Name	$\eta \times 10^6$
Bromine	$188.5^{99.7°}$
	$207.9^{139.7°}$
	$227.3^{179.7°}$
	$287.4^{302°}$
n-Butane	$84.0^{14.7°}$
	$84.1^{16.0°}$
	$109.2^{100°}$
iso-Butane	$75.5^{23°}$
iso-Butyl acetate	$76.4^{16.1°}$
	$112.0^{100°}$
iso-Butyl formate	$83.0^{17.7°}$
	$97.2^{63.6°}$
	$114.2^{99.9°}$
n-Butylamine	$82^{99.8°}$
iso-Butylamine	$88^{99.8°}$
Carbon dioxide	$103.3^{-78.4°}$
	$129.4^{-20.7°}$
	$138.0^{0°}$
	$143.6^{12°}$
	$160.0^{20°}$
	$197.2^{100°}$
	$214.3^{162.4°}$
	$238.5^{222°}$
	$268.2^{302°}$
pressure 1 atm.	$148^{20°}$
	$153^{30°}$
	$156^{35°}$
	$157^{40°}$
pressure 20 atm.	$156^{20°}$
	$159^{30°}$
	$163^{35°}$
pressure 40 atm.	$166^{20°}$
	$168^{30°}$
	$176^{40°}$
pressure 80 atm.	$565^{30°}$
	$528^{32°}$
	$361^{35°}$
	$218^{40°}$
Carbon disulfide	$91.1^{0°}$
	$96.4^{14.2°}$
Carbon monoxide	$56.5^{-191.6°}$
	$86.8^{-149.2°}$
	$128^{-78.4°}$
	$148^{-42.3°}$
	$167^{0°}$
	$175^{11.4°}$
	$184^{20°}$
	$210^{100°}$
Carbon oxysulfide	$119^{15°}$
	$154^{100°}$
Chlorine	$129.7^{12.7°}$
	$147.0^{20°}$
	$168.8^{99.1°}$
	$189.7^{146°}$
Chloroform	$94.4^{0°}$
	$98.9^{14.2°}$
	$102.9^{17.4°}$

Name	$\eta \times 10^6$
Chloroform	$130.7^{100°}$
	$166^{212.5°}$
Cyanogen	$93.5^{0°}$
	$107^{20°}$
	$128.1^{100°}$
Diethylamine	$92^{99.9°}$
Ethane	$63.4^{-78.5°}$
	$84.8^{0°}$
Ethyl acetate	$68.4^{0°}$
	$94.3^{100°}$
	$126^{212.5°}$
Ethyl alcohol	$82.7^{0°}$
	$88.5^{16.8°}$
	$108.8^{100°}$
	$141.7^{212.5°}$
Ethyl chloride	$93.5^{0°}$
	$105.0^{20°}$
	$144.0^{157.3°}$
	$171.4^{240.6°}$
Ethyl ether	$68.4^{0°}$
	$71.6^{10°}$
	$73.5^{18.9°}$
	$75.5^{25.8°}$
	$79.3^{36.5°}$
	$95.5^{100°}$
	$123.4^{212.5°}$
Ethyl formate	$92^{99.8°}$
Ethyl propionate	$75.0^{16.1°}$
	$105.4^{68.6°}$
	$116.1^{99.9°}$
Ethylene	$69.93^{-75.7°}$
	$76.85^{-44.08°}$
	$85.1^{-21.5°}$
	$90.66^{-0.05°}$
	$101.6^{15°}$
	$109.0^{20°}$
	$127.8^{99.25°}$
	$153.0^{182.4°}$
	$182.6^{302.6°}$
Helium	$29.46^{-258.1°}$
	$81.54^{-198.0°}$
	$139.2^{-102.6°}$
	$158.7^{-60.9°}$
	$178.8^{-22.8°}$
	$187.6^{0°}$
	$191.4^{9.8°}$
	$196.0^{15°}$
	$199.4^{21.4°}$
	$234.1^{100°}$
	$269.9^{184.6°}$
Hydrogen	$5.7^{-257.7°}$
	$9.9^{-251.6°}$
	$31.93^{-202.2°}$
	$36.9^{-191.8°}$
	$60.93^{-102.9°}$
	$71.03^{-60.2°}$
	$81.9^{-20.6°}$

VISCOSITY OF GASES AND VAPORS

Name	$\eta \times 10^6$
Hydrogen	$84.9^{0°}$
	$92.3^{15°}$
	$93.1^{20°}$
	$97.6^{53.4°}$
	$104.6^{100.5°}$
	$121.5^{182.4°}$
	$139.2^{302°}$
Hydrogen bromide	$181.9^{18.7°}$
	$234.4^{100.2°}$
Hydrogen chloride	$137.9^{0°}$
	$156.0^{20°}$
	$182.2^{100°}$
Hydrogen iodide	$185.7^{20.6°}$
	$238.3^{100.2°}$
Hydrogen sulfide	$116.6^{0°}$
	$124.1^{17°}$
	$158.7^{100°}$
Iodine	$184.3^{124°}$
	$203.8^{170°}$
	$219.8^{205.4°}$
	$239.7^{247.1°}$
Krypton	$233.4^{0°}$
	$240.5^{10.6°}$
	$245.9^{16.3°}$
	$306.3^{100°}$
Mercury	$494^{273°}$
	$551^{313°}$
	$641^{369°}$
	$654^{380°}$
Methane	$35.1^{-181.6°}$
	$76.7^{-78.4°}$
	$103.5^{0°}$
	$120.1^{20°}$
	$136.3^{100°}$
Methyl acetate	$101.5^{100°}$
	$135.9^{212.5°}$
Methyl bromide	$103.6^{0°}$
Methyl chloride	$93.6^{-15.3°}$
	$102.5^{0°}$
	$116^{20°}$
	$138.4^{99.1°}$
	$170.6^{182.4°}$
	$213.9^{302°}$
Methyl *iso*-butyrate	$75.4^{24°}$
	$99.9^{65.5°}$
	$112.2^{100°}$
Methyl ether	$90.5^{0°}$
	$102^{20°}$
	$109.2^{99.85°}$
Methyl ethyl ether	$102.9^{100°}$
Methyl formate	$92.3^{20°}$
	$135.2^{100°}$
Methyl propionate	$94^{99.8°}$
Neon	$298.1^{0°}$
	$308^{13.8°}$
	$365.2^{100°}$
Nitric oxide	$178^{0°}$

Name	$\eta \times 10^6$
Nitric oxide	$186^{20°}$
Nitrogen (chemical)	$56^{-191.5°}$
	$156.3^{-21.5°}$
	$167.4^{0°}$
	$173.7^{13.9°}$
	$184^{20°}$
	$189.4^{53.5°}$
	$212^{100°}$
	$246^{182.7°}$
Nitrogen (atm.)	$169.5^{0°}$
	$174.4^{15°}$
	$213.4^{101.1°}$
	$246.4^{183°}$
Nitrous oxide	$124.9^{-21.5°}$
	$136.2^{0°}$
	$149.8^{25°}$
	$160.6^{53.6°}$
	$173.9^{75.8°}$
	$182.9^{100.3°}$
	$216.1^{183.1°}$
	$261.0^{289.9°}$
	$307.3^{413.6°}$
Oxygen	$65^{-191.1°}$
	$112.8^{-129.8°}$
	$145^{-78.7°}$
	$169.3^{-39.5°}$
	$192^{0°}$
	$201.4^{15°}$
	$206^{20°}$
	$216^{53.5°}$
	$248.5^{99.74°}$
	$288.5^{185.8°}$
iso-Pentane	$88.5^{100°}$
	$116.4^{212.5°}$
Phosphine	$106.1^{0°}$
	$112.0^{15°}$
	$143.8^{100°}$
Propionic acid	$118^{139.8°}$
Propyl acetate	$74.3^{15°}$
	$95.4^{77.8°}$
	$109.6^{100°}$
n-Propyl alcohol	$93^{99.9°}$
iso-Propyl alcohol	$109^{99.8°}$
n-Propyl ether	$78.89^{100.1°}$
iso-Propyl ether	$84.24^{100.2°}$
Propyl formate	$92^{99.9°}$
Radon (Niton)	$212.4^{0°}$
Silane (SiH_4)	$112.4^{15°}$
	$142.4^{100°}$
Sulfur dioxide	$117^{0°}$
	$124.2^{18°}$
	$161.6^{100°}$
Water vapor	$90.4^{0°}$
	$97.5^{20.6°}$
	$100.6^{28.9°}$
	$127^{100°}$
	$145^{151.2°}$

VISCOSITY OF GASES AND VAPORS

Name	$\eta \times 10^6$
Water vapor	$168^{207.1°}$
	$190^{261.3°}$
Xenon	$210.7^{00°}$

Name	$\eta \times 10^6$
Xenon	$218^{10.9°}$
	$222.2^{15.3°}$
	$282.7^{100.1°}$

VISCOSITY OF AQUEOUS SOLUTIONS AT 20° C

	Viscosity in millipoises				
Formula	1.0 Molar	0.5 Molar	0.25 Molar	0.125 Molar	0.0625 Molar
$BaCl_2$	13.156	11.530	10.800	10.467	10.310
$Ba(NO_3)_2$	.....	.....	10.661	10.388	.....
$CaCl_2$	13.320	11.660	10.843	10.500	.....
$Ca(NO_3)_2$	13.062	11.536	10.786	10.402	.....
KCl	10.095	10.116	10.135	10.138	10.140
KNO_3	10.056	10.104	10.127	10.130	.....
$MgCl_2$	13.503	11.785	10.925	10.530	.....
$Mg(NO_3)_2$	13.896	11.910	11.016	10.588	.....
NaCl	11.225	10.620	10.385	10.261	10.201
$NaNO_3$	11.200	10.583	10.334	10.226	.....
$SrCl_2$	13.300	11.628	10.831	10.481	.....
$Sr(NO_3)_2$	12.876	11.389	10.740	10.400	.....

SPECIFIC VISCOSITY OF AQUEOUS SOLUTIONS AT 25° C

In the table below are given the specific viscosities of aqueous solutions of different concentrations. To convert these values to absolute viscosities multiply by the viscosity of water at 25°C. See special table for viscosity of water.

Name	1.0 Molar	0.5 Molar	0.25 Molar	0.125 Molar
Acetic acid	1.1131	1.0596	1.0304	1.0171
Aluminum sulfate	1.4064	1.1782	1.0825	1.0381
Ammonia	1.0245	1.0105	1.0058	1.0030
Ammonium chloride	0.9884	0.9976	0.9990	0.9999
Ammonium nitrate	0.9722	0.9862	0.9908	0.9958
Ammonium sulfate	1.1114	1.0552	1.0302	1.0148
Arsenic acid, ortho	1.2707	1.1291	1.0595	1.0309
Barium chloride	1.1228	1.0572	1.0263	1.0128
Barium nitrate	1.0893	1.0437	1.0214	1.0084
Beryllium sulfate	1.3600	1.1620	1.0749	1.0151
n-Butyric acid	1.2803	1.1317	1.0637	1.0308
iso-Butyric acid	1.2728	1.1287	1.0661	1.0322
Cadmium chloride	1.1342	1.0631	1.0310	1.0202
Cadmium nitrate	1.1648	1.0742	1.0385	1.0177
Cadmium sulfate	1.3476	1.1574	1.0780	1.0335
Calcium chloride	1.1563	1.0764	1.0362	1.0172
Calcium nitrate	1.1172	1.0553	1.0218	1.0076
Cesium chloride	0.9775	.....	.....	.....
Chloric acid	1.0520	1.0255	1.0145	1.0059
Cobalt chloride	1.2041	1.0975	1.0482	1.0232
Cobalt nitrate	1.1657	1.0754	1.0318	1.0180
Cobalt sulfate	1.3543	1.1598	1.0766	1.0402
Copper chloride	1.2050	1.0977	1.0470	1.0268
Copper nitrate	1.1792	1.0802	1.0400	1.0179
Copper sulfate	1.3580	1.1603	1.0802	1.0384
Dichloroacetic acid	1.2649	1.1318	1.0640	1.0287
Dimethylamine	1.3044	1.1440	1.0632	1.0300
Ferric chloride	1.2816	1.1334	1.0602	1.0302

SPECIFIC VISCOSITY OF AQUEOUS SOLUTIONS AT 25° C

Name	1.0 Molar	0.5 Molar	0.25 Molar	0.125 Molar
Formic acid	1.0312	1.0169	1.0092	1.0049
Hydrogen bromide	1.0320	1.0164	1.0095	1.0068
Hydrogen chloride	1.0671	1.0338	1.0166	1.0095
Lactic acid	1.2499	1.1192	1.0585	1.0319
Lead nitrate	1.1010	1.0418	1.0174	1.0066
Lithium chloride	1.1423	1.0665	1.0314	1.0116
Lithium sulfate	1.2905	1.1372	1.0655	1.0320
Magnesium chloride	1.2015	1.0940	1.0445	1.0206
Magnesium nitrate	1.1706	1.0824	1.0396	1.0198
Magnesium sulfate	1.3673	1.1639	1.0784	1.0320
Manganese chloride	1.2089	1.0982	1.0481	1.0230
Manganese nitrate	1.1831	1.0867	1.0426	1.0235
Manganese sulfate	1.3640	1.1690	1.0761	1.0366
Mercuric chloride	1.0460	.....	1.0116	1.0042
Methylamine	1.1554	1.0821	1.0340	1.0170
Nickel chloride	1.2055	1.0968	1.0443	1.0210
Nickel nitrate	1.1800	1.0840	1.0422	1.0195
Nickel sulfate	1.3615	1.1615	1.0751	1.0323
Nitric acid	1.0266	1.0115	1.0052	1.0027
Perchloric acid	1.0118	1.0032	0.9998	0.9992
Phosphoric acid, ortho	1.2871	1.1331	1.0656	1.0312
Potassium carbonate	1.1667	1.0784	1.0391	1.0192
Potassium chloride	0.9872	0.9874	0.9903	0.9928
Potassium chromate	1.1133	1.0528	1.0224	1.0116
Potassium dichromate	.....	1.0061	1.0034	0.9999
Potassium ferricyanide	1.0610	1.0211	1.0108	1.0182
Potassium ferrocyanide	1.1124	1.0514	1.0228	1.0116
Potassium hydroxide	1.1294	1.0637	1.0313	1.0130
Potassium nitrate	0.9753	0.9822	0.9870	0.9921
Potassium sulfate	1.1051	1.0486	1.0206	1.0078
Propionic acid	1.1968	1.0991	1.0471	1.0264
Rubidium chloride	0.9846	.....	.....	.....
Silver nitrate	1.1150	1.0491	1.0240	1.0114
Sodium acetate	1.3915	1.1806	1.0889	1.0439
Sodium benzoate	1.6498	1.2788	1.1303	1.0633
Sodium bromide	1.0639	1.0299	1.0148	1.0078
Sodium *n*-butyrate	1.6773	1.2933	1.1363	1.0659
Sodium *iso*-butyrate	1.6845	1.2997	1.1428	1.0707
Sodium carbonate	.....	1.2847	1.1367	1.0610
Sodium chlorate	1.0901	1.0421	1.0219	1.0117
Sodium chloride	1.0973	1.0471	1.0239	1.0126
Sodium citrate	1.3856	1.1730	1.0847	1.0470
Sodium formate	1.2069	1.0947	1.0447	1.0231
Sodium hydroxide	1.2355	1.1087	1.0560	1.0302
Sodium lactate	1.4988	1.2232	1.1043	1.0512
Sodium nitrate	1.0655	1.0259	1.0122	1.0069
Sodium oxalate	.....	.....	1.0573	1.0282
Sodium perchlorate	1.0462	1.0183	1.0096	1.0028
Sodium phthalate	1.4905	1.2246	1.1111	1.0614
Sodium propionate	1.5380	1.2352	1.1122	1.0548
Sodium succinate	1.3899	1.1792	1.0849	1.0448
Sodium sulfate	1.2291	1.1058	1.0522	1.0235
Sodium tartrate	1.3365	1.1502	1.0724	1.0300
Strontium chloride	1.1411	1.0674	1.0338	1.0141
Strontium nitrate	1.1150	1.0491	1.0240	1.0114
Sulfuric acid	1.0898	1.0433	1.0216	1.0082
Thallous nitrate	0.9471	.....	0.9865	0.9932

SPECIFIC VISCOSITY OF AQUEOUS SOLUTIONS AT 25° C

Name	1.0 Molar	0.5 Molar	0.25 Molar	0.125 Molar
Trimethylamine	1.6838	1.2992	1.1430	1.0677
iso-Valeric acid	.....	.....	1.0750	1.0375
Zinc chloride	1.1890	1.0959	1.0526	1.0238
Zinc nitrate	1.1642	1.0857	1.0390	1.0186
Zinc sulfate	1.3671	1.1726	1.0824	1.0358

VISCOSITY OF WATER AT VARIOUS TEMPERATURES

In the table below the viscosity of water at various temperatures is given in terms of 1000η or millipoises.

t°C	1000η	t°C	1000η	t°C	1000η	t°C	1000η
−10	26.0	22	9.608	54	5.153	86	3.317
−8	24.0	24	9.161	56	4.994	88	3.240
−6	22.2	26	8.746	58	4.843	90	3.166
−4	20.5	28	8.363	60	4.699	92	3.095
−2	19.1	30	8.004	62	4.561	94	3.027
0	17.938	32	7.670	64	4.431	96	2.962
+2	16.740	34	7.357	66	4.306	98	2.899
4	15.676	36	7.064	68	4.186	100	2.839
6	14.726	38	6.791	70	4.071	110	2.56
8	13.872	40	6.536	72	3.962	120	2.32
10	13.097	42	6.298	74	3.857	130	2.12
12	12.390	44	6.075	76	3.756	140	1.96
14	11.748	46	5.868	78	3.661	150	1.84
16	11.156	48	5.675	80	3.570	160	1.74
18	10.603	50	5.492	82	3.483		
20	10.087	52	5.320	84	3.396		

ABSOLUTE VISCOSITIES OF AQUEOUS GLYCEROL SOLUTIONS

M. L. Sheeley, *Ind. Eng. Chem. 24, 1060 (1932).*

Aqueous solutions of glycerol are suitable liquids for use as standards in calibrating technical viscosimeters. By means of an accurate specific gravity determination the percentage of glycerol concentration can be determined within ±0.02 per cent. (See special table of density of aqueous glycerol solutions.)

% Glycerol by Weight	Absolute Viscosity in Centipoises			% Glycerol by Weight	Absolute Viscosity in Centipoises		
	20°C.	25°C.	30°C.		20°C.	25°C.	30°C.
0.00	1.005	0.893	0.800	55.00	7.997	6.582	5.494
1.00	1.029	0.912	0.817	56.00	8.482	6.963	5.816
2.00	1.055	0.935	0.836	57.00	9.018	7.394	6.148
3.00	1.083	0.959	0.856	58.00	9.586	7.830	6.495
4.00	1.112	0.984	0.877	59.00	10.25	8.312	6.870
5.00	1.143	1.010	0.900	60.00	10.96	8.823	7.312
6.00	1.175	1.037	0.924	61.00	11.71	9.428	7.740
7.00	1.207	1.064	0.948	62.00	12.52	10.11	8.260
8.00	1.239	1.092	0.972	63.00	13.43	10.83	8.812
9.00	1.274	1.121	0.997	64.00	14.42	11.57	9.386
10.00	1.311	1.153	1.024	65.00	15.54	12.36	10.02
11.00	1.350	1.186	1.052	66.00	16.73	13.22	10.68
12.00	1.390	1.221	1.082	67.00	17.96	14.18	11.45
13.00	1.431	1.256	1.112	68.00	19.40	15.33	12.33
14.00	1.473	1.292	1.143	69.00	21.07	16.62	13.27
15.00	1.517	1.331	1.174	70.00	22.94	17.96	14.32
16.00	1.565	1.370	1.207	71.00	25.17	19.53	15.56
17.00	1.614	1.411	1.244	72.00	27.56	21.29	16.88
18.00	1.664	1.453	1.281	73.00	30.21	23.28	18.34
19.00	1.715	1.495	1.320	74.00	33.04	25.46	19.93
20.00	1.769	1.542	1.360	75.00	36.46	27.73	21.68
21.00	1.829	1.592	1.403	76.00	40.19	30.56	23.60
22.00	1.892	1.644	1.447	77.00	44.53	33.58	25.90
23.00	1.957	1.699	1.494	78.00	49.57	37.18	28.68
24.00	2.025	1.754	1.541	79.00	55.47	41.16	31.62
25.00	2.095	1.810	1.590	80.00	62.0	45.86	34.92
26.00	2.167	1.870	1.641	81.00	69.3	51.02	38.56
27.00	2.242	1.934	1.695	82.00	77.9	56.90	42.92
28.00	2.324	2.008	1.752	83.00	87.9	64.2	47.90
29.00	2.410	2.082	1.812	84.00	99.6	72.2	53.63
30.00	2.501	2.157	1.876	85.00	112.9	81.5	60.05
31.00	2.597	2.235	1.942	86.00	129.6	92.6	68.1
32.00	2.700	2.318	2.012	87.00	150.4	106.1	77.5
33.00	2.809	2.407	2.088	88.00	174.5	122.6	88.8
34.00	2.921	2.502	2.167	89.00	201.4	141.8	101.1
35.00	3.040	2.600	2.249	90.00	234.6	163.6	115.3
36.00	3.169	2.706	2.335	90.50	255.0	175.6	124.3
37.00	3.300	2.817	2.427	91.00	278.4	189.3	134.4
38.00	3.440	2.932	2.523	91.50	302.8	204.0	145.0
39.00	3.593	3.052	2.624	92.00	328.4	221.8	156.5
40.00	3.750	3.181	2.731	92.50	356.2	241.2	169.3
41.00	3.917	3.319	2.845	93.00	387.7	262.9	182.8
42.00	4.106	3.466	2.966	93.50	421.3	285.7	196.2
43.00	4.307	3.624	3.094	94.00	457.7	308.7	212.0
44.00	4.509	3.787	3.231	94.50	498.5	335.6	229.0
45.00	4.715	3.967	3.380	95.00	545	366.0	248.8
46.00	4.952	4.165	3.540	95.50	601	397.8	271.4
47.00	5.206	4.367	3.706	96.00	661	435.0	296.7
48.00	5.465	4.571	3.873	96.50	731	476.8	324.3
49.00	5.730	4.787	4.051	97.00	805	522.9	354.0
50.00	6.050	5.041	4.247	97.50	885	571	387.4
51.00	6.396	5.319	4.467	98.00	974	629	424.0
52.00	6.764	5.597	4.709	98.50	1080	698	465.3
53.00	7.158	5.910	4.957	99.00	1337	856	564
54.00	7.562	6.230	5.210	100.00	1499	945	624

COMPRESSIBILITY OF WATER

In the table below are given the relative volumes of water at various temperatures and pressures. The volume at 0°C. and one normal atmosphere (760 mm of Hg) is taken as unity.

P, atm	−10°C.	0°C.	10°C.	20°C.	40°C.	60°C.	80°C.
1	1.0017	1.0000	1.0001	1.0016	1.0076	1.0168	1.0287
500	0.9788	0.9767	0.9778	0.9804	0.9867	0.9967	1.0071
1000	0.9581	0.9566	0.9591	0.9619	0.9689	0.9780	0.9884
1500	0.9399	0.9394	0.9424	0.9456	0.9529	0.9617	0.9717
2000	0.9223	0.9241	0.9277	0.9312	0.9386	0.9472	0.9568
2500	0.9083	0.9112	0.9147	0.9183	0.9257	0.9343	0.9437
3000	0.8962	0.8993	0.9028	0.9065	0.9139	0.9225	0.9315
3500	0.8852	0.8884	0.8919	0.8956	0.9030	0.9115	0.9203
4000	0.8751	0.8783	0.8818	0.8855	0.8931	0.9012	0.9097
4500	0.8658	0.8692	0.8725	0.8762	0.8838	0.8919	0.9001
5000	0.8573	0.8606	0.8639	0.8675	0.8752	0.8832	0.8913
6000	.....	0.8452	0.8481	0.8517	0.8595	0.8674	0.8752
7000	.....	.....	0.8340	0.8374	0.8456	0.8534	0.8610
8000	.....	.....	.....	0.8244	0.8330	0.8408	0.8483
9000	.....	.....	.....	0.8128	0.8219	0.8297	0.8371
10000	.....	.....	.....	0.8027	0.8119	0.8196	0.8268
11000	.....	.....	.....	.....	0.8023	0.8101	0.8172
12000	.....	.....	.....	.....	0.7931	0.8009	0.8080

COEFFICIENTS OF COMPRESSIBILITY OF VARIOUS LIQUIDS AND AQUEOUS SOLUTIONS

In the table below are given values of β_t (the compressibility coefficient of a liquid at t°,.) to be used with the formula

$$\beta_t = \frac{1}{V_1}\left(\frac{V_1 - V_2}{P_2 - P_1}\right)$$

where V_1 is the volume of a liquid under a pressure of P_1 at t°C., and V_2 is the volume at some other pressure P_2, at the same temperature.

Liquid	t °C.	Pressure Range, atm.	βt $\times 10^6$
Acetic acid	25	at 92.5	81.4
" "	25	at 218.5	72.6
" "	25	at 494	57.1
Acetone	14.2	8.90 to 36.51	111
"	0	100 to 500	82
"	0	500 to 1000	59
"	0	1000 to 1500	47
"	0	1500 to 2000	40
"	25	at 82.5	111.8
Allyl alcohol	9.6	1 to 500	69
" "	9.6	500 to 1000	51
" "	9.6	1000 to 1500	43
" "	9.6	1500 to 2000	36
Ammonia, 2.29%	0	up to 10	50.9
" , 17.58%	0	up to 10	41.6
" , 21.58%	15	up to 10	36.5
Amyl alcohol	17.75	at 8	83.5
" "	13.8	8.5 to 37.12	88.2
Aniline	25	at 85.5	43.2
"	25	at 181.5	40.5

COEFFICIENTS OF COMPRESSIBILITY OF VARIOUS LIQUIDS

Liquid	t °C.	Pressure Range, atm.	$\beta t \times 10^6$
Aniline	25	at 281.5	38.3
"	25	at 390	36.1
Benzene	20	1 to 2	95.3
"	15.4	1 to 4	87
"	12.9	1 to 18.5	86.8
"	16	8.12 to 37.2	90
"	20	98.7 to 296	78.7
"	20	296 to 494	67.5
Bromine	20	0 to 98.7	63.5
"	20	98.7 to 197.4	58.4
"	20	197.4 to 296	54.6
"	20	296 to 395	52.1
"	20	395 to 494	49.9
Bromoform	20	0 to 98.7	51.0
"	20	98.7 to 197.4	47.5
"	20	197.4 to 296	44.0
"	20	296 to 395	42.0
"	20	395 to 494	41.0
n-Butyl alcohol	17.4	at 8	90
iso-Butyl alcohol	17.95	at 8	98
Butyl benzoate	10	1 to 5.25	59
Butyl butyrate	10	1 to 5.25	90
Butyl valerate	10	1 to 5.25	92
Calcium chloride, 5.8%	20	2 to 20	39.7
Calcium chloride, 9.9%	20	2 to 20	37.1
" " , 17.8%	20	2 to 20	31.3
" " , 40.9%	20	2 to 20	21.7
Caproic acid	30	20 to 400	68
" "	65	20 to 100	90
" "	100	20 to 200	109
Carbon dioxide	13	at 60	1740
" "	13	at 70	960
" "	13	at 80	660
" "	13	at 90	440
Carbon disulfide	20	1 to 2	80.95
" "	0	1 to 500	66
" "	0	500 to 1000	53
" "	0	1000 to 1500	43
" "	0	1500 to 2000	37
" "	0	2000 to 2500	33
Carbon tetrachloride	10	1 to 5.25	70
" "	20	0 to 98.7	91.6
" "	20	98.7 to 197.4	89.9
" "	20	197.4 to 296	83.5
" "	20	296 to 395	75.5
" "	20	395 to 494	69.9
" "	20	at 542.5	62.5
" "	20	at 664	55.0
Castor oil	14.8	1 to 10	47.2
Chlorine	20	9.9 to 98.7	118
"	20	98.7 to 197.4	110
"	20	197.4 to 296	102
"	20	296 to 395	90.7
"	20	395 to 494	84.5
Chlorobenzene	13.3	1 to 18.5	67.1
"	80	1 to 2	108.4

COEFFICIENTS OF COMPRESSIBILITY OF VARIOUS LIQUIDS

Liquid	t °C.	Pressure Range, atm.	$\beta t \times 10^6$
Chloroform	20	0 to 98.7	94.9
"	20	98.7 to 197.4	89.8
"	20	197.4 to 296	80.1
"	20	296 to 395	72.9
"	20	395 to 494	67.8
"	0	1 to 2	87.27
"	60	1 to 2	139.13
Cyclohexanol	40	98.7 to 296	56.4
Decane	23	0 to 1	105
Diphenylamine	65	0 to 500	57
"	100	0 to 300	64
"	185	0 to 100	110
Ethyl acetate	13.3	8.12 to 37.45	104
" "	99.6	8.13 to 37.15	250
Ethyl alcohol	20	1 to 50	112
" "	20	50 to 100	102
" "	20	100 to 200	95
" "	20	200 to 300	86
" "	20	300 to 400	80
" "	20	400 to 500	73
" "	20	500 to 600	69
" "	0	1 to 50	96
" "	0	600 to 700	60
" "	0	900 to 1000	52
" "	100	900 to 1000	73
Ethyl bromide	10.1	1 to 500	90
" "	10.1	500 to 1000	63
" "	10.1	1000 to 1500	50
" "	10.1	2000 to 2500	36
" "	13.7	1 to 18.5	113.4
Ethyl chloride	0	1 to 500	103
" "	0	500 to 1000	69
" "	0	1000 to 1500	55
" "	0	2000 to 2500	39
" "	15.2	8.7 to 37.22	153
" "	99	12.77 to 34.47	495
Ethyl ether	8.1	1 to 8	163.8
" "	13.5	8.43 to 25.4	169
" "	185	100 to 200	741
" "	185	100 to 400	478
" "	35	1 to 2000	42.5
" "	0	at 0	159
" "	0	at 100	125.7
" "	0	at 200	112.2
" "	0	at 500	84.5
" "	0	at 1000	63.5
" "	−109.8	at 1000	34.5
Ethyl iodide	10.6	1 to 500	74
" "	10.6	500 to 1000	56
" "	10.6	1000 to 1500	46
" "	10.6	1500 to 2000	38
" "	10.6	2000 to 2500	34
" "	10.6	2500 to 3000	31
Ethylene bromide	10	1 to 5.25	55.8
" "	64	1 to 5.25	76.6
Ethylene chloride	10	1 to 5.25	67.7

COEFFICIENTS OF COMPRESSIBILITY OF VARIOUS LIQUIDS

Liquid	t °C.	Pressure Range, atm.	$\beta t \times 10^6$
Ethylene chloride	75	1 to 5.25	111.1
Fluorobenzene	13.9	1 to 18.5	87.7
Glycerol	14.8	1 to 10	22.1
Heptane	23	0 to 1	134
Hexane	23	0 to 1	159
Mercury	22.8	1 to 500	3.8
"	22.8	500 to 1000	3.8
"	22.8	1000 to 1500	3.7
"	22.8	1500 to 2000	3.6
"	22.8	2000 to 2500	3.5
"	22.8	2500 to 3000	3.4
"	191.8	1 to 500	4.6
"	191.8	2500 to 3000	4.3
"	0	1 to 50	3.92
"	0	5810 to 6780	3.30
Mesitylene	20	98.7 to 296	68.4
"	20	296 to 494	59.1
Methyl acetate	14.3	8.10 to 37.53	97
Methyl alcohol	0	1 to 500	79
" "	0	500 to 1000	58
" "	0	1000 to 1500	47
" "	0	1500 to 2000	40
" "	0	2500 to 3000	29
" "	14.7	8.50 to 37.12	104
" "	18.1	at 8	120
Methyl butyrate	10	1 to 5.25	89
Methyl valerate	10	1 to 5.25	91
Nitrobenzene	25	at 86.5	46.1
"	25	at 192	43.0
"	25	at 303	40.1
"	25	at 419	38.1
Octane	23	0 to 1	121
Olive oil	20.5	1 to 10	63.3
" "	14.8	1 to 10	56.3
Palmitic acid	65	20 to 100	90
" "	185	20 to 300	134
" "	310	20 to 400	220
Paraffin, M. P. =55°	64	20 to 100	83
"	100	20 to 400	94
"	185	20 to 400	137
"	310	20 to 400	236
Paraffin oil	34	at 1	87
" "	34	at 2000	34
" "	34	at 4500	17
Pentane	0	1 to 29	174
"	20	1 to 29	242
"	0	at 0	175.9
"	0	at 484	94.6
"	0	at 967	68.9
Petroleum	1	1 to 15	67.91
"	16.1	1 to 15	76.77
"	35.1	1 to 15	82.83
"	52.2	1 to 15	92.21
"	72.1	1 to 15	100.16
"	94.0	1 to 15	108.8
Phosphorus trichloride	10.1	1 to 500	72

COEFFICIENTS OF COMPRESSIBILITY OF VARIOUS LIQUIDS

Liquid	t °C.	Pressure Range, atm.	$\beta t \times 10^6$
Phosphorus trichloride	10.1	500 to 1000	54
" "	10.1	1000 to 1500	45
" "	10.1	1500 to 2000	38
" "	10.1	2000 to 2500	33
Potassium chloride, 2.49%	20	2 to 20	42.6
" " , 4.40%	20	2 to 20	41.2
" " , 8.28%	20	2 to 20	38.9
" " , 16.75%	20	2 to 20	34.1
" " , 24.31%	20	2 to 20	30.1
n-Propyl alcohol	0	1 to 500	69
" "	0	500 to 1000	52
" "	0	1000 to 1500	42
" "	0	2500 to 3000	27
" "	5.6	at 8	89.5
isc-Propyl alcohol	5.65	at 8	95
" "	17.85	at 8	103
n-Propyl benzene	20	98.7 to 296	70.7
" "	20	296 to 494	61.0
iso-Propyl benzene	20	98.7 to 296	71.3
" "	20	296 to 494	61.2
Pseudocumene	20	98.7 to 296	65.2
"	20	296 to 494	56.9
Sodium chloride, 1.32%	15	at 10	45.3
" " , 13.53%	15	at 10	33.9
" " , 22.22%	15	at 10	28.2
" " , 26.21%	15	at 10	25.5
Sugar, cane, 0%	12.4	1 to 146	46.5
" " , 10%	12.4	1 to 146	42.65
" " , 20%	12.4	1 to 146	39.65
Sulfurous acid	0	1 to 16	302.5
Thymol	64	20 to 100	69
"	64	20 to 400	66
"	100	20 to 400	80
"	310	20 to 400	268
Toluene	10	1 to 5.25	79
"	66	1 to 5.25	114
"	20	1 to 2	91.47
"	25	at 114.5	80.6
"	25	at 230.5	70.3
"	25	at 355	62.1
p-Toluidine	45	1 to 150	51.2
"	28	20 to 100	56
"	100	20 to 400	77
"	185	20 to 400	112
"	310	20 to 400	243
Water, see special table			
Xylene	10	1 to 5.25	74
"	65	1 to 5.25	106
"	100	1 to 5.25	132

COEFFICIENTS OF CUBICAL EXPANSION FOR VARIOUS LIQUIDS AND AQUEOUS SOLUTIONS

See also the table *Coefficients of Cubical Expansion For Various Solids.*

In the table below are given the values of the coefficients a, b, and c in the equation $V_t = V_o (1 + at + bt^2 + ct^3)$. Where the compound is marked with * the basic volume is not that at 0°C, but at some other temperature, t_o. The equation then reads $V_t = V_{to}[1 + a(t - t_o) + b(t - t_o)^2 + c(t - t_o)^3]$. In the case of aqueous solutions, the concentrations in percent are given after the name.

Liquid	Coef. at 20°C. $\times 10^3$	Range °C.	$a \times 10^3$	$b \times 10^6$	$c \times 10^8$
Acetic acid	1.071	16 to 107	1.063	−0.12636	1.0876
Acetone	1.487	0 to 54	1.324	3.809	−0.87983
Allyl alcohol	1.049	0 to 94	0.97019	1.8725	0.36452
Allyl bromide	1.241	0 to 69	1.2275	−0.44365	2.5843
Allyl chloride	1.475	9 to 44	1.3218	5.078	−4.1915
Allyl ether	1.346	0 to 88	1.2519	2.2401	0.35775
Allyl iodide	1.091	0 to 101	1.0539	0.63572	1.0036
Amyl acetate	1.162	0 to 124	1.1501	−0.09046	1.3015
Amyl alcohol	0.902	−15 to 80	0.89001	0.65729	1.18458
Amyl benzoate	0.848	0 to 198	0.81711	0.7377	0.10593
Amyl bromide	1.102	0 to 80	1.02321	1.90086	0.19756
Amyl chloride	1.208	0 to 100	1.17155	0.50077	1.35368
Amyl iodide	0.986	20 to 142	0.92658	1.4647	0.05962
Aniline	0.858	0 to 141	0.82349	0.8408	0.10741
Arsenous chloride	1.020	−15 to 130	0.97907	0.96695	0.17772
Benzene	1.237	11 to 81	1.17626	1.27755	0.80648
Benzoyl chloride	0.880	12 to 146	0.85893	0.44219	0.27139
Bromine	1.113	−7 to 60	1.03819	1.711138	0.54471
n-Butyl alcohol	0.950	6 to 108	0.83751	2.8634	−0.12415
n-Butyric acid	1.063	0 to 100	1.02573	0.83760	0.34694
iso-Butyric acid	1.068	16 to 118	0.97625	2.3976	−0.32145
Calcium chloride, 40.9%	0.458	17 to 24	0.42383	0.8571	.....
Cane sugar, 43.2%	0.343	0 to 35	0.2536	2.247	.....
n-Caproic acid	0.975	15 to 155	0.94413	0.68358	0.26586
Carbon disulfide	1.218	−34 to 68	1.1398	1.37065	1.91225
Carbon tetrachloride	1.236	0 to 76	1.18384	0.89881	1.35135
Chloral	0.934	13 to 51	0.9545	−2.2139	5.6392
Chloroform	1.273	0 to 63	1.19715	4.66473	−1.74328
o-Cresol	.....	66 to 186	0.71072	1.1464	0.2242
m-Cresol	.....	65 to 194	0.77526	0.27102	0.3868
p-Cresol	.....	66 to 186	0.86476	0.53912	0.64418
Cymene	0.946	0 to 100	0.895	1.277	.....
Diallyl	1.375	0 to 60	1.3423	−0.34339	3.8693
Diethyl ketone	1.233	0 to 95	1.15342	1.88396	0.32021
Dipropyl	1.381	0 to 66	1.2948	1.7471	1.2363
Ethyl acetate	1.389	−36 to 72	1.2585	2.95688	0.14922
Ethyl alcohol	.....	0-80	1.04139	0.7836	1.7618
Ethyl alchol 50%	.....	0-39	0.7450	1.85	0.730
Ethyl benzoate	0.900	0 to 159	0.86606	0.8229	0.12084
Ethyl benzene	0.961	24 to 131	0.86172	2.5344	−0.18319
Ethyl bromide	1.418	−32 to 54	1.33763	1.50135	1.6900
Ethyl chloride	1.706	−32 to 26	1.57458	2.81366	1.56987
Ethyl ether	1.656	−15 to 38	1.51324	2.35918	4.00512
Ethyl formate	1.417	0 to 63	1.36446	0.13538	3.9248
Ethyl iodide	1.179	10 to 65	1.1520	0.26032	1.4181
Ethyl nitrate	1.299	9 to 72	1.1290	4.7915	−1.8413
Ethyl oxalate	1.136	0 to 141	1.06031	1.0983	2.6657

COEFFICIENTS OF CUBICAL EXPANSION FOR VARIOUS LIQUIDS AND AQUEOUS SOLUTIONS

Liquid	Coef. at 20°C. $\times 10^3$	Range °C.	$a \times 10^3$	$b \times 10^6$	$c \times 10^8$
Ethyl sulfide	1.278	0 to 90	1.19643	1.80653	0.78821
Ethylene chloride	1.161	−28 to 84	1.11893	1.0469	0.10342
Ethylene glycol	0.6375	11 to 136	0.5657	1.7074	0.293
Formic acid	1.025	5 to 104	0.99269	0.62514	0.5965
Glycerol	0.505	.....	0.4853	0.4895	.....
iso-Hexane	1.445	0 to 55	1.37022	0.97649	2.9819
Hydrochloric acid, 33.2%	0.455	0 to 33	0.4460	0.215	.....
4.2%	0.239	0 to 33	0.0652	4.355	.....
1.0%	0.211	0 to 32	0.0153	4.899	.....
*3.4%, t_e=110°	.....	110 to 140	0.620	4.5	.....
Isoprene	1.567	0 to 33	1.4603	0.99793	5.60149
Mercury	.....	0 to 100	0.18169041	0.002951266	0.0114562
	.....	24 to 299	0.181163	0.01155	0.0021187
Methyl acetate	1.427	0 to 58	1.34982	0.87098	3.5562
Methyl alcohol	1.259	−38 to 70	1.18557	1.56493	0.91113
Methyl benzoate	0.895	0 to 162	0.8633	0.7414	0.15896
Methyl bromide	1.684	−35 to 28	1.41521	3.31528	11.3809
Methyl cyanide	1.301	6 to 66	1.2118	1.7780	1.5322
Methyl ethyl ketone	1.315	0 to 76	1.18654	3.37043	−0.53365
Methyl formate	1.563	0 to 10	1.35824	10.538	−1.8085
Methyl iodide	1.273	5 to 39	1.1440	4.0465	−2.7393
Methyl propionate	1.304	0 to 74	1.3049	−1.3275	4.6943
Methyl sulfide	1.082	0 to 111	1.01705	1.57606	0.19072
Nitrobenzene	.....	144 to 164	0.8263	0.52249	0.13779
Olive oil	0.721	.....	0.68215	1.14053	−0.539
n-Pentane	1.656	−190 to 30	1.50697	3.435	0.975
iso-Pentane	1.680	0 to 27	1.46834	5.09626	0.6979
Petroleum, sp. gr. 0.8467	0.955	24 to 120	0.8994	1.396	.....
Petroleum ether	2.26	−190 to 0	1.46	1.60	.....
Phenol	.....	36 to 157	0.834	0.10732	0.4446
Phosphorus tribromide	0.868	0 to 100	0.8472	0.43672	0.25276
Phosphorus trichloride	1.154	−36 to 75	1.12862	0.87288	1.79236
Phosphorus oxychloride	1.116	0 to 107	1.06431	1.12666	0.5299
Potassium chloride, 24.3%	0.353	16 to 25	0.2695	2.080	.....
Propionic acid	1.102	0 to 133	1.0396	1.5487	0.04301
n-Propyl alcohol	0.956	0 to 94	0.7743	4.9689	−1.4069
iso-Propyl alcohol	1.094	0 to 83	1.04345	0.44303	2.7274
n-Propyl chloride	1.447	0 to 42	1.3306	3.8313	−1.3859
iso-Propyl chloride	1.591	0 to 34	1.3696	5.5287	.....
n-Propyl ether	1.354	0 to 88	1.2132	3.9318	−1.3644
iso-Propyl ether	1.452	0 to 67	1.2872	4.2923	−0.58573
Propyl iodide	1.102	10 to 98	1.0276	1.8658	−0.0051
Silicon tetrachloride	1.430	−32 to 59	1.29412	2.18414	4.08642
Sodium acid sulfate, 21%	0.555	0 to 34	0.5364	4.75	.....
Sodium chloride, 20.6%	0.414	0 to 29	0.3640	1.237	.....
Sodium sulfate, 1.9%	0.235	0 to 40	0.0449	4.749	.....
24%	0.410	11 to 40	0.3599	1.258	.....
Stannic chloride	1.178	−19 to 113	1.1328	0.91171	0.75798
Sulfur chloride	0.968	12 to 111	0.9591	−0.03819	0.73186
Sulfuric acid, conc.	.....	0–30	0.5758	−0.864	.....
Sulfuric acid 10.9%	0.387	0 to 30	0.2835	2.580	.....
5.4%	0.311	0 to 30	0.1450	4.143	.....
1.4%	0.234	0 to 30	0.03335	5.025	.....
*2.3%, t_e=100°	.....	110 to 140	0.729	2.8	.....

COEFFICIENTS OF CUBICAL EXPANSION FOR VARIOUS LIQUIDS AND SOLUTIONS

Liquid	Coef. at 20°C. $\times 10^3$	Range °C.	$a \times 10^3$	$b \times 10^6$	$c \times 10^8$
*4.5%, to=110°	.....	110 to 140	0.648	4.2	.....
Thymol	.....	62 to 157	0.84369	0.26625	0.35997
Titanium tetrachloride	0.998	−22 to 134	0.94257	1.34579	0.0888
Toluene	1.099	0 to 100	1.028	1.779	.....
o-Toluidine	0.847	0 to 141	0.82136	0.6046	0.14696
Trimethyl carbinol	1.023	20 to 77	1.31261	−8.8155	3.61209
n-Valeric acid	1.004	8 to 144	0.97557	0.61852	0.30378
Water (see also below)		−13 to 0	−0.09417	1.449	−59.85
o-Xylene	0.973	16 to 131	0.91734	1.3245	0.19586
m-Xylene	1.009	0 to 141	0.96396	1.0251	0.32753
p-Xylene	1.011	19 to 131	0.97013	0.8714	0.5287

WATER

To find the cubical expansion of water, substitute in the following formulas:

0° to 33°: $Vt = Vo(1 - 0.0_464268t + 0.0_5850526t^2 - 0.0_7678977t^3 + 0.0_9401209t^4$

0° to 80°: $Vt = Vo(1 - 0.0_453255t + 0.0_5761532t^2 - 0.0_7437217t^3 + 0.0_9164322t^4$

CUBICAL EXPANSION OF SOLIDS

The coefficient of cubical expansion is the increase in volume per unit volume per degree C. rise in temperature. For ordinary work the assumption may be made that the coefficient of cubical expansion is about three times the coefficient of linear expansion.

Substance	Temp. °C.	Coef. $\times 10^5$
Antimony	0 to 100	3.167
Beryl	0 to 100	0.105
Bismuth	0 to 100	3.948
Copper	0 to 100	4.998
Diamond	40	0.354
Emerald	40	0.168
Galena	0 to 100	5.58
Glass, hard	0 to 100	2.14
" , Jena, 59 III	20 to 100	1.56
" , silica	0 to 80	0.129
" , tube	0 to 100	2.76
Gold	0 to 100	4.411
Ice	−20 to −1	11.250
Iceland spar	50 to 60	1.447
Iron	0 to 100	3.550
Lead	0 to 100	8.399

Substance	Temp. °C.	Coef. $\times 10^5$
Paraffin	20	58.8
Platinum	0 to 100	2.65
Porcelain	0 to 100	1.080
" , Berlin	20	0.814
Potassium chloride	0 to 100	10.94
" nitrate	0 to 100	19.67
" sulfate	20	10.754
Quartz	0 to 100	3.840
Rock salt	50 to 60	12.120
Rubber	20	48.7
Silver	0 to 100	5.831
Sodium	20	21.364
Stearic acid	33.8 to 45.5	81
Sulfur, native	13.2 to 50.3	22.3
Tin	0 to 100	6.889
Zinc	0 to 100	8.928

COEFFICIENT OF CUBICAL EXPANSION OF VARIOUS COMPOUNDS

The following table gives values of the coefficient of cubical expansion of various compounds in millimeters per degree Centigrade as determined by Winkelmann and Schott, and Mayer and Havas.

Formula	Coef. $\times 10^7$	Formula	Coef. $\times 10^7$	Formula	Coef. $\times 10^7$	Formula	Coef. $\times 10^7$
AlF_3	4.4	CeO_2	4.2	MnO	0.1	Sb_2O_5	3.6
Al_2O_3	5.0	CoO	4.4	MnO_2	2.2	SiO_2	0.8
As_2O_5	2.0	Cr_2O_3	5.1	Na_3AlF_6	7.4	SnO_2	2.0
BaO	3.0	CuO	2.2	NaF	7.4	ThO_2	6.3
BeO	4.7	Fe_2O_3	4.0	Na_2O	10.0	TiO_2	4.1
B_2O_3	0.1	K_2O	8.5	NiO	4.0	ZnO	1.8
CaF_2	2.5	Li_2O	2.0	PbO	4.2	ZrO_2	2.1
CaO	5.0	MgO	0.1	P_2O_5	2.0		

COEFFICIENT OF LINEAR EXPANSION

In the table below are given the values of C in the formula:— $l_t = l_o (1+Ct)$, where l_o is the length of the material at 0°C., l_t is its length at t°C., and C is the coefficient of linear expansion. See also tables on properties of elements and properties of alloys.

Substance	Temp. °C.	C×10⁶
Alundum	25–900	8.7
Bakelite	20–60	22
Bauxite brick	25–100	4.4
Caoutchouc	16.7–25.3	77.0
Carborundum	25–100	6.58
"	100–900	4.74
Condesite, No. 100	16–79	44.0
" , No. 128	18–56	20.0
Diamond	40	1.18
Ebonite	25.3–35.4	84.2
Emerald, ‖ to axis	0–85	−1.35
" , ⊥ to axis	0–85	1.00
Fire clay brick	25–100	8.1
Fluorspar	0–100	19.50
Formica	20–60	30.0
Gas carbon	40	5.40
Glass, crown, mean	0–100	8.97
" " "	50–60	9.54
Glass, flint	50–60	7.88
" , Jena, 16 III	0–100	8.1
" , " , 59 III	0–100	5.8
" , " , 59 III	−191 to +16	4.24
" , plate	0–100	8.91
" , tube	0–100	8.33
" , tube	0–100	8.28
Graphite	40	7.86
Gutta percha	20	198.3
Ice	−20 to −1	51
Iceland spar, ‖ to axis	0–80	26.31
" " , ⊥ to axis	0–80	5.44
Limestone	25–100	9
Magnesium oxide	25–100	9.7–11.4
Marble	15–100	11.7
Paraffin	0–16	106.62
"	16–38	130.30
"	38–49	477.07
Porcelain	20–790	4.13
" , Bayeux	0	2.5
" , "	1000–1400	5.53
" , Berlin	0–100	3.1
Quartz, ‖ to axis	−190 to +16	5.21
" , ‖ " "	0–80	7.97
" , ⊥ " "	0–80	13.37

Substance	Temp. °C.	C×10⁶
Quartz glass	−190 to +16	−0.26
" "	16–500	0.57
" "	16–1000	0.58
Rock salt	40	40.4
Rubber, hard	0	69.1
" , "	−160	30.0
Sandstone	20	7–12
Slate	20	6–10
Topaz, ‖ to lesser horizontal axis	0–100	8.32
Topaz, ‖ to greater horizontal axis	0–100	8.36
Topaz, ‖ to vertical axis	0–100	4.72
Tourmaline, ‖ to longitudinal axis	0–100	9.37
Tourmaline, ‖ to horizontal axis	0–100	7.73
Vulcanite	0–18	63.60
Wedgwood ware	0–100	8.90
Wood, ‖ to fiber		
" , " Ash	0–100	9.51
" , " Beech	2–34	2.57
" , " Chestnut	2–34	6.49
" , " Elm	2–34	5.65
" , " Mahogany	2–34	3.61
" , " Maple	2–34	6.38
" , " Oak	2–34	4.92
" , " Pine	2–34	5.41
" , " Walnut	2–34	6.58
Wood, across fiber		
" , " Beech	2–34	61.4
" , " Chestnut	2–34	32.5
" , " Elm	2–34	44.3
" , " Mahogany	2–34	40.4
" , " Maple	2–34	48.4
" , " Oak	2–34	54.4
" , " Pine	2–34	34.1
" , " Walnut	2–34	48.4
Wax, white	10–26	230.0
" , "	26–31	312.0
" , "	31–43	486.0
" , "	43–57	1522.7

BAROMETRY AND BAROMETRIC CORRECTIONS

In principle, the mercurial barometer balances a column of pure mercury against the weight of the atmosphere. The height of the column above the level of the mercury in the reservoir can be measured and serves as a direct index of atmospheric pressure. The space above the mercury in a barometer tube should be a Torricellian vacuum, perfect except for the practically negligible vapor pressure of mercury. The perfection of the vacuum is indicated by the sharpness of the click noted when the barometer tube is inclined. A barometer should be in a vertical position, suspended rather than fastened to a wall, and in a good light but not exposed to direct sunlight or too near a source of heat. The standard conditions for barometric measurements are 0°C., and gravity as at 45° latitude and sea level. There are numerous sources of error but corrections for most of these are readily applied. Some of the corrections are very small and their application may be questionable in view of the probably larger errors. The degree of consistency to be expected in careful measurements is about 0.005 inch with a 0.25 inch tube, increasing to 0.0015 inch with a tube 0.5 inch in diameter.

In reading a barometer of the Fortin type (the usual laboratory instrument for precision measurements) the procedure should be as follows: (*1*) Observe and record the temperature as indicated by the thermometer attached to the barometer. The temperature correction is very important and may be affected by heat from the observer's body. (2) Set the mercury in the reservoir at zero level, so that the point of the pin above the mercury just touches the surface, making a barely noticeable dimple therein. Tap the tube at the top and verify the zero setting. (*3*) Bring the vernier down until the view at the light background is cut off at the highest point of the meniscus. Record the reading.

The corrections to be made on the reading are as follow: (*1*) Temperature, to correct for the difference in thermal expansion of the mercury and the brass (or glass) to which the scale is attached.—This correction converts the reading into the value at 0°C. The brass scale table is applicable to the Fortin barometer. See tables. (*2a*) Latitude-gravity correction, and (*2b*) altitude-gravity correction, to compensate for differences in gravity, which would affect the height of the mercury column by variation in mass.—If local gravity is unknown, an approximate correction may be made from the tables. Local values of gravity are often subject to irregularities which lead to errors even when the corrections here provided are made. It is, therefore, advisable to determine the local value of gravity, from which the correction can be effected in the following manner:

$$B_t = B_r + \left(\frac{g_1 - g_0}{g_0}\right) \times B_r$$

in which B_t and B_r are the true and the observed heights of the barometer respectively, g_0 is standard gravity (980,665 cm sec^{-2}), and g_1 is the local gravity. It may be noted that for most localities, g_1 is smaller than g_0, which makes the correction negative. These corrections compensate the reading to gravity at 45° latitude and sea level. (*3*) Correction for capillary depression of the level of the meniscus.—This varies with the tube diameter and actual height of the meniscus in a particular case. Some barometers are calibrated to allow for an average value of the latter and approximating the correction. See table. (*4*) Correction for vapor pressure of mercury.—This correction is usually negligible, being only 0.001 mm at 20°C. and 0.006 mm at 40°C. This correction is added. See table of vapor pressure of mercury.

All tables are given in both metric and English units. When a barometer reading is to be converted from one set of units to another, it is important that all corrections be made in the original units before the conversion is made.

The corrections above do not apply to an aneroid barometer. These instruments should be calibrated at regular intervals by checking them against a corrected mercurial barometer.

For records on weather maps, meteorologists customarily correct barometer readings to sea level, and some barometers may be calibrated accordingly. Such instruments are not suitable for laboratory use where true pressure under standard conditions is required. Scale corrections should be specified in the maker's instructions with the instrument, and are also indicated by the lack of correspondence between a gauge mark usually placed exactly 30 inches from the zero point and the 30 inch scale graduation.

BAROMETRIC CONVERSION TABLE

Inches to Centimeters.

1 inch = 2.54001 centimeters

Inches.	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
27.0	68.580	.606	.631	.656	.682	.707	.733	.758	.783	.809
27.1	.834	.860	.885	.910	.936	.961	.987	*.012	*.037	*.063
27.2	69.088	.114	.139	.164	.190	.215	.241	.266	.291	.317
27.3	.342	.368	.393	.418	.444	.469	.495	.520	.545	.571
27.4	.596	.622	.647	.672	.698	.723	.749	.774	.799	.825
27.5	.850	.876	.901	.926	.952	.977	*.003	*.028	*.053	*.079
27.6	70.104	.130	.155	.180	.206	.231	.257	.282	.307	.333
27.7	.358	.384	.409	.434	.460	.485	.511	.536	.561	.587
27.8	.612	.638	.663	.688	.714	.739	.765	.790	.815	.841
27.9	.866	.892	.917	.942	.968	.993	*.019	*.044	*.069	*.095
28.0	71.120	.146	.171	.196	.222	.247	.273	.298	.323	.349
28.1	.374	.400	.425	.450	.476	.501	.527	.552	.577	.603
28.2	.628	.654	.679	.704	.730	.755	.781	.806	.831	.857
28.3	.882	.908	.933	.958	.984	*.009	*.035	*.060	*.085	*.111
28.4	72.136	.162	.187	.212	.238	.263	.289	.314	.339	.365
28.5	.390	.416	.441	.466	.492	.517	.543	.568	.593	.619
28.6	.644	.670	.695	.720	.746	.771	.797	.822	.847	.873
28.7	.898	.924	.949	.974	*.000	*.025	*.051	*.076	*.101	*.127
28.8	73.152	.178	.203	.228	.254	.279	.305	.330	.355	.381
28.9	.406	.432	.457	.482	.508	.533	.559	.584	.609	.635
29.0	.660	.686	.711	.736	.762	.787	.813	.838	.863	.889
29.1	.914	.940	.965	.990	*.016	*.041	*.067	*.092	*.117	*.143
29.2	74.168	.194	.219	.244	.270	.295	.321	.346	.371	.397
29.3	.422	.448	.473	.498	.524	.549	.575	.600	.625	.651
29.4	.676	.702	.727	.752	.778	.803	.829	.854	.879	.905
29.5	.930	.956	.981	*.006	*.032	*.057	*.083	*.108	*.133	*.159
29.6	75.184	.210	.235	.260	.286	.311	.337	.362	.387	.413
29.7	.438	.464	.489	.514	.540	.565	.591	.616	.641	.667
29.8	.692	.718	.743	.768	.794	.819	.845	.870	.895	.921
29.9	.946	.972	.997	*.022	*.048	*.073	*.099	*.124	*.149	*.175
30.0	76.200	.226	.251	.277	.302	.327	.353	.378	.404	.429
30.1	.454	.480	.505	.531	.556	.581	.607	.632	.658	.683
30.2	.708	.734	.759	.785	.810	.835	.861	.886	.912	.937
30.3	.962	.988	*.013	*.039	*.064	*.089	*.115	*.140	*.166	*.191
30.4	77.216	.242	.267	.293	.318	.343	.369	.394	.420	.445
30.5	.470	.496	.521	.547	.572	.597	.623	.648	.674	.699
30.6	.724	.750	.775	.801	.826	.851	.877	.902	.928	.953
30.7	.978	*.004	*.029	*.055	*.080	*.105	*.131	*.156	*.182	*.207
30.8	78.232	.258	.283	.309	.334	.359	.385	.410	.436	.461
30.9	.486	.512	.537	.563	.588	.613	.639	.664	.690	.715

DETERMINATION OF HEIGHTS BY THE BAROMETRIC FORMULA OF BABINET

$$Z = C\frac{B_0 - B}{B_0 + B}$$

$$\text{C (in feet)} = 52494\left(1 + \frac{t_0°F + t°F - 64}{900}\right)$$

$$\text{C (in meters)} = 16000\left(1 + \frac{2(t_0°\text{C} + t°C)}{1000}\right)$$

Z = difference in height of two stations.

B_0, B = barometric readings at the lower and upper stations respectively.

t_0, t = temperature of the air at the lower and upper stations respectively.

BAROMETER TEMPERATURE CORRECTION—GLASS SCALE METRIC UNITS

The values in the table below are to be subtracted from the observed readings to correct for the difference in the expansion of the mercury and the glass scale at different temperatures.

Temp. °C.	Observed barometer height in millimeters						
	700	730	740	750	760	770	800
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.12	0.13	0.13	0.13	0.13	0.13	0.14
2	0.24	0.25	0.26	0.26	0.26	0.27	0.27
3	0.36	0.38	0.38	0.39	0.40	0.40	0.42
4	0.49	0.51	0.51	0.52	0.53	0.53	0.55
5	0.61	0.63	0.64	0.65	0.66	0.67	0.69
6	0.73	0.76	0.77	0.78	0.79	0.80	0.83
7	0.85	0.89	0.90	0.91	0.92	0.93	0.97
8	0.97	1.01	1.03	1.04	1.05	1.07	1.11
9	1.09	1.14	1.15	1.17	1.18	1.20	1.25
10	1.21	1.26	1.28	1.30	1.32	1.33	1.39
11	1.33	1.39	1.41	1.43	1.45	1.47	1.52
12	1.45	1.52	1.54	1.56	1.58	1.60	1.66
13	1.58	1.64	1.67	1.69	1.71	1.73	1.80
14	1.70	1.77	1.79	1.82	1.84	1.87	1.94
15	1.82	1.90	1.92	1.95	1.97	2.00	2.08
16	1.94	2.02	2.05	2.08	2.10	2.13	2.21
17	2.06	2.15	2.18	2.21	2.23	2.26	2.35
18	2.18	2.27	2.30	2.33	2.37	2.40	2.49
19	2.30	2.40	2.43	2.46	2.50	2.53	2.63
20	2.42	2.52	2.56	2.59	2.63	2.66	2.77
21	2.54	2.65	2.69	2.72	2.76	2.79	2.90
22	2.66	2.78	2.81	2.85	2.89	2.93	3.04
23	2.78	2.90	2.94	2.98	3.02	3.06	3.18
24	2.90	3.03	3.07	3.11	3.15	3.19	3.32
25	3.02	3.15	3.20	3.24	3.28	3.32	3.45
26	3.14	3.28	3.32	3.37	3.41	3.46	3.59
27	3.26	3.40	3.45	3.50	3.54	3.59	3.73
28	3.38	3.53	3.58	3.63	3.67	3.72	3.87
29	3.50	3.65	3.70	3.75	3.80	3.85	4.00
30	3.62	3.78	3.83	3.88	3.93	3.99	4.14
31	3.74	3.90	3.96	4.01	4.06	4.12	4.28
32	3.86	4.03	4.08	4.14	4.20	4.25	4.42
33	3.98	4.15	4.21	4.27	4.33	4.38	4.55
34	4.10	4.28	4.34	4.40	4.46	4.51	4.69
35	4.22	4.40	4.47	4.53	4.59	4.65	4.83

BAROMETER TEMPERATURE CORREC-

The values in the table below are to be subtracted from the observed readings to correct for the difference in the expansion of the mercury and the brass scale at

Temp. °C.	Observed barometer height in millimeters						
	640	650	660	670	680	690	700
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1	0.10	0.11	0.11	0.11	0.11	0.11	0.11
2	0.21	0.21	0.22	0.22	0.22	0.23	0.23
3	0.31	0.32	0.32	0.33	0.33	0.34	0.34
4	0.42	0.42	0.43	0.44	0.44	0.45	0.46
5	0.52	0.53	0.54	0.55	0.55	0.56	0.57
6	0.63	0.64	0.65	0.66	0.66	0.67	0.68
7	0.73	0.74	0.75	0.76	0.78	0.79	0.80
8	0.84	0.85	0.86	0.87	0.89	0.90	0.91
9	0.94	0.95	0.97	0.98	1.00	1.01	1.03
10	1.04	1.06	1.07	1.09	1.11	1.12	1.14
11	1.15	1.16	1.18	1.20	1.22	1.24	1.25
12	1.25	1.27	1.29	1.31	1.33	1.35	1.37
13	1.35	1.38	1.40	1.42	1.44	1.46	1.48
14	1.46	1.48	1.50	1.53	1.55	1.57	1.59
15	1.56	1.59	1.61	1.64	1.66	1.68	1.71
16	1.67	1.69	1.72	1.74	1.77	1.80	1.82
17	1.77	1.80	1.82	1.85	1.88	1.91	1.94
18	1.87	1.90	1.93	1.96	1.99	2.02	2.05
19	1.98	2.01	2.04	2.07	2.10	2.13	2.16
20	2.08	2.11	2.15	2.18	2.21	2.24	2.28
21	2.18	2.22	2.25	2.29	2.32	2.35	2.39
22	2.29	2.32	2.36	2.40	2.43	2.47	2.50
23	2.39	2.43	2.47	2.50	2.54	2.58	2.62
24	2.49	2.53	2.57	2.61	2.65	2.69	2.73
25	2.60	2.64	2.68	2.72	2.76	2.80	2.84
26	2.70	2.74	2.79	2.83	2.87	2.91	2.96
27	2.81	2.85	2.89	2.94	2.98	3.02	3.07
28	2.91	2.95	3.00	3.05	3.09	3.14	3.18
29	3.01	3.06	3.11	3.15	3.20	3.25	3.29
30	3.12	3.16	3.21	3.26	3.31	3.36	3.41
31	3.22	3.27	3.32	3.37	3.42	3.47	3.52
32	3.32	3.37	3.43	3.48	3.53	3.58	3.63
33	3.42	3.48	3.53	3.59	3.64	3.69	3.75
34	3.53	3.58	3.64	3.69	3.75	3.80	3.86
35	3.63	3.69	3.74	3.80	3.86	3.91	3.97

CORRECTION OF A BAROM-

(*Smithson-*

Metric Units

Diameter of tube, millimeters	Height of meniscus in millimeters							
	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8
	Correction to be added in millimeters							
4	0.83	1.22	1.54	1.98	2.37	....	....	....
5	0.47	0.65	0.86	1.19	1.45	1.80	....	....
6	0.27	0.41	0.56	0.78	0.98	1.21	1.43	....
7	0.18	0.28	0.40	0.53	0.67	0.82	0.97	1.13
8	....	0.20	0.29	0.38	0.46	0.56	0.65	0.77
9	....	0.15	0.21	0.28	0.33	0.40	0.46	0.52
10	....	....	0.15	0.20	0.25	0.29	0.33	0.37
11	....	....	0.10	0.14	0.18	0.21	0.24	0.27
12	....	....	0.07	0.10	0.13	0.15	0.18	0.19
13	....	....	0.04	0.07	0.10	0.12	0.13	0.14

TION—BRASS SCALE—METRIC UNITS

different temperatures.

Observed barometer height in millimeters								Temp. °C.
710	720	730	740	750	760	770	780	
mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.13	1
0.23	0.23	0.24	0.24	0.24	0.25	0.25	0.25	2
0.35	0.35	0.36	0.36	0.37	0.37	0.38	0.38	3
0.46	0.47	0.48	0.48	0.49	0.50	0.50	0.51	4
0.58	0.59	0.59	0.60	0.61	0.62	0.63	0.64	5
0.69	0.70	0.71	0.72	0.73	0.74	0.75	0.76	6
0.81	0.82	0.83	0.84	0.86	0.87	0.88	0.89	7
0.93	0.94	0.95	0.96	0.98	0.99	1.00	1.02	8
1.04	1.06	1.07	1.08	1.10	1.11	1.13	1.14	9
1.16	1.17	1.19	1.21	1.22	1.24	1.25	1.27	10
1.27	1.29	1.31	1.33	1.34	1.36	1.38	1.40	11
1.39	1.41	1.43	1.45	1.47	1.48	1.50	1.52	12
1.50	1.52	1.54	1.57	1.59	1.61	1.63	1.65	13
1.62	1.64	1.66	1.69	1.71	1.73	1.75	1.78	14
1.73	1.76	1.78	1.81	1.83	1.85	1.88	1.90	15
1.85	1.87	1.90	1.93	1.95	1.98	2.00	2.03	16
1.96	1.99	2.02	2.05	2.07	2.10	2.13	2.16	17
2.08	2.11	2.14	2.17	2.20	2.22	2.25	2.28	18
2.19	2.22	2.25	2.29	2.32	2.35	2.38	2.41	19
2.31	2.34	2.37	2.41	2.44	2.47	2.50	2.54	20
2.42	2.46	2.49	2.53	2.56	2.59	2.63	2.66	21
2.54	2.57	2.61	2.65	2.68	2.72	2.75	2.79	22
2.65	2.69	2.73	2.77	2.80	2.84	2.88	2.91	23
2.77	2.81	2.85	2.88	2.92	2.96	3.00	3.04	24
2.88	2.92	2.96	3.00	3.05	3.09	3.13	3.17	25
3.00	3.04	3.08	3.12	3.17	3.21	3.25	3.29	26
3.11	3.16	3.20	3.24	3.29	3.33	3.38	3.42	27
3.23	3.27	3.32	3.36	3.41	3.45	3.50	3.54	28
3.34	3.39	3.44	3.48	3.53	3.58	3.62	3.67	29
3.46	3.50	3.55	3.60	3.65	3.70	3.75	3.80	30
3.57	3.62	3.67	3.72	3.77	3.82	3.87	3.92	31
3.68	3.74	3.79	3.84	3.89	3.94	4.00	4.05	32
3.80	3.85	3.91	3.96	4.01	4.07	4.12	4.17	33
3.91	3.97	4.02	4.08	4.13	4.19	4.24	4.30	34
4.03	4.09	4.14	4.20	4.26	4.31	4.37	4.43	35

ETER FOR CAPILLARITY

ian Tables.)

English Units

Diameter of tube, inches	Height of meniscus in inches							
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8
	Correction to be added in inches							
0.15	0.024	0.047	0.069	0.092	0.116	.....	.....	.....
0.20	0.011	0.022	0.032	0.045	0.059	0.078	.....	.....
0.25	0.006	0.012	0.019	0.028	0.037	0.047	0.059	.....
0.30	0.004	0.008	0.013	0.018	0.023	0.029	0.035	0.042
0.35	.....	0.005	0.008	0.012	0.015	0.018	0.022	0.026
0.40	.....	0.004	0.006	0.008	0.010	0.012	0.014	0.016
0.45	.....	.....	0.003	0.005	0.007	0.008	0.010	0.012
0.50	.....	.....	0.002	0.004	0.005	0.006	0.006	0.007
0.55	.....	.....	0.001	0.002	0.003	0.004	0.005	0.005

BAROMETRIC TEMPERATURE CORREC-

The table below gives corrections for the expansion of the mercury and of the brass scale in a barometer. The zero correction for the mercury is at 32°F., and for the brass scale at 62°F. The zero correction for the barometer is at 28.5°F. Add or

Temp. °F.	Observed barometer height in inches									
	22.0	22.5	23.0	23.5	24.0	24.5	25.0	25.5	26.0	26.5
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
0	+0.057	+0.059	+0.060	+0.061	+0.063	+0.064	+0.065	+0.066	+0.068	+0.069
2	0.053	0.055	0.056	0.057	0.058	0.059	0.061	0.062	0.063	0.064
4	0.049	0.050	0.052	0.053	0.054	0.055	0.056	0.057	0.058	0.059
6	0.045	0.046	0.047	0.048	0.049	0.050	0.052	0.052	0.054	0.054
8	0.041	0.042	0.043	0.044	0.045	0.046	0.047	0.048	0.049	0.050
10	+0.037	+0.038	+0.039	+0.040	+0.041	+0.041	+0.042	+0.043	+0.044	+0.045
12	0.033	0.034	0.035	0.036	0.036	0.037	0.038	0.038	0.039	0.040
14	0.029	0.030	0.031	0.031	0.032	0.032	0.033	0.034	0.035	0.035
16	0.025	0.026	0.026	0.027	0.028	0.028	0.029	0.029	0.030	0.030
18	0.021	0.022	0.022	0.023	0.023	0.024	0.024	0.025	0.025	0.026
20	+0.017	+0.018	+0.018	+0.018	+0.019	+0.019	+0.020	+0.020	+0.020	+0.021
22	0.013	0.014	0.014	0.014	0.014	0.015	0.015	0.015	0.016	0.016
24	0.009	0.010	0.010	0.010	0.010	0.010	0.011	0.011	0.011	0.011
26	0.005	0.005	0.005	0.006	0.006	0.006	0.006	0.006	0.006	0.006
28	+0.001	+0.001	+0.001	+0.001	+0.001	+0.001	+0.001	+0.001	+0.001	+0.002
30	−0.003	−0.003	−0.003	−0.003	−0.003	−0.003	−0.003	−0.003	−0.003	−0.003
32	0.007	0.007	0.007	0.007	0.007	0.007	0.008	0.008	0.008	0.008
34	0.011	0.011	0.011	0.011	0.012	0.012	0.012	0.012	0.013	0.013
36	0.015	0.015	0.015	0.016	0.016	0.016	0.017	0.017	0.017	0.018
38	0.019	0.019	0.020	0.020	0.020	0.021	0.021	0.022	0.022	0.022
40	−0.023	−0.023	−0.024	0.024	−0.025	−0.025	−0.026	−0.026	−0.027	−0.027
42	0.027	0.027	0.028	0.029	0.029	0.030	0.030	0.031	0.032	0.032
44	0.031	0.031	0.032	0.033	0.033	0.034	0.035	0.035	0.036	0.037
46	0.035	0.035	0.036	0.037	0.038	0.038	0.039	0.040	0.041	0.042
48	0.039	0.040	0.040	0.041	0.042	0.043	0.044	0.045	0.046	0.046
50	−0.043	−0.044	−0.045	−0.046	−0.046	−0.047	−0.048	−0.049	−0.050	−0.051
52	0.047	0.048	0.049	0.050	0.051	0.052	0.053	0.054	0.055	0.056
54	0.051	0.052	0.053	0.054	0.055	0.056	0.057	0.058	0.060	0.061
56	0.055	0.056	0.057	0.058	0.060	0.060	0.062	0.063	0.064	0.065
58	0.059	0.060	0.061	0.063	0.064	0.065	0.066	0.068	0.069	0.070
60	−0.062	−0.064	−0.065	−0.067	−0.068	−0.069	−0.071	−0.072	−0.074	−0.075
62	0.066	0.068	0.069	0.071	0.073	0.074	0.076	0.077	0.079	0.080
64	0.070	0.072	0.074	0.075	0.077	0.078	0.080	0.081	0.083	0.085
66	0.074	0.076	0.078	0.079	0.081	0.083	0.085	0.086	0.088	0.089
68	0.078	0.080	0.082	0.084	0.085	0.087	0.089	0.090	0.093	0.094
70	−0.082	−0.084	−0.086	−0.088	−0.090	−0.091	−0.094	−0.095	−0.097	−0.099
72	0.086	0.088	0.090	0.092	0.094	0.096	0.098	0.100	0.102	0.104
74	0.090	0.092	0.094	0.096	0.098	0.100	0.103	0.104	0.107	0.108
76	0.094	0.096	0.098	0.101	0.103	0.104	0.107	0.109	0.111	0.113
78	0.098	0.100	0.103	0.105	0.107	0.109	0.112	0.113	0.116	0.118
80	−0.102	−0.104	−0.107	−0.109	−0.111	−0.113	−0.116	−0.118	−0.121	−0.123
82	0.106	0.108	0.111	0.113	0.116	0.118	0.121	0.122	0.125	0.127
84	0.110	0.113	0.115	0.118	0.120	0.122	0.125	0.127	0.130	0.132
86	0.114	0.117	0.119	0.122	0.124	0.126	0.130	0.132	0.135	0.137
88	0.118	0.121	0.123	0.126	0.129	0.131	0.134	0.136	0.139	0.142
90	−0.122	−0.125	−0.127	−0.130	−0.133	−0.135	−0.138	−0.141	−0.144	−0.146
92	0.126	0.129	0.132	0.134	0.137	0.140	0.143	0.145	0.149	0.151
94	0.130	0.133	0.136	0.139	0.142	0.144	0.147	0.150	0.153	0.156
96	0.134	0.137	0.140	0.143	0.146	0.149	0.152	0.155	0.158	0.161
98	0.138	0.141	0.144	0.147	0.150	0.153	0.156	0.159	0.163	0.165
100	−0.142	−0.145	−0.148	−0.151	−0.154	−0.157	−0.161	−0.164	−0.167	−0.170

TION—BRASS SCALE—ENGLISH UNITS

subtract the correction as indicated by its sign. On a metric scale barometer the zero correction is at 0°C. (32°F.); because of this difference, readings taken in inches which are to be converted to readings in centimeters should first be corrected for temperature.

Temp. °F.	Observed barometer height in inches									
	27.0	27.5	28.0	28.5	29.0	29.5	30.0	30.5	31.0	31.5
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
0	+0.070	+0.071	+0.073	+0.074	+0.076	+0.077	+0.078	+0.079	+0.081	+0.082
2	0.065	0.066	0.068	0.069	0.070	0.071	0.073	0.074	0.075	0.076
4	0.061	0.061	0.063	0.064	0.065	0.066	0.067	0.068	0.070	0.070
6	0.056	0.056	0.058	0.059	0.060	0.061	0.062	0.063	0.064	0.065
8	0.051	0.051	0.053	0.054	0.054	0.055	0.056	0.057	0.058	0.059
10	+0.046	+0.046	+0.047	+0.048	+0.049	+0.050	+0.051	+0.052	+0.053	+0.053
12	0.041	0.041	0.042	0.043	0.044	0.044	0.045	0.046	0.047	0.048
14	0.036	0.036	0.037	0.038	0.039	0.039	0.040	0.040	0.041	0.042
16	0.031	0.031	0.032	0.033	0.033	0.034	0.034	0.035	0.036	0.036
18	0.026	0.026	0.027	0.028	0.028	0.028	0.029	0.029	0.030	0.030
20	+0.021	+0.021	+0.022	+0.022	+0.023	+0.023	+0.024	+0.024	+0.024	+0.025
22	0.016	0.017	0.017	0.017	0.017	0.018	0.018	0.018	0.019	0.019
24	0.011	0.012	0.012	0.012	0.012	0.012	0.013	0.013	0.013	0.013
26	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.008
28	+0.002	+0.002	+0.002	+0.002	+0.002	+0.002	+0.002	+0.002	+0.002	+0.002
30	−0.003	−0.003	−0.003	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004	−0.004
32	0.008	0.008	0.009	0.009	0.009	0.009	0.009	0.009	0.009	0.010
34	0.013	0.013	0.014	0.014	0.014	0.014	0.015	0.015	0.015	0.015
36	0.018	0.018	0.019	0.019	0.019	0.020	0.020	0.020	0.021	0.021
38	0.023	0.023	0.024	0.024	0.025	0.025	0.026	0.026	0.026	0.027
40	−0.028	−0.028	−0.029	−0.029	−0.030	−0.030	−0.031	−0.031	−0.032	−0.032
42	0.033	0.033	0.034	0.034	0.035	0.036	0.036	0.037	0.038	0.038
44	0.038	0.038	0.039	0.040	0.040	0.041	0.042	0.042	0.043	0.044
46	0.043	0.043	0.044	0.045	0.046	0.046	0.047	0.048	0.049	0.049
48	0.047	0.048	0.049	0.050	0.051	0.052	0.053	0.053	0.054	0.055
50	−0.052	−0.053	−0.054	−0.055	−0.056	−0.057	−0.058	−0.059	−0.060	−0.061
52	0.057	0.058	0.059	0.060	0.061	0.062	0.064	0.064	0.066	0.066
54	0.062	0.063	0.064	0.065	0.067	0.068	0.069	0.070	0.071	0.072
56	0.067	0.068	0.069	0.070	0.072	0.073	0.074	0.075	0.077	0.078
58	0.072	0.073	0.074	0.076	0.077	0.078	0.080	0.081	0.082	0.084
60	−0.077	−0.078	−0.080	−0.081	−0.082	−0.084	−0.085	−0.086	−0.088	−0.089
62	0.082	0.083	0.085	0.086	0.088	0.089	0.091	0.092	0.094	0.095
64	0.086	0.088	0.090	0.091	0.093	0.094	0.096	0.097	0.099	0.101
66	0.091	0.093	0.095	0.096	0.098	0.099	0.101	0.103	0.105	0.106
68	0.096	0.098	0.100	0.101	0.103	0.105	0.107	0.108	0.110	0.112
70	−0.101	−0.103	−0.105	−0.106	−0.109	−0.110	−0.112	−0.114	−0.116	−0.117
72	0.106	0.107	0.110	0.111	0.114	0.115	0.118	0.119	0.122	0.123
74	0.111	0.112	0.115	0.117	0.119	0.121	0.123	0.125	0.127	0.129
76	0.116	0.117	0.120	0.122	0.124	0.126	0.128	0.130	0.133	0.134
78	0.120	0.122	0.125	0.127	0.129	0.131	0.134	0.136	0.138	0.140
80	−0.125	−0.127	−0.130	−0.132	−0.135	−0.136	−0.139	−0.141	−0.144	−0.146
82	0.130	0.132	0.135	0.137	0.140	0.142	0.145	0.147	0.149	0.151
84	0.135	0.137	0.140	0.142	0.145	0.147	0.150	0.152	0.155	0.157
86	0.140	0.142	0.145	0.147	0.150	0.152	0.155	0.158	0.161	0.163
88	0.145	0.147	0.150	0.152	0.155	0.158	0.161	0.163	0.166	0.168
90	−0.150	−0.152	−0.155	−0.157	−0.161	−0.163	−0.166	−0.169	−0.172	−0.174
92	0.154	0.157	0.160	0.163	0.166	0.168	0.172	0.174	0.177	0.180
94	0.159	0.162	0.165	0.168	0.171	0.174	0.177	0.179	0.183	0.185
96	0.164	0.167	0.170	0.173	0.176	0.179	0.182	0.185	0.188	0.191
98	0.169	0.172	0.175	0.178	0.181	0.184	0.188	0.190	0.194	0.197
100	−0.174	−0.177	−0.180	−0.183	−0.187	−0.190	−0.193	−0.196	−0.200	0.202

BAROMETRIC LATITUDE-GRAVITY TABLE—METRIC UNITS

(*Smithsonian Tables.*)

The values below are to be subtracted from the barometric reading for latitudes from 0 to 45° inculsive, and are to be added from 46 to 90°.

Deg. Lat.	Barometer readings, millimeters					
	680	700	720	740	760	780
	mm.	mm.	mm.	mm.	mm.	mm.
0	1.82	1.87	1.93	1.98	2.04	2.09
5	1.79	1.85	1.90	1.95	2.00	2.06
10	1.71	1.76	1.81	1.86	1.92	1.97
15	1.58	1.63	1.67	1.72	1.77	1.81
20	1.40	1.44	1.49	1.53	1.57	1.61
21	1.36	1.40	1.44	1.48	1.52	1.56
22	1.32	1.36	1.40	1.44	1.48	1.51
23	1.28	1.31	1.35	1.39	1.43	1.46
24	1.23	1.27	1.30	1.34	1.37	1.41
25	1.18	1.22	1.25	1.29	1.32	1.36
26	1.13	1.17	1.20	1.23	1.27	1.30
27	1.08	1.12	1.15	1.18	1.21	1.24
28	1.03	1.06	1.09	1.12	1.15	1.18
29	0.98	1.01	1.04	1.07	1.10	1.12
30	0.93	0.95	0.98	1.01	1.04	1.06
31	0.87	0.90	0.92	0.95	0.98	1.00
32	0.82	0.84	0.86	0.89	0.91	0.94
33	0.76	0.78	0.80	0.83	0.85	0.87
34	0.70	0.72	0.74	0.76	0.79	0.81
35	0.64	0.66	0.68	0.70	0.72	0.74
36	0.58	0.60	0.62	0.64	0.65	0.67
37	0.52	0.54	0.56	0.57	0.59	0.60
38	0.46	0.48	0.49	0.51	0.52	0.53
39	0.40	0.42	0.43	0.44	0.45	0.46
40	0.34	0.35	0.36	0.37	0.38	0.39
41	0.28	0.29	0.30	0.30	0.31	0.32
42	0.22	0.22	0.23	0.24	0.24	0.25
43	0.16	0.16	0.16	0.17	0.17	0.18
44	0.09	0.10	0.10	0.10	0.10	0.11
45	0.03	0.03	0.03	0.03	0.03	0.04
46	0.03	0.03	0.03	0.03	0.04	0.04
47	0.09	0.10	0.10	0.10	0.10	0.11
48	0.16	0.16	0.17	0.17	0.18	0.18
49	0.22	0.23	0.23	0.24	0.25	0.25
50	0.28	0.29	0.30	0.31	0.31	0.32
51	0.34	0.35	0.36	0.37	0.38	0.39
52	0.40	0.42	0.43	0.44	0.45	0.46
53	0.46	0.48	0.49	0.51	0.52	0.53
54	0.52	0.54	0.56	0.57	0.59	0.60
55	0.58	0.60	0.62	0.64	0.65	0.67
56	0.64	0.66	0.68	0.70	0.72	0.74
57	0.70	0.72	0.74	0.76	0.78	0.80
58	0.76	0.78	0.80	0.82	0.85	0.87
59	0.81	0.84	0.86	0.89	0.91	0.93
60	0.87	0.89	0.92	0.94	0.97	1.00
61	0.92	0.95	0.98	1.00	1.03	1.06
62	0.97	1.00	1.02	1.05	1.08	1.11
63	1.03	1.06	1.09	1.12	1.15	1.18
64	1.08	1.11	1.14	1.17	1.20	1.23
65	1.13	1.16	1.19	1.22	1.26	1.29
66	1.17	1.21	1.24	1.28	1.31	1.35
67	1.22	1.25	1.29	1.33	1.36	1.40
68	1.26	1.30	1.34	1.37	1.41	1.45
69	1.31	1.34	1.38	1.42	1.46	1.50
70	1.35	1.39	1.43	1.47	1.51	1.55
72	1.42	1.47	1.51	1.55	1.59	1.63
75	1.53	1.57	1.62	1.66	1.71	1.75
80	1.66	1.71	1.76	1.81	1.86	1.90
85	1.74	1.79	1.84	1.90	1.95	2.00
90	1.77	1.82	1.87	1.93	1.98	2.03

BAROMETRIC LATITUDE-GRAVITY TABLE—ENGLISH UNITS

(Smithsonian Tables.)

The values below are to be subtracted from the barometric reading for latituaes from 0 to 45° inclusive, and are to be added from 46 to 90°.

Deg. Lat.	Barometer readings, inches					
	25	26	27	28	29	30
	in.	in.	in.	in.	in.	in.
0	0.067	0.070	0.072	0.075	0.078	0.080
5	0.066	0.069	0.071	0.074	0.077	0.079
10	0.063	0.066	0.068	0.071	0.073	0.076
15	0.058	0.060	0.063	0.065	0.067	0.070
20	0.052	0.054	0.056	0.058	0.060	0.062
21	0.050	0.052	0.054	0.056	0.058	0.060
22	0.049	0.050	0.052	0.054	0.056	0.058
23	0.047	0.049	0.051	0.053	0.054	0.056
24	0.045	0.047	0.049	0.051	0.052	0.054
25	0.043	0.045	0.047	0.049	0.050	0.052
26	0.042	0.043	0.045	0.047	0.048	0.050
27	0.040	0.041	0.043	0.045	0.046	0.048
28	0.038	0.039	0.041	0.043	0.044	0.046
29	0.036	0.037	0.039	0.040	0.042	0.043
30	0.034	0.035	0.037	0.038	0.040	0.041
31	0.032	0.033	0.035	0.036	0.037	0.038
32	0.030	0.031	0.032	0.034	0.035	0.036
33	0.028	0.029	0.030	0.031	0.032	0.034
34	0.026	0.027	0.028	0.029	0.030	0.031
35	0.024	0.025	0.026	0.027	0.027	0.028
36	0.022	0.022	0.023	0.024	0.025	0.026
37	0.019	0.020	0.021	0.022	0.022	0.023
38	0.017	0.018	0.018	0.019	0.020	0.020
39	0.015	0.015	0.016	0.017	0.017	0.018
40	0.013	0.013	0.014	0.014	0.015	0.015
41	0.010	0.011	0.011	0.012	0.012	0.012
42	0.008	0.008	0.009	0.009	0.009	0.010
43	0.006	0.006	0.006	0.006	0.007	0.007
44	0.003	0.004	0.004	0.004	0.004	0.004
45	0.001	0.001	0.001	0.001	0.001	0.001
46	0.001	0.001	0.001	0.001	0.001	0.001
47	0.003	0.004	0.004	0.004	0.004	0.004
48	0.006	0.006	0.006	0.006	0.007	0.007
49	0.008	0.008	0.009	0.009	0.009	0.010
50	0.010	0.011	0.011	0.012	0.012	0.012
51	0.013	0.013	0.014	0.014	0.015	0.015
52	0.015	0.015	0.016	0.016	0.017	0.018
53	0.017	0.018	0.018	0.019	0.020	0.020
54	0.019	0.020	0.021	0.022	0.022	0.023
55	0.021	0.022	0.023	0.024	0.025	0.026
56	0.024	0.024	0.026	0.026	0.027	0.028
57	0.026	0.027	0.028	0.029	0.030	0.031
58	0.028	0.029	0.030	0.031	0.032	0.033
59	0.030	0.031	0.032	0.033	0.035	0.036
60	0.032	0.033	0.034	0.036	0.037	0.038
61	0.034	0.035	0.037	0.038	0.039	0.041
62	0.036	0.037	0.039	0.040	0.042	0.043
63	0.038	0.039	0.041	0.042	0.044	0.045
64	0.040	0.041	0.043	0.044	0.046	0.047
65	0.041	0.043	0.045	0.046	0.048	0.050
66	0.043	0.045	0.047	0.048	0.050	0.052
67	0.045	0.047	0.048	0.050	0.052	0.054
68	0.046	0.048	0.050	0.052	0.054	0.056
69	0.048	0.050	0.052	0.054	0.056	0.058
70	0.050	0.052	0.053	0.055	0.057	0.059
72	0.052	0.054	0.057	0.059	0.061	0.063
75	0.056	0.058	0.061	0.063	0.065	0.067
80	0.061	0.063	0.066	0.068	0.071	0.073
85	0.064	0.067	0.069	0.072	0.074	0.077
90	0.065	0.068	0.070	0.073	0.075	0.078

BAROMETRIC CORRECTION FOR GRAVITY

The values in the table below are to be subtracted from the readings taken on a mercurial barometer to correct for the decrease in gravity with increase in altitude.

Metric Units

Height above sea-level	Observed barometer height in millimeters								
	400	450	500	550	600	650	700	750	800
meters	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
100	....	....	....	....	....	....	0.02	0.02	0.02
200	....	....	....	....	....	....	0.04	0.05	0.05
300	....	....	....	....	....	....	0.07	0.07	0.07
400	....	....	....	....	....	....	0.09	0.10	0.10
500	....	....	....	....	....	....	0.11	0.12	0.13
600	....	....	....	....	....	0.12	0.13	0.14	....
700	....	....	....	....	....	0.14	0.15	0.16	....
800	....	....	....	....	....	0.16	0.18	0.19	....
900	....	....	....	....	....	0.18	0.20	0.22	....
1000	....	....	....	0.18	0.19	0.20	0.22	0.24	....
1100	....	....	....	0.19	0.21	0.22	0.24	....	....
1200	....	....	....	0.21	0.23	0.24	0.26	....	....
1300	....	....	....	0.22	0.24	0.26	0.29	....	....
1400	....	....	....	0.24	0.26	0.28	0.31	....	....
1500	....	....	0.24	0.26	0.28	0.30	0.33	....	....
1600	....	....	0.25	0.28	0.30	0.32	....	....	....
1700	....	....	0.27	0.30	0.32	0.34	....	....	....
1800	....	....	0.28	0.31	0.34	0.36	....	....	....
1900	....	....	0.30	0.33	0.36	0.39	....	....	....
2000	....	0.28	0.31	0.34	0.38	0.41	....	....	....
2100	....	0.30	0.33	0.36	0.40	....	....	....	....
2200	....	0.31	0.35	0.38	0.41	....	....	....	....
2300	....	0.32	0.36	0.40	0.43	....	....	....	....
2400	....	0.34	0.38	0.42	0.45	....	....	....	....
2500	0.31	0.35	0.39	0.43	0.47	....	....	....	....
2600	0.33	0.37	0.41	....	....	....	....	....	....
2800	0.35	0.40	0.44	....	....	....	....	....	....
3000	0.38	0.42	0.47	....	....	....	....	....	....
3200	0.40	0.46	....	....	....	....	....	.....	....
3400	0.43	0.48	....	....	....	....	....	.....	....

English Units

Height above sea-level feet	Observed barometer height in inches								
	14	16	18	20	22	24	26	28	30
	in.	in.	in.	in.	in.	in.	in.	in.	in.
1000	.....	.....	.....	.....	.....	.....	0.003	0.003	0.003
2000	.....	.....	.....	.....	.....	0.004	0.005	0.005	0.006
3000	.....	.....	.....	.....	0.007	0.007	0.008	0.008	.....
4000	.....	.....	.....	.....	0.009	0.009	0.010	.....	.....
5000	.....	.....	.....	0.010	0.011	0.011	0.012	.....	.....
5500	.....	.....	.....	0.011	0.012	0.013	.....	.....	.....
6000	.....	.....	.....	0.011	0.013	0.014	.....	.....	.....
6500	.....	.....	0.011	0.012	0.014	0.015	.....	.....	.....
7000	.....	.....	0.012	0.013	0.015	0.016	.....	.....	.....
7500	.....	.....	0.013	0.014	0.016	0.017	.....	.....	.....
8000	.....	0.012	0.014	0.015	0.017	.....	.....	.....	.....
8500	.....	0.013	0.015	0.016	0.018	.....	.....	.....	.....
9000	0.012	0.014	0.016	0.017	0.019	.....	.....	.....	.....
9500	0.013	0.015	0.016	0.018	0.020	.....	.....	.....	.....
10000	0.013	0.015	0.017	0.019	.....	.....	.....	.....	.....
10500	0.014	0.016	0.018	0.020	.....	.....	.....	.....	.....
11000	0.015	0.017	0.019	0.021	.....	.....	.....	.....	.....
11500	0.015	0.018	0.020	.....	.....	.....	.....	.....	.....
12000	0.016	0.018	0.021	.....	.....	.....	.....	.....	.....
12500	0.017	0.019	0.021	.....	.....	.....	.....	.....	.....
13000	0.017	0.020	.....	.....	.....	.....	.....	.....	.....
13500	0.018	0.021	.....	.....	.....	.....	.....	.....	.....
14000	0.019	0.021	.....	.....	.....	.....	.....	.....	.....
14500	0.019	.....	.....	.....	.....	.....	.....	.....	.....
15000	0.020	.....	.....	.....	.....	.....	.....	.....	.....

VALUES OF GRAVITY AT VARIOUS STATIONS

The following table gives values for the latitude, longitude, altitude and gravity of various places. Gravity is assumed to be the resultant acceleration caused by the attraction of gravity and the rotation of the earth. The values marked * have been corrected for the effect of topography and of isostatic compensation. All values are based on the Potsdam system.

Station	Latitude ° ′	Longitude ° ′	Altitude, meters	Gravity, cm/sec²
AFRICA				
Abu Hamed, Egypt	19° 32.0′	33° 19.9′E.	339	978.538
Algiers	36 44.8	3 3 E.	213	979.905
Bizerta, Tunisia	37 16.4	9 52.5 E.	7	979.975
Cape Town	33 56.1 S.	18 28.7 E.	11	979.657
Domjo Ndorobbo	3 8.8 S.	35 13.2 E.	1715	977.549
Freetown, Sierra Leone	8 29.4	13 14.3	65	978.200
Helwan, Egypt	29 51.5	31 20.4 E.	104	979.295
Johannesburg	26 10.9 S.	28 4.5 E.	1805	978.553
Kampo, Cameroons	2 21.2	9 49.6 E.	3	978.040
Khartum, Egypt	15 36.6	32 32.9 E.	383	978.308
Laghwat, Algeria	33 47.7	2 53 E.	755	979.356
Langenburg, S. Africa	9 35.8 S.	34 8.6 E.	477	977.907
Libreville, Gabon	0 22.3	9 27.2 E.	2	977.999
Loanda, Angola	8 48.6 S.	13 14.1 E.	4	978.212
Lourenco Marques	26 2.5 S.	32 19.8 E.	55	979.068
Luxor, Egypt	25 43.1	32 39.3 E.	82	978.982
Minia, Egypt	28 5.8	30 45.5 E.	42	979.155
Monrovia, Liberia	6 19.0	10 48.8	41	978.165
Mozambique	15 2.1 S.	38 25 E.	3	978.451
Ouled Rhamoun, Algeria	36 10.8	6 41 E.	687	979.709
Pangani	5 25.8 S.	38 58.8 E.	7	978.039
Rio del Rey, Nigeria	4 43.5	8 38.3 E.	2	978.087
Tangier, Morocco	35 46.5	5 48.6	63	979.737
Wadi Halfa, Egypt	21 55.8	31 19.9 E.	126	978.728
ALASKA				
Fort Egbert, Eagle City	64 47.4	141 12.4	269	982.141*
Percy Islands	54 55.8	131 35.3	4	981.511*
Point Young	58 11.5	134 33.4	7	981.703*
Quiet Harbor	56 14.1	132 39.6	4	981.590*
St. Michael	63 28.5	162 2.4	1	982.188*
St. Paul Island	57 7.3	170 16.6	10	981.767*
AUSTRALIA				
Brisbane	27 28.0 S.	153 1.6 E.	40	979.148
Hobart, Tasmania	42 53.6 S.	147 22.0 E.	58	980.441
Melbourne	37 49.9 S.	144 58.5 E.	26	979.987
Perth	31 57.1 S.	115 50.5 E.	58	979.378
Sydney	33 51.7 S.	151 12.7 E.	43	979.680
AUSTRIA				
Brenner	47 0.3	11 30.5 E.	1372	980.353
Dalaas	47 8	9 59 E.	838	980.454
Mixnitz	47 19.8	15 22 E.	445	980.657
Stilfserjoch	46 31.8	10 27.4 E.	2760	980.045
Vienna	48 12.7	16 21.5 E.	183	980.860
Waidhofen	47 57.7	14 46.7 E.	352	980.750
Wolfsthal	48 8.3	17 0.5 E.	146	980.904
BELGIUM				
Brussels	50 51.0	4 22 E.	102	981.112
CANADA				
Banff, Alberta	51 10.9	115 34.5	1376	980.741*

VALUES OF GRAVITY AT VARIOUS STATIONS

Station	Latitude ° ′	Longitude ° ′	Altitude, meters	Gravity, cm/sec²
CANADA (Cont.)				
Calgary, Alberta	51° 2.7′	114° 3.8′	1044	980.801*
Charlottetown, P.E.I.	46 13.9	63 7.5	8	980.746*
Halifax, N. S.	44 40.8	63 33.8	9	980.582*
Kenora, Ontario	49 46.0	94 30.0	330	980.992*
Kingston, Ontario	44 14.6	76 28.8	79	980.538*
Liard River, B. C.	59 58.7	123 47.5	160	981.731*
Moose Jaw, Sask.	50 23.4	105 31.8	541	980.946*
Ottawa, Ont.	45 23.6	75 43.0	83	980.618*
Peace River, Alta.	56 14.1	117 17.2	324	981.444*
Port Arthur, Ont.	48 26.0	89 13.0	189	980.806*
St. John, N. B.	45 16.0	66 5.0	33	980.679*
Sault Ste. Marie, Ont.	46 30.4	84 19.2	186	980.675*
Sydney, N. S.	46 8.4	60 11.8	12	980.745*
Vancouver, B. C.	49 16.8	123 6.8	6	980.903*
Winnipeg, Man.	49 54.4	97 8.0	231	980.992*
CENTRAL AMERICA, see SOUTH AMERICA				
CHINA				
Hankow	30 35.5	114 17.5 E.	73(?)	979.369
HongKong	22 18.2	114 10.5 E.	33	978.771
Port Arthur	38 47.9	121 22.3 E.	1	980.128
Shasi	30 18.1	112 14.8 E.	122(?)	979.303
Weihaiwei	37 30.0	122 11.0 E.	1	979.993
Zikawei	31 11.6	121 25.8 E.	4	979.437
CZEKOSLOVAKIA*				
Böhmerwald (Cesky Les)	49 40.1	12 59.3 E.	537	980.921
Cebon (Cebon)	50 0.9	13 0.4 E.	822	980.906
Karlowitz (Karlovice)	49 21.9	18 18.7 E.	510	980.890
Mount Hora (Hora Marenka)	49 10.3	15 42.4 E.	710	980.845
Rosenau (Roznava)	48 39.1	20 32 E.	281	980.871
DENMARK				
Copenhagen	55 41.2	12 34.7 E.	14	981.559
Frederikshavn	57 27.1	10 32.2 E.	15	981.740
Magleby	54 47.3	10 43.0 E.	14	981.502
Trige	56 15.2	10 9.5 E.	91	981.618
ENGLAND, see GREAT BRITAIN				
FINLAND				
Helsingfors	60 9.7	24 57.3 E.	29	981.912
Uleäborg	65 1.2	25 29.1 E.	9	982.262
Viborg	60 42.9	28 43.7 E.	12	981.928
FRANCE				
Arcachon	44 39.6	1 10.4	24	980.586
Bayonne	43 29.7	1 28.0	3	980.475
Bordeaux	44 50.1	0 31.4	72	980.572
Lihons	49 50.0	2 45 E.	106	981.038
Lyon	45 41.0	4 47 E.	286	980.629
Marseille	43 17.9	5 23 E.	61	980.482
Meudon	48 48.3	2 13.9 E.	130(?)	980.919
Mont Blanc	45 50	6 52 E.	4807	979.401
Nice	43 42.8	7 18 E.	367	980.471
Paris	48 50.2	2 20.3 E.	61	980.943
Port-Vendres	42 50.9	3 6 E.	25	980.456
Strasbourg	48 35.0	7 46.1 E.	137	980.904
Valence	44 56	4 53 E.	125	980.562
GERMANY				
Alter Bruch	50 45.7	15 44.6 E.	917	980.990*

*For other stations see end of this table.

VALUES OF GRAVITY AT VARIOUS STATIONS

Station	Latitude ° ′	Longitude ° ′	Altitude, meters	Gravity, cm/sec²
GERMANY (Cont.)				
Bremen	53° 5.0′	8° 49.2′ E.	0	981.341
Brocken	51 48.0	10 37 E.	1140	981.103*
Coburg	50 16.0	10 58 E.	290	981.015
Göttingen	51 32.0	9 57 E.	162	981.176
Hamburg	53 32.8	9 58.3 E.	24	981.375
Immenstaad	47 40.0	9 22.1 E.	403	980.709
Jena	50 55.6	11 35.2 E.	154	981.123
Karlsruhe	49 0.7	8 24.7 E.	114	980.967
Kiel	54 20.5	10 9 E.	41	981.464
Kolberg	54 11.3	15 35.8 E.	8	981.453
Königsberg	54 42.8	20 29.8 E.	22	981.477
Leipzig	51 20.1	12 23.5 E.	115	981.180
Munich	48 8.7	11 36.6 E.	525	980.733
Münster	51 57.9	7 37.9 E.	62	981.233
Potsdam	52 22.9	13 4.1 E.	87	981.274
Scharfenstein	51 50.0	10 36.0 E.	623	981.171*
Schneékoppe	50 44.2	15 44.6 E.	1605	980.886*
Stuttgart	48 46.9	9 10.5 E.	247	980.901
Waldsee	47 55	9 45.3 E.	590	980.706
GREAT BRITAIN				
Edinburgh, Scotland	55 57.4	3 9.4	104	981.584
Glasgow, Scotland	55 51.5	4 14.0	61	981.605
Greenwich, England	51 28.6	0 0.0	48	981.184
Kew, England	51 28.1	0 19	5	981.144
Plymouth, England	50 22.2	4 8.4	43	981.148
HOLLAND				
Amsterdam	52 21.9	4 54.7 E.	0	981.288
Breda	51 35.5	4 46.5 E.	1	981.213
De Bilt	52 6.2	5 10.7 E.	2	981.267
Delft	52 0.6	4 22.1 E.	2	981.264
Gronigen	53 13.2	6 34.0 E.	5	981.348
Leeuwarden	53 12.3	5 48.3 E.	1	981.348
Leiden	52 9.4	4 29.1 E.	2	981.273
Maastricht	50 51.2	5 41.6 E.	49	981.140
Terschelling	53 21.6	5 12.9 E.	6	981.376
Utrecht	52 5.2	5 7.8 E.	5	981.263
Winschoten	53 8.7	7 2.4 E.	0	981.346
HUNGARY				
Budapest	47 29.5	19 3.6 E.	108	980.852
Kis-Komarom	46 32.9	17 10.7 E.	115	980.745
INDIA				
Agra	27 10.3	78 1.1 E.	163	979.040*
Allahabad	25 25.9	81 55 E.	88	978.924*
Badnur	21 54.2	77 54.2 E.	641	978.627*
Chatra	24 12.7	88 23.4 E.	20	978.861*
Colaba	18 53.8	72 48.8 E.	10	978.633*
Cuttack	20 29.1	85 52.0 E.	28	978.661*
Dehra Dun	30 19.5	78 3.2 E.	682	978.985*
Dolhpur	26 42.0	77 54.8 E.	176	978.986*
Gesupur	28 33.0	77 42.0 E.	211	979.102*
Jacobabad	28 16.6	68 27.1 E.	56	979.164*
Jalpaiguri	26 31.3	88 44.2 E.	82	978.831*
Jubbulpore	23 8.9	79 59 E.	447	978.719*
Kalianpur	24 7.2	77 39.3 E.	537	978.790*
Madras	13 4.1	80 14.9 E.	6	978.321*

VALUES OF GRAVITY AT VARIOUS STATIONS

Station	Latitude ° ′	Longitude ° ′	Altitude, meters	Gravity, cm/sec²
INDIA (Cont.)				
Majhauli	26° 17.8′	83° 58′ E.	67	978.893*
Mian Mir	31 31.6	74 22.5 E.	216	979.352*
Moghal Sarai	25 17.0	83 6 E.	78	978.897*
Montgomery	30 39.8	73 6.3 E.	170	979.304*
Mussoorie	30 27.6	78 4.5 E.	2110	978.827*
Muzaffarpur	26 7.1	85 25 E.	55	978.898*
Quetta	30 12.2	67 0.7 E.	1682	978.877*
Raipur	21 13.9	81 41 E.	304	978.615*
Rajpur	30 24.2	78 5.8 E.	1012	978.938*
Sandakphu Peak	27 6.1	88 0.2 E.	3586	978.333*
Yercaud	11 46.9	78 12.5 E.	1369	978.026*
ISLANDS				
Auckland, New Zealand	36 50.9 S.	174 46.2 E.	3	979.962
Bastia, Corsica	42 41.2	9 27 E.	20	980.519
Batavia, Java	6 11.0 S.	106 49.8 E.	7	978.178
Bridgetown, Barbados	13 4.3	59 36.5	2	978.340
Catania, Sicily	37 30.2	15 4.7 E.	43	980.065
Fornells, Balearic Islands	40 3.4	4 7.9 E.	7	980.283
Honolulu, Hawaii	21 18.1	157 51.8	6	979.108*
Ibiza, Balearic Islands	38 54.3	1 26.1 E.	3	980.146
Jamestown, St. Helena	15 55 S.	5 43.7	10	978.889*
Karajak Glacier, Greenland	70 26.9	50 19.8	20	982.534
Kingston, Jamaica	17 57.7	76 47.3	2	978.591
Kudat, Borneo	6 53.0	116 50.7 E.	2	978.149
Las Palmas, Canary Islands	28 7.0	15 26.0	8	979.385
MaKassar, Celebes	5 7.3 S.	119 24.5 E.	2	978.138
Manila, Philippines	14 34.7	120 38.6 E.	3	978.360
Marau-Sound, Solomon Islands	9 49.1 S.	160 48.5 E.	3	978.349
Mauna Kea, Hawaii	19 49.2	155 28.8	3981	978.538*
Numea, New Caledonia	22 16.6 S.	166 27.8 E.	2	978.877
Palermo, Sicily	38 6.9	13 22.0 E.	20	980.069
Ponta Delgada, Azores	37 43.8	25 40.8	4	980.143
Port Vila, New Hebrides	17 45.0 S.	168 19.0 E.	3	978.637
Reykjavik, Iceland	64 8.5	22 0.3	39	982.273
St. George, Bermuda	32 21	64 40	2	980.024*
Santa Cruz de la Palma, Canary Islands	28 41.0	17 46.0	12	979.459
Singapore, Straits Settlements	1 16.5	103 50.3 E.	21	978.082
Stromboli, Lipari Islands	38 48.2	15 14.1 E.	48	980.212
Whales Point, Spitzbergen	77 30.4	20 58.8 E.	458(?)	982.899
Winter Quarters, Kaiser Wilhelm II Land	66 2.2 S.	89 38.1 E.	1	982.388
Valetta, Malta	35 53.8	14 31.3 E.	62	979.887
ITALY				
Alba	44 42.0	8 2.3 E.	169	980.444
Bologna	44 29.8	11 21.3 E.	51	980.450
Florence	43 46.8	11 15.2 E.	48	980.510
Genoa	44 25.1	8 55.3 E.	93	980.573
Livorno	43 32.0	10 18.5 E.	6	980.516*
Milan	45 28.0	9 11.5 E.	141	980.569
Padua	45 24.0	11 52.3 E.	19	980.658
Pola	44 51.8	13 50.7 E.	28	980.626
Pracchia	44 3.0	10 54.3 E.	627	980.378
Rome	41 53.5	12 29.7 E.	49	980.355*
San Remo	43 49.1	7 46.5 E.	23	980.505

VALUES OF GRAVITY AT VARIOUS STATIONS

Station	Latitude ° ′	Longitude ° ′	Altitude, meters	Gravity, cm/sec²
ITALY (Cont.)				
Turin	45° 4.1′	7° 41.8′ E.	233	980.549
JAPAN				
Aomori	40 49	140 45 E.	1	980.325
Fukushima	37 45	140 27 E.	67	980.022
Hachinohe	40 31	141 30 E.	21	980.408*
Hamada	34 54	132 6 E.	3	979.768
Himeji	34 50.1	134 42 E.	16 (?)	979.754
Kofu	35 39	138 35 E.	270	979.719
Kyoto	35 1.6	135 47.1 E.	55	979.727
Matsue	35 30	133 3 E.	23	979.812
Nagasaki	32 44.7	129 52.3 E.	30	979.594
Nagoya	35 10.4	136 53 E.	14	979.756
Okazaki	34 57.4	137 10 E.	25	979.764
Tokyo	35 42.6	139 46.0 E.	18	979.801
Uwajima	33 13	132 34.5 E.	2	979.597
Yamada	34 29.6	136 42.8 E.	4	979.727
JUGOSLAVIA				
Marburg	46 34	15 39 E.	270	980.708
Ragusa	42 38.6	18 6 E.	47	980.394
Serajevo	43 48.2	18 19.7 E.	511	980.382
NORWAY				
Bergen	60 23.9	5 18.3 E.	38	981.922
Dambaas	62 4.6	9 8.3 E.	643	981.892
Mehavn	71 1.3	27 47 E.	10	982.688
Oslo	59 54.7	10 43.5 E.	28	981.927
Rörvik	64 51.9	11 14.3 E.	10	982.313
Sorvaagen	67 53.6	13 2 E.	19	982.622*
Triset	59 25.8	8 10.8 E.	115	981.795
POLAND				
Bedzin	50 19.3	19 8.7 E.	256	981.058
Krakow	50 3.9	19 57.6 E.	205	981.054
Lwow (Lemberg)	49 50.2	24 0.0 E.	314	980.911
Tuchla	48 55.2	23 29 E.	540	980.789
PORTUGAL				
Camposancos	41 53.2	8 49.0	9	980.383
Lisbon	38 42.5	9 11.3	75	980.088
Oporto	41 8.2	8 36.1	94	980.290
Praia da Rocha	37 7.0	8 32.7	17	980.005
ROUMANIA				
Bocsa	46 56.9	22 42 E.	379	980.711
Bucharest	44 24.6	26 6.8 E.	83	980.553
Elesd	47 2.5	22 22 E.	225	980.794
Maros-Ludas	46 28.1	24 6 E.	281	980.715
RUSSIA and SIBERIA				
Alexandropol	40 47.0	43 49.7 E.	1519	979.785
Archangel	64 34	40 31.0 E.	5	982.278
Astrakhan	46 21.0	48 2.7 E.	−21	980.774
Dagarskoje	55 42.2	109 54 E.	465	981.32
Erivan	40 10.7	44 32.8 E.	990	979.880
Irkutsk	52 16.5	104 16.5 E.	470	981.096
Kazan	55 47.4	49 7.3 E.	70	981.572
Leningrad	59 56.5	30 17.7 E.	3	981.929
Listvinichnoe	51 51.0	104 52.5 E.	465	981.051
Moscow	55 45.3	37 34.3 E.	139	981.562
Novgorod	58 31.4	31 17.3 E.	48	981.780
Odessa	46 26.4	30 46.4 E.	43	980.769

VALUES OF GRAVITY AT VARIOUS STATIONS

Station	Latitude ° ′	Longitude ° ′	Altitude, meters	Gravity, cm/sec²
RUSSIA and SIBERIA (Cont.)				
Pulkova	59° 46.3′	30° 19.7′ E.	71	981.899
Simbirsk	54 19.0	48 24.2 E.	181	981.469
Tartu	58 22.8	26 43.2 E.	50	981.793
Tiflis	41 43.1	44 47.8 E.	412	980.176
Volkhovo	59 4.2	31 46.2 E.	21	981.826
SIAM				
Bankok	13 43.9	100 29.4 E.	7	978.278
SIBERIA see Russia				
SOUTH AMERICA				
Bahia Blanca, Argentina	38 47.1 S.	62 15.9	2	980.061
Buenos Aires, Argentina	34 36.5 S.	58 22.2	2	979.669
Bahia, Brazil	12 58.5 S.	38 31.0	4	978.331
Panama, Canal Zone	8 54.9	79 31.9	6	978.243
Valdivia, Chile	39 53.4 S.	73 28.3	10	979.920
Valparaiso, Chile	33 1.8 S.	71 38.5	60	979.609
Callao, Peru	12 4.1 S.	77 15.8	1	978.375
Acajutla, Salvador	13 34.7	89 50.4	12	978.303
Montevideo, Uruguay	34 54.5 S.	56 12.9	4	979.772
SPAIN				
Alcazar de San Juan	39 24.0	3 12.0	648	979.933
Arbas	43 0.9	5 45.0	1329	980.132
Barcelona	41 25.0	2 7.0 E.	407	980.240
Malaga	36 43.0	4 25.2	61	979.918
Salamanca	40 58.0	5 39.0	805	980.057
San Fernando	36 28.0	6 12.3	44	979.843
Seville	37 23.0	5 59.0	11	979.965
Tarita	36 0.0	5 37.0	29	979.748
Toledo	39 51.0	4 1.0	520	980.015
Valencia	39 29.0	0 23.0	6	980.127
Vivero	43 39.0	7 35.0	12	980.553
SWEDEN				
Haparanda	65 49.7	24 9.6 E.	4	982.337
Hernösand	62 37.8	17 57.0 E.	25	982.082
Lund	55 41.9	13 11.3 E.	32	981.564
Stockholm	59 20.6	18 3.5 E.	45	981.843
Upsala	59 51.5	17 37.6 E.	20	981.910
SWITZERLAND				
Basel	47 33.6	7 34.8 E.	277	980.788
Bern	46 56.5	7 26.8 E.	522	980.622
Chanrion	45 56.3	7 22.9 E.	2435	980.220*
Eggishorn	46 25.2	8 6.8 E.	2187	980.255*
Fribourg	46 47.6	7 9.4 E.	633	980.584
Gornergrat	45 59.0	7 46.8 E.	3016	980.157*
Grand St. Bernard	45 52.1	7 10.4 E.	2473	980.203*
Geneva	46 12.0	6 9.2 E.	402	980.592
Gsteig	46 23.2	7 56.2 E.	1185	980.395*
Lausanne	46 31.5	6 38.2 E.	531	980.599
Neuchatel	47 0.1	6 57.3 E.	467	980.627*
St. Maurice	46 13.0	7 0.2 E.	422	980.382*
Simplonhospiz	46 14.9	8 1.9 E.	1998	980.278*
Sion	46 14.1	7 21.5 E.	514	980.398*
Zermatt	46 1.5	7 45.0 E.	1603	980.243*
Zürich	47 22.7	8 33.1 E.	463	980.676
TURKESTAN				
Chardzhui	39 6.2	63 36.1 E.	192	980.014

VALUES OF GRAVITY AT VARIOUS STATIONS

Station	Latitude ° ′	Longitude ° ′	Altitude, meters	Gravity, cm/sec²
TURKESTAN (Cont.)				
Derbent, Bokhara	38° 12.0′	67° 3.2′E.	1012	979.672
Kala Khum, Bokhara	38 27.3	70 46.5 E.	1345	979.376*
Samarkand	39 39.1	66 58.7 E.	719	979.883
Sultan-Bend	37 7.5	62 28.0 E.	272	979.798
Tash Kent	41 19.5	69 17.7 E.	478	980.086
UNITED STATES				
Albany, N. Y.	42 39.1	73 46.1	61	980.338*
Apalachicola, Fla.	29 43.5	84 58.8	4	979.337*
Asheville, N. C.	35 35.9	82 33.3	670	979.629*
Atlanta, Ga.	33 45.0	84 23.3	324	979.538*
Austin, Tex.	30 17.2	97 44.2	189	979.282*
Baltimore, Md.	39 17.8	76 37.3	30	980.103*
Bismarck, N. D.	46 48.5	100 47.0	516	980.620*
Boise, Idaho	43 37.2	116 12.3	821	980.170*
Calais, Maine	45 11.2	67 16.9	38	980.641*
Cambridge, Mass.	42 22.8	71 7.8	14	980.408*
Charleston, W. Va.	38 20.9	81 37.7	184	979.926*
Charleston, S. C.	32 47.2	79 56.0	6	979.562*
Charlottesville, Va.	38 2.0	78 30.3	166	979.940*
Chicago, Ill.	41 47.4	87 36.1	182	980.285*
Cincinnati, Ohio	39 8.3	84 25.3	245	980.006*
Cleveland, Ohio	41 30.4	81 36.6	210	980.241*
Colorado Springs, Colo.	38 50.7	104 49.0	1841	979.483*
Denver, Colo.	39 40.6	104 56.9	1638	979.594*
Dover, Del.	39 9.7	75 32.0	12	980.112*
El Paso, Tex.	31 46.3	106 29.0	1146	979.125*
Galveston, Tex.	29 18.2	94 47.5	3	979.279*
Georgetown, Tex.	30 38.0	97 40.1	231	979.300*
Goldfield, Nev.	37 42.2	117 14.5	1716	979.483*
Hartford, Conn.	41 44.8	72 41.8	37	980.344*
Hinsdale, Mont.	48 23.8	107 5.3	661	980.722*
Hoboken, N. J.	40 44	74 2	11	980.277*
Indianapolis, Ind.	39 45.9	86 8.8	217	980.093*
Ithaca, N. Y.	42 27.1	76 29.0	247	980.305*
Kansas City, Mo.	39 5.8	94 35.4	278	979.989*
Key West, Fla.	24 33.6	81 48.4	1	979.005*
Lancaster, N. H.	44 29.5	71 34.3	261	980.493*
Las Vegas, N. M.	35 35.8	105 12.1	1960	979.221*
Little Rock, Ark.	34 45.0	92 16.4	89	979.722*
Madison, Wis.	43 4.6	89 24.0	270	980.368*
Minneapolis, Minn.	44 58.7	93 13.9	256	980.592*
Mount Hamilton, Cal.	37 20.4	121 38.6	1282	979.780*
New Orleans, La.	29 57.0	90 4.2	2	979.337*
New York, N. Y.	40 48.5	73 57.7	38	980.278*
Norris Geyser Basin, Wyo.	44 44.2	110 42.0	2276	979.981*
Pembina, N. D.	48 58.1	97 14.9	243	980.908*
Philadelphia, Pa.	39 57.1	75 11.7	16	980.205*
Pierre, S. D.	44 21.9	100 20.8	454	980.414*
Pittsburgh, Pa.	40 27.4	80 0.6	235	980.118*
Point Isabel, Tex.	26 4.7	97 12.4	8	979.091*
Portland, Ore.	45 31.4	122 40.7	8	980.630*
Potsdam, N. Y.	44 40.1	74 58.8	130	980.567*
Princeton, N. J.	40 21.0	74 39.5	64	980.191*
Richmond, Va.	37 32.2	77 26.1	30	979.970*
St. Louis, Mo.	38 38.0	90 12.2	154	980.002*

VALUES OF GRAVITY AT VARIOUS STATIONS

Station	Latitude ° ′	Longitude ° ′	Altitude, meters	Gravity, cm/sec²
UNITED STATES (Cont.)				
Salt Lake City, Utah	40° 46.1′	111° 53.8′	1322	979.762*
San Francisco, Cal.	37 47.5	122 25.7	114	980.010*
Sandpoint, Idaho	48 16.4	116 33.3	637	980.636*
Seattle, Wash.	47 39.6	122 18.3	58	980.713*
Springfield, Ill.	39 47.7	89 39.5	183	980.094*
State College, Pa.	40 47.9	77 51.8	358	980.134*
Terre Haute, Ind.	39 28.7	87 23.8	151	980.073*
Washington, D. C.	38 53.2	77 0.5	14	980.116*
Washington, D. C.	38 56.3	77 4.0	103	980.107*
Wilmington, N. C.	34 14.2	77 56.6	9	979.686*
Worcester, Mass.	42 16.5	71 48.5	170	980.342*
Yavapai, Ariz.	36 3.9	112 7.1	2179	979.226*
CZEKOSLOVAKIA (Cont.)				
Brno	49 12.4	16 36.0	247	980.961
Budejovice	48 52.0	14 17.0	1084	980.716
Dobsina	48 49.0	20 23.0	443	980.875
Mukacevo	48 26.0	22 43.0	123	980.940
Praha	50 8.0	14 28.2	356	981.016

REDUCTION OF THE BAROMETER TO SEA LEVEL

A barometer located at an elevation above sea level will show a reading lower than a barometer at sea level by an amount approximately 2.5 millimeters (0.1 inch) for each 30.5 meters (100 feet) of elevation. A closer approximation can be made by reference to the following tables which take into account, (1) the effect of altitude of the station at which the barometer is read, (2) the mean temperature of the air column extending from the station down to sea level, (3) the latitude of the station at which the barometer is read and, (4) the reading of the barometer corrected for its temperature, a correction which is applied only to mercurial barometers since the aneroid barometers are compensated for temperature effects.

Example.—A barometer which has been corrected for its temperature read 650 mm. at a station whose altitude is 1350 meters above sea level and at a latitude of 30°. The mean temperature (outdoor temperature) at the station is 20°C.

Table A (metric units) gives for these conditions a temperature-altitude factor of 135.2
The Latitude Factor Table gives for 135.2 at 30° lat. a correction of ..... +0.17
Therefore, the corrected value of the temperature-altitude factor is 135.37

Entering Table B (metric units), with a temperature-altitude factor of 135.37 and a barometric reading of 650 mm. (corrected for temperature), the correction is found to be 109.6
Accordingly the barometric reading reduced to sea level is 650 + 109.6 = 759.6 mm.

LATITUDE FACTOR—ENGLISH OR METRIC UNITS

For latitudes 0°-45° add the latitude factor, for 45°-90° subtract the latitude factor, from the values obtained in Table A.

Temp.—Alt. Factor From Table A	Latitude				
	0°	10°	20°	30°	45°
50	0.1	0.1	0.1	0.1	0.0
100	0.3	0.3	0.2	0.1	0.0
150	0.4	0.4	0.3	0.2	0.0
200	0.5	0.5	0.4	0.3	0.0
250	0.7	0.6	0.5	0.3	0.0
300	0.8	0.8	0.6	0.4	0.0
350	0.9	0.9	0.7	0.5	0.0
	90°	80°	70°	60°	45°

REDUCTION OF THE BAROMETER TO SEA LEVEL—METRIC UNITS

TABLE A. VALUES OF THE TEMPERATURE-ALTITUDE FACTOR FOR USE IN TABLE B.

(From *Smithsonian Meteorological Tables*, 3d Ed., 1907.)

Altitude in Meters	Mean Temperature of Air Column in Centigrade Degrees										
	−16°	−8°	−4°	0°	6°	10°	14°	18°	20°	22°	26°
10	1.2	1.1	1.1	1.1	1.1	1.0	1.0	1.0	1.0	1.0	1.0
50	5.8	5.6	5.5	5.4	5.3	5.2	5.1	5.0	5.0	5.0	4.9
100	11.5	11.2	11.0	10.8	10.6	10.4	10.3	10.1	10.0	9.9	9.8
150	17.3	16.7	16.5	16.2	15.9	15.6	15.4	15.1	15.0	14.9	14.7
200	23.0	22.3	22.0	21.6	21.1	20.8	20 5	20.2	20.0	19.9	19.6
250	28.8	27.9	27.5	27.0	26.4	26.0	25.6	25.2	25.0	24.9	24.5
300	34.5	33.5	33.0	32.5	31.7	31.2	30.7	30.3	30.1	29.8	29.4
350	40.3	39.0	38.5	37.9	37.0	36.4	35.9	35.3	35.1	34.8	34.3
400	46.0	44.6	43.9	43.3	42.3	41.6	41.0	40.4	40.1	39.8	39.2
450	51.8	51.3	49.4	48.7	47.6	46.8	46.1	45.4	45.1	44.8	44.1
500	57.5	55.8	54.9	54.1	52.9	52.0	51.2	50.5	50.1	49.7	49.0
550	63.3	61.4	60.4	59.5	58.1	57.2	56.4	55.5	55.1	54.7	53.9
600	69.0	66.9	65.9	64.9	63.4	62.4	61.5	60.6	60.1	59.7	58.8
650	74.8	72.5	71.4	70.3	68.7	67.6	66.6	65.6	65.1	64.6	63.7
700	80.6	78.1	76.9	75.7	74.0	72.9	71.7	70.7	70.1	69.6	68.6
750	86.3	83.7	82.4	81.1	79.3	78.1	76.9	75.7	75.1	74.6	73.5
800	92.1	89.2	87.9	86.5	84.6	83.3	82.0	80.8	80.1	79.6	78.4
850	97.8	94.8	93.4	92.0	89.8	88.5	87.1	85.8	85.2	84.5	83.3
900	103.6	100.4	98.9	97.4	95.1	93.7	92.2	90.8	90.2	89.5	88.2
950	109.3	106.0	104.4	102.8	100.4	98.9	97.4	95.9	95.2	94.5	93.1
1000	115.1	111.5	109.8	108.2	105.7	104.1	102.5	100.9	100.2	99.4	98.0
1050	120.8	117.1	115.3	113.6	111.0	109.3	107.6	106.0	105.2	104.4	102.9
1100	126.6	122.7	120.8	119.0	116.3	114.5	112.7	111.0	110.2	109.4	107.8
1150	132.3	128.3	126.3	124.4	121.6	119.7	117.9	116.1	115.2	114.4	112.7
1200	138.1	133.8	131.8	129.8	126.8	124.9	123.0	121.1	120.2	119.3	117.6
1250	143.8	139.4	137.3	135.2	132.1	130.1	128.1	126.2	125.2	124.3	122.5
1300	149.6	145.0	142.8	140.6	137.4	135.3	133.2	131.2	130.2	129.3	127.4
1350	155.3	150.6	148.3	146.0	142.7	140.5	138.4	136.3	135.2	134.2	132.3
1400	161.1	156.2	153.8	151.4	148.0	145.7	143.5	141.3	140.2	139.2	137.2
1450	166.8	161.7	159.3	156.8	153.3	150.9	148.6	146.4	145.3	144.2	142.1
1500	172.6	167.3	164.8	162.3	158.5	156.1	153.7	151.4	150.3	149.1	147.0
1550	178.3	172.9	170.2	167.7	163.8	161.3	158.8	156.4	155.3	154.1	151.8
1600	184.1	178.5	175.7	173.1	169.1	166.5	164.0	161.5	160.3	159.1	156.7
1650	189.8	184.0	181.2	178.5	174.4	171.7	169.1	166.5	165.3	164.1	161.6
1700	195.6	189.6	186.7	183.9	179.7	176.9	174.2	171.6	170.3	169.0	166.5
1750	201.4	195.2	192.2	189.3	185.0	182.1	179.3	176.6	175.3	174.0	171.4
1800	207.1	200.8	197.7	194.7	190.2	187.3	184.5	181.7	180.3	179.0	176.3
1850	212.9	206.3	203.2	200.1	195.5	192.5	189.6	186.7	185.3	183.9	181.2
1900	218.6	211.9	208.7	205.5	200.8	197.7	194.7	191.8	190.3	188.9	186.1
1950	224.4	217.5	214.2	210.9	206.1	202.9	199.8	196.8	195.3	193.9	191.0
2000	230.1	223.0	219.7	216.3	211.4	208.1	204.9	201.9	200.3	198.8	195.9
2050	235.9	228.6	225.1	221.7	216.7	213.3	210.1	206.9	205.3	203.8	200.8
2100	241.6	234.2	230.6	227.1	221.9	218.5	215.2	211.9	210.4	208.8	205.7
2150	247.4	239.8	236.1	232.5	227.2	223.7	220.3	217.0	215.4	213.8	210.6
2200	253.1	245.4	241.6	237.9	232.5	228.9	225.4	222.0	220.4	218.7	215.5
2250	258.9	250.9	247.1	243.4	237.8	234.1	230.6	227.1	225.4	223.7	220.4
2300	264.6	256.5	252.6	248.8	243.1	239.3	235.7	232.1	230.4	228.7	225.3
2350	270.4	262.1	258.1	254.2	248.3	244.5	240.8	237.2	235.4	233.6	230.2
2400	276.1	267.7	263.6	259.6	253.6	249.7	245.9	242.2	240.4	238.6	235.1
2450	281.9	273.2	269.1	265.0	258.9	254.9	251.0	247.3	245.4	243.6	240.0
2500	287.6	278.8	274.5	270.4	264.2	260.1	256.2	252.3	250.4	248.5	244.9
2550	293.4	284.4	280.0	275.8	269.5	265.3	261.3	257.3	255.4	253.5	249.8
2600	299.1	290.0	285.5	281.2	274.8	270.5	266.4	262.4	260.4	258.5	254.7
2650	304.9	295.5	291.0	286.6	280.0	275.7	271.5	267.4	265.4	263.4	259.6
2700	310.6	301.1	296.5	292.0	285.3	280.9	276.6	272.5	270.4	268.4	264.5
2750	316.4	306.7	302.0	297.4	290.6	286.1	281.8	277.5	275.4	273.4	269.4
2800	322.1	312.3	307.5	302.8	295.9	291.3	286.9	282.6	280.4	278.3	274.3
2850	327.9	317.8	313.0	308.2	301.2	296.5	292.0	287.6	285.4	283.3	279.2
2900	333.6	323.4	318.4	313.6	306.4	301.7	297.1	292.6	290.4	288.3	284.1
2950	339.4	329.0	323.9	319.0	311.7	306.9	302.2	297.7	295.5	293.3	289.0
3000	345.1	334.5	329.4	324.4	317.0	312.1	307.4	302.7	300.5	298.2	293.8

REDUCTION OF THE BAROMETER TO SEA LEVEL—METRIC UNITS

TABLE B. VALUES IN MILLIMETERS TO BE ADDED

(From *Smithsonian Meteorological Tables*, 3d Ed., 1907.)

Temp.—Alt. Factor	Barometer Reading in Millimeters						
	790	770	750	730	710	690	670
1	0.9	0.9	0.9	0.8	0.8	0.8	
5	4.6	4.4	4.3	4.2	4.1	4.0	
10	9.1	8.9	8.7	8.5	8.2	8.0	
15	13.8	13.4	13.1	12.7	12.4	12.0	
20	18.4	17.9	17.5	17.0	16.5	16.1	
25		22.5	21.9	21.3	20.7	20.1	
30		27.1	26.4	25.7	25.0	24.2	
35		31.7	30.8	30.0	29.2	28.4	
40		36.3	35.3	34.4	33.5	32.5	31.6
45			39.9	38.8	37.8	36.7	35.6
	750	730	710	690	670	650	630
50	44.4	43.3	42.1	40.9	39.7		
55	49.0	47.7	46.4	45.1	43.8		
60	53.6	52.2	50.8	49.3	47.9		
65	58.3	56.7	55.2	53.6	52.1		
70		61.3	59.6	57.9	56.2		
75		65.8	64.0	62.2	60.4		
80		70.4	68.5	66.6	64.6	62.7	60.8
85		75.0	73.0	70.9	68.9	66.8	64.8
90			77.5	75.3	73.1	71.0	68.8
95			82.1	79.7	77.4	75.1	72.8
	710	690	670	650	630	610	
100	86.6	84.2	81.8	79.3	76.9		
105	91.2	88.7	86.1	83.5	81.0		
110	95.9	93.2	90.5	87.8	85.1		
115	100.5	97.7	94.8	92.0	89.2		
120		102.2	99.3	96.3	93.3		
125		106.8	103.7	100.6	97.5	94.4	
130		111.4	108.2	104.9	101.7	98.5	
135		116.0	112.7	109.3	105.9	102.6	
140		120.7	117.2	113.7	110.2	106.7	
145			121.7	118.1	114.5	110.8	
	670	650	630	610	590	570	
150	126.3	122.5	118.8	115.0			
155	130.9	127.0	123.1	119.2			
160	135.5	131.5	127.4	123.4			
165	140.2	136.0	131.8	127.6			
170		140.5	136.2	131.9	127.5	123.2	
175		145.1	140.6	136.2	131.7	127.2	
180		149.7	145.1	140.5	135.9	131.3	
185		154.3	149.5	144.8	140.0	135.3	
190		158.9	154.0	149.2	144.3	139.4	
195			158.6	153.5	148.5	143.5	

Temp.—Alt. Factor	Barometer Reading in Millimeters					
	630	610	590	570	550	530
200	163.1	157.9	152.8	147.6		
205	167.7	162.4	157.1	151.7		
210	172.3	166.8	161.4	155.9		
215	176.9	171.3	165.7	160.1	154.5	148.9
220		175.8	170.1	164.3	158.5	152.8
225		180.4	174.5	168.5	162.6	156.7
230		184.9	178.9	172.8	166.7	160.7
235		189.5	183.3	177.1	170.9	164.7
240		194.1	187.8	181.4	175.0	168.7
245		198.8	192.3	185.7	179.2	172.7
	590	570	550	530	510	
250	196.8	190.1	183.4	176.8		
255	201.3	194.5	187.7	180.8		
260	205.9	198.9	191.9	185.0	178.0	
265	210.5	203.3	196.2	189.1	181.9	
270	215.1	207.8	200.5	193.2	185.9	
275	219.8	212.3	204.9	197.4	190.0	
280		216.8	209.2	201.6	194.0	
285		221.4	213.6	205.8	198.1	
290		225.9	218.0	210.1	202.1	
295		230.5	222.4	214.3	206.3	
	570	550	530	510	490	
300	235.1	226.9	218.6	210.4		
305	239.8	231.4	223.0	214.6	206.1	
310		235.9	227.3	218.7	210.1	
315		240.4	231.7	222.9	214.2	
320		245.0	236.1	227.2	218.3	
325		249.6	240.5	231.4	222.4	
330		254.2	244.9	235.7	226.5	
335		258.8	249.4	240.0	230.6	
340		263.5	253.9	244.4	234.8	
345			258.4	248.7	238.9	

REDUCTION OF THE BAROMETER TO SEA LEVEL—ENGLISH UNITS

TABLE A. VALUES OF THE TEMPERATURE-ALTITUDE FACTOR FOR USE IN TABLE B.

(From *Smithsonian Meteorological Tables*, 3d Ed., 1907.)

Altitude in Feet	Mean Temperature of Air Column in Fahrenheit Degrees										
	−20°	−8°	0°	10°	20°	30°	40°	50°	60°	70°	80°
100	3.7	3.6	3.5	3.5	3.4	3.3	3.2	3.2	3.1	3.0	3.0
200	7.4	7.2	7.1	6.9	6.8	6.6	6.5	6.3	6.2	6.1	6.0
400	14.8	14.4	14.1	13.8	13.5	13.2	13.0	12.7	12.4	12.2	11.9
600	22.2	21.6	21.2	20.7	20.3	19.9	19.5	19.0	18.6	18.2	17.9
800	29.6	28.8	28.3	27.7	27.1	26.5	25.9	25.4	24.8	24.3	23.8
1000	37.0	36.0	35.3	34.6	33.8	33.1	32.4	31.7	31.1	30.4	29.8
1200	44.3	43.2	42.4	41.5	40.6	39.7	38.9	38.1	37.3	36.5	35.8
1400	51.7	50.3	49.5	48.4	47.4	46.4	45.4	44.4	43.5	42.6	41.7
1600	59.1	57.5	56.5	55.3	54.1	53.0	51.9	50.8	49.7	48.7	47.7
1800	66.5	64.7	63.6	62.2	60.9	59.6	58.4	57.1	55.9	54.7	53.6
2000	73.9	71.9	70.6	69.1	67.7	66.2	64.8	63.4	62.1	60.8	59.6
2200	81.3	79.1	77.7	77.7	74.4	72.9	71.3	69.8	68.3	66.9	65.5
2400	88.7	86.3	84.8	84.8	81.2	79.5	77.8	76.1	74.5	73.0	71.5
2600	96.1	93.5	91.8	91.8	87.9	86.1	84.3	82.5	80.7	79.1	77.5
2800	103.5	100.7	98.9	98.9	94.7	92.7	90.8	88.8	87.0	85.1	83.4
3000	110.9	107.9	106.0	106.0	101.5	99.3	97.2	95.2	93.2	91.2	89.4
3200	118.2	115.1	113.0	113.0	108.2	106.0	103.7	101.5	99.4	97.3	95.3
3400	125.6	122.3	120.1	120.1	115.0	112.6	110.2	107.9	105.6	103.4	101.3
3600	133.0	129.4	127.2	127.2	121.8	119.2	116.7	114.2	111.8	109.5	107.2
3800	140.4	136.6	134.2	134.2	128.5	125.8	123.2	120.5	118.0	115.5	113.2
4000	147.8	143.8	141.3	141.3	135.3	132.4	129.6	126.9	124.2	121.6	119.2
4200	155.2	151.0	148.3	145.1	142.1	139.1	136.1	133.2	130.4	127.7	125.1
4400	162.6	158.2	155.4	152.0	143.8	145.7	142.6	139.6	136.6	133.8	131.1
4600	170.0	165.4	162.5	159.0	155.6	152.3	149.1	145.9	142.8	139.9	137.0
4800	177.3	172.6	169.5	165.9	162.3	158.9	155.6	152.2	149.0	145.9	143.0
5000	184.7	179.8	176.6	172.8	169.1	165.6	162.0	158.6	155.2	152.0	148.9
5200	192.1	187.0	183.7	179.7	175.9	172.2	168.5	164.9	161.5	158.1	154.9
5400	199.5	194.1	190.7	186.6	182.6	178.8	175.0	171.3	167.7	164.2	160.8
5600	206.9	201.3	197.8	193.5	189.4	185.4	181.5	177.6	173.9	170.3	166.8
5800	214.3	208.5	204.8	200.4	196.2	192.0	188.0	184.0	180.1	176.3	172.8
6000	221.7	215.7	211.9	207.3	202.9	198.7	194.4	190.3	186.3	182.4	178.7
6200	229.1	222.9	219.0	214.2	209.7	205.3	200.9	196.6	192.5	188.5	184.7
6400	236.4	230.1	226.0	221.1	216.4	211.9	207.4	203.0	198.7	194.6	190.6
6600	243.8	237.3	233.1	228.0	223.2	218.5	213.9	209.3	204.9	200.7	196.6
6800	251.2	244.5	240.1	235.0	230.0	225.1	220.4	215.7	211.1	206.7	202.5
7000	258.6	251.6	247.2	241.9	236.7	231.8	226.8	222.0	217.3	212.8	208.5
7200	266.0	258.8	254.3	248.8	243.5	238.4	233.3	228.4	223.5	218.9	214.4
7400	273.4	266.0	261.3	255.7	250.2	245.0	239.8	234.7	229.7	225.0	220.4
7600	280.8	273.2	268.4	262.6	257.0	251.6	246.3	241.0	235.9	231.1	226.4
7800	288.1	280.4	275.4	269.5	263.8	258.2	252.8	247.4	242.2	237.1	232.3
8000	295.5	287.6	282.5	276.4	270.5	264.8	259.2	253.7	248.4	243.2	238.3
8200	302.9	294.8	289.6	283.3	277.3	271.5	265.7	260.1	254.6	249.3	244.2
8400	310.3	302.0	296.6	290.2	284.0	278.1	272.2	266.4	260.8	255.4	250.2
8600	317.7	309.1	303.7	297.1	290.8	284.7	278.7	272.7	267.0	261.4	256.1
8800	325.1	316.3	310.7	304.0	297.6	291.3	285.2	279.1	273.2	267.5	262.1
9000	332.5	323.5	317.8	310.9	304.3	297.9	291.6	285.4	279.4	273.6	268.0

REDUCTION OF THE BAROMETER TO SEA LEVEL—ENGLISH UNITS

TABLE B. VALUES IN INCHES TO BE ADDED

(From *Smithsonian Meteorological Tables*, 3d Ed., 1907.)

Temp. —Alt. Factor	Barometer Reading in Inches				
	31	30	29	28	27
1	0.04	0.03	0.03	....	....
5	0.18	0.17	0.17	....	....
10	0.36	0.35	0.34	0.32	....
15	0.54	0.52	0.51	0.49	....
20	0.72	0.70	0.68	0.65	....
25	....	0.88	0.85	0.82	....
30	....	1.05	1.02	0.98	....
35	....	1.23	1.19	1.15	....
40	....	1.41	1.37	1.32	1.27
45	....	1.60	1.54	1.49	1.44
50	....	....	1.72	1.66	1.60
55	....	....	1.90	1.83	1.76
60	....	....	2.07	2.00	1.93
65	....	....	2.25	2.18	2.10
70	....	....	2.43	2.35	2.27
75	....	....	....	2.53	2.43
80	....	....	....	2.70	2.60
85	....	....	....	2.88	2.78
90	....	....	....	3.06	2.95
95	....	....	....	3.24	3.12

	28	27	26	25	24
75	2.53	2.43	2.34	....	....
80	2.70	2.60	2.51	....	....
85	2.88	2.78	2.67	....	....
90	3.06	2.95	2.84	....	....
95	3.24	3.12	3.01	....	....
100	3.42	3.29	3.17	....	....
105	3.60	3.47	3.34	3.21	....
110	....	3.65	3.51	3.38	....
115	....	3.82	3.68	3.54	....
120	....	4.00	3.85	3.70	....
125	....	4.18	4.02	3.87	....
130	....	4.36	4.20	4.04	....
135	....	4.54	4.37	4.20	....
140	....	....	4.55	4.37	4.20
145	....	....	4.72	4.54	4.36
150	....	....	4.90	4.71	4.52
155	....	....	5.08	4.88	4.69
160	....	....	5.26	5.06	4.85
165	....	....	5.44	5.23	5.02
170	....	....	5.62	5.40	5.19

Temp. —Alt. Factor	Barometer Reading in Inches				
	25	24	23	22	21
175	5.58	5.36	....	....	....
180	5.76	5.53	5.30	....	....
185	5.93	5.70	5.46	....	....
190	6.11	5.87	5.62	....	....
195	6.29	6.04	5.79	....	....
200	6.47	6.21	5.96	....	....
205	....	6.39	6.12	....	....
210	....	6.56	6.29	....	....
215	....	6.74	6.46	....	....
220	....	6.92	6.63	6.34	....
225	....	7.10	6.80	6.51	....
230	....	7.28	6.97	6.67	....
235	....	7.46	7.15	6.84	....
240	....	....	7.32	7.00	....
245	....	....	7.49	7.17	....
250	....	....	....	7.34	....
255	....	....	....	7.51	....
260	....	....	....	7.68	7.33
265	....	....	....	7.85	7.49
270	....	....	....	8.02	7.66

	22	21	20
275	8.19	7.82	....
280	8.37	7.99	....
285	8.54	8.16	....
290	8.72	8.32	....
295	8.90	8.49	8.09
300	9.08	8.66	8.25
305	9.26	8.83	8.41
310	9.44	9.01	8.58
315	9.62	9.18	8.74
320	9.80	9.35	8.91
325	....	9.53	9.08
330	....	9.71	9.24

SYMBOLS OF THERMODYNAMICAL AND PHYSICO-CHEMICAL QUANTITIES AND CONVENTIONS RELATING TO THEIR USE

Chem. and Ind., 56, 951 (1937).

The name of any quantity for which a given symbol is a second preference is printed in parentheses.

A	free energy—Helmholz; atomic weight; surface area.
A.	Angstrom unit.
a	activity; (acceleration).
a.	ampere, in sub-units *
B	magnetic induction.
C	concentration; electrostatic capacity. *with subscript:* molecular heat capacity.
C.	Centigrade.
c	velocity of light *in vacuo.*
c	velocity; concentration. *with subscript:* specific heat.
D	diffusion coefficient.
d	diameter; distance; (density).
d	differential.
∂	partial differential.
E	energy; (intrinsic energy); potential difference, especially electromotive force of voltaic cells. *with subscript:* single electrode potential.
e	electronic charge—charge equal and opposite in sign to that of an electron.
e	quantity of electricity, especially electrostatic charge. *with subscript:* single electrode potential.
e	base of natural logarithms.
F	Faraday's constant.
F	force; (free energy—Helmholz).
F.	farad; Fahrenheit.
f	acceleration; activity coefficient, for molar concentration; partition function.
f	function.
G	thermodynamic potential, Gibbs function, free energy —G. N. Lewis.
g	acceleration due to gravity, standard value.
g	acceleration due to gravity, as a variable; osmotic coefficient.
g.	gram.
H	enthalpy, total heat, heat content; magnetic field strength.
H.	henry.
h	Planck's constant.
h	height.
I	moment of inertia; ionic strength; electric current; intensity of light.
i	vapor pressure constant; van't Hoff's factor.
J	mechanical equivalent of heat.
J	gram-equivalent weight.
K	chemical equilibrium constant; (compressibility). K_s solubility product.
K.	Kelvin.
k	Boltzmann's constant.
k	thermal conductivity; velocity constant of chemical reaction.
L	latent heat per mol; self-inductance; (solubility product).
l	latent heat per g.; length; mean free path of molecules. *with subscript:* equivalent ionic conductance, "mobility."
l.	liter.
M	molecular weight; mutual inductance; magnetic moment.
M.	molar concentration.
m	rest mass of an electron.
m	mass.
m.	meter.

* *E.g.*, "ma." for "milliampere"; but "amp." is preferred for "ampere."

SYMBOLS OF THERMODYNAMICAL AND PHYSICO-CHEMICAL QUANTITIES AND CONVENTIONS RELATING TO THEIR USE

N	Avogadro's number.
N	mol fraction.
N.	normal concentration.
n	number of mols. *with subscript:* (transport number). *with subscript:* refractive index.
P	pressure.
$[P]$	parachor.
p	pressure.
Q	quantity of electricity.
q	heat entering a system.
R	gas constant per mol; Rydberg's constant.
R	electrical resistance.
$[R]$	*with subscript:* molecular refraction.
r	radius; (specific resistance). *with subscript:* specific refraction.
r.	Röntgen unit.
S	entropy.
s	solubility; (surface area).
T	temperature, on absolute Kelvin scale. *with subscript:* transport number.
t	time; (temperature—not on absolute scale).
U	intrinsic energy.
u	velocity component. *with subscript:* velocity of ions.
V	volume; potential, potential difference, including Volta potential.
v.	volt.
v	volume; velocity; velocity component.
W	(work done by or on a system).
w.	watt.
w	work done by or on a system; velocity component.
X	force component; potential gradient in electric field.
x	mol fraction.
Y	force component.
Z	force component; g.-equivalent weight; number of molecular collisions per second; atomic number.
z	valency of an ion.
α	degree of electrolytic dissociation; angle of optical rotation.
$[\alpha]$	specific optical rotation.
Γ	surface concentration excess.
γ	ratio of specific heats; surface tension.
Δ	increment.
δ	very small increment.
ϵ	dielectric constant; molar extinction coefficient.
ζ	electrokinetic potential.
η	efficiency of any process; viscosity; electrolytic polarization, overvoltage.
θ	angle of contact; temperature—not on absolute scale.
κ	compressibility; specific conductance; magnetic susceptibility—volume.
Λ	equivalent conductance.
λ	wave-length.
μ	chemical potential; dipole moment; magnetic permeability. *with subscript:* (refractive index).
μ.	micron.
ν	frequency; wave-number.
Π	pressure, especially osmotic pressure.
Π	product.
π	(electrolytic polarization, overvoltage).
π	ratio of circumference to diameter.
ρ	density; specific resistance.
Σ	sum.
σ	diameter of molecules; (surface tension); (specific conductance).

SYMBOLS OF THERMODYNAMICAL AND PHYSICO-CHEMICAL QUANTITIES AND CONVENTIONS RELATING TO THEIR USE

τ	time interval, especially half or mean life.	χ	magnetic susceptibility—mass.
ϕ	fluidity; electronic exit work function; magnetic flux.	ψ	wave function.
Φ	function.	Ω.	ohm.
		ω	angular velocity; specific magnetic rotation.

Note: The following distinctive letters have not been used in the lists above:

Italic capital: *O*. Greek capitals: Θ, Ξ, Υ, Φ, Ψ.
Lower case italic: *b*, *j*, *o*, *y*. Lower case Greek: β, ξ.

PREFIXES

The following prefixes to abbreviations for the names of units should be used to indicate the specified multiples or sub-multiples of these units:

M	mega-	$10^{6}\times$	c	centi-	$10^{-2}\times$
k	kilo-	$10^{3}\times$	m	milli-	$10^{-3}\times$
d	deci-	$10^{-1}\times$	μ	micro-	$10^{-6}\times$

e.g., MΩ. denotes megohm; kw., kilowatt; and μg., microgram. The use of $\mu\mu$. instead of mμ. to denote 10^{-7} cm., or of γ to denote microgram, is deprecated.

SUBSCRIPTS AND OTHER MODIFYING SIGNS

I, II . . .	*especially with symbols for thermodynamic functions*, referring to different systems or different states of a system.
1, 2 . . .	
A, B . . .	referring to molecular species A, B, etc.
i	referring to a typical ionic species i.
u	referring to an undissociated molecule.
+, −	referring to a positive or negative ion, or to a positive or negative electrode.
p, *v*, *T*	indicating constant pressure, volume, and temperature, respectively.
q	indicating adiabatic conditions.
w	indicating that no work is performed.
p, *c*, *a*	*with symbol for an equilibrium constant*, indicating that it is expressed in terms of pressure, concentration, or activity.
G, V, L, X	referring to gas, vapor, liquid, and crystalline states, respectively.
f, e, s, t, d	referring to fusion, evaporation (vaporization of liquid), sublimation, transition, and dissolution or dilution, respectively.
c	referring to the critical state or indicating a critical value.
0	referring to a standard state, or indicating limiting value at infinite dilution.
C, D, F	*with symbols for optical properties*, referring to a particular wave-length.

SYMBOLS OF THERMODYNAMICAL AND PHYSICO-CHEMICAL QUANTITIES AND CONVENTIONS RELATING TO THEIR USE

Where a symbol has to be added to a symbol which already carries a subscript, the two subscripts may be separated by a comma or the symbol with the first subscript may be enclosed in parentheses with the second subscript outside.

°	*as right-hand superscript to symbol*, referring to a standard state.
[ ]	*enclosing formula of chemical substance*, indicating its molar concentration.
{ }	*enclosing formula of chemical substance*, indicating its molar activity.

In crystallography it is recommended that:
Millerian indices be enclosed in parentheses, ( );
Laue indices be unenclosed;
Indices of a plane family be enclosed in braces, { };
Indices of a zone axis or line be enclosed in brackets, [ ].

Numerals attached to a symbol for a chemical element in various positions have the following meanings:

upper left	mass number of atom.
lower left	nuclear charge of atom.
lower right	number of atoms in molecule.

e.g., ${}^{7}_{3}\mathrm{Li}$; ${}^{2}_{1}\mathrm{H}_2$ (= D_2).

COMMON PHYSICAL CHEMISTRY EQUATIONS

By Frank Hovorka, Ph. D.

Gases

1. Molecular weight, volume, and temperature.

Perfect Gas Law: $PV = \frac{W}{M}RT$

Van der Waals' Equation: $\left[P + \frac{a}{V^2}\left(\frac{W}{M}\right)^2\right]\left[V - b\frac{W}{M}\right] = \frac{W}{M}RT$

Berthelot's Equation: $PV = \frac{W}{M}RT\left[1 + \frac{9}{128}\frac{P}{Pc}\frac{Tc}{T}\left(1 - 6\frac{Tc^2}{T^2}\right)\right]$

R is a constant independent of the nature of the gas and must be expressed in the same units as the pressure and the volume. It has the following values:

$R = 0.08205$ liter-atmospheres per degree per mole
82.05 cc-atmospheres per degree per mole
8.315 joules per degree per mole
1.986 calories per degree per mole
8.315×10^7 ergs per degree per mole

P, V, T, M, and W are the pressure, volume, absolute temperature, molecular weight, and the mass of the gas respectively. Pc and Tc are the critical pressure and the critical absolute temperature; a and b are individual constants that must be determined empirically for each substance. (See critical temperature and volume.) When V is in cubic centimeters then b must be expressed in cubic centimeters per molecular weight. When P is in atmospheres a must be in cc^2-atmospheres per molecular weight.

2. Critical temperature, pressure, and volume.

$$Pc = \frac{a}{3Vc^2} \qquad Tc = \frac{8PcVc}{3R}$$

$$Vc^3 = \frac{ab}{Pc} \qquad a = 3PcVc^2 \qquad b = \frac{Vc}{3}$$

Vc is the critical volume. For explanation of the other terms see part (1).

3. Effusion of Gases. $c = \sqrt{\frac{3PV}{mn}} = \sqrt{\frac{3RT}{mn}} = \sqrt{\frac{3RT}{d}}$

c is the root mean square velocity; m is the mass of each molecule; n is the number of molecules in a volume V at the pressure P or at the temperature T. When c is in centimeters per second, m is expressed in grams, V in cubic centimeters, P in dynes per square centimeter and R in ergs; d is the density.

COMMON PHYSICAL CHEMISTRY EQUATIONS

Graham's Law: $\frac{c_1}{c_2} = \sqrt{\frac{d_2}{d_1}} = \sqrt{\frac{M_2}{M_1}}$

c_1 and c_2, d_1 and d_2, M_1 and M_2 are the root mean square velocities, densities, and molecular weights of the two gases under consideration.

$$\frac{t_1}{t_2} = \frac{c_2}{c_1} = \sqrt{\frac{M_1}{M_2}}$$

t_1 and t_2 are the times of passage of each gas under a given pressure through an orifice. For an explanation of the other terms in the equation see the preceding equation.

$$\bar{n} = n\sqrt{\frac{RT}{2\pi M}}$$

$\bar{n}$ is the number of molecules striking a surface per square centimeter per second; n is the total number of molecules per cubic centimeter; M is the molecular weight; T is the absolute temperature; R is expressed in ergs per degree and is equal to 8.315×10^7 ergs.

4. Dissociation. $\alpha = \frac{d_1 - d_2}{d_2(n-1)} = \frac{M_1 - M_2}{M_2(n-1)} = \frac{V_2 - V_1}{V_1(n-1)}$

d_1, M_1, and V_1 are respectively the density, the molecular weight, and the volume of the undissociated gas; d_2, M_2, and V_2 are respectively the density, the apparent molecular weight, and the volume of the dissociated gas at the same temperature; α is the degree of dissociation, and n is the number of particles into which a molecule dissociates.

5. Adsorption.

Freundlich's Isotherm: $\log \frac{x}{m} = k + \frac{1}{n} \log P$

x is the mass of the gas absorbed; m is the mass of the absorbent; k and n are experimentally determined constants; P is the pressure of the gas.

Langmuir's Equation: $\frac{P}{x} = a + bP$

x is the number of gram molecules adsorbed per square centimeter at a pressure P; a and b are experimentally determined constants.

Liquids

1. Viscosity. $\frac{n_1}{n_2} = \frac{d_1 t_1}{d_2 t_2}$

n_1 and n_2, d_1 and d_2, t_1 and t_2 are respectively the absolute viscosities, densities, and times of flow in seconds of the two liquids through the same capillary at the same temperature and pressure; $\frac{n_1}{n_2}$ is the relative viscosity where n_2 usually refers to water.

COMMON PHYSICAL CHEMISTRY EQUATIONS

2. Surface tension. $\gamma = \frac{1}{2}hdgr$

γ is the surface tension in dynes per centimeter, h is the height in centimeters to which a liquid of the density d rises in a capillary of the radius r (in centimeters); g is the gravitational constant expressed in centimeters per sec.[2]

Molecular Surface Energy: $\gamma\left(\frac{M}{d}\right)^{2/3} = k(t_c - t - 6)$

M, d, and t_c are respectively the molecular weight, density, and the critical temperature of the liquid; t is the experimental temperature; k is the constant (Eötvos constant) equal to 2.12 for unassociated liquids.

Molecular Weight: $M = \left[\frac{k(t_2 - t_1)}{\gamma_1 d_1^{-2/3} - \gamma_2 d_2^{-2/3}}\right]^{3/2}$

γ_1 and γ_2, d_1 and d_2 are respectively the surface tensions and densities of a liquid at the temperature t_1 and t_2 respectively.

Eötvos Constant: $k = \frac{\gamma_1\left(\frac{M}{d_1}\right)^{2/3} - \gamma_2\left(\frac{M}{d_2}\right)^{2/3}}{t_2 - t_1}$

For explanation of the terms in this equation see equations on molecular surface energy and molecular weight.

Association: $x = \left(\frac{2.12}{k}\right)^{3/2}$

x is the degree of association.

Gibbs Adsorption Equation: $\mu = -\frac{C}{RT} \times \frac{d\gamma}{dC}$

μ is the excess of solute per unit surface or interface; C is the concentration of the solute, and $\frac{d\gamma}{dC}$ is the rate at which surface tension changes with concentration.

Sugden's Parachor: $P = \frac{m}{D - d} \times \gamma^{1/4}$

P is the parachor of the liquid under consideration, m is its molecular weight, D its density, γ its surface tension, and d the density of its saturated vapor (d may be neglected at low pressures).

3. Boiling Point and the Heat of Vaporization.

The Law of Ramsay and Young: $\frac{T_A}{T_B} = \frac{T_{A1}}{T_{B1}} + C(T_{A1} - T_A)$

T_A and T_B are the absolute boiling points of the substances A and B under the same pressure. T_{A1} and T_{B1} are the corresponding boiling points under another pressure. C is a constant. This relation holds very closely for related substances for which C is practically zero.

COMMON PHYSICAL CHEMISTRY EQUATIONS

Heat of Vaporization. *Trouton's Rule*: $\frac{\Delta H}{T} = 21$

Nernst-Bingham Rule: $\frac{\Delta H}{T} = 17 + 0.011T$

ΔH is the heat of vaporization per molecular weight and T its absolute boiling point under one atmosphere of pressure.

Both rules hold quite well for non-associated liquids.

4. Index of Refraction.

Lorenz and Lorentz Equation: $\frac{n^2 - 1}{n^2 + 2} \times \frac{1}{d} = r$

n is the index of refraction, d the density, and r the specific refraction.

Solutions

1. Vapor Pressure. Raoult's Law: $P = P_0 X_0$

P is the vapor pressure of the solvent or volatile solute over its solution; X_0 is the mole fraction and P_0 is the vapor pressure of the pure solvent or the volatile solute at the same temperature as the solution.

2. Molecular Weight of Solutes.

Rise of Boiling Point: $M = 1000 K_b \frac{g}{G \Delta T_b}$

Lowering of the Freezing Point: $M = 1000 K_f \frac{g}{G \Delta T_f}$

Lowering of the Vapor Pressure: $M = \frac{gm}{G} \times \frac{P}{P_0 - P}$

M is the molecular weight of the solute, g is the mass of the solute and G is the weight of the solvent. K_b and K_f are the molal boiling point and molal freezing point constants. T_b and T_f are the experimental boiling point raising and freezing point lowering respectively. m is the molecular weight of the solvent, P_0 is the vapor pressure of pure solvent and P is the vapor pressure of the solvent from its solution at the same temperature.

3. Conductivity.

Resistance: $R = \frac{E}{I}$

R is the resistance in ohms, E the voltage and I the amperage.

Conductance: $L = \frac{1}{R}$

L is the conductivity in reciprocal ohms; R is the resistance in ohms.

COMMON PHYSICAL CHEMISTRY EQUATIONS

Specific Conductivity: $\overline{L} = \frac{l}{A} \times L$

$\overline{L}$ is the specific conductivity, l is the distance between the electrodes, A the area of the electrodes, and L is the conductivity in reciprocal ohms.

Cell Constant: $K = \frac{A}{l}$

K is the cell constant; l is the distance between the electrodes and A the area of the electrodes.

Equivalent Conductivity: $\Lambda = \frac{1000\overline{L}}{C}$

Λ is the equivalent conductivity, $\overline{L}$ is the specific conductivity, and C is the normality of the solute.

Thermodynamics

1. First Law of Thermodynamics: $\Delta E = q - W$

ΔE is the change of internal energy of a system, q is the heat absorbed by the system, and W is the work done by the system against the surroundings.

Work Done by an Ideal Gas During Expansion:

(1) Against constant external pressure: $W = P(V_2 - V_1)$

(2) Against variable external pressure:

$$W = RT \ln \frac{V_2}{V_1} = RT \ln \frac{P_1}{P_2}$$

W is the work done, and P is the external pressure. P_1, V_1, P_2, V_2 are the initial and final pressures and volumes. If P is expressed in atmospheres and V is expressed in cubic centimeters, then W is in cc-atmospheres. One calorie is equal to 41.3 cc-atmospheres. When R is in calories then the term W (in 2) is in calories regardless of the units of V or P.

2. Effect of Temperature on Equilibrium.

In all of the following equations ΔH is positive when heat is absorbed.

Clapeyron Equation: $\frac{dP}{dT} = \frac{\Delta H}{T(V_2 - V_1)}$

$\frac{dP}{dT}$ is the rate of change of vapor pressure of a pure substance with temperature. V_1 and V_2 are the initial and final volumes. ΔH is the amount of heat absorbed by the substance undergoing a change of phase. T is the absolute equilibrium temperature of the two phases. When P is in atmospheres and V in cubic centimeters, ΔH must be in cc-atmospheres. (One calorie = 41.3 cc-atmospheres.) Likewise when V_1 refers to one gram of a substance, V_2 and ΔH also must refer to one gram.

COMMON PHYSICAL CHEMISTRY EQUATIONS

Clausius-Clapeyron Equation: The following equation is applicable to vaporization and sublimation only: $$\ln \frac{P_1}{P_2} = \frac{\Delta H}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

P_1 and P_2 are the vapor pressures at absolute temperatures T_1 and T_2 respectively. ΔH is the molecular heat of vaporization or sublimation. If R is in calories, ΔH will be in calories regardless of the units of pressure.

$$\ln \frac{C_1}{C_2} = \frac{\Delta H}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

C_1 and C_2 are the solubilities of a substance (in any units) at the absolute temperature T_1 and T_2. ΔH is the molecular heat of solution. When R is expressed in calories, then ΔH must be expressed in calories.

Van't Hoff's Isochore: $$\ln \frac{K_{c1}}{K_{c2}} = \frac{\Delta H}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

$$\ln \frac{K_{p1}}{K_{p2}} = \frac{\Delta H}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

All K_c and K_p values are obtained by placing the products in the numerator and the reactants in the denominator. K_{c1} and K_{p1} are the equilibrium constants at absolute temperature T_1; K_{c2} and K_{p2} are the equilibrium constants at absolute temperature T_2. ΔH is the heat of reaction for that reaction on which K_c and K_p are based. When R is in calories ΔH must also be in calories.

Free Energy and Equilibrium Constant: $\Delta F^0 = -RT \ln K_p$

ΔF^0 is equal to the change in free energy for a reaction in which the reactants are in their standard states (1 atmosphere) and are converted into products at 1 atmosphere.

Nernst Heat Theorem: $$\log K_p = -\frac{\Delta H}{4.58T} + \Sigma n(1.75 \log T) + \Sigma(nc)$$

ΔH is the heat of reaction at the absolute temperature T. Σn is equal to the number of moles of gaseous products minus the number of moles of gaseous reactants. $\Sigma(nc)$ is the sum of the Nernst constants; it is equal to the sum of individual constants (each constant must be multiplied by the number of moles of that substance) for gaseous products minus the sum of constants for gaseous reactants. For the values of Nernst constants see Taylor, *Treatise on Physical Chemistry*, p 586 (1931). In cases where the constant has not been determined for a particular substance, 3 to 3.2 may be used as a fair approximation.

Rates of Reaction

1. Unimolecular Reaction: $$k = \frac{1}{t}\ln\left(\frac{a}{a-x}\right)$$

$$t_{1/2} = \frac{0.693}{k}$$

k is the velocity constant, a is the initial concentration, $(a - x)$ is the concentration remaining after the time t, x is the amount reacting in the time t, and $t_{½}$ is the period of half life of a unimolecular reaction.

2. Bimolecular Reaction.

(1) When equimolecular quantities (a and b) of the initial substance are used:

$$k = \frac{1}{t} \times \frac{x}{a(a-x)}$$

(2) When other than equimolecular quantities of the initial substances are used:

$$k = \frac{1}{t(a-b)} \ln \frac{b(a-x)}{a(b-x)}$$

3. Influence of Temperature on the Rate of Reaction.

Arrhenius Equations:

$$\frac{d \ln k}{dt} = \frac{E}{RT^2}$$

$$\ln \frac{k_1}{k_2} = \frac{E}{R}\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

E represents the energy of activation per gram mole of a substance; k_1 and k_2 are the specific reaction rates at absolute temperatures T_1 and T_2 respectively; R is the gas constant.

Electromotive Force

1. Variation with Temperature: $E = T\left(\frac{dE}{dT}\right) - \frac{\Delta H}{nF}$

E is the electromotive force of a system; n is the change in valence of the ion causing the potential difference; F is equal to the charge carried by gram ion or is equal to 23,060 calories; $\frac{dE}{dT}$ is the rate of change of electromotive force with temperature; T is the experimental absolute temperature; ΔH is the heat of reaction.

2. Concentration Cell.

(1) *Without transference*: $E = \frac{RT}{nF} \ln \frac{C_1}{C_2}$

(2) *With transference*: $E = \left(\frac{2\mu}{\mu + v}\right)\frac{RT}{nF} \ln \frac{C_1}{C_2}$

μ and v are the velocities of the positive and negative ions respectively; C_1 and C_2 are the concentrations (in any units); the velocity of the faster ion is inserted in the numerator. See part 1 for the explanation of the other terms.

DEFINITIONS OF CHEMICAL AND PHYSICAL TERMS

Absolute Zero—The beginning or zero point in the absolute (thermodynamic) temperature scale. According to the kinetic theory of heat, it represents the temperature at which all thermal motion ceases. It is equal to −273.18°C. or −459.72°F.

Absorption, Heat of—The heat evolved when a given amount of a substance is absorbed.

Acetyl Number (value)—A number or value which indicates the extent to which a substance may be acetylated. In the analysis of fats, oils, etc., it is taken as the measure of the amount of hydroxy acids and higher alcohols which are present since other substances ordinarily present are not affected by the acetylating agent. It is expressed in milligrams of potassium hydroxide required to neutralize the acetic acid liberated from one gram of acetylated fat or oil.

Acetylene—Any open chain hydrocarbon containing one or more triple bonds; specifically the hydrocarbon CH:CH, in distinction from diacetylene, triacetylene, etc., with two, or three, etc., respectively, triple bonds.

Acid—Any chemical compound containing hydrogen capable of being replaced by positive elements or radicals to form salts. In terms of the dissociation theory, it is a compound which on dissociation in solution yields excess hydrogen ions.

Acid Number (value)—A number or value which indicates the amount of free acids present in a substance. In the analysis of fats, oils, etc., it is expressed by the number of milligrams of potassium hydroxide which are required to neutralize the free fatty acids in a gram of substance.

Active Mass—A term used in connection with the law of mass action. Guldberg and Waage defined the term as the molarity of the reacting substance, or its partial pressure. Expressed in this form, the law of mass action is only approximately correct. To make the law exact, "activities" must be substituted for molarities and "fugacites" for partial pressures.

Activity—A thermodynamic term denoted by a. Activities are *effective* concentrations and have the dimensions of concentrations. When activities are employed in a mass law expression the equilibrium constant has a fixed value.

Activity Coefficient—A factor which, when multiplied by the molecular concentration, yields the active mass. The activity coefficient is evaluated by thermodynamic calculations, usually from data on the e. m. f. of certain cells, or the lowering of the freezing point of certain solutions. It is a correction factor which makes the thermodynamic calculations correct.

Additive Property—A property, the numerical value of which is equal to the sum of the values for the component parts and which depends only on the number and kinds of molecules or atoms present without any regards to their arrangements; e.g., the molecular weight, which is the sum of the weights of the component atoms.

Adiabatic Process—A process carried out in such a way that no heat is absorbed or evolved by a system.

Adsorption—A surface phenomenon exhibited by solids which consists in the adhesion, in an extremely thin layer, of the molecules of gases, of liquids, or of dissolved substances with which they are in contact.

Alcohol—Any one of a class of compounds which are analogous to ethyl alcohol in constitution in that they are hydroxides of organic radicals; specifically, the term is applied to ethyl alcohol.

Aldehyde—Any one of a class of organic compounds intermediate in oxidation between a primary alcohol and a carboxylic acid, having two hydrogen atoms less than the alcohol, and characterized by the radical −CH:O; specifically, the term aldehyde is applied to acetaldehyde, CH_3CHO.

Alicyclic—See *cyclic*.

DEFINITIONS OF CHEMICAL AND PHYSICAL TERMS

Alkali—Any compound having marked basic properties; see *base.*

Alkalinity—The combining power of a base measured by the maximum number of equivalents of an acid with which it can react to form a salt. In water analysis, it represents the carbonates, bicarbonates, hydroxides, and occasionally the borates, silicates, and phosphates in the water and is determined by titration with standard acid to certain standard datum points and expressed as milligrams of calcium carbonate per liter (nearly the same as "parts per million").

Alkaloid—An alkaline organic substance (i.e., an organic base) with marked physiological action. The term is usually restricted to substances which occur naturally in plants and animals; e.g., nicotine, quinine, morphine, etc.

Alloy—The product formed by the blending of a metal with other metals or non-metals usually by fusion and solution in each other when molten.

Alpha Radiation—The radiation of doubly positively charged particles, called *alpha particles*, emitted during certain radioactive transformations. These particles have a mass of 4.00 and are identical with the nuclei of helium atoms.

Ampere—The practical unit of intensity of electric current being defined by U. S. statute as the unvarying current which, when passed through a standard solution of silver nitrate in water, deposits silver at the rate of 0.001118 grams per second. It is equal to the current produced by an electromotive force of one volt flowing through a circuit of one ohm resistance.

Angstrom—A unit of length, used especially in expressing the length of light waves, equal to one ten-thousandth of a micron, or one hundred-millionth of a centimeter (1×10^{-8}cm.)

Anhydrous—A term meaning without water. It is usually applied in referring to the absence of water of crystallization.

Animal Oil—An oily material obtained, in any manner of various ways, from animal substances. It usually refers to a mixture of the glyceryl esters of various organic acids although it is also applied to substances other than glycerides; e.g., bone oil, which is a mixture containing pyrrole, pyridine, quinoline, amines, and other nitrogenous compounds, as well as hydrocarbons, etc., which are obtained on the destructive distillation of bones.

Anion—The charged particle in a solution of an electrolyte which, under the influence of an electrical potential, moves toward the anode. It is the negatively charged ion.

Anode—The electrode at which an oxidation process occurs. It is the negative pole of a battery, or the positive pole of a solution of an electrolyte through which current is being forced. In a vacuum tube, the anode is the electrode towards which the electrons flow within the tube.

Aqueous Tension—The vapor pressure of pure water, or the partial pressure of water vapor over any aqueous solution or solid hydrate, at any given temperature.

Athermanous—Not transmitting radiant heat; not *diathermanous* (q.v.)

Atom—According to the atomic theory, the smallest quantity of an element which is capable of entering into chemical combination or that can exist alone.

Atomic Number—A number, characteristic of an element, which designates the position of the element in the periodic table. It represents the net positive charge on the nucleus of each atom, or the number of electrons outside of the nucleus.

Atomic Radius—The radius of the volume occupied by an atom. This volume may approximate a sphere or, in many cases, a highly distorted sphere. In a given crystal, the atomic radii when added together equal the inter-atomic distances within the crystal. The ionic radius of the same species of atom will be somewhat less, or greater, than that of the atomic radius because the outermost shell of electrons has been stripped off, or increased, in the formation of the ion.

DEFINITIONS OF CHEMICAL AND PHYSICAL TERMS

Atomic Theory—A theory postulating that all elements are composed of small discrete unit particles called atoms. The atoms of any one element are supposed to be of the same size and essentially of the same weight, but differ in both from element to element. Chemical combination is the union of atoms of various elements into the smallest discrete entities of the compound; viz., the molecules.

Atomic Weight—The relative weight of the atom of an element, referred to some element taken as a standard. An atomic weight of 16 for oxygen is the one usually adopted as a basis for reference.

Average Life—In radioactivity, the reciprocal of the radioactive constant (q.v.)

Avogadro's Hypothesis—The hypothesis that equal volumes of all gases, under the same conditions of temperature and pressure, contain equal numbers of molecules.

Avogadro's Number—The number representing the number of molecules in one gram-molecular weight of any substance, as for oxygen, the number in 32 grams. It is equal to 6.061×10^{23}.

Base—A compound of a metal, or a metal-like group, with hydrogen and oxygen in the proportion to form an OH radical, which ionizes in aqueous solution to yield hydroxyl ions. A base is formed when a metallic oxide reacts with water.

Beta Radiation—See *radioactivity*.

Bicyclic—Containing two rings in the molecule, usually fused rings as in naphthalene.

Boiling Point—The temperature at which the vapor pressure of a liquid becomes equal to the external pressure. This temperature differs from the same liquid under different pressures. The *normal boiling point* is the temperature at which the vapor pressure reaches 760 mm. of mercury.

Boiling Point, Molal Elevation of—See *molecular elevation*.

Boyle's Law—The law that the volume of any gas varies inversely as the pressure upon it, providing the temperature is kept constant. It is also known as *Mariotte's law*.

Brinell Hardness—A value of the hardness of a material obtained by pressing a hardened ball, having a diameter of 10 mm., into the surface of the specimen to be tested. The weight applied to steels is 3000 kg. for 30 seconds; to brasses and bronzes 500 kg. for 60 seconds. The diameter of the impression forms the basis for calculating hardness.

British Thermal Unit (B.T.U.)—The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at, or near, its point of maximum density (39.1°F.) The B.T.U. is equivalent to 0.252 kilogram-calorie.

Buffer—Any substance, or combination of substances, which when dissolved in water produces a solution which resists a change in its hydrogen ion concentration upon the addition of acid or alkali.

Calorie—The small calorie (*c*) is an energy unit used to measure the quantity of heat. It is equal to the amount of heat required, at a pressure of one atmosphere, to raise the temperature of one gram of water one degree Centigrade. Since the specific heat of water varies with the temperature, the rise of one degree is sometimes specified to be between certain temperature intervals (as from 0° to 1°C.; at or near the temperature of greatest density, which is 4°C.; or, at from 15° to 16°C., in which case the unit is almost exactly that of the *mean calorie*). The amount of heat required to raise one gram of water from 0° to 100°C. is the *rational calorie*, one hundredth of the rational calorie being called the *mean calorie*.

Carbocyclic—See *cyclic*.

Carbohydrate—Any one of a group of compounds composed of carbon, hydrogen, and oxygen with the ratio of hydrogen to oxygen usually as in water; viz., 2H:1O. They are neutral compounds comprising the sugars, starches, celluloses, pentosans, galactans, etc.

Catalyst or Catalytic Agent—Any substance which, by virtue of its presence,

affects the rate of a chemical reaction and which may be recovered practically unchanged at the end of the reaction. The term *contact agent* is often applied to a solid catalyst in contact with gaseous reactants.

Cathode—The electrode at which reduction occurs. It is the negative electrode in a cell through which current is being forced, but it is the positive pole of a battery. In a vacuum tube, the cathode is the electrode from which electrons are liberated; see also the term *anode.*

Cation—The charged particle in the solution of an electrolyte which, under the influence of an electrical potential, moves toward the cathode. It is the positively charged ion.

Causticity—A measure of the hydrogen ion concentration in a sample of water; see *hardness.*

Cell (galvanic or electromotive)—A combination made up of a cup, or other vessel, containing a solution of a suitable electrolyte and two suitable electrodes which dip into it. It may be used either for generating electricity by chemical action, or for use in electrolysis (in the latter case it is called an *electrolytic cell*).

Cellulose—An anhydroglucose polysaccharide which constitutes the major portion of plant materials and which can be hydrolyzed by acid into glucose. *Alpha cellulose* is the cellulosic fraction which is insoluble in aqueous 17.5% sodium hydroxide solution. *Beta cellulose* is the cellulosic fraction which is soluble in aqueous 17.5% sodium hydroxide solution and from which it can be precipitated by acidifying the solution. *Gamma cellulose* is the cellulosic fraction which is soluble in aqueous 17.5% sodium hydroxide solution in which it remains dissolved, even after the solution is acidified.

Ceramic—Pertaining to the manufacture, or the products therefrom, of material made from earth by the agency of fire, such as pottery, enamel, cement, glass, etc. For definitions of ceramic terms see special *glossary of ceramic terms.*

Charles' Law—The law that at constant pressure the volume of a gas varies directly as the absolute temperature. The variation in volume amounts to 1/273 of its volume at 0°C. for each degree Centigrade.

Chemical Equivalent—See *equivalent weight.*

Chemiluminescence—See *luminescence.*

Colligative Property—A property depending only upon the number of atoms or molecules present in a system and not upon the nature of the atoms or molecules; e.g., gaseous pressure is a colligative property.

Colloid—A state of subdivision of matter characterized by a particle size intermediate between molecular dispersion (true solution), and a size just about visible with an ordinary microscope; i.e., from 10^{-5} to 10^{-7} cm. in diameter. A colloidal substance, when apparently dissolved in a liquid, diffuses not at all or very slowly through a membrane and shows no pronounced effect on the freezing point or vapor pressure of the solvent.

Combining Weight—See *equivalent weight.*

Combustion, Heat of—The total amount of heat evolved when a definite quantity of a substance is completely burned (oxidized). It is expressed variously, as in calories per gram or per gram molecule, or (especially for fuels) in British thermal units (B.T.U.) per pound.

Compressibility, Coefficient of—The decrease in volume per unit volume produced by a unit change in pressure.

Concentrated Solution—A solution containing a relatively large amount of dissolved substance per unit volume of solvent.

Condensation, Heat of—A value numerically the same as the *heat of vaporization* (q.v.).

Conductance—The property of an electrical circuit which determines, for a

given applied potential across its terminals, the rate at which electrical energy is converted into heat. It is the reciprocal of the electrical resistance and its unit, the *mho*, is the reciprocal of the ohm.

Constant Proportions, Law of—The law of chemical combination which states that a chemical compound always contains the same elements combined in the same proportions by weight.

Constitutive Property—A property dependent on the arrangement of the molecules or atoms in a substance (constitution) rather than on their kind or number; e.g., a physical property, such as the rotation of the plane of polarized light, which depends on the arrangement of atoms within the molecule, is called a constitutive property.

Coulomb—The practical unit quantity of electricity. It is the quantity of electricity which must pass through a circuit to deposit 0.0011180 grams of silver from a solution of silver nitrate. An ampere is one coulomb per second. A coulomb is also the quantity of electricity on the positive plate of a condenser of one-farad capacity when the electromotive force is one volt.

Critical Point—The transition point at which the liquid and gaseous states of a substance merge into each other. It is the temperature above which a substance cannot exist in two phases, no matter how great the pressure. See also *critical temperature* and *critical pressure.*

Critical Pressure—The pressure which is just sufficient to cause the appearance of two phases at the critical temperature. It is the vapor pressure of a liquid at the critical temperature.

Critical Temperature—The temperature above which a gas cannot be liquefied by pressure alone. At this temperature there is no distinction between liquid and vapor, both having the same density and constituting one homogeneous system.

Critical Volume—The volume occupied by unit mass of a substance at the critical temperature *and* critical pressure.

Crystal—A homogeneous particle of solid formed by the solidification, under favorable conditions, of a chemical element, a compound, or an isomorphous mixture, whose boundary surfaces are planes symmetrically arranged at definite angles to one another in a definite geometrical form. Many chemical substances solidify into various such forms, each being quite characteristic for every substance. See also *liquid crystal.*

Crystalline Form—A combination of faces included under a general crystallographic symbol. Faces of two or more crystal forms are often exhibited by a single crystal and these supplement one another or truncate on another's edges or corners.

Crystalline System—The six (or seven) groups into which crystals are classified according to forms which are dependent upon the relative lengths and inclinations of the axes to which they are referred. The systems are the *isometric, tetragonal, triclinic, hexagonal* (including the *rhombohedral*), *orthorhombic,* and *monoclinic.* See definitions for each of these systems.

Crystalloluminescence—See *luminescence.*

Cubic Form—See *isometric.*

Cycle or Cyclical Process—A process conducted in such a manner that at the end of a complete course of operations of some kind the system is back at its starting point with restoration of the original state.

Cyclic—Pertaining to, or characterized by, a ring or closed-chain formation. Compounds in which the ring is composed solely of carbon atoms are called *carbocyclic;* of atoms of the same kind, whether of carbon or not, *isocyclic* or *homocyclic;* of atoms of different kinds, *heterocyclic;* carbon ring compounds not derived from benzene are called *alicyclic.*

Dalton's Law of Partial Pressures—In any mixture of gases the total pressure is equal to the sum of the pressures which each gas would exert were it alone present in the volume occupied by the mixture; i.e., the total pressure P is

equal to the sum of the partial pressures of the individual gases.

Decomposition, Heat of—The heat evolved or absorbed by the decomposition of a compound into its elements or into two or more simpler products, the nature of which must be specified in connection with the numerical value of the heat of decomposition. It is usually expressed in calories per gram molecule.

Decomposition Potential or Voltage—The minimum voltage required to keep a steady current passing through a solution or, in other words, to cause a steady electrolysis in the solution.

Decrepitation—The property, possessed by some crystalline material, of making a crackling noise when heated and which is due to decomposition with evolution of gases, water vapor, etc.

Deflagration—The act of burning suddenly with the appearance of flame and sparks.

Deliquescence—The liquefaction of a solid substance due to the solution of the solid by absorption of moisture from the air.

Density—The ratio of the amount of anything per unit volume; e.g., weight of any substance per unit volume at any definite temperature (see also *specific gravity*); the quantity of an electric charge distributed in space per unit volume; or, the quantity of energy per unit volume.

Depression (molecular), Coefficient of—The depression of the freezing point produced by the solution of one gram molecule of a substance in 1000 grams of the solvent.

Dew Point—The temperature at which the liquefaction of a vapor begins; the term is usually applied to condensation of moisture from the water vapor in the atmosphere.

Dextro (rotatory)—A clockwise or right-handed turning motion usually applied to the turning of the plane of polarized light.

Diamagnetic—Possessing, or pertaining to, the magnetic properties of bodies whose permeability is less than unity (i.e., less than that of a vacuum). Diamagnetic substances are repelled by a magnet if the surrounding medium is air.

Diathermanous—Possessing, or pertaining to, the property of affording a free passage of heat rays.

Dielectric—A material which does not conduct the electric current because the lines of force of an electrostatic field will pass through it, thus making it the seat of the strain.

Dielectric Constant—A constant factor (ϵ) which is part of the formula for the force between two charges separated by a dielectric; viz., $\epsilon f\gamma^2 = Q_1Q_2$, where f is the force between two charges Q_1 and Q_2 separated by a distance of γ.

Diffusion, Coefficient of—The quantity of gas traveling one centimeter per second through a surface of one square centimeter.

Dilute Solution—A solution containing a relatively small amount of dissolved substance per unit volume of solvent.

Dilution, Heat of—The heat evolved per mole of solute when a solution is diluted.

Diolefin—Any open chain hydrocarbon containing two double bonds; e.g., $CH_2{:}CH{\cdot}CH{:}CH_2$. See *olefin*.

Dissociation—The splitting up of a compound or element into two or more simpler molecules, atoms, or ions. The term is applied usually to the effect of the action of heat or other forms of energy on gases, and of solvents upon dissolved substances. Dissociation is a reversible reaction and not as permanent as decomposition; i.e., when the dissociated gas is cooled, the split parts recombine; when the solvent is removed, the ions recombine.

Dissociation, Degree of—The ratio of the amount of substance which has dissociated to the total amount originally present.

Dissociation, Heat of—The heat evolved or absorbed during the dissocia-

tion of a compound. It is usually expressed in calories per gram molecule.

Distillation—The process of heating a liquid to its boiling point, removing the vapors through a cooling and condensing apparatus, and finally collecting the condensed liquid in a separate receiver. It is commonly used for the separation of two or more liquids in a mixture, or for the separation of the solvent from dissolved substances.

Distribution Coefficient—See *distribution law.*

Distribution Law (Nernst)—The law that the ratio in which a dissolved substance distributes itself between two immiscible solvents (the *coefficient of distribution* or *partition*) is a constant at constant temperature.

Drying Oil—An oil which, when exposed in a thin film to the air, readily forms a hard, tough, elastic substance. The chemical constitution of such oils is characterized by unsaturated linkages between carbon atoms.

Dulong and Petit's Law—The principle that the specific heat of a solid element multiplied by the atomic weight is a constant equal approximately to 6.2 to 6.4.

Efflorescence—The act or process by which crystalline material changes on the surface, or throughout, to a whitish, mealy, or crystalline powder from the loss of water on exposure to the air. The term is also applied to the process of becoming covered with such a crust; e.g., bricks may effloresce because of soluble salts in them.

Electrochemical Equivalent—The weight in grams of a substance caused to react (in some cases to deposit) when one coulomb of electricity is passed through a solution of the substance. It is the 1/96,500*th* part of the gram equivalent.

Electrode—The pole or plate of an electrolytic cell by which the current enters or leaves the cell.

Electrode Potential—The difference in potential established between an electrode and a solution when the electrode is immersed in the solution. Since it is impossible to measure such a single electrode potential experimentally, the values listed in tables are relative values, the standard being a rigidly defined hydrogen electrode, which is arbitrarily given a potential of zero volts. See *Table of Standard Electrode Potentials.*

Electroluminescence—See *luminescence.*

Electrolysis—Electrolysis is the process of the passage of an electric current through a solution with simultaneous chemical changes either in the electrodes or in the solutions in contact with the electrodes, or both.

Electrolyte—Any substance which, when in solution or fused, forms a liquid which will conduct the electric current. Acids, bases, and salts are common electrolytes.

Electrolytic Dissociation Theory—The theory, first proposed by Arrhenius, which postulates that whenever an electrolyte is placed in a dissociating medium, such as water, part or all of the molecules dissociate into ions. Some of these ions are positively, the rest negatively, charged; but in any case the oppositely charged ions are present in exactly equivalent quantities.

Electromotive Force—The driving tendency behind an electric current. It is often abbreviated as e.m.f. and it is measured in volts.

Electron—The most elementary negatively charged particle which is the constituent of all matter. It is the electrical opposite of the proton and is the quantity of electricity equal to 4.77×10^{-10} c.g.s. electrostatic units. Its mass is approximately 1/1845 of that of the proton. Electrons constitute cathode rays and beta rays, and are emitted by hot bodies.

Electron Theory of Matter—The atom is pictured as a nucleus around which are arranged electrons, or negative charges, equal in number to the net charge on the nucleus. The nuclear

charge and the number of external electrons vary from element to element, increasing by one for every increase in the atomic number of the elements. The total number of external electrons is thus identical with the atomic number of the element.

Elongation—The total stretch (deformation) in the direction of load, or per unit length, caused by a tensile force. It is the amount of permanent stretch before rupture and is usually expressed as a percentage of the original length.

Emulsion—The product of the dispersion of one liquid in another liquid, the dispersed phase particles being larger than colloidal size. The liquid in which the particles or globules are suspended is called the *continuous phase*, the particles or globules the *dispersed phase*. In photography, the term is applied to the light-sensitive coating of gelatine in which silver halide salts are suspended in an extremely fine state of separation and which is applied to glass plates, film, and paper.

End Point—The point indicating the end of some operation or at which a certain definite change is observed. In titration this change is frequently a change in color of an indicator which has been added to the solution, or to the disappearance or excess of one of the reactants which is colored. In the analysis of liquids, such as gasoline, the end point is the temperature at which liquid ceases to distill over.

Entropy—A thermodynamic quantity. In any *reversible* process, the increase in entropy of any system, or part of a system, is equal to the heat which it absorbs, divided by the absolute temperature at which the heat is absorbed.

Enzyme—Any one of a class of naturally occurring, complex, organic substances which catalyze specific reactions. Enzymes are elaborated by cells of plants and animals but their action is independent of life processes.

Equilibrium (chemical)—The state in a reversible chemical reaction at which the rate of the direct action is equal to the rate of the opposing reaction.

Equilibrium Constant—According to the law of mass action, for any reaction such as: $aA + bB \ldots . \rightleftarrows dD + eE \ldots .$, $\frac{C_D^d \times C_E^e}{C_A^a \times C_B^b} = K_c$ at any definite temperature. Here C is the equilibrium concentration of the constituents in moles per liter, while K_c is a constant known as the equilibrium constant.

Equivalent Weight—One of the comparative weights of different compounds, elements, or radicals, which possess the same chemical value for reaction when compared by reference to the same standard (usually oxygen = 8). The following are examples of this relationship:
(1) An equivalent weight of an acid, or a base, is the quantity that would furnish one gram-ionic weight of hydrogen ion (1.008 grams), or hydroxyl ion (17.008 grams), respectively, if the substance were completely ionized. Thus, an equivalent of H_2SO_4 is one-half the molecular weight; an equivalent of $Fe(OH)_3$ is one-third the molecular weight. (2) An equivalent weight of a salt is the gram-molecular weight divided by the total positive, or total negative, valence. Thus, an equivalent of $Al_2(SO_4)_3$ is one-sixth of the molecular weight. (3) An equivalent weight of an oxidizing, or reducing, agent is the gram-molecular weight divided by the total change in valence of all atoms in the molecule which change valence (usually only one element). Thus, when $KMnO_4$ in acid solution is reduced to Mn^{++}, the valence of Mn decreases from $+7$ to $+2$, a change of five units. In this case, an equivalent weight of $KMnO_4$ is one-fifth the gram-molecular weight.

Essential Oil—Any one of a class of odoriferous, volatile liquids, insoluble in water, which are obtained from plants to which they impart odors and other characteristic properties. They are of various organic types, such as ethers, aldehydes, esters, etc., or mixtures of the same. Some contain dissolved resin and are known as *oleoresins*. They are sometimes called *volatile oils* in distinction from *fixed oils*.

Ester—A compound which may be regarded as formed by the replacement of the acid hydrogen of an acid, organic

or inorganic, by a hydrocarbon radical. When the radical is not specified in the name, *ethyl* is often understood; e.g., acetic ester is ethyl acetate.

Ester Number (value)—The numerical difference between the saponification number and the acid number. It is a measure of the neutral fats (esters of the fatty acids) present.

Exfoliation—The property possessed by substances which are capable of casting or throwing off from their surfaces scales, laminae, or splinters.

Expansion, Coefficient of—The ratio of the increase in length (linear coefficient), area (superficial), or volume (cubical) of a body for a given rise in temperature (usually from 0° to 1°C.) to the original length, area, or volume, respectively. These three coefficients are approximately in the ratio of 1:2:3. When not expressly specified, the cubical coefficient is usually intended.

Explosive—A substance which acts by explosive chemical reaction to liberate, at high speed, gas and heat thus causing tremendous pressure.

Factor—A quantity by which a measure must be multiplied in order to express it in other terms. The number which is used to multiply a given weight of some compound in order to obtain the equivalent weight of some other compound is called a *gravimetric factor;* similarly, volumes may be interconverted by *volumetric factors.*

Faraday's Laws of Electrolysis—The law that: (1) For any electrolyte the amount of electrolysis is proportional to the quantity of electrical current which is passed through a solution; (2) for the same quantity of current passed through solutions of various electrolytes, the amounts liberated at the electrodes are directly proportional to chemical equivalents of the electrolytes. The quantity of current required to deposit one chemical equivalent weight is one *faraday* which is equal to 96,500 coulombs.

Fat—Any one of a class of compounds, composed of carbon, hydrogen, and oxygen, which are glyceryl esters of certain acids, such as stearic, palmitic, etc. The fats are neutral in reaction and on saponification all yield glycerol. The various varieties of natural fats are mixtures of different glycerides. A fat which is liquid at room temperatures is called a *fatty oil.* See *oil.*

Fixed Carbon—The percentage of combustible material in a sample (of coal usually) which is not volatile at 950°C.

Fixed Oil—An oil which is not readily volatile as distinguished from *volatile* or *essential oil* (q.v.) The term is especially applied to the liquid fats (glycerides) found in the fatty tissue of plants and animals, and in the seeds of plants. See *oil.*

Fluid—A substance which yields readily to any force which tends to alter its shape. Fluids possess no definite shape. The term includes both liquids and gases.

Fluorescence*—The property of emitting radiation as the result of absorption of radiation from some other source. The emitted radiation persists only as long as the exposure is subjected to radiation which may be either electrified particles or waves. The fluorescent radiation generally has a longer wave length than that of the absorbed radiation. If the fluorescent radiation includes waves of the same length as that of the absorbed radiation it is termed resonance radiation. See *Raman effect.*

Formation, Heat of—The heat evolved or absorbed when a compound is formed by direct union of its elements at some stated temperature. It is usually expressed in calories per gram-molecule of the compound.

Formula Weight—The sum of the atomic weights of all the atoms appearing in a chemical formula.

Free Energy—A thermodynamic term. Absolute values for free energy are unknown but when a system changes from one state to another at constant temperature and pressure, the decrease in free energy is numerically equal to the maximum useful work which can be done. This does not include work done on or by the atmosphere.

* For laws, see *photochemistry.*

DEFINITIONS OF CHEMICAL AND PHYSICAL TERMS

Freezing Point—The temperature at which a liquid solidifies. It is the temperature at which the liquid and solid states of a substance are in equilibrium at a given pressure (usually atmospheric). For pure substances it is identical with the melting point of the solid form.

Fusion, Latent Heat of—The amount of heat which must be supplied at the melting point to a unit quantity of a solid in order to transform it into a liquid at the same temperature (usually at standard pressure). The term is also called *heat of fusion.* It is usually expressed in calories per gram, or B.T.U. per pound.

Gamma Radiation—A form of radiation emitted by certain radioactive substances. This radiation is similar to, but of shorter wave length than, X rays (about 10^{-8} to 10^{-9}cm.) Like X rays, it is used in cancer therapy.

Gas—An aeriform fluid, having neither independent shape nor volume, but tending to expand indefinitely. Without qualification, the word is often popularly used to denote anesthetics, combustibles (gasoline), poisonous war materials, etc., whether liquids or solids at ordinary temperatures.

Gas Constant—A general term for all gases, being the term R in the ideal gas law equation: $PV = nRT$. It is an energy term equal to 0.08205 liter-atmospheres per degree per mole; or, 1.986 calories per degree per mole; or, 8.314×10^7 ergs per degree per mole.

Gay-Lussac's Law of Volumes—The law that in gaseous reactions the volume of the combining gases, if at the same pressure, bear to each other, as well as to the product of the reaction, a simple whole numbered relationship. That is, the volume of the product is either equal to the sum of the volumes of the reactants or is less than, and bears a simple ratio to, this sum.

Gibbs' Phase Rule—An equation advanced by Gibbs which defines the general conditions under which a system of several phases may be in heterogeneous equilibrium. It is: $F = C - P + 2$. Here F is the number of degrees of freedom of a system (i.e., the number of independent variables which must be fixed to completely define the system); C is the smallest number of components in terms of which the chemical composition of each phase may be described by means of a chemical equation; and P is the number of phases present at any stage.

Glucoside—Any one of a class of compounds, either natural or synthetic, which on hydrolysis yields a sugar, usually glucose, and one or more substances. Widely distributed in plants, they are generally white or colorless, crystalline compounds, often bitter, poisonous, and optically active. They are hydrolyzed by enzymes which are often present in the same plant from which they are obtained, by alkalies and by acids. Similar compounds derived from other aldose sugars or ketose sugars are called *aldosides* or *ketosides*, respectively.

Graham's Law of Effusion—The mean (root-mean-square) velocities of the molecules of two gases are inversely proportional to the square roots of their densities or of their molecular weights. If two gases are forced through the same small aperture, under the same pressure difference, then the rates of effusion (the time required for the same weight of each gas to pass through the aperture) are inversely proportional to the mean velocities of the molecules, and therefore directly proportional to the square roots of the molecular weights or of the densities.

Gram-atomic Weight—The mass, in grams, of an element equal numerically to its atomic weight.

Gram-molecular Weight—The mass, in grams, of an element or a compound equal numerically to its molecular weight.

Gravimetric Factor—See *factor.*

Grotthus, Law of—The law that only those rays of light which are absorbed produce chemical change.

Guldberg and Waage's Law—See *mass action law.*

DEFINITIONS OF CHEMICAL AND PHYSICAL TERMS

Gum—Any one of a class of colloidal substances exuded by, or extracted from, plants. Gums are either soluble in water, or swell up and become glutinous when moist but harden on drying. The term is often applied to a variety of other plant exudations such as resins, gum resins, etc.

Half Period or Half Life—A term used in chemical kinetics to denote the time (in years, days, seconds, etc.) for half of a given initial quantity of material to decompose.

Hardness (of water)—The hardness or soap destroying power of water is due principally to the calcium and magnesium ions present in the water and is independent of the accompanying acid ions. The *total hardness* is measured in terms of "parts per million" of calcium carbonate (more accurately milligrams of calcium carbonate per liter). It may be divided into two parts, the "temporary" and the "permanent" hardness. The *temporary hardness* is that part of the total hardness which is removed by boiling and corresponds roughly, but not quantitatively, to the calcium and magnesium bicarbonates in the water. The *permanent hardness* is that remaining after boiling and is due principally to the sulfates, chlorides, and nitrates of calcium and magnesium, and to the small amount of carbonates still held in solution. The total hardness also may be divided into the "alkalinity" or "carbonate" hardness and the "non-carbonate" hardness. The *alkalinity* of a natural water represents its content of carbonates, bicarbonates, hydroxides, and occasionally borates, silicates, and phosphates. It is determined by titration with dilute (usually 0.02 *N*) sulfuric acid to a methyl orange end point. Alkalinity is roughly equivalent to the temporary hardness. The difference between the total hardness and the alkalinity is the *non-carbonate hardness*, which is roughly equivalent to the permanent hardness. When the hardness of a water is greater than its alkalinity, the amount of hardness due to the alkalinity is called *carbonate hardness* and the amount of hardness in excess of this is called *non-carbonate hardness* or *incrustants;* when the hardness of a water is less than its alkalinity then the alkalinity, or part of the alkalinity, will be the *carbonate hardness* and the excess of the alkalinity over the hardness is called *negative non-carbonate hardness.* The *causticity* of a water is that part of its alkalinity due to hydroxides.

Heat Capacity—The *average* or *mean heat capacity* of a system, between any two given temperatures, is the quantity of heat required to raise the temperature of the system from the lower to the higher temperature divided by the difference between the two temperatures. The *true heat capacity*, c, at any given temperature is defined by the differential equation:

$c = \left(\frac{q}{dT}\right)$, where q is the infinitesimal amount of heat required to change the temperature by an amount dT, at the given temperature. The heat capacity is usually determined either at constant pressure, or at constant volume. The heat capacity per gram is the *specific heat.* The heat capacity per mole is called the *molar heat capacity* (at constant pressure or volume).

Hehner Number (value)—A number expressing the percentage (i.e., grams per 100 grams) of water-insoluble fatty acids in an oil or fat.

Henry's Law—The law that the solubility of a gas in a liquid is directly proportional to the pressure of the gas above the liquid at a definite temperature.

Hess' Law of Heat Summation—The law that the quantity of heat liberated or absorbed in any chemical transformation is independent of the manner in which the reaction takes place, provided the initial and final states are the same in every case. That is, the total heat of the reaction is the sum of the heats of the various intermediate steps. This is true only if all steps of the process are carried out either at constant volume or at constant pressure.

Heterocyclic—See *cyclic.*

Hexagonal System—One of the groups of crystalline form (including the *rhombohedral* division) in which three equal

lateral angles intersect at angles of 60° and with a vertical axis of variable length at right angles, as in the hexagonal prism.

Homocyclic—See *cyclic.*

Humidity—In hygrometry the *absolute humidity* is the amount of vapor actually present in the air and is expressed either in its expansive force, or in its weight per given volume. *Relative humidity* is the ratio of the quantity of vapor actually present to the greatest amount possible at the given temperature. Complete saturation of the air by a vapor is designated as humidity 100.

Hydration, Heat of—The heat evolved or absorbed when hydration occurs. It is the difference between the heats of solution of the anhydrous and the hydrated forms. It is usually expressed in calories per gram molecule.

Hydrocarbon—A chemical compound containing only hydrogen and carbon.

Hydrogen Ion Concentration—The concentration of hydrogen ions in a solution in gram-ionic weights per liter. See *pH.*

Hydrometer—A floating instrument for determining specific gravities, especially of liquids and solutions. It is usually a hollow glass or metal instrument, weighted at one end so as to float upright. The stem of the instrument is graduated so as to indicate the gravity of the liquid. Many instruments, for use with specific solutions, have arbitrary scales and are usually known by the names of the inventors. See special section on *Hydrometers.*

Hygroscopic—Readily absorbing, becoming coated with, and retaining moisture but not enough to make a liquid. See *deliquescence.*

Indicator—A substance, which by some visible change, such as a change of color, indicates the condition of a solution as to the presence of free acid, alkali, or other substance. Indicators are employed in volumetric (titrimetric) analysis to indicate the end points of reactions.

Inorganic—Designating, or pertaining to, the branch of chemistry which deals with substances of earthy or mineral matter. It includes the treatment of all substances with the exception of those classed as *organic* (q.v.)

Intumescence—A swelling or bubbling caused by heat.

Iodine Number (value)—A number expressing the percentage (i.e., grams per 100 grams) of iodine absorbed by a substance. It is a measure of the proportion of unsaturated linkages present and is usually determined in the analysis of oils and fats.

Ion—In electrolytic phenomenon, a particle bearing an electric charge which is formed when a neutral atom, or group of atoms, loses or gains one or more electrons. Loss of electrons results in positive charges producing a *cation;* gain of electrons results in the formation of an *anion* with negative charges. The valence of an ion is equal to the number of charges borne by it. In some crystals, such as NaCl, ions are supposed to form the units of the space lattice. Solution of such a crystal in an ionizing solvent such as water merely separates the ions. In other cases, ionization probably does not occur until the substance is dissolved in the solvent. Gaseous ions may be formed by the exposure of a gas to X rays, fast moving electrons, alpha or beta particles, etc.

Ionic Radius—See *atomic radius.*

Ionization Constant—The equilibrium constant for the reversible dissociation of a weak electrolyte. For example, if the weak acid HA dissociates into H^+ and A^-, then

$$K_i = \frac{(C_{H^+})\ (C_{A^-})}{(C_{HA})}$$

where K_i is the ionization constant if the concentrations of ions is expressed in gram-ionic weights per liter and the concentration of the unionized molecules, HA, is expressed in gram-moles per liter. See *equilibrium constant.*

Ionization, Heat of—The amount of heat evolved or absorbed when a definite amount of a solute ionizes. It is usually expressed in calories per gram molecule.

DEFINITIONS OF CHEMICAL AND PHYSICAL TERMS

Ionization Theory—See *electrolytic dissociation theory.*

Isocyclic—See *cyclic.*

Isometric System—One of the groups of crystalline form in which the three axes of a crystal are at right angles, as in the cube, regular octahedron, etc.

Isotopes—Forms of an element that differ from one another in the mass of their atoms and in the properties dependent on that mass. Having the same atomic number and the same number of valence electrons, isotopes occupy the same position in the periodic table and have identical chemical properties. They are distinguishable only by the small differences in atomic weight or by radioactive transformations.

Izod—The units of impact strength as obtained on an Izod impact testing machine.

Ketone—Any one of a class of compounds having two hydrogen atoms less than a secondary alcohol, and characterized by the carbonyl group (:CO) united to two hydrocarbon radicals.

Kinetic Energy—Energy, or the capacity for performing work, which a body or system possesses by virtue of its motion.

Kinetic Theory of Gases—The theory that all gases are made up of discrete spherical entities, molecules, which are in constant motion. It is assumed that the molecules move in straight lines with high average velocity, continually encountering one another, and hence changing their individual velocities and directions by perfectly elastic collisions. The distances between the molecules are large compared with their size. Temperature is due to the average kinetic energy of these molecules, while pressure is caused by the bombardment of the walls of the container by the molecules.

Latent Heat of Vaporization (or of fusion)—See *heat of vaporization (or of fusion).*

Lattice (or space-lattice)—The geometrical arrangement of the atoms in a crystal as disclosed by X ray analysis. It is the sum total of the points of intersection of any three sets of equidistant parallel planes.

Le Chatelier-Braun Principle (or law)—When a system, which is in equilibrium, is subjected to a stress, the system tends to adjust itself in such a way as to partly relieve the stress. The stress may be an increase or decrease in temperature, in pressure, in the concentration of one of the reactants or one of the products, etc. For example, in the equilibrium: $2NH_3 \leftrightarrows N_2 + 3H_2$, if the pressure is increased the equilibrium will be shifted toward the left because two ammonia molecules occupy less space than three molecules of hydrogen plus one molecule of nitrogen; the shifting of the equilibrium in this direction will tend to counteract the pressure stress in this case.

Levo (rotatory)—A counterclockwise or left-handed turning motion usually applied to the turning of the plane of polarized light.

Lignin—A plant material which, in conjunction with cellulose, forms the cell walls and the cementing material between them in woods and many plants. It can be isolated by means of aqueous 72% sulfuric acid under properly controlled conditions of temperature and time.

Liquefaction—The act or process of transforming any substance into a liquid, especially the conversion of a solid into a liquid by heat, or of a gas into a liquid by cooling or pressure.

Liquefaction, Heat of—This is also called heat of fusion or of condensation. See *fusion, heat of.*

Liquid—A form of fluid which is characterized by free movement of the constituent molecules among themselves but (differing in this respect from gases) without the tendency to separate from one another. Liquids differ from solids in yielding easily to pressure and the ease with which their particles move upon one another, thus causing them to adopt themselves to the shape of the containing vessel. See also *fluid.*

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Liquid Crystal—A liquid having certain physical properties characteristic of crystals, such as double refraction and interference colors. It is an anisotropic liquid.

Loss of Head (or friction loss)—The pressure lost in a pipe line due to the velocity of the liquid in the pipe line, the condition of the pipe wall, and the alignment of the pipe. It is usually expressed as loss of head in feet per thousand feet of pipe.

Luminescence—Any emission of light occurring at low temperatures and not caused by incandescence. It may be produced in various ways, such as, by chemical action (chemiluminescence); by electric action (electroluminescence); by crystallization (crystalloluminescence); by friction (triboluminescence); by moderate and sudden heating of substances previously exposed to light or cathode rays (thermoluminescence); by exposure to light (photoluminescence; called *fluorescence* if observed during excitation, and *phosphorescence* if observed after excitation); by autoluminescence of radioactive substances (without exposure to light or external excitation).

Magnetic—See *diamagnetic* and *paramagnetic.*

Malleable—Possessing the property of being shaped or extended by beating with a hammer or by pressure of rollers.

Mariotte's Law—See *Boyle's law.*

Mass Action, Law of—The law, established by Guldberg and Waage, that the rate of a chemical reaction is proportional at any instant to the active masses of the reacting substances. By "active mass" is meant the molecular concentration of the substance available for chemical reactions; i.e., the number of moles per unit volume. For dissolved substances the active mass may sometimes be expressed in terms of osmotic pressure, and with gases in terms of the partial pressures of the reactants.

Mass Number—The mass of the individual atoms of an isotope compared with the value of 16.0000 as the mass of the atom of the most abundant isotope of oxygen. It is the whole number nearest the isotopic weight.

Maumene Number (value)—The maximum rise in temperature, expressed in degrees Centigrade, obtained by slowly introducing 10 cc. of concentrated sulfuric acid into 50 g. of oil.

Mechanical Equivalent of Heat—The amount of work which is equivalent to one calorie of heat. It is equal to 4.1852 $\pm$ 0.0006 absolute joules per gram-calorie (15°).

Melting Point—The normal melting point of a solid is the temperature at which the solid and the liquid phases of the material are in equilibrium, under a pressure of one atmosphere.

Metal—In a broad sense (including alloys, q.v.), a metal is any one of a class of substances which typically show metallic luster, are good conductors of heat and electricity, are opaque, are malleable and ductile, and may be fused. In a narrow sense, the term refers to metallic elements.

Metal Shrinkage (or pattern maker's allowance)—The allowance which must be taken into account in constructing a pattern because of the diminution in volume (shrinkage) which occurs when metal passes from the liquid to the solid form.

Metalloid—See *metal* and *nonmetal.*

Methoxyl Number (value)—The amount of methoxyl, a chemical radical CH_3O, which occurs as a substituent group in some substances and which can be determined as methyl iodide by treating the substances with hydriodic acid.

Mho—See *conductance.*

Mineral—Any element or compound occurring naturally in the mineral kingdom as distinguished from occurrence in either the vegetable or animal kingdoms.

Mineral Oil—Any oil of mineral origin as distinguished from plant and animal oils. The mineral oils include such

materials as petroleum, shale oil, or oils obtained from them by distillation. They are essentially mixtures of hydrocarbons.

Modulus (coefficient) of Elasticity—The modulus of elasticity is the ratio of the internal stress to the strain giving rise to it. For any special type of deformation it is a number characteristic of each substance. Special coefficients are used for deformations involving changes both in volume and in shape. Young's modulus is most often used and applies to the stretching of a wire or rod, or to the compression of a pillar; it is the ratio of F/A to l/L, where F is the increase in the force acting over the cross section whose area is A, corresponding to a change in length l of a wire or rod whose original length was L.

Molality—The strength of a solution expressed in gram moles of solute per 1000 grams of solvent; e.g., a solution containing 2 moles of sodium chloride per 1000 grams of water is 2 molal.

Molarity—The strength of a solution expressed in gram moles of solvent per liter of solution.

Mole (or mol)—The weight of a substance equal numerically to its molecular weight. A gram-mole is the weight in grams equal to the molecular weight; a pound-mole is the weight in pounds equal to the molecular weight.

Molecular Depression (or lowering)—See *depression (molecular), coefficient of.*

Molecular Elevation—The increase of the boiling point in degrees Centigrade produced by the solution of one gram molecular weight of a substance in 1000 grams of a specified solvent.

Molecular Volume—The quotient obtained by dividing the molecular weight of a substance by its density in grams per cubic centimeter at the desired temperature is the molecular volume in cubic centimeters per gram-mole.

Molecular Weight—The sum of the atomic weights of all the constituent atoms in the molecule of an element or a compound.

Molecule—When atoms combine they form a molecule. In the case of an element or a compound, a molecule is the smallest unit which chemically still retains the properties of the substance in mass.

Mole (or mol) Fraction—The quotient obtained by dividing the number of moles of any one substance in a system by the total number of moles of all substances in the system.

Monoclinic System—One of the groups of crystalline form in which there are three unequal axes, with one oblique intersection, as in the oblique rhombic prism.

Neutralization, Heat of—The heat evolved in dilute solution by neutralization of a gram equivalent of an acid with a base at some specified temperature. For strong acids and bases, the heats of neutralization are nearly constant, the average being 13,800 gram calories per gram-mole at 20°C.

Non-carbonate Hardness—See *hardness.*

Nonmetal—An element which does not possess the properties of a metal (q.v.) Unlike the metals, the nonmetals form stable compounds with hydrogen and do not form basic oxides or hydroxides. Certain elements, such as arsenic and antimony, are classed as *metalloids* because they share certain properties of both the metals and the nonmetals.

Normal Solution—A solution of such a concentration that it contains one gram-equivalent of a substance per liter of solution.

Octane Number—This is a number which is a measure of the antiknock value, or better of the detonation characteristic, of a motor fuel. It represents the percentage by volume of "iso-octane" (2,2,4-trimethylpentane) in a mixture of iso-octane and normal heptane which gives the same amount of detonation as the fuel to be rated *when tested under the same conditions.* Cf. ASTM Standards of Petroleum Products and Lubricants, No. D-357-34T.

DEFINITIONS OF CHEMICAL AND PHYSICAL TERMS

Ohm—The international ohm is the resistance offered at 0°C. by a column of mercury 106.300 centimeters in length, of constant cross-sectional area, and weighing 14.4521 grams. Such a column has a cross-sectional area of approximately one square millimeter.

Oil—Any one of a large class of substances which are liquid at room temperature, soluble in ether and in alcohol, insoluble in water, and usually lighter than water. They are classified in various ways; from their origin, as *mineral*, *vegetable*, and *animal;* according to their behavior when heated as *fatty* or *fixed*, and *essential* or *volatile*. The fixed oils are further subclassified as *drying*, *semi-drying*, and *non-drying*, according to the degree with which they absorb oxygen thus becoming hard and resinous when exposed in a thin film to the air. See also *fat*, and *wax*.

Olefin—Any open-chain hydrocarbon containing one double bond. Olefins are members of the ethylene series and have the general formula C_nH_{2n}. Somewhat similar hydrocarbons, but having two, three, or more, double bonds, are called diolefins or dienes (C_nH_{2n-2}), triolefins or trienes (C_nH_{2n-4}), etc.

Oleoresin—See *essential oil*.

Optical Activity—Possessing the property of rotating the plane of polarized light. See *polarization*.

Organic—Designating, or pertaining to, the branch of chemistry which treats of the hydrocarbons and their derivatives (or, which is almost the same, the chemistry of the carbon compounds), whether of natural or of synthetic origin.

Orthobaric Density—The density of a liquid substance and the density of the vapor of the substance in equilibrium with the liquid at a given temperature and pressure. As the temperature rises, the density of the liquid decreases, while the density of the vapor increases, until they become equal at the critical temperature and critical pressure.

Orthobaric Volume—The reciprocal of the orthobaric density. See *orthobaric density*.

Orthorhombic System—One of the groups of crystalline form in which there are three unequal axes at right angles, as in the right rhombic prism.

Osmotic Pressure—The unbalanced pressure which gives rise to the phenomena of diffusion and of osmosis; as when a solution is separated from a pure solvent or from another solution of different concentration by a semi-permeable membrane, molecules of the solvent will diffuse through the membrane from the more dilute to the more concentrated solution. The hydrostatic pressure required to stop this diffusion is the osmotic pressure. Closely related to gas pressure, it is proportional to the absolute temperature and also to the molecular concentration, and apparently it is equal to what the pressure of the dissolved substance would be if it were a gas at the same temperature and had a volume equal to that of the pure solvent.

Oxidation—In a broad sense oxidation is the increase in positive valence or decrease in negative valence of any element in a substance. On the basis of the electron theory, oxidation is a process in which an element loses electrons. In a narrow sense, oxidation means the chemical addition of oxygen to a substance.

Oxidation, Heat of—The heat evolved when a substance is oxidized. It is usually expressed in calories per gram-molecule.

Oxidizing Agent—A chemical reagent which causes oxidation of other substances and is thereby reduced. See *oxidation* and *reduction*.

P (proton) Number—A term used, instead of isotopic weight, to designate the whole-numbered atomic weight or the number of hydrogen nuclei.

Packing Fraction—The packing fraction of any atomic species is equal to $(A - W)/W$, where A is the exact atomic weight of the species and W is the integer nearest to A. Values 10,000 times larger than the values given in the preceding definition are also called the packing fraction and commonly employed.

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Parachor—A constant dependent on the constitution of a compound and related to its molecular volume. Being an additive property, it finds application in organic chemistry for checking structure of compounds. The parachor (P) is equal to $(M \times \gamma^{\frac{1}{4}})/(D - d)$, where M is the molecular weight, γ the surface tension, D the density of the liquid, and d the density of the vapor at the same temperature.

Paramagnetic—Possessing, or pertaining to, the magnetic properties of bodies whose permeability is greater than unity (i.e., greater than that of a vacuum). Paramagnetic substances are attracted by a magnet if the surrounding medium is air. See *diamagnetic.*

Partial Pressure, Law of—See *Dalton's law.*

Partition Coefficient—See *distribution law.*

Pearl—A term used in pharmacy for a glass capsule containing some volatile liquid for inhalation, as amyl nitrite. For use, the capsule is crushed in a handkerchief and the vapors inhaled therefrom.

Pentosan—Any one of a group of anhydropentose residues which generally occur as polysaccharides in plant materials and which can be hydrolyzed by acid to pentose sugars.

Perfect Gas—A perfect or ideal gas is one which fulfills two conditions: (1) the equation $PV = nRT$ is obeyed exactly when the temperature T, the pressure P, and the volume V are varied (n is the number of moles of gas, and R is the gas constant, q.v.); and, (2) its internal energy E is a function of the temperature alone, and does not change with a change in volume of the gas at a constant temperature.

Periodic Law—The law that the chemical and physical properties of the elements are periodic functions of their atomic numbers. By periodic function is meant that the properties repeat at certain intervals. See *periodic table.*

Periodic Table—A table in which the elements are arranged in order of increasing atomic number. Elements of similar properties are placed one under the other, yielding families or groups of elements of which there are eight. Within each group there is a gradation of chemical and physical properties, but in general a similarity of chemical behavior. From group to group, however, there is a progressive shift of chemical behavior from one end of the table to the other.

pH—The exact significance of pH is still in dispute (cf. *J. Am. Chem. Soc. 60, 1094 (1938)*). It is commonly considered to be the negative logarithm (to the base 10) of the hydrogen ion concentration of a solution. Others interpret it as the negative logarithm of the "activity" of the hydrogen ions in a solution. Exactly, neither is correct but the experimental determination of pH continues to offer valuable information as to the immediate acidity, as contrasted to the total acidity, (which may be titrated), of a solution. The experimental meaning of pH is given by the following equation: pH = (e.m.f. of H_2-calomel cell − e.m.f. of calomel half-cell at temp. T)/0.000198322T.

Phenol—Any one of a series of aromatic hydroxyl derivatives which has the OH group directly attached to the ring and of which phenol (carbolic acid) is the type. Specifically the term phenol is applied to carbolic acid, C_6H_5OH.

Phenol Coefficient—The ratio of the dilution of a disinfectant required to kill the Hopkins strain of typhoid bacillus under carefully controlled conditions in a specified time compared with the dilution of phenol required for the same organism under the same conditions. Usually 2.5 and 15 minute time limits are used and the coefficient is calculated from the average of these two. For example, if 1:80 and 1:110 dilutions of phenol kill in 2.5 and 15 minutes, respectively, and the corresponding dilutions of a disinfectant under test are 1:375 and 1:650, then the phenol coefficient of the disinfectant is $\frac{1}{2}[(375/80) + (650/110)]$ or 5.30.

Photochemistry—The branch of chemistry concerned with the effect of radiant energy, especially light, in causing chemical changes. *First law (Grotthuss-*

Draper law)—Only that light which is absorbed can act chemically. *Bunsen-Roscoe law*—The amount of material transformed in a photochemical change is proportional to the product of the light intensity and the time of illumination. *Second law* (*Einstein photochemical equivalence law*)—Each absorbed quantum should cause one light-absorbing molecule to react. *First law of fluorescence* (*De Ment absorption law*)—Energy must be absorbed by a luminescent system before emission can occur. *Second law of fluorescence* (*Stoke's emission law*)—The energy emitted as light during fluorescence is less than the energy absorbed as light for excitation; i.e., the absorbed wave lengths are shorter than the emitted wave lengths. *Third law of fluorescence* (*luminescence equivalence law*)—The absorption of radiation by a luminescent system is a quantum process involving one quantum per absorbing particle (e.g., atom or "center"), the yield being unity in the ideal case.

Photoluminescence—See *luminescence.*

Pitot Tube—A device used to measure the velocity of fluid flow. It consists of a tube with a short right-angled bend, placed vertically in the moving body of fluid with the bent part lowermost and its opening normal to the direction of flow.

Planck's Constant—The term h in the fundamental equation of the quantum theory: $\Delta E = h\nu$, where ΔE is the difference in energy of an electron in two different orbits of an atom, ν the frequency of the radiation emitted by the atom when the electron jumps from one orbit to the other in which its energy is less, and h a universal constant with dimensions the same as those of action. It is equal to 6.55×10^{-27} erg-seconds.

Plastic—A substance capable of, or the property of, being deformed continuously and permanently in any direction without rupture, under a stress greater than the yield value.

Polar—Designating, or characterized by, a union of atoms in which the bonds are electrostatic attractions between oppositely charged particles (ions). Thus, in potassium chloride (KCl), the potassium atom has lost an electron to the chlorine thereby becoming positively charged (K^+), while the chlorine has thereby become negatively charged (Cl^-). The term polar is used also to designate molecules which possess a permanent *electric moment*, or *dipole moment*, μ.

Polarization (of light)—The act or process of affecting light in such a manner that the vibrations assume a definite form. In nonpolarized light the vibrations are in all directions perpendicular to the ray, whereas in polarized light the paths of the vibrations (all in a plane perpendicular to the ray) may be straight lines, *plane polarized;* or circles, *circularly polarized;* or ellipses, *elliptically polarized.*

Potential Energy—Energy which a system possesses by virtue of its position or configuration.

Potentiometer—An apparatus for the dividing of a given potential into any fractional part. An instrument for measuring or comparing electromotive forces, in which the impressed potential is opposed by a known potential until there is no current flow.

Primary Standard—A term in analytical chemistry designating a substance of constant composition and of sufficient purity to be used for standardizing volumetric (titrimetric) solutions, or which may be used for the preparation of volumetric (tritrimetric) solutions, and when made up to an exact volume the solution requires no further standardization.

Proof Spirit—In the United States proof spirit is an alcoholic liquor of specific gravity $0.93426\frac{60}{60}$°F. Such a solution contains one-half its volume of an alcohol with the specific gravity 0.7939^{60}° F. which represents 42.49% of absolute alcohol by weight, or 50 parts of alcohol to 53.71 parts of water by volume, the apparent excess of water being due to a contraction in volume on mixing the alcohol with the water. Liquors containing less alcohol than proof spirit are termed *under proof;* thus, 10% or 10° under proof is a spirit which at 60°F. contains 90 volumes of proof

spirit and 10 of water. Similarly a 25° *overproof* (or *above proof*) indicates a spirit of such a concentration that 100 volumes at 60°F. must be diluted with water to 125 volumes to obtain proof spirit. Although the laws in the United States are worded in terms of proof spirit, it is more customary to express the concentration of alcohol in % by volume.

Protein—Any one of a class of naturally occurring compounds containing carbon, hydrogen, oxygen, nitrogen, often sulfur, phosphorus, occasionally iron and a few other elements. They are essentially very complex combinations of amino acids and are constituents of all living cells both animal and vegetable. They combine with both acids and bases, and are usually amorphous and colloidal. Since most proteins contain about 16% nitrogen, it is customary in analytical chemistry to multiply the total nitrogen by the factor 6.25 in computing the per cent of protein in a sample. Proteins are an essential constituent of the diet of the animal organism.

Proton—The positive nucleus of the light isotope of hydrogen. It forms the principal part of the atomic mass of hydrogen. The nuclei of the heavier elements are supposed to be whole number multiples of the proton although it is not known whether or not protons exist as such in these nuclei.

Proton Number—See *P number*.

Quantum—The "bundle" of radiant energy which, according to the quantum theory, is emitted as a unit by a "resonator" vibrating with a frequency ν. The energy of such a bundle (i.e., of a quantum) is equal to $h\nu$, where h is Planck's constant (q.v.)

Radical—A group of atoms remaining unchanged during a series of reactions and which may be regarded as playing the part of a single atom. See special *table of radicals*.

Radioactive Constant—The constant λ in the equation for the rate of change of radioactive material: $E = E_0 e^{-\lambda t}$, in which E_0 is the initial quantity of radioactive material undergoing change, E the quantity remaining unchanged after the lapse of any interval of time t, e the base of the Naperian logarithmic system, and λ the radioactive (decay) constant, by which is meant the fraction of the total which changes in unit of time.

Radioactivity—The property possessed by certain elements and their compounds of spontaneously emitting radiation by the disintegration of the nuclei of the atoms. The radiation consists of alpha or beta rays. Alpha rays are emitted when an atom loses a helium nucleus and thereby changes to an atom with an atomic number two units lower. Beta rays are the result of the loss of an electron from the nucleus whereby an atom is formed with an atomic number one unit higher. These changes are sometimes accompanied by the emission of gamma rays which are vibrations of high frequency. A series of such changes (disintegration series) continues until a stable product (an isotope of lead) is formed.

Raman Effect—The changing of the wave length of some of the scattered rays when a beam of light is passed through a pure liquid or vapor. It is useful in the determination of constitution.

Raoult's Law—The lowering of the vapor pressure of a solvent due to the presence of dissolved solute, divided by the vapor pressure of the pure solvent, is equal to the mole fraction of the solute. The law may be used for the calculation of the vapor pressure of solutions containing non-volatile solutes, or the partial pressure of the solvent if the solute is volatile. This law plays the same role with solutions as do the perfect gas laws in the case of gases; i.e., it expresses the conditions which exist in an ideal solution. It does not hold for electrolytes because of dissociation.

Rare Earth—Any one of a series of very similar oxides of metals with consecutive atomic numbers from 57 through 71 (with the exception of cerium, No. 58, which is sometimes considered not to be a member of the series) and a characteristic valence of three. They occur in widely distributed but relatively scarce minerals.

DEFINITIONS OF CHEMICAL AND PHYSICAL TERMS

Reacting Weight—See *equivalent weight.*

Reaction, Heat of—The heat evolved or absorbed during a chemical reaction in which the final state of the system is brought to the same temperature as that of the initial state. The numerical values for heats of reaction usually accompany a chemical equation expressing the reaction and are for the number of gram-moles (usually) involved in the equation as written.

Reaction (or van't Hoff) Isochore—The equation which represents the variation of the equilibrium constant with temperature: $d \ln K_c / dT = Q/RT^2$, where $\ln K_c$ is the logarithm to the base e of the equilibrium constant obtained when the "active masses" of the products and reactants are measured in moles per liter at the absolute temperature T; R is the gas constant expressed in calories per degree per mole (1.986); and Q is the heat of the reaction at constant volume expressed in calories.

Reducing Agent—A chemical reagent which brings about the reduction of some other substance and is itself simultaneously oxidized. See *reduction* and *oxidation.*

Reduction—In a narrow sense reduction means the decrease in the oxygen content, or the increase in the hydrogen content, of a substance. In a broad sense, reduction is the decrease in positive valence or the increase in negative valence of an element. See also *oxidation.*

Reflection, Law of—The law that light, falling upon a plane surface, is so reflected that the angle of incidence is equal to the angle of reflection, and that the incident ray, the reflected ray, and the normal all lie in the same plane.

Refractive Index—See *refraction, index of.*

Refraction—The deflection from a straight path suffered by a ray of light in passing obliquely from one medium into another in which its velocity is changed. See also *refraction, index of.*

Refraction, Index of—A constant, characteristic of each substance, which represents the ratio of the velocity of light in a vacuum to that in the substance. It is the ratio of the sine of the angle of incidence to the sine of the angle of refraction when light passes obliquely into a medium. It varies with the temperature, pressure, wave length of light, and with the media. *Absolute index* is the ratio of the velocity of light in a vacuum to that in a given medium. Since the index of refraction of air is so near unity, it is commonly used as a more convenient standard than a vacuum. *Relative Index* is the ratio of the velocity of light in two different media. See also special section *index of refraction.*

Reichert-Meissl Number—The number of milliliters of decinormal alkali required for neutralization of the volatile water-soluble fatty acids obtained from 5.5 grams of a fat or oil by a certain method of saponification and distillation. The number is a measure of the amount of low molecular weight fatty acids present in the sample.

Resin—A solid or semi-solid, amorphous (noncrystalline) organic substance which often softens and melts but not at any definite temperature. The natural resins are chiefly of plant origin, usually yellowish to brown in color, soluble in alcohol, ether, etc., but not in water. They are chiefly excretion products and exude from plants alone or as mixtures with essential oils, with gums, etc. Some are found as fossils after decay of the plant. The term is also applied to synthetic products of various types of chemical combinations which possess many of the same properties as the natural resins. They are all nonconductors of electricity and many are transparent or translucent.

Resistivity—The electrical resistance offered to the passage of a steady current. The specific resistance of a material is numerically equal to the resistance of a cylinder one centimeter in length and one square centimeter in cross-section.

Rhombohedral System—A division of the hexagonal system (q.v.) in which the form is referred to three equal oblique axes parallel to the faces of the fundamental rhombohedron.

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Roentgen Ray—See *X ray*.

Salt—Any one of a class of similar compounds formed when the acid hydrogen of an acid is partly or wholly replaced by a metal or a metallic radical. They are formed by the action of acids on metals (with the elimination of hydrogen), and on oxides and hydroxides (with the elimination of water), by the direct action of an acid with ammonia or an ammonia derivative, and in other ways. Specifically, the term salt is applied to sodium chloride, NaCl.

Saponification—Process, act, or result of hydrolysis of an ester by an inorganic base, the product being a salt and an alcohol. When the ester being saponified is an animal or vegetable fat, the products are soap and glycerol. By extension, the hydrolysis of compounds other than esters.

Saponification Number—In the analysis of fats, oils, etc., the number of milligrams of potassium hydroxide required for the complete saponification of one gram of substance.

Saturated Solution—A solution which contains at any constant temperature as much dissolved substance as it can possibly hold in presence of solid solute.

Sectile—A mineralogical term applied to minerals which are capable of being severed by the knife with a smooth cut, but yet pulverizable, as distinguished from brittle or malleable.

Shrinkage—See *metal shrinkage*.

Single Electrode Potential—See *electrode potential*.

Soap—The sodium or potassium salt of a higher molecular weight fatty acid; by extension, any salt of the fatty acids and commonly called a *metallic soap* when containing some metal other than sodium or potassium.

Solid—A part of space bounded on all sides and which does not perceptibly flow. Between typical solids and liquids are many gradations designated by terms such as *viscous solid*, *semi-solid*, *viscous liquid*, etc.

Solidification Point—The temperature at which a liquid changes into a solid. It may be identical with, or lower than, the melting point.

Solubility—The quantity of solute present in a given amount of the saturated solution, at a certain temperature, is called the solubility of the solute. It is expressed in any of the units used to express concentration of solution, such as grams of solute per 100 milliliters of solvent, grams solute per 100 grams of solution, moles of solute per liter of solution or per 1000 grams of solvent, etc.

Solubility Product—The maximum product of the ionic concentrations of a difficultly soluble salt which can exist in equilibrium with the solid phase at a definite temperature, each concentration being raised to its proper power. In general, if $A \rightleftarrows bB \times cC$ represents the equilibrium between the molecule A and its ions B and C in a saturated solution, then the solubility product K_{sp} is given by the equation: $K_{sp} = [B]^b \times [C]^c$, where $[B]$ and $[C]$ are expressed in gram-ionic weights per liter.

Solute—When a solid is dissolved in a liquid, the solid is termed the *solute*, the liquid the *solvent*. When one liquid is dissolved in a second liquid, the liquid present in the smaller amount is usually called the solute. In this case, the designation is arbitrary, particularly when the liquids are completely miscible.

Solution—A homogeneous mixture formed by the process in which a substance, whether solid, liquid, or gaseous, is mixed with a liquid (or by extension, with a solid, or gas) called the solvent. The term is usually associated with liquids but may include solids, as in alloys, or gaseous mixtures.

Solution, Heat of—The heat evolved or absorbed when a substance (solute) dissolves in a solvent. The *integral heat of solution* is the heat absorbed when one mole of solute is dissolved in a sufficient quantity of solvent to produce the specified concentration. Most values of heats of solutions are integral heats of solution of the solute in a large amount or specified amount of solution. The *differential heat of solution* is the amount

of heat absorbed when one mole of solute is dissolved in such a large volume of solution of definite concentration that the concentration of the solution is not apparently altered. The differential heat of solution is the rate of change of the integral heat of solution per mole of solute at any specified concentration.

Solvent—See *solute.*

Specific Gravity—The ratio of the weight of any volume to the weight of an equal volume of some other substance taken as the standard at stated temperatures. For solids or liquids the standard is usually water, and for gases the standard is air or hydrogen.

Specific Heat—The amount of heat required to raise a unit weight of substance one degree of temperature at either constant pressure or constant volume. It is usually expressed in calories per gram per degree Centigrade. See *heat capacity* for distinction between mean and true specific heats.

Spectrum—A series of radiant energies arranged in order of wave length; as for example, when a beam of light is subjected to dispersion and then brought to a focus to form a series of images arranged in order of their wave lengths.

Standard Solution—A solution, of accurately known or standard concentration, used as a reagent.

Sublimation—The process of passing from the solid to the gaseous state directly. There is a definite vapor or sublimation pressure for a solid at each temperature. At this pressure and temperature the gaseous and solid phases are in equilibrium. If the temperature is kept constant and the outside pressure on the system is lowered, the solid will sublime. Substances like camphor, which sublime at atmospheric pressure, have a sublimation pressure at that temperature which is greater than the atmospheric pressure.

Sublimation, Heat of—The heat evolved or absorbed in subliming a unit mass at a specified temperature.

Supersaturated Solution—A solution which contains more dissolved substance than it can normally hold at the same temperature in the presence of undissolved solute.

Surface Tension—The property, due to molecular forces, existing in the surface film of all liquids which tends to contract the volume into a form with the least surface area. The particles in the surface film are inwardly attracted thus resulting in tension.

Symbol—An arbitrary or conventional sign, such as a character, a letter, abbreviation, etc., used instead of a word or words, as in chemistry, mathematics, etc., to represent elements, operations, etc.

Tensile Strength—The greatest longitudinal stress a substance can withstand without rupture. It is usually expressed with reference to a unit cross-sectional area, as kilograms per square centimeter, or pounds per square inch, necessary to produce rupture.

Tetragonal System—One of the groups of crystalline form in which three axes are at right angles, but only two, the lateral axes, equal, as in the right square prism.

Thermal Conductivity—The quantity of heat passing in unit time through a plate of unit area and unit thickness, with a temperature differential of one degree between the faces of the plate. See special section on *heat conductivity.*

Thermal Expansion—See *expansion, coefficient of.*

Thermochemical Equation—An equation which, besides the stoichiometric chemical relationships, indicates also the energy change involved in a reaction.

Thermochemistry—That branch of chemical science concerned with the relations existing between chemical action and heat (thermal changes) which accompany chemical reactions.

Thermo (electric) Couple—Two bars or wires of dissimilar metals joined at one extremity and which develop a current (thermoelectric current) when heated.

Thermodynamics, Laws of—The laws of thermodynamics expressing certain

energy relationships which were found to be true empirically. *First law*—This law, known also as the law of the conservation of energy, states that energy can be neither created nor destroyed; when one form of energy disappears another form always appears in equivalent quantity. *Second law*– This law states that heat cannot pass spontaneously from a colder to a warmer body; when free interchange of heat takes place, it is always the hotter of two bodies which loses energy and the colder that gains energy. *Third law*—This law states that every substance has a finite positive entropy, but at absolute zero the entropy may become zero, and is zero in the case of perfect crystalline substances.

Thermoluminescence—See *luminescence.*

Thermoneutrality, Law of—The law that no thermal effect is produced when dilute solutions of neutral salts are mixed and no precipitation occurs.

Titer—The titer, as applied to solutions, is the concentration of a dissolved substance as determined by titration. The term is also applied to the minimum amount or volume required to bring about a given result in titration. The titer, as applied to fats, is the solidification point of the fatty acids liberated from a fat by hydrolysis.

Titration—A method, or the process, of using a standard solution for the determination of the amount of some substance in another solution. The known solution is usually added in a definite quantity to the unknown until equivalent quantities have been added. If the reaction in question is in itself invisible, an indicator, having a visible reaction, correlated with the invisible, is used. From the quantity of known substance added and the reaction involved the quantity of unknown substance may be calculated.

Titrimetric—A word synonymous with volumetric when used with reference to chemical titration.

Transference Number—In electrolysis, a number denoting the fraction of the total current passed through a solution of an electrolyte which any one ion carries. If n is the transference number of the anion, then $1-n$ is that of the cation.

Transition Point (or temperature)—The temperature at which two crystalline forms of a substance are in equilibrium with each other. The transition temperature changes with the pressure on the system.

Triboluminescence—See *luminescence.*

Triclinic System—One of the groups of crystalline form in which there are three unequal axes and intersections oblique, as in the oblique rhomboidal prism.

Ultimate Strength—The maximum force or load per square inch for a substance under tension.

Unsaponifiable—That portion of a fat or oil which does not react with alkali in the hydrolysis to form glycerol and fatty acid soaps.

Valence—The degree of combining power of an element or a radical. It is usually expressed by a number based upon hydrogen equal to unity. Thus when H = 1, then Na = 1, Mg = 2, PO_4 = 3.

Van't Hoff Isochore—See *reaction isochore.*

Van't Hoff's Law—The law that, when a system is in equilibrium, of the two opposed interactions the endothermic is promoted by raising the temperature, the exothermic by lowering it. It is a particular case of Le Chatelier's law (q.v.)

Vapor Density—The weight of a vapor per unit volume at any stated temperature and pressure.

Vapor Pressure—The pressure exerted by a vapor when a state of equilibrium has been reached between a liquid, solid, or solution, respectively, and its vapor, is called the vapor pressure of a liquid, solid, or solution. When the vapor pressure of a liquid exceeds that of the confining atmosphere the liquid commonly is said to be boiling. See *boiling point.*

Vaporization, Heat of—The quantity of heat required to convert a unit quantity of liquid at a definite tempera-

ture to vapor at the same temperature. It is usually expressed in calories per gram, or calories per gram-mole.

Vegetable Oil—Any oil from plant origin as distinguished from animal (origin) oil. Usually the volatile (essential) oils are not included in this classification which is primarily intended to designate the fixed oils (i.e., glyceryl esters of various fatty acids). See *oil* and *animal oil.*

Viscosity—The resistance offered by a fluid (liquid or gas) to flow. The viscosity is a characteristic property and is a measure of the combined effects of adhesion and cohesion.

Vitamin—Any one of a group of constituents of most foods in their natural state and of which very small amounts are essential for normal nutrition. See special section on *vitamins.*

Volatile Acid—In analytical chemistry, any one of those acids which can be distilled from an aqueous solution at atmospheric pressure, such as acetic, butyric, etc., in contradistinction to the fixed acids, such as tartaric, phosphoric, etc.

Volatile Matter (in coal)—The percentage of the sample which consists of combustible material which is volatile, in the absence of air, at 950° ± 20°C.

Volatile Oil—An oil which is appreciably volatile. See *essential oil.*

Volt—The unit of electromotive force. It is the difference in potential required to make a current of one ampere flow through a resistance of one ohm.

Volumetric—A measurement of, or by, volumes as with standard solutions in titrimetric analysis or with the eudiometer in gas analysis.

Volumetric Factor—See *factor.*

Watt—A unit of power. The power, P, in watts developed by an electric current of I amperes flowing under a potential drop of E volts is : $P = EI$.

Wax—Any one of a class of substances of plant or animal origin, insoluble in water, partly soluble in alcohol, ether, etc., and miscible in all proportions with oils and fats. They consist of esters and often, in addition, free fatty acids, free alcohols, and higher hydrocarbons. Usually, *true waxes* are distinguished chemically from fats (which are esters of glycerol) as consisting chiefly of esters of higher monohydroxy alcohols. Sometimes the distinction between waxes and fats is based only on physical properties, the waxes being less greasy, more brittle and harder than fats. The *mineral waxes* are substances of similar properties but of mineral origin and consist mostly of higher hydrocarbons.

Weir—A device for determining fluid flow by measurements of the depth of fluid over the crest of sill and known dimensions of the device.

X ray—Any of the radiations, similar to light radiation but of much shorter wave length, which are emitted by suddenly changing the velocity of a moving electric charge by impact of a cathode ray on a target in a vacuum tube and by the changes in the atoms of the target caused by the impact. These rays possess the peculiar properties of ionizing a gas through which they pass, of penetrating various solids, of affecting photographic plates, and of causing certain substances to fluoresce. They are also known as *Roentgen rays.*

Yield Strength—The stress at which a material exhibits a specified limiting permanent set.

DEFINITIONS OF PHARMACEUTICAL PREPARATIONS AND THERAPEUTIC TERMS

Compiled by E. H. Wirth, Ph. C., Ph. D.

Most crude drugs are not suitable for administration in their natural state being either too bulky or too nauseous. Preparations suitable for administration are therefore prepared from them by the pharmacist. Brief definitions for the more common pharmaceutical preparations are given.

Therapeutic terms are employed to designate the effect of drugs when applied as remedial agents in the treatment of disease. In the cases of drugs which are cited as illustrations, it should be especially noted that most drugs have several distinct therapeutic effects, the effect cited being but one of the several characteristic of the drug. In selecting the examples an attempt has been made to cite one or two drugs which exhibit the therapeutic effect described. In certain cases of diseases many drugs are contraindicated because of certain other therapeutic activities and for this reason the following brief description is not intended as an aid to self medication.

Aceta (Vinegars)—Liquid preparations made by extracting the drug with diluted acetic acid and filtering.

Aliments (Foods) — Substances which maintain some vital process or renew some structural material. They may be vegetable, animal, or mineral in origin and are either *oxidizable* (sugar, starch), *nitrogenous* (albumin), or *unoxidizable* (water, inorganic salts). See *restoratives*.

Alteratives—Drugs which alter or change morbid conditions by furthering metabolism or modifying nutritive processes (sarsaparilla). As most alteratives promote absorption of inflammatory deposits they are also called *resolvents* or *discutients*.

Ampullae (Ampuls)—Hermetically sealed containers filled with a sterilized medicinal liquid intended for hypodermic or intravenous injection. They are usually made of glass which should be of high quality especially in regard to its resistance to water.

Analgesics (Anodynes) — Drugs which relieve pain by either (*a*) depressing sensory nerve centers, or (*b*) impairing nerve-fiber conductility (opium, belladonna, antipyrine). See *cerebral depressants*.

Anaphrodisiacs—Substances which lessen sexual functions and appetite, by diminishing excitability of the nerves of the genital organs or by depressing the genital centers in the brain and spinal cord, or by decreasing local circulation (bromides, camphor).

Anesthetics—Drugs which reduce sensory nerve-functions until nerves cannot receive or conduct sensation. When the sensory nerve conductility is generally impaired the anesthesia is said to be *general*; when the skin's end organs are depressed the action is designated as *local* anesthesia (ether,

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chloroform; novocaine). See also *cerebral depressants*, and *sedatives*.

Anhydrotics—Drugs which check perspiration by reducing the action of the sweat glands, the excitability of the sweat centers, or the circulation in the skin (pilocarpine, belladonna).

Anodynes—See *analgesics*.

Anthelmintics—Drugs which destroy (*vermicides*) or expel (*vermifuges*) intestinal worms (vermifuges: castor oil, jalap; vermicides for: (*a*) thread worms—alum, tannin, quassia, and (*b*) round worms—santonin, chenopodium, and (*c*) tape worms (*taenifuges*)—aspidium).

Antiemetics—Drugs which lessen nausea and vomiting. If the action is a sedative one on the end organs of the gastric nerves it is said to be *local* (bismuth sub-nitrate); if the irritability of the vomiting center in the medulla is reduced the action is *general* (chloral).

Antihydrotics—See *anhydrotics*.

Antilithics—Drugs which are supposed to prevent the formation of urinary and biliary concretions in the excretory passages (alkaline salts).

Antimonial—A medicine containing the element antimony.

Antiperiodic—Drugs which prevent recurrence of certain periodic febrile diseases usually by arresting further development of successive crops of pathogenic organisms in the blood (cinchona).

Antiphlogistics—Drugs which reduce inflammation of serous membranes (mercury, opium).

Antipyretics (Febrifuges)—Drugs which reduce abnormally high body temperature. This may be accomplished either by decreasing heat production (by lessening tissue change or reducing circulation) or by increasing heat loss (by dilating skin vessels or causing perspiration) (quinine; acetanilide).

Antiscorbutic—A remedy for the treatment or prevention of scurvy (lemon juice, vitamin C).

Antiseptic—A substance which prevents or retards septic decomposition by killing bacteria or arresting their development (mercuric chloride, phenol). See *antizymotics*.

Antispasmotics—Drugs which relax spasm (belladonna, lobelia). See *cerebral excitants*.

Antitoxin—A serum employed hypodermically for the treatment or prevention of those diseases caused by bacterial toxins (diphtheria antitoxin).

Antivenin—A serum used hypodermically to counteract or neutralize snake venom.

Antizymotics—Drugs which arrest fermentation dependent upon organic ferments (enzymes) or organized ferments (yeasts, bacteria). Antizymotics are usually classified into (*a*) antiseptics, (*b*) disinfectants, and (*c*) deodorants.

Aperients—See *laxatives*.

Aphrodisiacs—Drugs which stimulate sexual appetite by acting directly or reflexly upon the cerebral or spinal genital center (strychnine, cannabis, alcohol).

Aquae (Aquae Aromaticae; Aromatic Waters)—Preparations made by impregnating distilled water with volatile substances. Aromatic waters when prepared from volatile oils are intended to be, as nearly as possible, saturated solutions. They must be clear and free from solid particles. They are prepared either by distillation or solution.

Aromatics—See *carminatives*.

Arsenicals—Medicines containing the element arsenic.

Astringents—Drugs which contract

muscular fiber by direct irritation and sometimes condense tissues by precipitating albumin and gelatin (alum, tannin).

Bougies (Pencils)—Small solid cylinders impregnated with various drugs for insertion into the urethra, uterus, or nose. They are made of gelatin, glycerogelatin, or oil of theobroma.

Cachets (Wafers; Konseals)—Various sized, concave wafers made of unleavened bread or starch paper; the cavity, formed by moistening the concave edges of two and pressing them together, containing the drug.

Capsulae (Capsules)—Various sized transparent casings (short tubes, usually with one open end fitting over that of another) of gelatin. They are either hard, or soft and elastic, and are used for the administration of nauseous or disagreeable solids or liquids.

Cardiac Depressants (Cardiac Sedatives)—Drugs which lessen the force and frequency of the heart's action and control its over-action and palpitation (aconite, veratrum viride).

Cardiac Stimulants (Cardiac or Heart Tonics)—Drugs which stimulate the cardiac muscle, slow and strengthen its contractions (digitalis).

Carminatives (Aromatics)—Drugs which expel gases from the stomach and intestines by increasing peristalsis, by stimulating the circulation, and by relaxing the pyloric and cardiac orifices (peppermint, cardamon seed).

Cataplasmata (Poultices) — Soft pasty masses for external application of moist heat, with or without the addition of active medicaments. Substances commonly employed in the preparation of poultices are bran, flaxseed meal, kaolin, glycerol, and oatmeal. Glycerol or fixed oil is added to prevent caking.

Cathartics—See *purgatives.*

Caustics—See *escharotics.*

Cerata (Cerates)—Adhesive preparations for external use containing wax which are capable of being spread at ordinary temperatures and do not melt at body temperature.

Cerebral Depressants—Drugs which lower or suspend the higher brain functions usually after a preliminary stage of excitement. Cerebral depressants or cerebral sedatives are usually classified as follows: (*a*) narcotics; (*b*) hypnotics; (*c*) analgesics; and (*d*) anesthetics; see these latter terms.

Cerebral Stimulants (Cerebral Excitants; Antispasmotics)—Drugs which increase the functional activity of the brain without causing subsequent depression of the cerebral functions (caffeine, valerian).

Cholagogue—See *purgatives.*

Ciliary Excitants — Drugs, which when dissolved in the saliva, increase bronchial mucous expectoration, usually through reflex action on the bronchial and tracheal cilia (ammonium chloride, acacia).

Clysters—*See enemata.*

Collodia (Collodions)—Preparations for external use, either simple collodion (a solution of nitrocellulose in ether or alcohol), or simple collodion containing active medicinal substances. They form a protective film over the skin due to the rapid evaporation of the solvent.

Counter-irritants—These are irritants which when applied to the skin are used to produce reflex action on remote parts. See *irritants.*

Decocta (Decoctions) — Aqueous solutions of vegetable drugs prepared by boiling for 15 minutes in a closed vessel, allowing to cool, and expressing and straining. They are usually prepared in 5% concentrations.

Demulcents—Substances intended to soothe the parts to which they are

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applied, usually mucous membranes (acacia).

Dental Anodynes—Drugs used locally in toothache due to caries (oil of cloves, phenol).

Dentifricia (Dentifrices; Tooth Powders)—Finely powdered drugs, usually antiseptic, antacid, non-irritating, non-gritty, saponaceous, sweetened and flavored.

Deodorants—Substances which destroy foul odors. They may be volatile and act chemically on the obnoxious gases (chlorine) or non-volatile and act by condensing or decomposing the odoriferous substance (charcoal, potassium permanganate). See *antizymotics*.

Depresso-motors—See *motor depressants*.

Diaphoretics (Sudorifics)—Drugs which cause secretion of sweat. They may be (*a*) simple; i.e., enter the circulation and stimulate the suderiferous glands by which they are eliminated (pilocarpus); (*b*) nauseating; i.e., relax and dilate the superficial capillaries (ipecac, tartar emetic); or (*c*) refrigerant; i.e., reduce circulation by acting on the sweat centers in the medulla (potassium citrate).

Digestive Acids—Drugs which check all glandular acid secretion thus increasing alkaline secretion (dilute mineral acids). See *restoratives*.

Digestive Ferments—Enzymes aiding digestion (pepsin, diastase). See *restoratives*.

Discutients—See *alteratives*.

Disinfectants—Substances which destroy specific germs, etc. They may react by (*a*) acting as oxidizing agents; (*b*) combining with albumin; (*c*) chemically combining to form substitution compounds; (*d*) arresting molecular changes; and (*e*) altering the reaction of the media (potassium permanganate, mercuric chloride, chlorine, sulfur dioxide, chlorinated lime). See *antizymotics*.

Diuretics—Drugs which increase renal secretion. They act by (*a*) raising the local or general blood pressure; (*b*) stimulating the nerves or secreting cells of the kidneys; or (*c*) mechanically washing out of the kidneys with a large volume of water. They may be classified into (*a*) refrigerants—which excite the renal epithelium (potassium acetate); (*b*) hydragogue—which increase the amount of water in the urine owing to a local or general raising of the blood pressure (spirit of ethyl nitrite, digitalis); (*c*) stimulant—which act directly on the renal tissue (buchu, juniper, uva-ursi).

Ecbolics (Oxytocics)—Drugs which stimulate the muscular fibers of the gravid uterus to contraction, thus causing premature birth or abortion (ergot, cottonroot-bark).

Elixira (Elixers)—Sweet, aromatic, hydro-alcoholic, medicated liquids. The alcoholic strength varies between 20 and 25%.

Emetics—Drugs which cause vomiting. The action may be local; i.e., by the irritation of the end organs of the gastric, pharyngeal or esophageal nerves by reflex action (zinc sulfate); or systematic; i.e., by stimulating the vomiting centers directly through the circulation (apomorphine, ipecac).

Emmenagogues—Drugs which restore the menstrual function, either by stimulating directly the uterine muscular fiber (ergot), or indirectly by enriching the blood and thus toning up the nervous system (quinine, iron).

Emollients—Substances which soften and relax the tissues when applied locally. They diminish tension and pressure on the nerves, dilate the vessels and protect inflamed surfaces. They are usually applied to the skin (fixed oils).

Emplastra (Plasters)—Substances, solid at ordinary temperatures but

pliable and adhesive at body temperature. They are intended for external application. They may or may not be spread.

Emulsa (Emulsions) — Aqueous milk-like mixtures of oils, fats or resins in a minutely divided state, suspended by mucilaginous materials.

Enemata (Enemas)—Liquids intended for injection into the rectum.

Epispastics—See **vesicants.**

Errhines—See **sternutatories.**

Escharotics (Caustics)—Substances which destroy tissue either by abstraction of water, combining with the albumin of the skin, or by corrosive deoxidation of the tissues, thus causing slough (mineral acids, sodium hydroxide, phenol). See *irritants.*

Excito-motors—See *motor excitants.*

Expectorants—Drugs which change the broncho-pulmonary mucous membrane secretion promoting its expulsion (ammonium chloride, senega, squill).

Extracta (Extracts)—Pasty or semi-solid masses, or dry, solid or powdered products prepared by exhausting organic drugs with appropriate solvents and then carefully evaporating the solutions. Pasty or semi-solid extracts are usually referred to as *pilular extracts.*

Febrifuges—See **antipyretics.**

Ferments—See *digestive ferments.*

Fluidextracta (Fluidextracts) — Concentrated liquid preparations made from organic drugs by extracting with suitable solvents. The activity of one cubic centimeter of the fluid extract is adjusted to equal that of one gram of the drug. Various menstrua are employed, generally mixtures of alcohol and water, or mixtures of alcohol and water with glycerol or acids.

Foods—See *aliments*; *restoratives.*

Galactagogues—Drugs which increase lacteal secretion (pilocarpine, alcohol).

Gargarismata (Gargles)—Fluid preparations intended for gargling.

Germicides—See *parasiticides.*

Glycerita (Glycerites)—Solutions of a drug in glycerol; usually intended for external use.

Hematinics—Drugs which increase the amount of hematin in the blood (iron salts, chalybeate waters).

Hemostatics—Substances which arrest hemorrhage (bleeding). Some authorities consider the word synonymous with styptics, others consider the word hemostatic as limited to those substances which are for internal application (ergot, ceanothus), whereas styptic signifies external use (alum, ferric chloride).

Honeys—See *mellita.*

Hormone—A chemical secretion from a gland which by passage through the blood stream stimulates the activity of another organ.

Hydragogue—See *diuretic, purgatives.*

Hypnotics (Sonnificants; Soporifics)—Drugs which produce sleep leaving undisturbed the normal relationship of the mental faculties to the external world. In a broad sense these may be considered to include narcotics and anesthetics (chloral hydrate, sulfonal). See *cerebral depressants.*

Hypodermic—A subcutaneous (beneath the skin) injection.

Infusa (Infusions)—Aqueous solutions of vegetable drugs prepared by adding boiling water to the drug in a closely-covered container and allowing to stand for half an hour, then straining and expressing. They are usually prepared in a 5% concentration.

Irritants (Counter-irritants)—Sub-

stances which when applied to the skin cause vascular excitement. They are called *counter-irritants* if they are used to promote reflex action on remote parts. Irritants are usually classified as (*a*) rubifacients, (*b*) vesicants, (*c*) pustulants, and (*d*) escharotics. See these latter terms.

Juices—See *succi.*

Konseals—See *cachets.*

Laxatives (Aperients)—Purgatives which excite moderate peristalsis giving soft movements without irritation (magnesia). See *purgatives.*

Linimenta (Liniments)—Solutions or mixtures for external application usually by rubbing. They usually contain fixed or volatile oils.

Liquores (Liquors)—Aqueous solutions of non-volatile substances, usually inorganic compounds.

Lithotriptics—Drugs supposedly dissolving or causing the excretion of urinary and biliary concretions (urates: alkaline salts; calcium oxalate: acids, carbonated waters; phosphatic deposits: ammonium benzoate).

Lozenges—See *trochisci.*

Magmae—Suspensions of finely divided insoluble substances in water usually produced by chemical reaction. The suspensions are fairly stable and are often known as *milks.*

Massae (Masses)—Pill masses preserved in bulk, to be used when required.

Medicated Pencils—See *stili medicamentorum.*

Mellita (Honeys)—Mixtures of medicinal substances with clarified honey.

Misturae (Mixtures)—Liquid preparations of insoluble, suspended, active substances, or solutions containing more than one liquid of medicinal activity.

Motor Depressants (Depresso-motors)—Drugs which lower the functional activity of the motor apparatus and spinal cord (amyl nitrite, gelsemium).

Motor Excitants (Excito-motors; Spinants)—Drugs which increase the functional activity of the motor apparatus and spinal cord (nux-vomica, picrotoxin).

Mucilagines (Mucilages)—Saturated aqueous liquids, either adhesive or jelly-like, prepared from gums or starch.

Mydriatics—Drugs which dilate the pupil of the eye (atropine).

Myotics—Drugs which contract the pupil of the eye (pilocarpine).

Narcotics—Drugs which first excite and stimulate all body functions, then cause profound sleep, stupor, coma, insensibility and may cause death by paralyzing the medulla centers governing respiration and other vital functions (opium, cannabis). See *cerebral depressants.*

Nebulae (Sprays)—Aqueous or oily (light liquid petrolatum) solutions to be used in an atomizer for nares and throat.

Ointments—See *unguenta.*

Olea (Oils)—Fixed or volatile oils, the former obtained by expression and the latter by distillation.

Oleata (Oleates)—Solutions of medicinals in oleic acid, usually intended for external application.

Oleoresinae (Oleoresins)—Natural solutions of resins in volatile oils, occurring as such in plants.

Oxytocics—See *ecbolics.*

Parasiticides (Germicides)—Substances which kill animal and vegetable parasites (mercuric chloride, phenol).

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Pastilles—See *trochisci.*

Pencils—See *bougies.*

Pilulae (Pills)—Solid bodies, usually spherical or oval, containing medicinal substances, and intended to be swallowed whole. They may be uncoated or coated with various substances (gelatin, sucrose, cacao, tolu, etc.) to mask unpleasant taste. If it is desired that the pill pass unchanged through the stomach and be dissolved in the intestine, it is coated with keratin or salol. Such a coating is known as an *enteric* coating.

Plasters—See *emplastra.*

Poultices—See *cataplasmata.*

Prophylactics—Substances administered to prevent disease (diptheria antitoxin).

Protectives—Substances used as mechanical coverings to protect various injured parts from air, water, and friction (collodion).

Pulmonary Sedatives—Drugs which lessen the irritability of the respiratory nerves or center, thereby diminishing cough and dyspnea. They may depress the center, remove irritating substances from the passages, lessen local congestion, or lower excitability of the vagus end-organs and afferent filaments of the respiratory tract (morphine, codeine, hydrogen cyanide).

Pulveres (Powders)—Finely powdered drugs or mixtures of the same, frequently consisting in part of some suitable diluent.

Purgatives (Cathartics) — Drugs which increase or hasten intestinal evacuations. They are usually classified as follows: (*a*) *laxatives*; (*b*) *simple purgatives*, which cause active peristalsis and stimulate secretion of the intestinal glands, giving one or more copious, semi-fluid movements accompanied by some irritation and griping (aloe, castor oil); (*c*) *saline purgatives*, which stimulate intestinal glands, increase peristalsis and osmosis, causing watery stools (magnesium sulfate); (*d*) *drastic purgatives*, which cause violent peristalsis, watery stools, griping and irritation (jalap, colocynth; (*e*) *hydragogue cathartics*, which remove much water from the vessels causing watery stools (croton oil, elaterinum); (*f*) *cholagogue purgatives*, which stimulate the flow of bile causing free purgation of green colored (bilious), liquid stools (aloe, mercurials).

Pustulants—Drugs which cause blisters. See *irritants.*

Refrigerants—Drugs which allay thirst, giving the sensation of coolness (diluted vegetable and mineral acids).

Resolvents—See *alteratives.*

Respiratory Sedatives (Depressants)—Drugs which lower the activity of the respiratory center resulting in shallow and slow respirations (aconite, physostigma).

Respiratory Stimulants — Drugs which stimulate the respiratory center resulting in deeper and quicker breathing (strychnine, digitalis).

Restoratives—Substances which give strength and vitality. Restoratives are classified into (*a*) foods, (*b*) digestive ferments, (*c*) digestive acids, (*d*) fats, (*e*) hematinics, and (*f*) tonics. See these latter terms.

Rubefacients—Substances which produce temporary redness and skin congestion. If left too long the action may become vesicant or even escharotic (mustard).

Sedatives—In general, drugs which allay nervous irritation and irritability. Synonymous with cerebral depressants. See *pulmonary sedatives.*

Semi-alteratives (Alkalis)—Drugs which stimulate acid secretions and check alkaline secretions (carbonates).

Sialagogues—Substances which promote the secretion and flow of saliva

DEFINITIONS OF PHARAMACEUTICAL PREPARATIONS AND THERAPEUTIC TERMS

and buccal mucous (capsicum, physostigma).

Somnificants—See *hypnotics.*

Soporifics—See *hypnotics.*

Species (Teas)—Mixtures of cut or bruised vegetable drugs from which teas can be made.

Spinants—See *motor excitants.*

Spiriti (Spirits)—Solutions of volatile substances in alcohol or diluted alcohol.

Sprays—See *nebulae.*

Sternutatories—Drugs which cause sneezing. When used to increase nasal secretion by applying to the mucous membrane of the nose they are usually referred to as *errhines* (ipecac, cubeb).

Stili Medicamentorum (Medicated Pencils)—Medicinal agents made into a plastic mass and rolled into cylinders for external application.

Styptics—See *hemostatics.*

Succi (Juices)—Expressed vegetable juices usually preserved by the addition of alcohol.

Sudorifics—See *diaphoretics.*

Suppositoria (Suppositories) — Solids of various shapes: cone-shaped, pencil-shaped, globular, or oviform, which contain medicines and melt when inserted into the rectum, nares, urethra, or vagina. They are usually made from oil of theobroma, glycerinated gelatin, or sodium stearate.

Syrupi (Syrups) — Concentrated aqueous solutions of sucrose containing either medicinal agents or flavoring agents.

Tabellae (Tablets)—Solid disk-like lenticular bodies made by compression. *Tablet triturates* are prepared by triturating drugs and then moulding; lactose is usually employed as the diluent. See also *trochisci* and *toxitabellae.*

Taenifuges—See *anthelmintics.*

Teas—See *species.*

Tincturae (Tinctures) — Alcoholic solutions of drugs, prepared either by maceration, percolation, or solution. The alcoholic strength is variable and the drugs generally used are non volatile. The drug strength, where the drug is potent, is usually 10%. Where the drug is not very potent the strength is usually 20%.

Tonics—Drugs which improve the tone of specific tissues by stimulating vital functions (mineral: phosphates; vegetable: gentian). See *restoratives.*

Toxitabellae (Poison Tablets)—These are tablets of angular shape (not discoid) each having the word "poison" and the skull and cross bones distinctly stamped upon it. The purpose of the distinctive shape and marking is to diminish poisoning by their accidental ingestion. The common one is corrosive sublimate.

Trochisci (Troches)—Solid, round, oval, or flat masses composed of medicinal agents combined with sugar or extract of licorice, massed with mucilage of tragacanth, flavored, and dried. They are also called *lozenges.* In England they are called *tablets* and are of a definite weight and have a chocolate base; *pastilles* (in England) have a glyco-gelatin base.

Unguenta (Ointments)—These are soft or solid fatty preparations for external use, liquifying when applied to the skin and containing medicaments in a base of benzoinated lard, petrolatum, wool fat, prepared suet, expressed oil of almond, wax, spermaceti, paraffin, etc. They are also called *salves.*

Vermicides—See *anthelmintics.*

Vermifuges—See *anthelmintics.*

DEFINITIONS OF PHARMACEUTICAL PREPARATIONS AND THERAPEUTIC TERMS

Vesicants (Epispastics)—Substances which produce much inflammation of the skin with the effusion of serum between the epidermis and the derma (cantharides, volatile oil of mustard). See *irritants*.

Vina (Wines)—Liquids differing from tinctures in that the drug is extracted with white wine. The alcoholic content varies between 7 and 12%.

Vinegars—See *aceta*.

Wafers—See *cachets*.

Wines—See *vina*.

MEDICAL PRESCRIPTION NOTATION

1 drachm	... ℥ i, or ℥ j.	4 "	... gr. iv.
1½ "	... ℥ iss.	8 "	... gr. viii. or gr. viij.
2 "	... ℥ ii, or ℥ ij.	½ ounce	... ℥ ss.
3 "	... ℥iii, or ℥ iij.	1 "	... ℥ i, or ℥ j.
3½ "	... ℥ iiiss.	1½ "	... ℥ iss.
1 gallon	... Ci or Cj.	½ pint	... Oss.
½ grain	... gr. ss.	1 "	... Oi or Oj.
1 "	... gr. j, or gr. i.	½ scruple	... ℈ ss.
1½ "	... gr. iss.	1 "	... ℈ i. or ℈ j.
2 "	... gr. ii, or gr. ij.	1½ "	... ℈ iss.
2½ "	... gr. iiss.	2 "	... ℈ ii, or ℈ ij.

℞ (L. *recipe*, take)—A symbol placed at the beginning of a prescription. It is supposed to have been originally ♃, the symbol of Jupiter, serving as an invocation to this king of the gods that the compound might act beneficially.

PHYSIOLOGICAL RESPONSE TO VARIOUS CONCENTRATIONS OF SOME COMMON GASES AND VAPORS

Reproduced from "Dow Calcium Chloride for Refrigeration," copyright 1929 by The Dow Chemical Co., by permission.

Vapor or gas	Kills most animals in a very short time		Dangerous in 30 to 60 minutes		Max. amt. for 60 min. with out serious disturbances		Slight symptons after several hours or max. amt. for prolonged exposure	
	% by volume	Relative order	% by volume	Relative order	% by volume	Relative order	% by volume	Relative order
Phosgene	0.02 – 0.05	1	0.0025	1	No data	0	0.0001	1
Chlorine	0.10	2	0.004[a.b.] – 0.006[a.c.]	2	0.0004	2	0.0001	1
Bromine	0.1	3	0.004 – 0.006	3	0.0004	3	0.0001	1
Hydrogen sulfide	0.06 – 0.10[c] 0.10 0.20[a]		0.05 – 0.07[a.c.]	6	0.02 – 0.03	7	0.01 – 0.015[a] 0.02[c]	7
Hydrocyanic acid	0.48[c] 0.30[a]	5	0.012 – 0.015[a.b.] 0.024[c]	4	0.005 – 0.006	4	0.002 – 0.004	3
Hydrogen chloride	0.1 0.2[a.b.] 0.5[c]	6	0.15 – 0.2	7	0.005 – 0.01	5	0.005	4
Sulfur dioxide	0.20[c]	7	0.04 – 0.05	5	0.005 – 0.02[a]	6	0.01[c] 0.001[b]	2
Carbon monoxide	0.5 – 1.0[c] 0.3 – 1.5[a]	8	0.2 – 0.3 0.2	8	0.05 – 0.10[c] 0.05[a]	9	0.05[a] 0.04[c]	9
Ammonia	0.5 – 1.0	9	0.25 – 0.45	10	0.03 – 0.05	8	0.01[a]	6
Benzene	1.9	10	No data		0.31 – 0.47	11	0.15 – 0.31[b]	13
Gasoline	2.4	11	1.1 – 2.2	11	0.43 – 0.71	14	No data	
Methyl bromide ..	2.0 – 4.0[d]	12	0.2 – 0.4[d]	9	0.1[d]	10	0.005 – 0.017[d]	5
Chloroform.....	6.8 – 8.2[a]	13	1.4	12	0.5 – 0.6	13	0.02	8
Carbon tetrachloride	2.5[d] 4.8 – 6.3	14	2.4 – 3.2	14	0.4 – 0.6	12	0.16	11
Ethyl bromide ...	10.0 – 20.0[d]	15	1.0 – 2.0[d]	13	0.6[d]	15	0.17 – 0.3[d]	12
Methyl chloride...	15.0 – 30.0[d]	16	2.0 – 4.0[d]	15	0.7[d]	16	0.05 – 0.10[d]	10
Ethyl chloride	15.0 – 30.0[d]	17	6.0 10.0[d]	16	4.0[d]	17	2.0[d]	14

From Physiological Response attending exposure to Vapors of Methyl Bromide, Methyl Chloride, Ethyl Bromide and Ethyl Chloride. By—Bayers, Yant, Thomas and Berger, Bureau of Mines, Report No. 746-B; 156.

(a) Bureau of Mines Technical Paper No. 248, 1921.
(b) Henderson, Yandell, and Haggard, H. H., "Noxious Gases" A. C. S. Monograph No. 35, 1927.
(c) International Critical Tables, Vol. II, 1927.
(d) Data from Figures 3, 4, 5, and 6, and Tables 6, 7, 8, and 9 of this report.

PHENOL COEFFICIENTS

Phenol coefficient determinations as usually performed do not always give a true indication of the value of a germicide in actual use. Organisms dried on various surfaces should also be exposed to the action of the germicide in order to test practical effectiveness and Shippen[7] subcultures should be made. Many antiseptics inhibit growth rather than kill. This is well known in the case of mercurials.[6]

Compound	Method	Temperature* Deg. C.	Values obtained with Following test organisms	
			Staph. aureus	*B. typhosus*
Chlorine Group				
Chloramine	Rideal-Walker (1)	37	133	100
Dakin's Solution	A.P.H.A. (2)	20	.....	0.78
ICl_3 (0.5% aq. soln.)	A.P.H.A.	20	.....	2.40
Phenolic Group				
Lysol	F.D.A. (Reddish)	20	.....	5.0
Lysol	F.D.A. (Reddish)	20	3.2	.....
Lysol	F.D.A. (Reddish)	37	4.6	.....
Creolin	Rideal-Walker	37	.....	9–10
Kreso-Dip	F.D.A. (Reddish)	20	.....	6
Tricresol	(3)	....	.....	2.6
Ethyl phenol	Rideal-Walker (4)	25	6.0	7.4
n-Propyl phenol	Rideal-Walker (4)	25	16.5	21.6
n-Butyl phenol	Rideal-Walker (4)	25	50	68
n-Amyl phenol	Rideal-Walker (4)	25	139	197
n-Hexyl phenol	Rideal-Walker (4)	25	375	500
Naphthol	Hygienic Laboratory	20	.....	11.4
Hexyl resorcinol	Reddish (Modification)	20	150	72
Mercury Compounds				
Mercuric chloride	Reddish	20	143	100
Mercurochrome (220 soluble)	Reddish (Modification)	20	1.7	.....
Merthiolate ($C_2H_5HgSC_6H_4CO_2Na$)	Reddish	20	40–50	40–50
Metaphen ($C_{11}H_{11}O_7NHg_2$)	Reddish (Modification)	20	1500	.....
Phenylmercuric nitrate (6) $C_6H_5HgNO_3 \cdot C_6H_5HgOH$	Reddish (Modification)	25	300	625
Miscellaneous				
Formalin	Rideal-Walker	37	0.3	0.7
Hydrogen peroxide	Rideal-Walker	20	.....	0.01
Tinct. of iodine USP	Reddish (Modification)	20	38	.....
Tinct. of iodine USP 3% Alcoholic I_2, USP tinct. dil. C_2H_5OH	Reddish	20	6.3	5.8
Lugol's iodine	A.P.H.A.	20	5.1	5.0
Menthol	Hygienic Laboratory	20	.....	5.1
Menthol isomers:				
l-Menthol	Rideal-Walker	12–16	5–8	.....
d-Menthol	Rideal-Walker	12–16	7–12	.....
dl-Menthol (racemic)	Rideal-Walker	12–16	7–12	.....
dl-iso-Menthol	Rideal-Walker	12–16	7–12	.....
Methyl salicylate	Hygienic Laboratory	20	.....	1.76
Picric acid (2-3% in C_2H_5OH)	Rideal-Walker	37	.....	6.0

*The time of exposure of the organisms to the disinfectants was 7.5 minutes.

(1) Approved Technique of the Rideal-Walker Test. London: H. K. Lewis and Co. (1921). (2) American Public Health Association. *Amer. J. Pub. Health* 7, 506 (1918). (3) Public Health Report, 36, 1559 (1921). (4) Schaffer and Tilley, *Jour. Bacteriology* 14, 259 (1927). (5) Klarman et al., *Jour. Bacteriology* 17, (1929). (6) Ecker, Hovorka, and Smith, *Mod. Hospital* 49, 80 (1937). (7) Shippen, *Am. J. Pub. Health* 18, 1231 (1928).

PHOTOGRAPHIC FORMULAS

The purest water, preferably distilled, should be used for making all photographic solutions. Dissolve all chemicals in the order given. Do not add the next chemical until the last is completely dissolved. Use judgment in the warming of solutions during the dissolving of chemicals. Slightly warm water will produce prompt dissolving, but too much heat may cause reactions to occur which will destroy the value of the solution.

Throughout this table all references to sodium sulfite and sodium carbonate indicate the desiccated or anhydrous salt. If monohydrated or crystalline salt is used, increase the amount by 17 per cent for the monohydrated salt or double the amount for the crystalline form. In some formulas a proprietary alkali known as "Kodalk" is used. These formulas are designated by the letters "DK" before the formula number.

In most cases the manufacturer now encloses with each package of film, plates or paper a group of formulas which have been tested and found to give the best results for that particular product. Whenever such information is available, the user should not hesitate to take advantage of it, as it is to the manufacturer's advantage to have his customers obtain the best possible results with his product.

Many manufacturers of sensitized materials make available the most useful of their formulas in prepared form for large and smaller users. All the photographer needs to do is to dissolve the powders in the proper volume of water as directed in the instructions printed on the package, in order to have the best possible formula for his particular job. This method is especially recommended for people doing only occasional photographic processing since each batch is fresh when used and, because of the small volumes available, it is not necessary to save solutions in the interest of economy. This method also eliminates the necessity of maintaining large stocks of the individual chemicals necessary.

DEVELOPERS

Fine Grain (Kodak DK-20)

	Avoirdupois	Metric
Water, about 125°F. (50°C.)	96 ounces	750.0 c.c.
Elon	290 grains	5.0 grams
Sodium Sulfite, desiccated	13¼ ounces	100.0 grams
Kodalk	116 grains	2.0 grams
Sodium Thiocyanate (Sulfocyanate)	58 grains	1.0 gram
Potassium Bromide	29 grains	0.5 gram
Cold water to make	1 gallon	1.0 liter

Dissolve chemicals in the order given.

Time of development, 15 to 25 minutes in a tank at 65°F. (18°C.) according to the contrast desired. Decrease the time about 20% for tray use. Develop underexposures fully for best results.

High Contrast (Kodak D-19)

STOCK SOLUTION

	Avoirdupois	Metric
Water (about 125°F.) (50°C.)	64 ounces	2.0 liters
Elon	128 grains	8.8 grams
Sodium Sulfite, desiccated	12 ozs. 360 grains	384.0 grams
Hydroquinone	1 oz. 75 grains	35.2 grams
Sodium Carbonate, desiccated	6 ozs. 180 grains	192.0 grams
Potassium Bromide	290 grains	20.0 grams
Cold water to make	1 gallon	4.0 liters

Dissolve chemicals in the order given.

Use without dilution. Develop 3 to 6 minutes in a tray at 65°F. (18°C.) according to the contrast desired. Increase the time about 25% for tank development.

For infrared landscape photography, dilute as follows: stock solution 1 part, water 4 parts. Develop about 5 minutes at 65°F. (18°C.).

This developer may also be used for x-ray films and in most cases where high contrast is desired.

PHOTOGRAPHIC FORMULAS

Low Contrast (Kodak D-76)

	Avoirdupois	Metric
Water (about 125°F.) (50°C.)	96 ounces	3.0 liters
Elon	116 grains	8.0 grams
Sodium Sulfite, desiccated	13¼ ounces	400.0 grams
Hydroquinone	290 grains	20.0 grams
Borax, granular	116 grains	8.0 grams
Water to make	1 gallon	4.0 liters

Dissolve chemicals in the order given.

Develop amateur roll films and acro films about 20 minutes in a tank or 16 minutes in a tray of fresh developer at 65°F. (18°C.).

Develop professional films and plates 10 to 25 minutes in a tank at 68°F. (18°C.) according to the contrast desired. For tray use, decrease the time about 20%. This developer gives greatest shadow detail on fine grain panchromatic films.

A faster working developer can be obtained by increasing the quantity of borax. A still more active developer can be obtained by replacing the borax by Kodalk.

The developer may become slightly muddy due to the formation of a suspension of colloidal silver but this is harmless and can be ignored.

For duplicate negative film, average time of development is 6 to 9 minutes at 65°F. (18°C.).

Extreme Contrast (Kodak D-8)

STOCK SOLUTION

	Avoirdupois	Metric
Water	96 ounces	3.0 liters
Sodium Sulfite, desiccated	12 ounces	360.0 grams
Hydroquinone	6 ounces	180.0 grams
Sodium Hydroxide (Caustic Soda)	5 ounces	150.0 grams
Potassium Bromide	4 ounces	120.0 grams
Water to make	1 gallon	4.0 liters

Dissolve chemicals in the order given. Stir the solution thoroughly before use.

For use, take 2 parts of stock solution and 1 part of water. Develop about 2 minutes in a tray at 65°F. (18°C.). This formula is especially recommended for making line and half-tone screen negatives for printing directly on metal.

A formula which is slightly less alkaline and gives almost as much density can be obtained by using 3¾ ounces of sodium hydroxide per gallon of stock solution (112 grams per 4 liters) instead of the quantity given in the formula.

General Elon-Hydroquinone (Kodak D-61a)

STOCK SOLUTION

	Avoirdupois	Metric
Water (about 125°F.) (50°C.)	16 ounces	500.0 c.c.
Elon	45 grains	3.1 grams
Sodium Sulfite, desiccated	3 ounces	90.0 grams
Sodium Bisulfite	30 grains	2.1 grams
Hydroquinone	85 grains	5.9 grams
Sodium Carbonate, desiccated	165 grains	11.5 grams
Potassium Bromide	24 grains	1.7 grams
Cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given.

For *tray* use take 1 part of stock solution to 1 part of water. Develop for about 7 minutes at 65°F. (18°C.)

For *tank* use take 1 part of stock solution and 3 parts of water. At a temperature of 65°F. (18°C.), the development time is about 14 minutes. It is advisable to make up a greater quantity than is needed to fill the tank. If the developer in the tank is of normal strength, but the volume of solution has been reduced, add a sufficient quantity of the surplus solution diluted 1:3 to fill the tank.

PHOTOGRAPHIC FORMULAS

Photomicrographic Low and Medium Contrast (D-76c)

	Avoirdupois	Metric
Water (about 125°F.) (50°C.)	96 ounces	3.0 liters
Elon	116 grains	8.0 grams
Sodium Sulfite, desiccated	13¼ ounces	400.0 grams
Hydroquinone	290 grains	20.0 grams
Borax, granular	116 grains	8.0 grams
Potassium Iodide, 1% solution	1 dram	4.0 c.c.
Potassium Bromide, 2.5% solution	10 drams	40.0 c.c.
Cold water to make	1 gallon	4.0 liters

Dissolve chemicals in the order given.

Use without dilution.

For low contrast, develop about 5 minutes, and for normal contrast, about 6½ minutes, at 65°F. (18°C.) in a tray of fresh developer. Increase the time about 25% for tank development.

Photomicrographic High Contrast (D-19) See formula D-19 given previously.

Tropical Non-blistering (Kodak DK-15)

	Avoirdupois	Metric
Water (about 125°F.) (50°C.)	24 ounces	750.0 c.c.
Elon	82 grains	5.7 grams
Sodium Sulfite, desiccated	3 ounces	90.0 grams
Kodalk (Potassium Metaborate)	¾ ounce	22.5 grams
Potassium Bromide	27 grains	1.9 grams
* Sodium Sulfate, desiccated	1½ ounces	45.0 grams
Cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given.

Average time for tank development is 9 to 12 minutes at 65°F. (18°C.) and 2 to 3 minutes at 90°F. (32°C.), in the fresh developer according to the contrast desired. When working *below* 75°F. (24°C.) the sulfate may be omitted if a more rapid formula is required. Development time *without* the sulfate is 5 to 7 minutes at 65°F. (18°C.). Develop about 20 per cent less for tray use.

When development is completed rinse the film or plate in water for 1 or 2 seconds only and immerse in the Tropical Hardener (Formula SB-4) for 3 minutes (omit water rinse if film tends to soften); then fix for at least 10 minutes in an acid hardening fixing bath, such as Formula F-5, and wash for 10 to 15 minutes in water (not over 95°F.) (35°C.).

Further details on tropical development will be found in the booklet "Tropical Development" obtainable on request from the Eastman Kodak Co., Rochester, N. Y.

Infrared Medium Contrast (D-76) See formula D-76 given previously.

Infrared High Contrast (D-19) See formula D-19 given previously.

Lantern Slide (Kodak D-32)

STOCK SOLUTION A

	Avoirdupois	Metric
Water (about 125°F.) (50°C.)	16 ounces	500.0 c.c.
Sodium Sulfite, desiccated	90 grains	6.3 grams
Hydroquinone	100 grains	7.0 grams
Potassium Bromide	50 grains	3.5 grams
Citric Acid	10 grains	0.7 gram
Cold water to make	32 ounces	1.0 liter

STOCK SOLUTION B

Cold water	32 ounces	1.0 liter
Sodium Carbonate, desiccated	1 ounce	30.0 grams
Sodium Hydroxide (Caustic Soda)	60 grains	4.2 grams

* If it is desired to use crystalline sodium sulfate instead of the desiccated sulfate then 3½ ounces per 32 ounces (105 grams per liter) should be used.

PHOTOGRAPHIC FORMULAS

Dissolve chemicals in the order given.

For use, take 1 part of A and 1 part of B. For warmer tones, 1 part of A and 2 parts of B.

Develop about 5 minutes at 70°F. (21°C.).

Oscillograph, Cardiograph, and other line record materials.

See high contrast developer formula D-19 given previously.

Universal Paper (Kodak D-72)

STOCK SOLUTION

	Avoirdupois	Metric
Water (about 125°F.) (50°C.)	16 ounces	500.0 c.c.
Elon	45 grains	3.1 grams
Sodium Sulfite, desiccated	1½ ounces	45.0 grams
Hydroquinone	175 grains	12.0 grams
Sodium Carbonate, desiccated	2¼ ounces	67.5 grams
Potassium Bromide	27 grains	1.9 grams
Water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given.

For chloride papers take stock solution 1 part, water 2 parts. Develop 45 seconds at 70°F. (21°C.).

For bromide papers take stock solution 1 part, water 4 parts. Develop not less than 1½ minutes at 70°F. (21°C.).

For lantern slides take stock solution 1 part, water 2 parts. Develop 1 to 2 minutes at 70°F. (21°C.). For greater contrast dilute 1:1 and for less contrast dilute 1:4.

Warm Tone Paper (Kodak D-52)

STOCK SOLUTION

	Avoirdupois	Metric
Water (about 125°F.) (50°C.)	16 ounces	500.0 c.c.
Elon	22 grains	1.5 grams
Sodium Sulfite, desiccated	¾ ounce	22.5 grams
Hydroquinone	90 grains	6.3 grams
Sodium Carbonate, desiccated	½ ounce	15.0 grams
Potassium Bromide	22 grains	1.5 grams
Cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given.

For professional contact papers, use stock solution 1 part, water 1 part.

For professional enlarging papers and bromide papers, use full strength solution.

Develop all papers not less than 1½ minutes at 70°F. (21°C.).

FIXING BATHS

Acid Hardening (Kodak F-5)

	Avoirdupois	Metric
Water (about 125°F.) (50°C.)	20 ounces	600.0 c.c.
Sodium Thiosulfate (Hypo)	8 ounces	240.0 grams
Sodium Sulfite, desiccated	½ ounce	15.0 grams
*Acetic Acid (28% pure)	1½ fluid ozs.	48.0 c.c.
**Boric Acid, crystals	¼ ounce	7.5 grams
Potassium Alum	½ ounce	15.0 grams
Cold water to make	32 ounces	1.0 liter

Dissolve the hypo in the specified volume of water (about 125°F.) (52°C.) and then add the remaining chemicals in the order given, taking care that each chemical is dissolved before adding the next. Then dilute with water to the required volume.

The F-5 fixing bath has the advantage over the older type of fixing baths, which do not contain boric acid, in that it gives much better hardening and has a lesser tendency to precipitate a sludge of aluminum sulfite throughout its useful life.

* To make 28% acetic acid from glacial acetic acid, dilute three parts of glacial acetic acid with eight parts of water.

** Crystalline boric acid should be used as specified. Powdered boric acid dissolves only with great difficulty, and its use should be avoided.

PHOTOGRAPHIC FORMULAS

Non-hardening (Kodak F-24)

	Avoirdupois	Metric
Water (about 125°F.) (50°C.)	16 ounces	500.0 c.c.
Sodium Thiosulfate (Hypo)	8 ounces	240.0 grams
Sodium Sulfite, desiccated	145 grains	10.0 grams
Sodium Bisulfite	365 grains	25.0 grams
Cold water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given.

This bath is recommended for films, plates or paper when no hardening is desired. It may be used satisfactorily only in case the temperature of the developer, rinse bath, and wash water is not higher than 65°F. (18°C.), and provided ample drying time is allowed so that relatively cool drying air can be used.

MISCELLANEOUS

Acid Rinse Bath (Kodak SB-1); Short Stop

	Avoirdupois	Metric
Water	32 ounces	1.0 liter
*Acetic Acid (28% pure)	1½ fluid ozs.	48.0 c.c.

Rinse prints for at least 5 seconds.

With a 1 to 2 second drain, the equivalent of approximately twenty-five 8 by 10 prints may be processed by 1 quart (1 liter) of this bath before it becomes alkaline and should be discarded.

Hardener-Rinse Bath (Kodak SB-3)

	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Potassium Chrome Alum	1 ounce	30.0 grams

This bath is intended for use in hot weather after development and before fixation in conjunction with formula F-5.

Agitate the negatives for several seconds when first immersed in the hardener and allow to remain in the solution for 3 to 5 minutes to secure maximum hardening.

IMPORTANT: The bath should be renewed frequently and if there is any tendency for scum to form on the films, it should be removed by swabbing with cotton. The bath should be skimmed each day before use.

Intensifier (Kodak IN-4)

STOCK SOLUTION	Avoirdupois	Metric
Potassium Bichromate	3 ounces	90.0 grams
Hydrochloric Acid, C. P.	2 fluid ozs.	64.0 c.c.
Water to make	32 ounces	1.0 liter

For use, take 1 part of stock solution to 10 parts of water.

Harden the negative with an alkaline solution of formalin (Formula SH-1) before treatment with the chromium intensifier, or the gelatin may reticulate and ruin the negative.

Bleach thoroughly at 65°F. (18°C.), then wash five minutes and redevelop fully (about 5 minutes) in artificial light or daylight (not sunlight) in any quick-acting, non-staining developer containing the normal proportion of bromide, such as Formula D-72, diluted 1:3. If the negative is not redeveloped fully then fix for five minutes, and wash thoroughly. Fixing is unnecessary if redevelopment is thorough. The degree of intensification may be controlled by varying the time of redevelopment. Greater intensification can be secured by repetition.

Warning: Developers containing a high concentration of sulfite, such as Formula D-76, are not suitable for redevelopment, since the sulfite tends to dissolve the bleached image before the developing agents have time to act on it.

Negatives intensified with chromium are more permanent than those intensified with mercury.

* To make 28% acetic acid from glacial acetic acid dilute three parts of glacial acetic acid with eight parts of water.

PHOTOGRAPHIC FORMULAS

The Eastman Chromium Intensifier Powders are equally as satisfactory as Formula In-4, and are supplied in prepared form ready to use simply by dissolving in water.

Reducer (Kodak R-4a)

STOCK SOLUTION A

	Avoirdupois	Metric
Potassium Ferricyanide	1¼ ounces	37.5 grams
Water to make	16 ounces	500.0 c.c.

STOCK SOLUTION B

Sodium Thiosulfate (Hypo)	16 ounces	480.0 grams
Water to make	64 ounces	2.0 liters

For use take: Stock Solution A, 1 ounce (30 c.c.), stock solution B, 4 ounces (120 c.c.), and water to make 32 ounces (1 liter). Add A to B, then add the water.

Pour the mixed solution at once over the negative to be reduced. Watch closely. The action is best seen when the solution is poured over the negative in a white tray. When the negative has been reduced sufficiently, wash thoroughly before drying.

Solutions A and B should not be combined until they are to be used. They will not keep long in combination.

Hand Stain Remover (Kodak S-5)

SOLUTION NO. 1

	Avoirdupois	Metric
Potassium Permanganate	¼ ounce	7.5 grams
Water	32 ounces	1.0 liter

SOLUTION NO. 2

Sodium Bisulfite	16 ounces	480.0 grams
Water	32 ounces	1.0 liter

Rub the hands with a small amount of the No. 1 solution, rinse in water; then rinse with the No. 2 solution which will remove the stains.

Tray Cleaner (Kodak TC-1)

	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Potassium Bichromate	3 ounces	90.0 grams
Sulfuric Acid, C.P.	3 fluid ozs.	96.0 c.c.

Add the sulfuric acid slowly while stirring the solution rapidly.

For use, pour a small volume of the tray cleaner solution in the vessel to be cleaned. Rinse around so that the solution has access to all parts of the tray; then pour the solution out and wash the tray six or eight times with water until all traces of the cleaning solution disappear.

Desensitizer

In the development of panchromatic emulsions it is necessary to work in absolute darkness, or with the very dense panchromatic safelight. When visual control of development is necessary, Pinacryptol Green is used as a desensitizer. Two methods are available for using this material, namely in a preliminary bath, or mixed with the developing solution. As it is sometimes necessary to change the method used, it has been found best to make up a stock solution of the following proportions:

Pinacryptol Green	1 part
Water	500 parts

To use this solution as a separate preliminary bath, the stock solution is diluted 10 times, making a solution of 1 in 5000 in the tray. If the desensitizer is to be used in the developer, the stock solution is added in the ratio of 1 ounce of solution to every 10 ounces of developer. After the film has been immersed in the solution a minute, the red light may be turned on, but to be absolutely safe it is best to use a strong green light.

Special Formalin Hardener (Kodak SH-1)

Formalin (37% formaldehyde solution)	2½ drams	10.0 c.c.
Sodium Carbonate	73 grains	5.0 grams
Water to make	32 ounces	1.0 liter

PHOTOGRAPHIC FORMULAS

This formula is recommended for the treatment of negatives which would normally be softened considerably by a chemical treatment in the removal of several types of stains, or by intensification or reduction.

After treatment for 3 minutes in the hardening solution, films or plates should always be rinsed and immersed for 5 minutes in a fresh acid fixing bath and well washed before giving any further chemical treatment.

Tropical Hardener (Kodak SB-4)

This solution is recommended for use in conjunction with the Tropical Developer (Formula DK-15), when working above 75°F. (24°C.).

	Avoirdupois	Metric
Water	32 ounces	1.0 liter
Potassium Chrome Alum	1 ounce	30.0 grams
*Sodium Sulfate, desiccated	2 ounces	60.0 grams

Agitate the negatives for 30 to 45 seconds when first immersing in the hardener, or streakiness will result. Leave them in the bath for at least 3 minutes between development and fixation. If the temperature of the developer is below 85°F. (29°C.) rinse for 1 to 2 seconds in water before immersing in the chrome alum hardener bath. The hardening bath is a violet blue color by tungsten light when freshly mixed, but it ultimately turns a yellow-green with use; it then ceases to harden and should be replaced with a fresh bath. The hardening bath should never be overworked. An unused bath will keep indefinitely, but the hardening properties of a partially used bath fall off rapidly on standing for a few days.

Chrome Alum-Bisulfite Hardener

	Avoirdupois	Metric
Water	1 pint	500 c.c.
Potassium Chrome Alum	150 grains	10 grams
Sodium Bisulfite	150 grains	10 grams

Negatives are allowed to remain in this bath for 4–6 minutes. A freshly prepared bath is to be used and discarded after one day's use. Where stock solutions must be kept on hand, the chrome alum and the bisulfite are made up into separate solutions of 20 grams each per liter of water (300 grains per quart). Equal portions of these solutions are mixed when needed.

Hypo Eliminator (Kodak HE-1)

	Avoirdupois	Metric
Water	16 ounces	500.0 c.c.
Hydrogen Peroxide, (3% sol'n.)	4 ounces	125.0 c.c.
Ammonia, (3% sol'n.)	3¼ ounces	100.0 c.c.
Water to make	32 ounces	1.0 liter

Wash the prints for about 30 minutes at 65° to 70°F. in running water which flows rapidly enough to replace the water in the vessel (tray or tank) completely once every 5 minutes. Then immerse each print about 6 minutes at 70°F. in hypo eliminator solution (HE-1) and finally wash about 10 minutes before drying. Further details on the use of this formula will be found by referring to the paper "Elimination of Hypo from Photographic Images" by Crabtree, Eaton, and Muehler, *Jour. Phot. Soc. Amer. 6, page 6, (1940)*.

Hypo Test

Process with the batch of prints an unexposed white sheet of photographic paper of the same weight and size as the majority of prints in the batch. After the final wash, cut off a strip of this sheet and immerse it in a 1 per cent solution of silver nitrate solution for about 3 minutes; then rinse in water and compare, while wet, in subdued daylight or artificial light with the wet, untreated portion. If the hypo has been completely removed no color difference should be observed. A yellow-brown stain indicates the presence of hypo.

* If it is desired to use crystalline sodium sulfate instead of the desiccated sulfate, then use 4 ozs. 290 grains per 32 ounces (140 grams per liter) when mixing the formula.

PHOTOGRAPHIC FORMULAS

TONERS FOR SLIDES AND FILMS

Uranium Toner (Kodak T-9) For Brown to Red Tones

	Avoirdupois	Metric
Uranium (Uranyl) Nitrate	35 grains	2.5 grams
Potassium Oxalate	35 grains	2.5 grams
Potassium Ferricyanide	15 grains	1.0 gram
Ammonium Alum	85 grains	6.0 grams
Hydrochloric Acid, 10% sol	1¼ drams	5.0 c.c.
Water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given.

The solution should be perfectly clear and pale yellow in color. *It is light sensitive, however, and should be stored in the dark.* The maximum effect is produced in about 10 minutes, the tone passing from brown to red during this time.

It is convenient to keep 10% stock solutions of the constituent chemicals of the above toning bath for quick compounding of a new bath.

For motion picture work, 120 gallons of the above bath will tone about 12,000 feet of film without any appreciable change in the tone. A volume of acid may then be added equal to that originally used, when a further 12,000 feet may be toned. After toning the second quantity of film, the bath should be discarded.

After toning, wash for about 10 minutes, though the washing should not be prolonged, especially if the water is slightly alkaline, since the toned image is soluble in alkali.

Sulfide Toner (Kodak T-10) For Sepia Tones

SOLUTION A	Avoirdupois	Metric
Potassium Ferricyanide	1 ounce	30.0 grams
Potassium Bromide	½ ounce	15.0 grams
Water to make	32 ounces	1.0 liter
SOLUTION B		
*Sodium Sulfide, fused (not sulfite)	13 grains	0.9 gram
Water to make	32 ounces	1.0 liter

The well washed slide is thoroughly bleached in A, washed for 5 minutes, and immersed in Solution B for about 2 minutes until thoroughly toned. The slide should then be washed thoroughly for 10 to 15 minutes before drying. The transparency of the tone is much improved by the addition of a little hypo to the B solution, say, 66 grains per 32 ounces or 4.5 grams per liter.

Iron Toner (Kodak T-11) For Blue Tones

	Avoirdupois	Metric
Ammonium Persulfate	7 grains	0.5 gram
Iron and Ammonium Sulfate (Ferric Alum)	20 grains	1.4 grams
Oxalic Acid	45 grains	3.0 grams
Potassium Ferricyanide	15 grains	1.0 gram
Ammonium Alum	75 grains	5.0 grams
Hydrochloric Acid 10%	¼ dram	1.0 c.c.
Water to make	32 ounces	1.0 liter

Dissolve chemicals in the order given.

The method of compounding this bath is very important. Each of the solid chemicals should be dissolved separately in a small volume of water, the solutions then mixed strictly in the order given, and the whole diluted to the required volume. If these instructions are followed, the bath will be pale yellow in color and perfectly clear.

Immerse the slides or films from 2 to 10 minutes at 70°F. (21°C.) until the desired tone is obtained. Wash for 10 to 15 minutes until the highlights are clear. A very

* Use three times the quantity of crystalline sodium sulfide.

slight permanent yellow coloration of the clear gelatin will usually occur, but should be too slight to be detectable on projection. If the highlights are stained blue, then either the slide (film) was fogged during development, or the toning bath was stale or not mixed correctly.

Since the toned image is soluble in alkali, washing should not be carried out for too long a period, especially if the water is slightly alkaline.

Dye Toners (Kodak T-20)

	Avoirdupois	Metric
*Dye	x grains	x grams
Acetone or Wood Alcohol	3¼ fluid ozs.	100.0 c.c.
Potassium Ferricyanide	15 grains	1.0 gram
Acetic Acid (glacial)	1¼ drams	5.0 c.c.
Water to make	32 ounces	1.0 liter

The nature of the tone varies with time of toning and eventually a point is reached beyond which it is unsafe to continue as the gradation of the toned image becomes affected. Average toning time at 65°F. (18°C.) is from 3 to 9 minutes. Further details on the use of this formula may be obtained by referring to the paper by Crabtree and Ives.†

ORGANIC COMPOUNDS USED AS PHOTOGRAPHIC DEVELOPERS

Acrol—See amidol.
Activol—See rhodinal.
Adurol—See chlorohydroquinone and bromohydroquinone.
Amidol (Acrol; Diamol; Nerol)—2, 4-Diaminophenol dihydrochloride, $C_6H_3(OH)(NH_2)_2 \cdot 2HCl$.
Athenon—See glycin.
Azol—See rhodinal.
Brom(o)hydroquinone (Adurol-Schering) — 2-Bromo-1, 4-dihydroxybenzene, $Br_6H_3(OH)_2$.
Catechol—See pyrocatechin.
Certinal—See rhodinal.
Chloranol—A combination of chlorohydroquinone and metol base, $ClC_6H_3(OH)_2 \cdot (CH_3NH)C_6H_4OH$.
Chlornol—See chlorohydroquinone. Not to be confused with chloranol (*q.v.*)
Chlor(o)hydroquinone (Adurol-Hauff; C.H.Q.; Chlornol; Quinotol)—2-Chloro-1, 4-dihydroxybenzene, $ClC_6H_3(OH)_2$.
C.H.Q.—See chlorohydroquinone.
Citol—See rhodinal.
Diamine-H—See para-phenylenediamine hydrochloride.
Diamine-P—See para-phenylenediamine.
Diaminophenol—See amidol.
Diamol—A trade name for either amidol (*q.v.*) or para-phenylenediamine base (*q.v.*) The term used in French literature usually refers to amidol. In the U.S.A. the term is a trade name of one company for its *p*-phenylenediamine.
Diogen—Sodium α-aminonaphthol-disulfonate, $NH_2C_{10}H_4(SO_3Na)_2OH$, (1:3:6:8)?
Diolene—See ortho-phenylenediamine.
Duratol—*p*-Benzylaminophenol, $C_6H_5CH_2 \cdot NHC_6H_4OH$.

* The quantity of dye varies according to the dye used as follows:

Safranine (Extra Bluish)	3 grains	0.2 gram
Chrysoidine 3R	3 grains	0.2 gram
Auramine	6 grains	0.4 gram
Victoria Green	6 grains	0.4 gram
Rhodamine B	6 grains	0.4 gram

All dyes listed can be supplied by the National Aniline and Chemical Co., 40 Rector St., New York, N. Y.

† "Dye Toning With Single Solutions" by J. I. Crabtree and C. E. Ives, *Trans. Soc. Mot. Pict. Eng. 12: 967 (1928).*

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Edinol—*m*-Hydroxymethyl-*p*-hydroxyaniline hydrochloride, $(CH_2OH)(OH)C_6H_3NH_2 \cdot HCl$.

Eikonogen—Sodium aminonaphtholsulfonate, $(NH_2)(HO)(SO_3Na)C_{10}H_5 \cdot 2\frac{1}{2}H_2O$ (1:2:6)

Elon—See metol.

Finegrainol—Undisclosed formula; probably a mixture or a double salt of two of the more common developing agents together with small amounts of some other substance.

Genol—See metol.

Glycin (Athenon; Monazol)—*N*-(*p*-Hydroxyphenyl)-glycine; (*p*-hydroxyphenylamino)-acetic acid, $HOC_6H_4 \cdot NHCH_2CO_2H$.

Gradol—Undisclosed formula; probably a derivative of *p*-aminophenol.

Hydramine—A combination of hydroquinone and *p*-phenylenediamine, $C_6H_4(OH)_2 \cdot C_6H_4(NH_2)_2$.

Imogen—AGFA compound not made public.

Hydroquinone—*p*-Dihydroxybenzene, $C_6H_4(OH)_2$.

Kachin—See pyrocatechin.

Kodelon—See par(a)aminophenol.

Meritol—A combination of pyrocatechin and *p*-phenylenediamine, $C_6H_4(OH)_2 \cdot C_6H_4(NH_2)_2$.

Metol (Elon; Genol; Monotol; Photol; Pictol; Rhodol; Satrapol; Veritol)—*p*-Methylaminophenol sulfate, $HOC_6H_4(NHCH_3) \cdot \frac{1}{2}H_2SO_4$.

Metoquinone—A combination of hydroquinone and metol base, $C_6H_4(OH)_2 \cdot 2C_6H_4(OH)(NHCH_3)$.

Monazol—See glycin.

Monomet—*p*-Amino-*o*-cresol hydrochloride, $C_6H_3(CH_3)(OH)(NH_2) \cdot HCl$ (1:2:5).

Monotol—See metol.

Neol—Aminosalicylic acid, $C_6H_3(NH_2)(OH)(CO_2H)$(5:2:1).

Nerol—See amidol.

Orthamine—See ortho-phenylenediamine.

Ortho-phenylenediamine (Diolene; Orthamine) — 1, 2-Diaminobenzene, $C_6H_4(NH_2)_2$.

Ortol—A mixture of hydroquinone and *o*-methylaminophenol sulfate, $C_6H_4(OH)_2 + C_6H_4(OH)(NHCH_3) \cdot \frac{1}{2}H_2SO_4$.

Paraminol—A condensation product of hydroquinone and *p*-aminophenol.

Par(a)aminophenol (Kodelon)—*p*-Aminophenol, usually sold as the oxalate or the hydrochloride salt. Free base: $C_6H_4(OH)(NH_2)$; Kodelon: $C_6H_4(OH)(NH_2) \cdot HCl$.

Paranol—See rhodinal.

Para-phenylenediamine (Diamine-P; Diamol) — 1, 4-Diaminobenzene, $C_6H_4(NH_2)_2$.

Para-phenylenediamine Hydrochloride (Diamine-H; P.D.H.)—1, 4-Diaminobenzene dihydrochloride, $C_6H_4(NH_2)_2 \cdot 2HCl$.

P.D.H.—See para-phenylenediamine hydrochloride.

Phenylenediamine—See para-phenylenediamine and ortho-phenylenediamine.

Photol—See metol.

Pictol—See metol.

Pyrocatechin (Catechol; Kachin)—*o*-Dihydroxybenzene, $C_6H_4(OH)_2$.

Pyro—See pyrogallol.

Pyrogallic Acid—See pyrogallol.

Pyrogallol (Pyro; Pyrogallic Acid)—1, 2, 3-Trihydroxybenzene, $C_6H_3(OH)_3$.

Quinotol—See chlorohydroquinone.

Reducin—1, 3, 5-Triamino-2-hydroxybenzene trihydrochloride, $C_6H_2(OH)(NH_2)_3 \cdot 3HCl$.

Rhodinal (Activol; Azol; Certinal; Citol; Paranol)—Sodium *p*-aminophenolate, $C_6H_4(NH_2)(ONa)$. Usually sold in the form of a solution.

Rhodol—See metol.

Rubinol—Undisclosed formula; probably a derivative of pyrogallol.

Satrapol—See metol.

Veritol—See metol.

PHOTOGRAPHIC FORMULAS

TRADE NAMES AND CHEMICAL SYNONYMS OF DYES FOR SENSITIZING PHOTOGRAPHIC PLATES

Trade Name	Chemical Name	Sensitizer for
Ethyl red	1, 1′-diethylisocyanine iodide	Green and yellow
Pinachrome	1, 1′-diethyl-6, 6′-diethoxyisocyanine bromide	Green and orange
Pinaverdol	1, 1′, 6-trimethylisocyanine iodide	Green and yellow
Sensitol green cf. pinaverdol.		
Pinacyanol	1, 1′-diethyl-2, 2′-carbocyanine iodide	Orange and red
Sensitol red cf. pinacyanole		Orange and red
Erythrosin	Sodium salt of tetra-iodo fluorescein	Yellow-green
Orthochrome T	6, 6′-dimethyl-1, 1′-diethylisocyanine iodide	Green
Kryptocyanine	1, 1′-diethyl-4, 4′-carbocyanine iodide	Infra red
Dicyanine A	4′, 2-dimethyl-1, 1′-diethyl-6, 6′-diethoxy-2, 4′-carbocyanine iodide	Extreme red
Neocyanine	1, 1′-diethyl-8-(4-quinolyl ethiodide) methyl 4, 4′-carbocyanine iodide	Infra red

COMPARATIVE PHOTOGRAPHIC EMULSION SPEED RATINGS

Relative Value	Weston	Scheiner		H & D		DIN
		American	European	American	European	
1.00	3	14		159		7/10
1.28	4	15		200		8/10
1.63	5	16		252		9/10
2.07	6	17	23	318	1300	10/10
2.64	8	18	24	400	1700	11/10
3.37	10	19	25	504	2100	12/10
4.29	12	20	26	635	2700	13/10
5.46	16	21	27	800	3500	14/10
6.94	20	22	28	1000	4400	15/10
8.85	24	23	29	1270	5600	16/10
11.3	32	24	30	1600	7200	17/10
14.4	40	25		2020		18/10
18.4	50	26		2540		19/10
23.3	64	27		3200		20/10

The table must be used with caution because the various speed ratings, being based upon entirely different principles, cannot be compared directly with each other. It must be borne in mind that an effective speed of a given emulsion depends upon the type and character of developer used in processing.

PHOTOGRAPHIC FILM EMULSIONS

The following table gives an *approximate* comparison of the properties of various photographic emulsions. It should not be considered as a comparison of products from different manufacturers. The values given in the column headed *Mfrs. Approximate Percentage* are comparable only within a group of emulsions from the same manufacturer and are intended to show the relative speeds based upon a particular emulsion to which has been given the arbitrary rating of 100%. Thus, an emulsion rated at 200 is twice as fast as the emulsion prepared by the same manufacturer which is rated at 100 and requires only ½ the exposure; similarly, a 50 rating indicates ½ the speed of the 100 base and would require twice the exposure time.

The speed ratings given in the column headed *Weston* and *Scheiner* are also subject to a number of variables such as spectral quality of the light used in the exposure, the type of developer, the method and degree of development, age of the emulsion, etc. Inasmuch as Weston and Scheiner speeds are not exactly comparable a number of inconsistencies are bound to appear in these speed rating columns. The user of this table is therefore advised to use the same as a guide to selecting various films and to depend upon the values supplied by the manufacturer of the exposure meter being used and the development advised by the manufacturer of the film.

The filter factors are those for the well known Wratten filters. It should be noted that properties given in the column headed *Characteristics and Special Properties* will vary widely with different processes and procedures of development.

The manufacturers are indicated by the abbreviations as follows: A, Agfa; D, Defender; Du, Du Pont; Dy, Dufay; E, Eastman; G, Gevaert; P, Perutz.

Type and Name of Film	Manufacturer	Speed					Filter Factors												Characteristics and Special Properties
		Mfr.	Weston		American Scheiner		Yellow				Orange		Red		Green				
							Light K-1		Medium K-2		G		A		Light X-1		Dark X-2		
		Approximate Percentage	Day	Tungsten	Day	Tungsten	Day	Tung.	Day	Tung.	Day	Tung.	Day	Tung.	Day	Tung.	Day	Tung.	
Orthochromatic																			
Fine Grain Plenachrome	A	100	16	6	21	17	2	2	5	3	7	6	..	..	7	...	10	...	Wide latitude and fine grain
Super Plenachrome	A	150	24	12	25	22	1.5	1.7	2.5	2.2	4	3	..	..	3	3	4	3	Wide latitude and fast
Plenachrome	A	100	16	6	21	17	2	2	4	3	7	4	..	..	6	4	8	5	Wide latitude for general work
Super Plenachrome Press	A	450	50	32	..	..	2	1.4	3	2	..	..	..	..	..	3	...	...	For extreme action
Supersensitive Plenachrome	A	150	24	12	24	20	1.6	1.3	2	1.5	4	3	..	..	3	4	4	3	Fast. Wide latitude
Commercial Orthochromatic	A	100	16	6	20	16	2	2	4	3	7	4	..	..	6	...	8	5	Good contrast for general work

PHOTOGRAPHIC FILM EMULSIONS

Type and Name of Film	Manufacturer	Speed					Filter Factors												Characteristics and Special Properties
		Mfr.	Weston		American Scheiner		Yellow				Orange		Red		Green				
							Light K-1		Medium K-2		G		A		Light X-1		Dark X-2		
		Approximate Percentage	Day	Tungsten	Day	Tungsten	Day	Tung.	Day	Tung.	Day	Tung.	Day	Tung.	Day	Tung.	Day	Tung.	
X-F Orthochromatic	D	190	32	16	24	27	1.7	1.5	4	1.7	..	..	..	..	..	..	..	..	For action
X-F Ortho Press	D	190	32	16	24	27	1.7	1.5	4	1.7	..	..	..	..	..	..	..	..	Fast press
Portrait HGS	D	140	24	12	22	24	2	1.7	5	2.5	..	..	..	..	..	..	..	..	High green sensitivity
Portrait	D	75	12	4	20	20	4	2.5	10	8	..	..	..	..	..	..	..	..	Portrait, landscape and general
Pentagon	D	75	12	6	20	21	2	1.7	5	2.5	..	..	..	..	..	..	..	..	Good contrast for general work
Kodak Verichrome	E	100	16	6	20	16	2	1.5	2.5	2	5	3	..	..	..	..	..	..	For general work. Wide latitude
Kodak Regular N. C.	E	70	12	4	17	13	3	2.5	5	4	24	14	..	..	..	..	..	..	Low price film for general work
Super Speed Ortho Portrait A. H.	E	125	20	10	22	19	2	1.5	2.5	2	..	..	..	..	..	..	..	..	Fast. High green sensitivity. For portrait
Super Speed Ortho Portrait	E	115	16	...	21	16	2.5	2	3.5	2.5	..	..	..	..	..	..	..	..	Portrait, landscape and general work
Safety Ortho Press	E	90	16	6	20	16	2.5	2	3.5	2.5	..	..	..	..	..	..	..	..	Press and general work
Par Speed Portrait	E	60	12	4	18	14	4	3	8	5	24	14	..	..	..	..	..	..	Portrait, landscape and general work
Commercial Ortho	E	55	10	4	16	12	3	2.5	5	4	..	..	..	..	..	..	..	..	Copying and general work
Express Superchrome	G	150	20	12	22	19	1.8	1.7	7.9	5	..	..	..	..	..	..	..	..	Fast with good latitude
Studio High Speed	G	175	24	12	23	21	1.8	1.7	7.9	5	..	..	..	..	..	..	..	..	Fast. For action
Ortho Commercial	G	55	8	4	18	14	1.8	1.7	7.9	5	..	..	..	..	..	..	..	..	Good contrast for general use
Process Extra	G	6	1	0.5	9	5	1.8	1.7	7.9	5	..	..	..	..	..	..	..	..	Very contrasty
Persenso	P	200	24	16	23	20	1.8	1.7	2.5	2	..	..	..	..	..	..	..	..	Very fast. For action
Neo-Persenso	P	150	20	8	21	17	2	1.5	3	2.5	..	..	..	..	..	..	..	..	Fine grain and fast
Panchromatic																			
Ultra Speed Panchromatic	A	450	64	40	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Extremely fast. Night action
Fine Grain Superpan	A	150	24	16	24	22	1.4	1.2	2	1.5	3	2	6	3	4	3	6	5	Very fast. Fine grain and full color sensitivity
Finopan	A	100	16	10	21	19	1.4	1.2	2	1.5	3	2	6	3	4	3	6	5	Very fine grain for extreme enlargement
Fine Grain Reversible Superpan	A	100	20	12	23	21	..	..	..	..	..	..	..	..	..	..	..	..	Reversible. For projection
Superpan	A	150	24	16	25	24	1.3	1.2	2	1.4	2	1.8	6	3	3	3	4	4	Very fast. Good latitude
Superpan Press	A	600	64	40	..	..	1.5	1.2	1.7	1.4	..	..	4	2	..	3	..	..	Extremely fast. Night action

PHOTOGRAPHIC FILM EMULSIONS

Type and Name of Film	Manufacturer	Speed					Filter Factors												Characteristics and Special Properties
		Mfr.	Weston		American Scheiner		Yellow				Orange		Red		Green				
							Light K-1		Medium K-2		G		A		Light X-1		Dark X-2		
		Approximate Percentage	Day	Tungsten	Day	Tungsten	Day	Tung.	Day	Tung.	Day	Tung.	Day	Tung.	Day	Tung.	Day	Tung.	
Superpan Portrait	A	150	24	16	24	22	1.3	1.2	2	1.4	2	1.8	6	3	3	6	4	4	Very fast. Full color sensitivity
Supersensitive Panchromatic	A	150	24	16	24	22	1.5	1.2	2	1.5	2	1.5	4	2.5	4	4	6	7	Full color sensitivity. Very fast
Isopan	A	100	16	12	21	19	1.4	1.2	2	1.5	2.5	1.6	6	3	4	6	6	6	Fine grain and good contrast
Commercial Panchromatic	A	100	16	10	20	18	1.5	1.2	2	1.4	2.3	2	6	3	4	...	6	7	Good contrast
X-F Panchromatic	D	150	24	16	23	26	**				**		**		**				Very fast. Full color sensitivity
X-F Pan Press	D	150	24	16	23	26	**				**		**		**				Very fast. Full color sensitivity
Fine Grain Panchromatic	D	75	12	8	20	23	**				**		**		**				Fine grain and good contrast
Pan Process	D	10	1.5	2	13	16	**				**		**		**				Extreme contrast
Superior Panchromatic	Du	150	24	16	24	21	2	..	2	..	3	..	8	3	..	...	...	...	Very fast. Wide latitude
Fine Grain Parpan	Du	50	8	4	..	..	2	..	2	..	3	..	8	3	..	...	...	...	Fine grain. Good contrast
Micropan	Du	25	4	3	15	12	2	..	3	..	3	..	11	4	..	...	...	...	Very fine grained and contrasty
XL Pan	Du	300	64	40	..	..	2	..	2	..	3	..	8	3	..	...	...	...	Very fast. Wide latitude
Super XX	E	360	80	50	28	26	..	..	..	..	..	..	..	..	..	...	...	...	Extremely fast
Super X Panchromatic	E	180	24	16	25	23	1.5	1.5	2	1.5	2.5	2	7	4	5	...	...	5	Very fast. For night action
Supersensitive Panchromatic	E	135	20	12	23	20	1.5	1.5	2	1.5	3	2	7	4	..	3	...	...	Full color sensitivity
Kodak Plus-X	E	180	40	24	25	23													Finer grained than panatomic
Panatomic-X	E	90	24	16	23	21													Finer grained than panatomic
Panatomic	E	90	16	10	19	16	1.5	1.5	2	1.5	2.5	2	4	2	5	...	...	5	Fine grain and good contrast
Kodak Panatomic	E	70	12	8	19	16	1.5	1.5	2	1.5	2.5	2	4	2	5	...	...	5	Fine grain and good contrast
Panchro-Press	E	170	24	16	25	23	1.5	1.5	2	1.5	2.5	2	4	2	5	4	6	5	Very fast. For night action
Portrait Panchromatic	E	115	20	12	21	18	1.5	1.5	2	1.5	3	2	10	5	4	3	5	4	Portrait and general work
Safety Panatomic	E	85	12	8	18	15	1.5	1.5	2	1.5	2.5	2	4	2	5	4	6	5	Fine grain for extreme enlargement. Good contrast
Commercial Panchromatic	E	70	12	6	20	17	2.5	1.5	3	2.5	5	3	10	4	6	4	7	5	Good contrast for general work
Panchromatic Process	E	9	1.5	0.8	9	6	2.5	1.5	3	2.5	5	3	10	4	6	4	7	5	Extreme contrast for line work

** Exact factors for cut film vary with different batches and are supplied by the manufacturer in each package.

PHOTOGRAPHIC FILM EMULSIONS

Type and Name of Film	Manufacturer	Speed: Mfr. Approximate Percentage	Speed: Weston Day	Speed: Weston Tungsten	Speed: American Scheiner Day	Speed: American Scheiner Tungsten	Filter Factors: Yellow Light K-1 Day	Yellow Light K-1 Tung.	Yellow Medium K-2 Day	Yellow Medium K-2 Tung.	Orange G Day	Orange G Tung.	Red A Day	Red A Tung.	Green Light X-1 Day	Green Light X-1 Tung.	Green Dark X-2 Day	Green Dark X-2 Tung.	Characteristics and Special Properties
Panchromosa	G	175	24	16	23	21	1.4	1.3	2.3	1.5	3	2.5	10	6	4*	2.2*	6.5*	.	Fast and full color sensitivity
Panchromosa Micro-gran	G	115	12	6	22	17	1.4	1.3	2.3	1.5	3	2.5	10	6	4*	2.2*	6.5*	.	Very fine grain and full color sensitivity
Ultra Panchro Press	G	175	24	16	23	21	1.4	1.3	2.3	1.5	3	2.5	10	6	4*	2.2*	6.5*	.	Fast and full color sensitivity
Ultra Panchro Studio	G	110	16	10	21	19	1.4	1.3	2.3	1.5	3	2.5	10	6	4*	2.2*	6.5*	.	Fine grain and full color sensitivity
Peromnia	P	200	24	16	23	20	1.5	1.5	2	1.5	2.5	2	7	4	5	...	...	5	Fine grain and very fast
Perpantic	P	150	20	10	21	18	1.5	1.5	2	1.5	3	2	7	4	..	3	...	.	Fine grain, fast and good latitude
Pergrano	P	115	10	6	17	14	1.5	1.5	2	1.5	2.5	2	4	2	5	...	...	5	Very fine grain and good contrast
Blue Sensitive																			
Standard	A	75	12	4	18	14	3	3	9	8	..	..	..	..	..	...	...	.	For general work at low cost
Portrait **	A	100	16	6	21	17	..	..	..	..	..	..	..	..	..	...	...	.	Portrait work
Commercial **	A	50	8	2	17	..	..	..	..	..	..	..	..	..	..	...	...	.	Copying work
Process	A	15	3	0.3	10	..	..	..	..	..	..	..	..	..	..	...	...	.	Extreme contrast for line work
Direct Copy	A	0.3	...	3#	..	..	..	..	..	..	..	..	..	..	..	...	...	.	Direct positive transparencies
Commercial	D	40	6	3	17	19	..	..	..	..	..	..	..	..	..	...	...	.	Copying and general work
Process	D	5	0.4	0.75	6	9	..	..	..	..	..	..	..	..	..	...	...	.	Extreme contrast for line work
Commercial	G	65	10	5	19	15	..	..	..	..	..	..	..	..	..	...	...	.	Good contrast for copying and general work
Infra-Red																			
Infra Red	A	12†	2†	...	11†	..	..	..	..	..	..	..	..	..	..	...	...	.	Haze cutting and scientific work
Infra Red	E	25	4	6	..	..	..	..	..	..	..	..	..	..	..	...	...	.	Haze cutting and scientific work
Color																			
Dufay Color	Dy	50	8	3§	18	14§	..	..	..	..	..	..	..	..	..	...	...	.	Additive screen type color transparency
Kodachrome Regular	E	50	8	3‡	17	..	..	..	..	..	..	..	..	..	..	...	...	.	Subtractive, screenless, dyed image, color transparency
Kodachrome A	E	50	8‡	12	..	17	..	..	..	..	..	..	..	..	..	...	...	.	

* X-filters not recommended.
** Without or with matte base for retouching.
Exposure reading in minutes.
† With dark yellow filter.
§ With 1A filter and photoflood or photoflash lamp.
‡ With filter recommended by manufacturer.

LABORATORY ARTS AND RECIPES

PLATINUM (Courtesy J. Bishop and Co. Platinum Works, Malvern, Pa.)

1. Purposes for which Platinum can be used

A—Fusions

1. Fusions with sodium carbonate or fusion mixture.
2. Fusions with sodium carbonate and sodium nitrate or nitrite.
3. Fusions with sodium borate or sodium metaphosphate.
4. Fusions with alkali bifluorides.
5. Fusions with alkali or alkaline earth chlorides.
6. Fusions with alkali bisulfates.

Loss of weight of the platinum amounts to only a fraction of a milligram in case 1 and is practically nil in case 4. Nitrates or nitrites in the fusion mixture (case 2) cause heavier losses of platinum, but under the usual laboratory conditions these are not likely to exceed 1-2 mg. Borax is inert to platinum and sodium metaphosphate attacks the metal only at very high temperatures or under reducing conditions. Alkali chlorides and alkaline earth chlorides attack the metal above 1000° C. in the presence of air which liberates chlorine from the fused salt; in a neutral atmosphere they are inert. Alkali bisulfates attack platinum slightly above 700° C.; the attack is diminished by addition of ammonium sulfate.

In all cases except case 4, traces of platinum should be looked for in the solutions when making accurate analyses; the platinum is precipitated with the hydrogen sulfide group.

B—Evaporations

1. Evaporations with sulfuric acid with or without hydrofluoric acid.
2. Evaporations with hydrofluoric acid.
3. Evaporations with hydrofluoric and nitric acids in the absence of halides, especially chlorides.
4. Evaporations with hydrochloric acid in the absence of oxidizing agents which yield nascent chlorine.
5. Evaporations with alkali hydroxides or carbonates to avoid contamination of the solution with silica, etc.
6. Evaporations with sodium peroxide solutions (cf. II. C. 6).

C—Ignitions

1. Ignition of barium sulfate.
2. Ignition of alkaline earth carbonates, oxalates, etc.
3. Ignition of sulfates of metals which are not readily reducible.
4. Ignition of oxides which are not readily reducible, e. g., Al_2O_3, MgO, BaO, CaO, SrO, TiO_2, ZrO_2, ThO_2, MoO_3, WO_3, Ta_2O_5, Cr_2O_3, Mn_3O_4, and in the absence of carbonaceous matter ZnO, Co_3O_4, NiO, CdO.
5. Determination of ash in organic materials, e. g., coke, coal, plants.

The carbonaceous matter should be burnt off at as low a temperature as possible with free access of air to avoid danger of contamination of the platinum with sulfur, phosphorus, iron, etc., derived from reduction of sulfates, phosphates, iron compounds, etc., present in the material.

6. Determination of volatile matter in fuels. Here the maintenance of a non-oxidizing atmosphere is essential to prevent loss of fixed carbon hence there is a greater danger of contamination of the platinum, especially when the fuel is rich in sulfur or phosphorus compounds.

D—Electrolytic Operations

1. As an anode in most electrolytes except strongly acid chloride solution.
2. As cathode for the deposition of metals from acid, alkaline or ammoniacal solutions. For the deposition of zinc, gallium and bismuth, the platinum should first be copper-plated to prevent superficial alloying with the deposited metal.

Atmospheres in Which Platinum Can Be Heated:

1. Air, nitrogen and oxygen up to the melting point of platinum.
2. Oxides of nitrogen.
3. Bromine and iodine vapor.
4. Hydrogen, carbon dioxide.

2. *Conditions Under which Platinum is Attacked*

A—By Heating in Atmospheres Containing the Following Gases:

1. Ammonia: the surface becomes darker, less lustrous and soon develops pores and a crystalline appearance.
2. Sulfur dioxide: sulfur trioxide is formed and the platinum surface becomes coated with platinous sulfide.
3. Chlorine: the metal becomes converted into a mass of crystals due to the alternate formation and decomposition of platinous chloride.
4. Volatile chlorides especially those which readily decompose.
5. Highly carburetted gases and vapors; the metal disintegrates, possibly with the formation of PtC_2, and becomes very brittle. Hence platinum ware should never be heated in the reducing zone of a gas flame.

B—By Heating in the Following Liquids:

1. Aqua Regia.
2. Hydrochloric acid and oxidizing agents.
3. Concentrated sulfuric acid. The action is extremely slow and, for all laboratory purposes, negligible.
4. Concentrated phosphoric acid. Here again the action is noticeable only after very prolonged heating.

C—By Heating in the Following Solids, Their Fusions or Vapors:

1. Sulfur, selenium and tellurium. The action of sulfur vapor is very slow, and prolonged heating is required to produce any serious effect; selenium and tellurium readily combine with platinum.
2. Phosphorus, arsenic and antimony. Combination with platinum occurs readily at a red heat.
3. Magnesium pyrophosphate above 900° C.
4. Silica and borax at high temperatures.
5. Molten lead, zinc, tin, bismuth, silver, gold, or copper or mixtures which form these metals by reduction.
6. Fused alkali oxides and peroxides, and, to a smaller extent in the presence of air, alkali hydroxides.
7. Fused nitrates. The action is intensified by the presence of alkali hydroxides or carbonates but in no case is it very severe (see I. A. 2 *et seq.*).
8. Phosphorus pentoxide or phosphoric acid. The action is relatively small.
9. Fused cyanides. Platinocyanides are formed.
10. Iron oxide above 1200° C. Oxygen is liberated and the iron combines with the platinum.
11. Silica, silicates, alumina and magnesia above 1600° C. At lower temperatures no action occurs.
12. Fused alkali and alkali chlorides in the presence of air at 1000° C. or above (see I. A. 5).
13. Lead and bismuth oxides above 1250° C.

CLEANING PLATINUM

(Reprinted by permission of the Baker Platinum Works, Newark, N. J.

Every careful analyst of necessity uses clean utensils. The habit of cleaning and polishing platinum ware immediately after using is easily formed, and repays the user with increased confidence in his work as well as with the prolonged life of the article.

The loosening effect of the Bunsen flame upon the surface of platinum exposed to its action produces the familiar gray appearance which cannot be removed except by burnishing. Rubbing the surface of platinum with moist sea sand (round grains only), applied with the finger, serves to remove most impurities and to polish the metal, without material loss in weight.

Fusing bisulphate of potash or borax in the vessel and then boiling in water and polishing as above with sand is recommended by Gmelin. When it is desired to clean the outer surface of vessels in this manner, they must be placed in dishes of sufficient size to allow the fused flux to envelope completely the article to be cleaned.

LABORATORY ARTS AND RECIPES

Sodium amalgam possesses the property of wetting platinum without amalgamating with it, even when other metals are purposely added to the amalgam. This substance is, therefore, useful for effecting a quick and thorough cleansing of platinum. The amalgam is gently rubbed upon the metal with a cloth and then moistened with water, which oxidizes the sodium and leaves the mercury free to alloy with foreign metals. The mercury is then wiped off and the article cleaned and polished with sand, as above described.

If the existence of a base metal alloyed with the platinum is suspected, immerse the article in question first in boiling HCl for a few minutes; then, after thoroughly rinsing with clean water, in boiling HNO_3 free from chlorine. If the article is unaffected in weight or appearance, and the acid baths fail to give reaction for base metals, the absence of such is assured.

PERMANENT MARKING OF GLASS AND PORCELAIN VESSELS.

(Reprinted from *The Chemist-Analyst*, J. T. Baker Chemical Co., Phillipsburg, N. J., publishers, by permission.)

According to H. G. Isbell (*Vol.* 20, *No.* 3, *p.* 20, 1931) a good ceramic ink can be made from the following: 1 part K_2CO_3, 1 part $Na_2B_4O_7$, 2 parts PbO, 2 parts $Co(NO_3)_2$ or other salt of cobalt. Grind this mixture in a mortar to a fine powder (dry if necessary). Mix intimately with a mixture of 4 parts copaiba balsam, 1 part clove oil, and 1 part lavender oil; if these oils are not available raw linseed oil may be used in place of the oil mixture. The amount of oil used should be such that the mixture will run slowly from a pen. The desired markings are made on a clean surface which is then warmed gently over a flame to dry the oil and prevent cracking in the final heating. The place where the marking has been made is then heated slowly by holding against the side of a flame at a tangent and the article rotated slightly. The marking first turns black due to the carbonization of the oil after which it will begin to glow red. At this point the article is removed from the flame and allowed to cool slightly after which it is reheated until the markings, not the glass, begin to glow. The marking thus obtained presents a smooth and shiny surface, blue in color, which cannot be removed by mechanical or the usual chemical means.

Robbins (*The Chemist-Analyst, Vol.* 18, *No.* 1, *p.* 18, 1929) gives the following directions for the marking of glassware by lead etching.—(1) Take a quantity of PbO or Pb_3O_4, break up all lumps to a fine powder, place in a dish, and warm slightly over a flame to remove traces of moisture. (2) The glass to be etched must be free from finger prints, moisture, or grease. (3) An ordinary rubber stamp having the desired lettering and an ordinary stamp pad are used. Stamp the wording on the part to be etched, shake a small quantity of the lead oxide over the wording, and brush off the excess lead oxide with a camel's hair brush. The ink from the stamp pad acts only as a binder for the oxide. (4) Run the piece of glassware through the flame until the oxide has a glassy appearance. In some cases the wording may become black due to the formation of a higher oxide of lead by the use of the oxidizing part of the flame. This higher oxide may be removed by holding in the extreme upper part of the flame, and burning the oxide off, leaving a clear etching. (5) Care must be taken to avoid too hot a flame as this has a tendency to spread the lead.

Matthews (*The Chemist-Analyst, Vol.* 18, *No.* 1, *p.* 22, 1929) prepares a marking ink for chemical porcelain as follows: —18.8 grams of commercial, black cobalt oxide, 1.2 grams of bismuth subnitrate, 15 cc of turpentine, 15 drops of Dresden thick oil. This mixture is ground together and applied to the porcelain with a pen. The porcelain is then heated slowly to evaporate the liquids and finally ignited.

Gifford (*The Chemist-Analyst, Vol.* 18, *No.* 1, *p.* 16, 1929) recommends that apparatus, flasks, test tubes, beakers, etc., which are used daily in making routine analyses be marked with a good grade of automobile enamel of any desired color. The marking is placed on the etched circle with either a marking brush or a tooth pick. When it is desired to remove the marking it is first scraped with a knife and finally washed with carbon tetrachloride or other suitable solvent.

LABORATORY ARTS AND RECIPES

Hirsch (*The Chemist-Analyst, Vol.* 19, *No.* 1, *p.* 18, 1930) finds that permanent identification marks, superior to those often written with blue wax pencils, may be made on laboratory ware, such as crucibles, evaporating dishes, etc., with ordinary blue black ink, using a pen as a marker. The surface to be marked is wiped dry and the desired characters made conveniently with a fountain pen, using sufficient ink to give a continuous opaque film. After allowing the ink to dry, the surface is gradually ignited over a Meeker burner, finally bringing the flame to bear directly upon the configurations until fused into the surface or glaze. A successful marking is reddish brown, smooth, homogeneous, and without any appearance of external roughness. This method was applied to marking tare weights on pyrex beakers used as drying dishes, thereby obviating continual reweighing. During the ignition to fuse in the numerals, the beakers lost about ½ milligram in weight; allowance, therefore, was made in marking. The marked weights themselves serve as identifications. A similar procedure is employed by Liebschultz (*ibid. No.* 9, *p.* 11, 1914) and by Baker (*ibid. No.* 7) for the marking of crucibles except that they recommend the addition of a trace of platinum chloride to the ink used in marking.

Schollenberger (*The Chemist-Analyst, Vol.* 18, *No.* 1, *p.* 17, 1929) recommends that porcelain and silica ware be marked with platinum. According to his procedure, about one decigram of scrap platinum is dissolved in aqua regia in a small porcelain crucible and the solution evaporated to dryness. About 1 cc of lavender oil is added and the mixture stirred until permanently mixed. The ware to be marked is warmed slightly and the mixture applied with a rubber stamp or thinly painted on with a fine brush, sharpened match, or something of the kind. The ware is then gently heated to burn off the oil and strongly ignited to fuse the metal into the surface, producing a distinct black mark. If applied too thickly the characters may be blurred, or may be a metallic mirror less distinct than the black deposit. If the marking ink becomes gummy after long keeping, it may be thinned with a little more of the oil.

Temporary marks may be made on glass or porcelain by writing with a graphite pencil on a ground or sandblasted portion. Glassware is often furnished with a small sandblasted label for such markings, but often the sandblasting is so poorly done that a legible result is difficult to produce. By the use of a discarded piece of alundum ware, a good ground surface is easily made on glass or porcelain; the edge of the alundum is wetted with water and rubbed with short firm strokes at the place desired. Surfaces so ground take pencil more readily than a sandblasted label and the mark is more readily erased with a rubber eraser when desired. Even porcelain crucibles thus marked may be ignited and the mark survive several ignitions but ink is better for this purpose. Ground surfaces thus produced have not been found to increase liability to breakage on heating.

CLEANING MIXTURES FOR CHEMICAL GLASSWARE AND PORCELAIN

The commonly employed chromic acid cleaning mixture which may be used repeatedly until the crystals have disappeared and the solution assumes a greenish tinge, is prepared by mixing with the usual precautions 800 cc of crude, concentrated sulfuric acid with 500 cc of a saturated solution of potassium dichromate in water.

Potassium dichromate, the active material in the ordinary dichromate-sulfuric acid cleaning mixture, leaves the by-products potassium sulfate and chromic sulfate which gradually accumulate leaving the mixture worthless. If heat has been applied to hasten the action or to evaporate any water which has been absorbed, the chromic sulfate sometimes adheres so firmly to the apparatus which is being cleaned that it can only be removed with difficulty. Various solutions have been devised to replace it. Trisodium phosphate as a possible laboratory detergent has been investigated and has much to recommend it. A 15% solution, heated to about 70°C. may be used for cleaning burettes and other volumetric glassware with satisfactory results.

Mathers (*The Chemist-Analyst, No.*

LABORATORY ARTS AND RECIPES

13, *p.* 10, 1915) recommends placing the glass or porcelain apparatus in a large evaporating dish containing hot sulfuric acid and a little nitric acid. If the apparatus is not completely immersed in the hot acids, it is turned after a few minutes so that the cleaning solution comes in contact with every part. The acids should be kept very warm but not hot enough to evolve sulfur trioxide or to distil out the nitric acid. The solution is permanent except that sufficient nitric acid must be added from time to time to keep it white or at least yellow in color rather than black. This mixture has been found especially useful in cleaning dyes, gums and waxes from glassware. A thin film like a dye will be removed almost instantly, but the removal of masses of organic material requires longer treatment.

Gibbs (*The Chemist-Analyst, Vol.* 20, *No.* 4, *p.* 17, 1931) describes a material which effectively cleans glassware in a minimum of time and which works effectively in cold water. It is prepared as follows. Take a 10 oz. cake of a good grade of cleaning and polishing grit cake soap, such as "Bon Ami" and pulverize it to a powder with a mortar and pestle. Cut a 12 oz. cake of a good grade of rosin laundry soap, such as "Octagon," into thin slices and add just enough water to cover the mass. Slowly heat on a hot plate until the soap has dissolved in the water and a clear solution results. Add this liquid soap mixture to the powdered grit cake in a beaker or earthen jar, stirring the mixture well. Allow to stand over night or until the resulting mixture has solidified into a soft mass. This mixture can then be applied to the wet glassware in the usual manner with a brush or the hands, scrubbing thoroughly and finally rinsing in running water. It is only necessary to add small quantities of water from time to time to keep the mixture at the proper consistency.

REMOVAL OF MARKINGS FROM LABORATORY PORCELAIN

It is often desirable to change the old markings on porcelain beakers or evaporating dishes. Cox (*The Chemist-Analyst, Vol.* 19, *No.* 4, *p.* 22, 1930) describes a method for removing such markings leaving a clean, easily remarked surface. It consists merely of washing the old marks with hydrofluoric acid solution and washing the excess acid off as soon as the mark is removed. The hydrofluoric acid is easily applied with a rubber policeman on the end of a glass stirring rod. The acid attacks the markings before it does the porcelain, but if the acid is left on longer than necessary to remove the marks, the porcelain may become etched. The same process may be used to make a surface on new porcelain so that it will take ink easily and not allow the ink to run in burning.

INK REMOVERS

Mathews (*The Chemist-Analyst, Vol.* 18, *No.* 1, *p.* 22, 1929) suggests the following procedure for the removal of ink from paper or cloth. An alkali hypochlorite is first applied to the ink to be removed, followed by an application of dilute acid. To remove red ink stains, cover the spot with concentrated potassium permanganate solution for five minutes. Then place the material in an oxalic acid solution until the permanganate spot disappears. A rather concentrated solution of sodium bicarbonate may be used to neutralize the oxalic acid. Wash the material thoroughly with water. Repeat the process if the stain is not completely removed. Black ink stains may be removed in a similar manner. Always wash well with fresh water after using these solutions.

PURIFICATION OF MERCURY

The purest mercury is obtained by special methods of distillation, a description of which is beyond the scope of this book. The reader is referred to the description of a method by Booth and Jones (*Jour. Ind. Eng. Chem.*, 19, 104, 1927). But for many laboratory uses one of the following methods will yield a material of sufficient purity. If the mercury is very dirty an initial purification can be made by filtering through a dry filter paper having several pin-holes

at the apex; or it may be squeezed through the pores in a piece of clean chamois skin.

(*a*) Mercury is shaken in a separatory funnel with a paste of concentrated sulfuric acid and mercurous nitrate, after which it is separated, washed with water, separated from the water, poured into a porcelain evaporating dish, the last visible traces of water removed with a clean blotter or piece of filter paper, and then dried in an oven at 100-10°C.

(*b*) Mercury is placed in a glass or porcelain beaker, then covered with a layer of nitric acid (10 cc concentrated acid diluted with 90 cc of water) and air bubbled through the mercury layer for about 24 hours, after which it is separated, washed, and dried as described in part *a*.

(*c*) Mercury is allowed to spray from a funnel, with a capillary point, into an aqueous 10% sodium hydroxide solution contained in a glass tube one inch in diameter and about three feet in length, which is held in a vertical position and which has fused to its lower end a smaller diameter tube bent so as to form a U-tube and of a length somewhat more than 1/13.6 the length of the aqueous column in the large tube. A small amount of mercury is poured into the U-tube and this supports the column of aqueous solution above it in the large diameter tube. The open end of the small tube is bent over at the top (but for only a very short distance to prevent its acting as a syphon) to form a convenient delivery for the mercury. As the mercury enters the large diameter tube it falls to the bottom of the U-tube and over-flows through the small tube. After several successive passages through the column of sodium hydroxide solution, the mercury is passed in the same manner through dilute nitric acid (10 cc concentrated nitric acid and 90 cc of water), and finally several times through distilled water, after which it is dried as described in method *a*.

DESICCATOR LID LUBRICANT

Case (*The Chemist-Analyst, Vol.* 21, *No.* 2, *p.* 23, 1932) recommends the following preparation as an economical and efficient lubricant for desiccator lids. Two grams of dry soap powder are added to 100 cc of medium grade lubricating oil. The mixture is heated to 150-200°C. (300-400°F.) with stirring for a few minutes until the solution is complete. Twenty grams of paraffin wax are then added with stirring, thus forming a stiff jelly which is not subject to the usual room temperatures. The addition of the paraffin produces a smoother grease which permits a desiccator lid to slide easily even under considerable vacuum.

STOPCOCK LUBRICANT

Meloche and Frederick (*Jour. Amer. Chem. Soc.* 54, 3264, 1932) describe the preparation of a stopcock grease which is not affected by many organic solvents and in which most other greases are soluble. It is prepared as follows. A thick paste is prepared by mixing 25 grams of anhydrous glycerol, 7 grams of dextrin, and 3.5 grams C. P. *d*-mannitol, then heating until the mixture just begins to boil and cooling to room temperature with stirring. The viscosity of the mixture can be increased by the addition of more dextrin and the fluidity can be increased by the addition of more glycerol. The grease is suitable for use with the following solvents: acetic anhydride, acetophenone, benzaldehyde, benzene, bromobenzene, carbon disulfide, carbon tetrachloride, chlorobenzene, tetrachloroethane, cyclohexane, ethyl acetate, ethyl acetoacetate, ethyl bromide, ethyl carbonate, ethylene bromide, ethylene chloride, methyl acetate, methylaniline, nitrobenzene, nitromethane, petroleum ether, diphenyl ether, toluene, *o*-toluidine, turpentine, and *o*-xylene. It is not suitable for use with aniline, acetic acid, *tert*-amyl alcohol, benzyl alcohol, *n*-butyl alcohol, *tert*-butyl alcohol, ethyl alcohol, methyl alcohol, diethylamine, ethylene chlorohydrin, ethylene glycol, formic acid, propionic acid, pyridine, quinoline, water, and solvents containing water.

Shepherd and Ledig (*Jour. Ind. and Eng. Chem.* 9, 1059, 1927) have developed several different stopcock greases of the following compositions. (*a*) For high vacuum work requiring a viscous lubricant, 31 parts pale crepe rubber, 24 parts white vaseline, 5 parts paraffin (melting point 36°C.). (*b*) For general laboratory

LABORATORY ARTS AND RECIPES

uses, 6 parts pale crepe rubber, 7 parts vaseline, 1 part paraffin. (*c*) A light grease for volumetric burette cocks where easy manipulation is desired, 10 parts smoked sheet or pale crepe rubber, 18 parts white or yellow vaseline, 1 part paraffin (melting point 30°C.) The mixture of the respective ingredients is heated to 155°C. for 190 hours with continuous stirring, then poured into 2-ounce ointment cans, a small portion to each can and chilled on ice immediately. After aging for 10 days the grease is ready for use.

LABORATORY CEMENTS

Litharge-glycerol cement is prepared by adding sufficient litharge to a mixture of six parts commercial 95% glycerol (glycerine) with one to three parts of water to form a paste of the desired consistency. Inert materials such as iron oxide, sand, or Fuller's earth are often added to retard the setting time and to prevent cracking. This cement is fairly acid resistant.

Jackson (*The Chemist-Analyst, Vol.* 20, *No.* 2, *p.* 23, 1931) prepares a general laboratory cement from the following materials: 1 part or 25 grams of asphalt, 6 parts or 150 grams of rosin, 3 parts or 75 grams of rubber, and 1 part or 25 cc of turpentine. Mix the rosin and asphalt, heat with a small flame and then add the rubber (an old inner tube is satisfactory). The mixture is heated at as low a temperature as possible to keep it fluid and until nearly all the rubber is melted, which requires about two or three hours. The turpentine is then added and the heating continued two or three hours or until the mass becomes homogeneous. It is best to heat in a large beaker as there is a tendency to frothing and it should be stirred at intervals of fifteen minutes. The cement may then be cast into sticks for convenient use. The cement is applied (to dry surfaces only) by holding in a small flame until it liquifies or catches fire; it is then applied directly. This cement is satisfactory for an adhesive to make gas tight joints as well as other uses where it is desired to stick two objects together. It is not affected by chemical reagents in moderate concentrations. The formula above gives a pliant cement that is somewhat sticky when cold; it does not adhere to the fingers when touched. A harder and less pliant cement may be made by increasing the amount of rosin.

Matthews (*The Chemist-Analyst, Vol.* 18, *No.* 1, *p.* 22, 1929) suggests a cement for porcelain, metals or stoneware. Casein is soaked in an equal weight of water for two hours during which time the casein swells but does not dissolve. At the end of this time, sodium silicate and lime are stirred in and the cement is ready for use.

LACQUER

Taylor (*The Chemist-Analyst, Vol.* 20, *No.* 4, *p.* 10, 1931) finds that an excellent label lacquer and general utility cement may be prepared from the pyroxylin handles of discarded tooth brushes. The bristled end is broken off and the handle dissolved in enough of a solvent such as butyl acetate, acetone, or ether-alcohol to give a glycerine-like consistency. About 300 cc of solution usually results. The color of the original handle is unimportant since even the darkest ones give an almost colorless film. The lacquer so prepared is not only useful for protecting labels but has been used successfully for sealing leaks in apparatus, notably vacuum distillation, and sealing bottles against moisture. It is a good library paste since it does not wrinkle paper, and it may also be used to cement pieces of glass together.

TEMPERATURE SENSITIVE PAINTS

Paper impregnated with temperature sensitive paint will change color when heated by a flame, electric spark, etc. Such paper is suitable for use in recording systems, for application to bearings, on condensers to indicate if sufficient water is being used for cooling, and other readily suggested uses. Any one of the following four mixtures is suitable for this purpose. (1) One part by weight of cuprous iodide and 1 part of mercuric chloride are ground to a fine powder and mixed with a thin, light colored, non-acid oil or spirit varnish. It is applied to a surface with a brush (do not apply to aluminum). The color is bright red be-

low 130°F. at which temperature it begins to darken, becoming noticeably darker at 135°F. and at 145°F. the color is maroon; at 155°F the color changes to a light chocolate, to a dark chocolate at 160°F, and at 212°F it is black. Decomposition begins at 300°F.

(2) Aniline hydrochloride 9.8 grams, potassium nitrate 8.0 grams, and water 100 cc.

(3) Nickel nitrate 5.0 grams, sodium thiosulfate 3.9 grams, sodium nitrate 1.0 grams, 1% gelatin solution 5 cc, and water 100 cc.

(4) Gelatin 10 grams, sodium chloride 5 grams, phenolphthalein 0.5 grams, and water 100 cc.

BLACK ACID PROOF STAIN FOR WOOD

Kiskadden (*The Chemist-Analyst, Vol. 20, No. 3, p. 17, 1931*) gives the following formula for an acid proof stain for wood. Solution No. 1: Iron sulfate 4 parts, copper sulfate 4 parts, potassium permanganate 9 parts, and water 83 parts. Solution No. 2: Aniline 12 parts, hydrochloric acid 18 parts, and water 70 parts. Apply two coats of No. 1; the second coat being applied as soon as the first has dried. Rub off the excess of the last coat when dry and apply two coats of No. 2. Dry thoroughly and apply a coat of linseed oil using a cloth. The color develops into an ebony black in a few hours. The surface may be washed with soap and water. One hundred cc of No. 1 will cover approximately 20 sq. ft. of surface; 50 cc of No. 2 will cover approximately 20 sq. ft. of surface.

According to the U. S. Bureau of Chemistry the same results are obtained by an application of the following two solutions. No. 1: Copper sulfate 125 grams and potassium chlorate 125 grams are dissolved in 1000 cc of water. No. 2: Aniline hydrochloride 60 grams and hydrochloric acid (sp. gr. 1.20) 90 cc are dissolved in 500 cc of water. Application: Paint the wood first with solution No. 1 and as soon as it dries sufficiently, apply a coat of solution No. 2; allow to dry for several hours. Wash with hot water and repeat the operations until the color is a dark green. Finish by rubbing with raw linseed oil until a jet black surface is obtained.

DRESSING WAX FOR ALBERENE DESK TOPS

Melt 450 grams of paraffin on a water bath, cool to 60°C., add 340 cc of kerosine with constant stirring, and then add 340 cc of gasoline.

HEAT FILTERS

Either of the following two solutions may be employed to prevent heat rays from passing, and permit light rays to pass through. They are used in glass cells being placed between the source of artificial light and other parts of the optical apparatus. Solution No. 1: copper sulfate 0.5 grams, water 100 cc, and sulfuric acid 1 drop. Solution No. 2: ferrous ammonium sulfate 20 grams, water 100 cc, and sulfuric acid sufficient to clear the solution or about 5 drops. These solutions are stable for about two weeks.

ELECTRICAL POLARITY INDICATORS

Dipping the ends of the two wires into a dilute solution of sulfuric acid or of salt will produce about the negative terminal a larger number of bubbles of gas than appear at the positive terminal.

Another method is to cut strips of filter paper and then immerse them in a solution of sodium chloride containing a few drops of phenolphthalein indicator; the strips thus prepared are then dried. When ready for use, they are moistened with water and the terminal wires are touched to the paper strips. A pink coloration appears at the point of contact with the negative terminal.

PRESERVATIVE FOR ALGAE, etc.

King's fluid for the preservation of algae consists of the following mixture: 50 grams of distilled water, 0.5 grams of glacial acetic acid, 0.2 grams of copper nitrate crystals, 0.2 grams of copper chloride crystals, and 50 grams of camphor water prepared by allowing a lump of camphor to stand in distilled water for a few days.

FORMULAS AND PROPERTIES OF DENATURED ALCOHOLS

The information given in the tables on denatured alcohols has been compiled from information furnished by Dr. Carl Haner of the Publicker Commercial Alcohol Company, Philadelphia, Pa., and from the publication *ALCOHOLS AND SOLVENTS*, copyright 1936 by the Publicker Commercial Alcohol Co.; reprinted by permission of the publishers. Cf. also Appendix to Regulations, No. 3 (1939); 5¢, Supt. of Documents, Washington, D. C.

Because of its use in beverages, nearly every country has considered alcohol a proper article for taxation and government control. The tax on alcohol is usually high so that the cost of pure alcohol is far above the cost of actual manufacture. In the United States of America, alcohol which has not been denatured is subject to the Internal Revenue Tax except to Colleges, Charitable Institutions, Scientific Research Laboratories, Hospitals and Sanitariums, which institutions may obtain Tax-free Permits upon application to the Department of Internal Revenue. Alcohol which is intended for industrial purposes is not subject to this high tax, but to make possible the removal from taxation it is necessary to render the alcohol unfit for beverage purposes. Such non-beverage alcohol is termed *denatured alcohol.*

Under the regulations of the Department of Internal Revenue, ethyl alcohol may be denatured with a wide variety of materials which render the alcohol unfit for beverage purposes. Each formula of *specially denaiured alcohol* has its approved uses and in many cases the formula has been devised particularly for one exacting type of industry. Sales of specially denatured alcohol are permitted only to those who have qualified under Internal Revenue Regulations and who hold the permit indicating authorization for use in specified processes. Certain types of denatured alcohol, which have been rendered unfit for beverage purposes by the addition of denaturants prescribed by the Department of Internal Revenue, may be purchased for manufacturing requirements, for anti-freeze purposes, or for any other legitimate use by the general public without the necessity of obtaining any form of permit. Dealers selling *completely denatured alcohol* must keep accurate records of receipts and sales including serial numbers, which must be available to authorized government officers at any time.

In the tables which follow, the formulas, their numbers, and authorized uses, are set by the United States Government. They are the only ones that can be used by manufacturers in the United States. These are changed from time to time but at no set interval. The Government can make changes at will either for the benefit of the manufacturers of new products or for the protection of the revenue. In the past, changes have not been numerous but an attempt is being made at the present time to reduce the number of available formulas. If this proves feasible, some major changes may be expected in the near future.

The values in the table, giving specific gravity and weight per gallon of the specially denatured alcohols prepared from 190° proof alcohol, are those determined by the U. S. Bur. of Standards. The specific gravity is "true specific gravity," *i.e.*, all weighings are corrected for the buoyancy of the air. It was necessary, therefore, to change these values to "apparent specific gravity" before they could be multiplied by the weight of a gallon of water (8.32823 pounds in air at 15.6°C.) to give the weight of a gallon of alcohol at the same temperature. The magnitude of this correction to specific gravity is as follows:

True specific gravity at 15.6°/15.6°C.	Correction	Apparent Specific gravity at 15.6°/15.6°C.
0.70	−0.00035	0.69965
0.80	−0.00023	0.79977
0.90	−0.00012	0.89988

The type of shipping container suitable for transportation of the various denatured alcohols is indicated by the abbreviations **T, D, B,** and **G** which mean tank car, drum, barrel, and glass, respectively.

FORMULAS FOR SPECIALLY DENATURED ALCOHOL

Formula Number	Composition: Giving amounts of denaturants to be added to 100 gallons of 190° proof ethyl alcohol	Properties of Finished Formula: Weight in lbs./gal. at 15.6°C.	Sp. gr. in vac. 15.6°/15.6°C.	% Ethyl alcohol: by vol.	% Ethyl alcohol: by wt.
1	5 gal. approved wood alcohol (*b*) T, D, or B	6.785	0.8149	90.47	86.30
1A	10 gal. of denaturing grade isopropanol and 0.5 gal. of commercial α-terpineol T, D, or B	6.809	0.8175	85.98	80.64
2A	2 gal. approved wood alcohol and 2 gal. benzene T, D, or B	6.805	0.8173	91.34	86.13
2B	0.5 gal. benzene (*a*) T, D, or B	6.795	0.8161	94.52	91.75
3A	5 gal. commercially pure methyl alcohol (*b*) T, D, or B	6.781	0.8144	90.48	86.31
3B	1 gal. pine tar (Pix Liquida, U. S. P.) T, D, or B	6.810	0.8179	94.05	91.06
4	1 gal. of the following mixture: 5 gal. of an aqueous solution containing 40% nicotine; 3.6 oz. methylene blue; water to make 100 gal. (*c*) T, D, or B	6.823	0.8195	94.19	91.29
5	65 lbs. ethyl ether; 3 lbs. cadmium iodide; 3 lbs. ammonium iodide B or G	6.777	0.8140	85.50	80.05
6A	15 gal. of condensed fumes recovered in the process of manufacture T, D, or B	.....	.....	.....	.....
6B	0.5 gal. pyridine bases T, D, or B	6.801	0.8169	94.52	91.75
11	100 lbs. sulfuric acid and 10 lbs. cadmium iodide B or G	6.779	0.8142	80.92	75.76
12A	5 gal. benzene T, D, or B	6.820	0.8192	90.47	86.30

(*a*) For use only in closed and continuous process.

(*b*) Approved wood alcohol is wood spirit containing ketones, aldehydes, unsaturated compounds, etc., that render separation very difficult. In order to be approved the wood alcohol must pass general tests for the impurities and must be a wood distillation product. It is for this reason that all uses of Formula 3A are conditional.

(*c*) Specially denatured alcohol formula number 4 authorized for use in the manufacture of cigars or fluids, sprays, or other liquids designed for use in the manufacture of cigars, must be made from rum of not over 150° proof or alcohol distilled at not over 150° proof. Cf. appendix to regulations No. 3.

FORMULAS FOR SPECIALLY DENATURED ALCOHOL

Formula Number	Composition: Giving amounts of denaturants to be added to 100 gallons of 190° proof ethyl alcohol	Properties of Finished Formula: Weight in lbs./gal. at 15.6°C.	Sp. gr. in vac. 15.6°/15.6°C.	% Ethyl alcohol: by vol.	% Ethyl alcohol: by wt.
13A	10 gal. ethyl ether T or D	6.740	0.8095	86.40	81.15
15	3 gal. sulfuric acid and 1 gal. kerosene (*d*) B or G	7.105	0.8532	91.52	87.67
17	0.05 gal. (6.4 fluid oz.) of animal oil (Dippels) T, D, or B	6.795	0.8161	94.94	92.33
18	100 gal. vinegar, containing not less than 9% acetic acid T (wood) or B	7.802	0.9369	48.70	41.27
19	100 gal. ethyl ether D only	6.468	0.7769	47.60	40.25
20	5 gal. crude chloroform (*e*) T, D, or B	7.062	0.8481	90.49	86.32
22	10 gal. U. S. P. formaldehyde solution (*f*) B or G	7.037	0.8451	86.70	81.50
23	10 gal. acetone and 2 gal. benzene T, D, or B	6.797	0.8164	84.82	79.01
23A	10 gal. acetone T, D, or B	6.788	0.8153	86.37	81.11
23B	15 lbs. camphor, U. S. P.; 2 lbs. menthol, U. S. P.; 3 lbs. phenol, U. S. P. B or G	6.827	0.8200	93.50	90.33
23C	10 lbs. phenol, U. S. P.; 15 lbs. resorcinol, U. S. P.; 5 lbs. methyl salicylate, U. S. P. B or G	6.898	0.8285	.....	.....
23D	20 lbs. tannic acid, U. S. P.; 25 lbs. camphor, U. S. P. B or G	6.937	0.8331	90.95	86.92
23E	9 lbs. benzaldehyde, U. S. P.; 1 lb. salicylic acid, U. S. P. B or G	6.840	0.8215	94.02	91.00

(*d*) In manufacturing nitrous ether, after the tax-free alcohol has all been converted into nitrous ether it will be permissible for the manufacturer to add alcohol in order to dilute the product so that it may be more readily transported, or, for other purposes, but such added alcohol must in all cases be tax-paid alcohol.
(*e*) This formula can be used only in the manufacture of chloroform by a continuous process.
(*f*) The amount of denatured alcohol to be used in the finished product must not exceed 20%.

FORMULAS FOR SPECIALLY DENATURED ALCOHOL

Formula Number	Composition: Giving amounts of denaturants to be added to 100 gallons of 190° proof ethyl alcohol	Properties of Finished Formula: Weight in lbs./gal. at 15.6°C.	Sp. gr. in vac. 15.6°/15.6°C.	% Ethyl alcohol: by vol.	% Ethyl alcohol: by wt.
23F	3 lbs. salicylic acid, U. S. P.; 1 lb. resorcinol, U. S. P.; 1 gal. oil of bergamot, N. F. 5th edition B or G	6.808	0.8177	93.59	90.45
23G	10 gal. acetone; 4.25 lbs. sucrose octa-acetate	.....	.....	86.05	80.71
24	29 gal. *sulfuric acid* (*g*) G only	9.137	1.0970	83.10	77.15
25	20 lbs. iodine, U. S. P.; 15 lbs. potassium iodide, U. S. P., or sodium iodide, U. S. P. B or G	7.040	0.8455	93.65	90.54
25 Alt.	Solution composed of 20 lbs. iodine, U. S. P.; 15 lbs. potassium iodide, U. S. P., or 15 lbs. sodium iodide, U. S. P.; 15 lbs. water B or G	7.066	0.8486	93.15	88.51
26	5 gal. aniline oil T, D, or B	6.890	0.8275	90.50	86.33
27	1 gal. oil of rosemary, U. S. P.; 30 lbs. camphor, U. S. P. T, D, or B	6.846	0.8222	90.82	86.75
27A	35 lbs. camphor, U. S. P.; 1 gal. oil of cloves, U. S. P. T, D, or B	6.867	0.8247	90.90	86.79
27B	1 gal. oil of lavender flowers, U. S. P., and 100 lbs. soft soap, U. S. P. T, D, or B	7.027	0.8439	85.21	79.68
28	10 gal. approved benzene (*h*) T, D, or B	6.843	0.8219	86.36	81.12
28A	1 gal. gasoline (*i*) T, D, or B	6.786	0.8150	90.90	86.84
29	1 gal. 100% acetaldehyde or 5 gal. alcoholic solution of acetaldehyde containing not less than 20% acetaldehyde T, D, or B	6.822	0.8194	94.06	91.05

(*g*) In the manufacture of phenacetin: No part of the alcohol to remain in the finished product, which product must meet the specifications of the United States Pharmacopoeia. Alcohol so denatured to be used in the complete process for the manufacture of phenacetin and not merely for any one stage. Process to be closed and continuous.
(*h*) To be used in a closed and continuous process. Conditional authorization as motor fuel.
(*i*) With absolute alcohol as a base.

FORMULAS FOR SPECIALLY DENATURED ALCOHOL

Formula Number	Composition: Giving amounts of denaturants to be added to 100 gallons of 190° proof ethyl alcohol	Properties of Finished Formula: Weight in lbs./gal. at 15.6°C.	Sp. gr. in vac. 15.6°/15.6°C.	% Ethyl alcohol by vol.	% Ethyl alcohol by wt.
30	10 gal. pure methyl alcohol T, D, or B	6.785	0.8149	86.36	81.12
31A	100 lbs. glycerol, U. S. P.; 20 lbs. hard soap, toilet grade containing not in excess of 5% moisture T, D, or B	7.167	0.8608	85.17	79.64
31B	5.5 gal. oil of peppermint, U. S. P.; 1.25 gal. eucalyptol, U. S. P.; 4 lbs. menthol, U. S. P. T, D, or B	6.846	0.8223	88.63	83.93
31C	33 lbs. citric acid, U. S. P.; 33 lbs. menthol, U. S. P. B or G	6.974	0.8376	89.01	84.41
32	5 gals. ethyl ether T, D, or B	6.769	0.8130	90.53	86.33
33	30 lbs. methyl violet B or G	6.893	0.8279	92.22	88.60
33A	13 lbs. erythrosin B or G	6.869	0.8250	94.05	91.06
35	35 gal. ethyl acetate T, D, or B	6.956	0.8355	70.77	63.26
35A	5 gal. ethyl acetate (*j*) T, D, or B	6.821	0.8193	90.48	86.33
36	3 gal. concentrated aqua ammonia T, D, or B	6.837	0.8211	92.53	88.91
37	45 oz. eucalyptol, U. S. P.; 30 oz. thymol, U. S. P.; 20 oz. menthol, U. S. P. T, D, or B	6.794	0.8160	94.20	91.30
37A	5 lbs. menthol, U. S. P.; 10 lbs. camphor, U. S. P. T, D, or B	6.814	0.8184	94.48	91.72
38	5 gal. of a water solution of 60 oz. zinc chloride, U. S. P., and 10 lbs. of any one of the following: (1) methyl salicylate, U. S. P., (2) oil of wintergreen, U. S. P.; (3) oil of cassia, U. S. P.; (4) oil of cloves, U. S. P.; (5) oil of peppermint, U. S. P. B or G	6.970	0.8371	91.07	87.08

(*j*) To be used in closed process only.

FORMULAS FOR SPECIALLY DENATURED ALCOHOL

Formula Number	Composition: Giving amounts of denaturants to be added to 100 gallons of 190° proof ethyl alcohol	Properties of Finished Formula: Weight in lbs./gal. at 15.6°C.	Sp. gr. in vac. 15.6°/15.6°C.	% Ethyl alcohol: by vol.	% Ethyl alcohol: by wt.
38A	5 oz. menthol, U. S. P.; 9 oz. emetine hydrochloride, U. S. P.; 16 lbs. benzoic acid, U. S. P. B or G	6.853	0.8231	93.51	90.35
38B	A total of 10 lbs. of a mixture of two or more of the U. S. P. oils and substances listed below: (*k*) Camphor, chlorothymol, eucalyptol, menthol crystals, oil of bay, oil of bergamot, oil of cassia or cinnamon, oil of citronella, oil of cloves or eugenol, oil of eucalyptus, oil of lavender, oil of mustard (volatile), oil of peppermint, oil of pine or pine needles, oil of rosemary, oil of sassafras, oil of spearmint, oil of thyme, oil of turpentine, oil of wintergreen or methyl salicylate, phenols, phenyl salicylate, safrol with a specific gravity not less than 1.096 and not more than 1.110 at 16°C., thymol	6.804	0.8172	93.70	90.61
38C	160 oz. menthol, U. S. P.; 1.25 gal. solution of formaldehyde, U. S. P. B or G	6.832	0.8206	92.60	89.12
38D	40 oz. menthol, U. S. P.; 2.5 gal. formaldehyde, U. S. P. B or G	6.863	0.8242	92.53	89.02
38E	5 gal. fluid extract ipecac, U. S. P., or 40 lbs. ipecac, U. S. P. B or G	6.924	0.8316	91.00 91.40	86.99 87.52
39	1.25 gal. N. F. fluid extract quassia, and (1) 9 lbs. sodium salicylate, U. S. P.,	6.863	0.8242	92.50	88.98
	or (2) 9 lbs. salicylic acid, U. S. P., and ⅛ gal. of denaturing grade tert-butyl alcohol B or G	6.863	0.8242	92.44	88.90

(*k*) Any one desiring to use this formula must specify in the application which substances in the list of denaturants are selected to make up the 10 lbs. of denaturants required. Any one desiring to use 10 lbs. of only one of the denaturants must request the privilege from the Department setting out the denaturant and the reasons for the particular request so that the matter may be taken under advisement. Upon application the substitution of other essential oils or substances for those listed will be given consideration provided they are efficient denaturants and it is conclusively shown that none of the denaturants listed or any combinations thereof are satisfactory for the manufacture of any particular product.

FORMULAS FOR SPECIALLY DENATURED ALCOHOL

Formula Number	Composition: Giving amounts of denaturants to be added to 100 gallons of 190° proof ethyl alcohol	Properties of Finished Formula: Weight in lbs./gal. at 15.6°C.	Sp. gr. in vac. 15.6°/15.6°C.	% Ethyl alcohol: by vol.	% Ethyl alcohol: by wt.
39A	60 oz. of any one of the following U. S. P. alkaloids or salts: (1) quinine; (2) quinine bisulfate; (3) quinine hydrochloride (4) cinchonidine; or, (5) cinchonidine sulfate and 1/8 gal. of denaturing grade tert-butyl alcohol B or G	6.806	0.8174	93.70	90.61
39B	2.5 gal. diethyl phthalate and 1/8 gal. denaturing grade tert-butyl alcohol T, D, or B	6.856	0.8234	92.66	89.20
39C	1 gal. diethyl phthalate (*m*) T, D, or B	6.824	0.8196	94.05	91.10
39D	1 gal. oil of bay, N. F., and (1) 50 oz. quinine sulfate, U. S. P., or (2) 200 oz. sodium salicylate, U. S. P. B or G	6.819 6.819	0.8190 0.8190	93.82 92.54	90.78 89.04
40	3 oz. of the alkaloid brucine or brucine sulfate; 1/8 gal. denaturing grade tert-butyl alcohol T, D, or B	6.792	0.8158	94.43	91.63
41	20 lbs. menthol, U. S. P. T, D, or B	6.811	0.8180	92.48	88.96
42	80 grams potassium iodide, U. S. P.; 109 grams red mercuric iodide, U. S. P. B or G	6.797	0.8164	94.91	92.30
43	30 lbs. methyl salicylate, U. S. P. B or G	6.875	0.8258	92.00	88.31
44	10 gals. *n*-butyl alcohol T, D, or B	6.790	0.8155	86.33	81.07
44A	4 gals. approved methyl alcohol (*b*) (denaturing grade, sp. gr. 0.81984) and 10 gal. of any one of the following denaturants: (1) *n*-butyl alcohol (2) refined fusel oil (3) amyl alcohol (synthetic or natural) T, D, or B	6.790 6.794 6.792	0.8155 0.8160 0.8158	83.33 83.25 83.34	77.43 77.34 77.45

(*m*) Authorized for use in the manufacture of high grade perfumes and toilet waters containing not less than 2% by weight of essential oils, or their equivalent in perfume materials.

FORMULAS FOR SPECIALLY DENATURED ALCOHOL

Formula Number	Composition: Giving amounts of denaturants to be added to 100 gallons of 190° proof ethyl alcohol	Properties of Finished Formula: Weight in lbs./gal. at 15.6°C.	Sp. gr. in vac. 15.6°/15.6°C.	% Ethyl alcohol: by vol.	% Ethyl alcohol: by wt.
45	300 lbs. of white or orange shellac, arsenic and rosin free (*n*) D or B	7.545	0.9061	73.15	65.84
46	25 fluid oz. phenol, U. S. P.; 4 oz. methyl salicylate, U. S. P. B or G	6.805	0.8173	94.83	92.19
47	7 gal. fluid extract arnica flowers, N. F. (4th edition) B or G	6.882	0.8265	88.36	83.60

FORMULAS FOR COMPLETELY DENATURED ALCOHOL

Revised to July, 1936

Formula Number	Composition: Giving amounts of denaturant to be added to 100 parts by volume of ethyl alcohol of not less than 160° proof (*p*)	Properties of Finished Formula: Weight in lbs./gal. at 15.6°C.	Sp. gr. in vac. 15.6°/15.6°C.
11	3 parts by volume of "Pontol-K"(*r*), or a similar compound; 3 parts by volume of "ST-115", or a similar compound; 1 part by volume of gasoline; 0.5 part by volume of "Hydronol" or a similar compound	6.827	0.8198
12	4 parts by volume of "Pontol-K"(*r*), or a similar compound; 2 parts by volume of methyl isobutyl ketone; 1 part by volume of gasoline; 1 part by volume of "Agdite" or a similar compound, or 2 parts by volume of "Hydronol"(*r*), or a similar compound	6.827	0.8198
13	4 parts by volume of "ST-115"(*r*), or a similar compound; 2 parts by volume of methyl isobutyl ketone; 1 part by volume of "Agdite"(*r*), or a similar compound, or 1 part by volume of "Hydronol" or a similar compound	6.827	0.8198

(*n*) Applications to use this formula will be approved only when filed by proprietors of bonded denaturing plants, and such persons will be allowed to sell or dispose of such specially denatured alcohol only after it has been compounded with other ingredients of the character and in the manner approved by the Department. Each application to use specially denatured alcohol Formula No. 45 should show the other ingredients which it is proposed to add and the process to be employed.

(*p*) All types of completely denatured alcohol may be compounded with anhydrous alcohol where required.

(*r*) These are the trade names for denaturants of various manufacturers. Pontol is a DuPont product consisting principally of a mixture of primary and secondary aliphatic higher alcohols and other compounds of characteristic odor and taste. ST-115 is a Tennessee Eastman product, free from wood alcohol, containing a definite proportion of the pyroligneous compounds obtained in the destructive distillation of wood. Hydronol is a DuPont product free from water and suspended materials, having a characteristic taste and odor, and prepared by hydrogenation of organic substances. Agdite, prepared by the Standard Oil Company of California, is a compounded petroleum product free from water and all suspended materials, containing at least 4.5% sulfur.

AUTHORIZED USES OF DENATURED ALCOHOL FORMULAS

In the Manufacture of:	Formula No.
Acetaldehyde	1
Acetanilide	1; 3A
Acetate of lime	18
Acetic acid (glacial)	29
Acetic ether (ethyl acetate)	1; 2A; 2B; 3A; 12A; 15; 17; 19; 24; 35A
Acetone	18
Acet-p-aminophenolsalol	35
Acetphenetidine	1; 2B; 3A; 6B; 12A; 17; 24
Aconite	1
Adalin	3A
Adeps lanae	1
Alcoholic dye solutions	23; 23A
Aldehydes	29
Alkaform	13A
Alkaloids	3A
Alkaloids and alkaloidal salts	1
Aloin	1
Ammonium salts of lauric and oleic acids	13A
Aniline dyes, solutions of	23; 23A
Ammunition	1; 2B; 12A
Anesthetic ether	13A
Anhydrous soap	12A
Analytical work	1
Antipyrine	1
Antiseptic alcohol	46
Antiseptic solutions for external use	27A; 37; 37A
Apocyanin	1
Arabinose	1
Arbutin	1
Artificial feathers	1
Artificial flowers	1
Artificial leather	23A
Artificial leather solutions and thinners	44A
Artificial musks	30
Artificial silk	19; 23A; 34
Arsphonamine	1; 2B; 13A
Asclepiadin	1A
Aspirin	1
Atophan	1
Avenin	1
Backing of films	19
Barbers' supply preparations	39; 39A; 39B
Barbital	2B; 3A; 12A
Barometer tubes	1
Bay rum	39D
Benzaldehyde	1
Benzene	1
Benzidine	1
Benzoic acid	1; 12A
Benzoin	1
Benzonaphthol	3A
Benzoyl cyanide	1
Beta-naphtha centralites	2B
Billiard and pocket balls composition	1
Bluing (laundry)	1
Bottle caps	1
Bromocamphor	1
Bromofluorescein	3A
Bronze powders	1
Brown mixture tablets	3A
Brushes	1
Butyric ether (ethyl butyrate)	1; 6B; 13A; 24; 29
By-products, distillery slop	3A; 19
Calorene gas (ethylene)	32
Carbon remover	44
Camphor, synthetic	1; 2B
Candy glaze	35; 45
Caproic acid	13A
Caproic ether (ethyl caproate)	13A
Casing fluids	4
Caustic potash or soda	1; 12A
Celluloid, pyralin and similar products	2A
Celluloid cement	30
Celluloid scraps (reworking)	1; 30
Cements	1; 2B
Certified food colors	13A; 33A
Chemical preparations	13A
Chemical and physical laboratory purposes	30
Chewing tobacco	4
Chloral hydrate	1; 6B; 17
Chloroform	1; 20; 29
Chloroform liniment	27
Cigarettes	4
Cigars	4
Cimicifugin	1
Cinchona bark alkaloid and preparations	3A
Cinchophen	1
Citronellol	12A
Cleaning fluid	12A
Cocoa butter	1
Codeine	3A
Collodion	1; 13A; 19
Collodion corn remedy	1
Color powders	1
Compasses	1
Composition billiard and pocket balls	1
Concentrations (non-liquid)	1
Confectioners' colors	1

AUTHORIZED USES OF DENATURED ALCOHOL FORMULAS

In the Manufacture of:	Formula No.
Coumarin	1
Cutlery	1
Cutting oils	3A
Dandelion	1
Dehydration of nitrocellulose	2B
Dehydration of film material	3A
Dental alloy	1
Dental gold	30
Dentifrices	38; 38A; 38B; 38C; 38D; 38E
Deodorants	1; 3A; 23A
Dextrin	1
Dextrose	1
Diacetylmorphine	3A
Diaminophenol	2B
Diastase	35A
Dichloroethane	6B; 17
Diethylaniline	1; 26
Diethylbarbituric acid (barbital)	2B; 3A; 12A
Diethyl oxalate	2B
Diethyl phthalate	2B
Diethyl sulfate	2B
Digestive ferments	1; 30
Digitalis	1
Dikote solution	44
Dimethylglyoxime	1
Dimethyl sulfate	2B
Dinitrotoluene	1
Disinfectant germicide	1
Door checks	1
Dry extracts for food products	13A
Duplicating fluid	3A; 30
Dye intermediates	12A; 26
Dyeing feathers	1; 23A
Dyeing furs	30
Dyes	2B; 26
Dyestuffs	1
Dyes for industrial purposes	1
Embalming fluid	1; 3A; 22
Emulsions	43
Enamel	1
Eosine	1
Essential oil orris	1
Esters	3A
Ether	1; 2B
Ether for anesthesia	13A
Etherial oil	13A
Ethyl acetate	1; 2A; 2B; 3A; 12A; 15; 17; 19; 24; 35A
Ethyl aniline	1; 26
Ethyl benzoate	1
Ethyl bromide	1; 6B; 15
Ethyl butyrate	1; 6B; 13A; 24; 29
Ethyl chloride	1; 2B; 3A; 6B; 15; 17; 29
Ethylene	2B; 17; 32
Ethyl ester, dye intermediates	12A
Ethyl esters of cinnamic, lauric, benzoic, and pelargonic acids	2B
Ethyl formate	1
Ethyl lactate	2B; 29
Ethyl levulinate	1
Ethyl morphine	3A
Ethyl nitrite	15
Ethyl oxide hydrate	24
Ethyl palmitate	2B
Ethyl propionate	13A
Ethyl sulfate	2B
Ethyl valerate	24; 29
Experimental purposes	3A; 12A
Extracts (solid and powdered)	23A
Extracting glycerol from distillery slop	1
Felt base floor covering	1
Fertilizers	1
Filaments for incandescent lamps	1
Film, backing of	19
Films	3A
Fireworks	1
Food colors (certified)	13A; 33A
Food products, washing of	32
Foot powder	1
Formaldehyde	1
Formaldehyde for (preserving)	22
Formic ether (ethyl formate)	1
Fungicides	1; 23A
Fulminate of mercury	1; 6A
Fulminate of mercury (para)	6B
Fur dyeing	30
Fur luster	23A
Gaduol	1
Galactose	1
Gallocyanine	1
Gas mantles	1
Gelatine capsules	1
Gentian (solid extract)	1
Geraniol	1; 12A
Glandular products	30
Glass	1
Glass enamel	1
Glue	1; 3A
Glycerophosphates	1; 3A
Gradometers	3A
Green soap, tincture of	27B
Guaiacol	1; 2B; 6B
Guaiacol carbonate	1
Gum and pyroxylin solutions	1; 44A
Hats	1

AUTHORIZED USES OF DENATURED ALCOHOL FORMULAS

In the Manufacture of:	Formula No.
Heliotropin	1
Hexachlorobenzene	1
Homatropin	3A
Honeycomb (remedies for treatment of)	22
Hydrastis (alkaloid of)	1
Hydrazoanisole	12A
Hydroquinone	2B; 6B
Hydrosulfate sodium	2A
Hypodermic tablets	30
Imitation ivory goods	1
Imitation leather	1
Imitation rubber	12A
Incandescent lamp filaments	1
Incense	1
Incorporating certified color in food products	33A
Inks	1
Insecticides	1
Insulin	1; 13A
Intermediates	26
Inulin	1
Iodine, or tincture of	25; 25 alt.
Iodizers	19
Iriscin	1
Isinglass	1
Jalapin (non-liquid concentration of)	1
Japans	1
Jewelry	1
Ketone, Michler's	2B
Laboratory purposes	1; 2B; 30
Lacquers	1; 23A; 44A
Lacquer thinners and solvents	1; 23A; 44A
Lacquer substitutes	1; 23A; 44A
Lanasol	3A
Leather dressing	23A
Leather finishes	23A
Leather goods finish	1
Leather substitutes	1
Levulose	1
Ligatures	1; 12A; 42
Liniment of soft and green soap	27B
Liniments	23; 23A; 23B; 23C; 23D; 23E; 23F; 27A; 47
Liquid sealing compound	12A
Liquid soap	1; 3B; 31A; 31B; 31C
Liquor cresolis compositus	1
Lithographers' transfers	19
Lotions for external use	23; 23A; 23B; 23C; 23D; 23E; 23F; 37; 37A; 38B; 39B; 39D; 47
Lozenges	41
Lysol	1
Maltose	1
Mandrake (powdered and solid, extract of)	1
Mannose	1
Meat branding inks	33
Melibiose	1
Metol	1; 2B
Mercuric chloride tablets	3A
Mercurochrome	30
Methyl sulfate	2B
Mica insulators	1
Michler's ketone	2B
Milk protein	12A
Mirrors	1; 3A; 30
Moulding and picture frames	1
Morphine	3A
Moth-proof products	23A
Moth repellant	1
Motor fuel	1; 2B; 28; 28A
Mouth washes	38; 38B; 38C; 38E
Mucilage	1
Mustard oil (synthetic)	1; 3A
β-Naphthol	1; 3A
β-Naphthyl benzoate	1; 3A
β-Naphthyl salicylate	1
Neoarsphenamine	2B; 13A
Neosalvarsan	2B; 13A
Nitrocellulose (solution and solvent of)	1
Nitrophenetole (p)	12A
Nitroso-β-naphthol	1
Nitrous ether	2B; 15
Oils, greases, lubricants, and soluble thread-cutting oils	1
Oil burner preparations	44
Oleoresins	1; 30
Optical goods	1
Orris, essential oil of	1
Paints	1
Paper	1
Paper-testing compound	1
Paraffin	1
Parafulminate of mercury	6B
Pastes	1
Pastes and varnishes from soluble cotton	1
Patent leather	1
Pectin	2B; 35A
Pencils	1
Pepsin and similar products	1
Perfume bases (synthetic)	1
Perfumes	39B; 39C; 40
Petroleum oils, white	2B; 30

AUTHORIZED USES OF DENATURED ALCOHOL FORMULAS

In the Manufacture of:	Formula No.
Phenacetin	1; 2B; 3A; 6B; 12A; 17; 24
Phenetidine (p)	6B; 17
Phenolphthalein	1
Phenyl-cinchoninic acid	1; 3A
Phenylacetic acid	2B
Photo enlargements	5
Photographic collodion	5; 11
Photographic emulsions	3A
Photographic engravings	1; 5; 11; 13A; 19
Photographic dry plates	1; 30
Photographic films	1; 3A; 19
Photoprints	5; 11
Phytolacin (concentration of)	1
Picric acid test for U. S. Government	2B
Pipe-cleaning preparations	1; 23A
Plumbing material	1
Podophyllin resin and similar products	1
Polish preparations for metals and furniture	1
Potassium cyanate	1
Potassium hydroxide	1; 12A
Potassium sodium xanthate	2B
Powdered chemicals	2B
Powder compact	1
Powdered drugs and extracts	1; 23A
Print paper and enlargements	1
Propionic ether (ethyl propionate)	13A
Protargentum	13A
Pyroxylin cements	1; 30
Pyroxylin plastics	2B
Pyroxylin solutions	1; 44A
Raffinose	1
Recrystallization and purification purposes	1
Refining mineral oils	1
Refining potassium and sodium hydroxides	1; 12A
Refining precious metals	1
Resin of scammony	1
Resins	1
Resorcinol	1
Rhamnose	1
Rhodinol	1
Rouge compact	1
Rubbing alcohol compounds	23G
Saccharine	1; 2B
Saccharose	1
Sajodin	3A
Salicylate cocaine	3A
Salicylaldehyde	1
Salicylic acid	1; 3A
Salol	1; 3A
Salophen	1
Salvarsan	1; 2B; 13A
Sanatogen	12A
Santonin and strychnine	1
Saponification of the waxes of acid-fast bacteria	12A
Saponin	1
Senna (extract of)	3A
Shampoo	3A; 3B; 31A; 31B; 31C
Shampoo jelly	1; 3A; 3B
Shampoo liquid	1
Shaving cream	31A; 31B; 31C; 36
Shellac	1
Shellacs and varnishes	1A
Shellac substitutes	44A
Shellac thinner	1
Shellac varnish	1
Shoe polish	1
Silk, artificial	19; 23A; 34
Silk fabrics	1
Silverware and bronze	1
Smelling salts	3B
Smoking tobacco	4
Smokeless powder	1; 2B; 12A
Soap, anhydrous	12A
Soap liniment	27; 27B
Soap (liquid)	1; 3B; 31A; 31B; 31C
Soap, soft	27B
Soap (tincture of benzoin)	3A
Soap, green (tincture of)	27B
Soap (transparent)	1; 3A
Sodium	3A
Sodium benzoate	1
Sodium ethyl sulfate	13A
Sodium hydroxide	1; 12A
Sodium hyposulfite	2B
Soldering flux	1
Solid confections	41
Solid extracts	1; 23A
Solidified alcohol	1
Solution for aniline spirits and varnishes	1
Solution and solvent for nitrocellulose	1
Solvent purposes	1
Sorbitol	1
Spirit varnishes	23A; 44A
Stains	1
Stanolind	1
Stencil inks	1
Stencil paper	1
Sterile surgical ligatures	42
Sterilizing solution for corks	1
Sterilizing alcohol	46
Strontium	3A
Strychnine	1; 3A

AUTHORIZED USES OF DENATURED ALCOHOL FORMULAS

In the Manufacture of:	Formula No.
Strychnine alkaloids and preparations	3A
Sulfonic acids	1
Sulfuric ether	1; 2B; 13A
Suppositories	37
Surgical ligatures	1; 12A; 42
Tannic acid	1
Terpeneless oils	30
Terpin hydrate	1; 12A
Textile cleaning soap	1
Theobromine	1
Thermometer tubes	1
Thermometers and hydrometers	1
Thermostatic devices	1
Thybromol	30
Tincture of benzoin soap	3A
Tincture of green soap	27A
Tincture of iodine	25; 25 alt.
Tinfoil	1
Tobacco	1; 4
Toilet preparations	3B; 40
Toilet waters	39B; 39C
Toluenesulfamide (o)	1
Toluidine	1
Tooth paste	31A; 31B; 31C
Transparent paper	1
Transparent soap	1; 3A
Transparent soap for waterproofing cement	1
Trehalose	1
Trinitrotolene	1; 2B; 12A
Trioxyaline	1
Tuberculin purified	1
Tubes (collapsible)	12A
Urea	12A
Uric acid	1
Vacuum tubes	30
Vanillin	3A
Varnish	2A; 30
Varnish remover	1; 23A
Vegetable colors	1
Vegetable oils	30
Veronal	2B; 3A; 12A
Viburnum (concentration)	1
Vinegar	18
Viscaloid	2B
Vitamines, extraction from cod liver oil	1
Washing food products	32
Washing lenses	1
Watches	1
Water colors	1
Waterproofing fiber signs	1
Wax (prepared)	1
White petroleum oils	2B; 30
Wood filler	1
Wood finish	1
Wool fat	1
Xanthates	23
Xylose	1

DIMENSIONAL FORMULAS

Dimensional formulas show the relation of various physical quantities and their units in terms of the fundamental quantities of mass, length, and time. In these equations l = length; m = mass; t = time; θ = angle; ω = solid angle; T = temperature; ψ = luminous flux; ϵ = dielectric constant; μ = magnetic permeability; and v = volume = l^3. In the electrostatic, or *cgse*, system: l = cm.; m = g.; t = mean solar second; T = absolute degree Centigrade; and ϵ = dielectric constant of a vacuum. In the electromagnetic, or *cgsm*, system ϵ is replaced by μ, magnetic permeability.

Absorptivity; coefficient of absorption $[l^{-1}]$
Acceleration $[lt^{-2}]$
Acceleration, angular $[\theta\, t^{-2}]$
Action $[ml^2t^{-1}]$
Angle $[\theta]$
Angle, solid $[\omega]$
Area $[l^2]$
Brightness, surface $[\psi\, l^{-2}\, \omega^{-1}]$
Bulk modulus, *cf.* stress.
Capacity, electrical $[\epsilon l]$; $[\mu^{-1}\, l^{-1}t^2]$
Charge $[\epsilon^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{3}{2}}t^{-1}]$; $[\mu^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}]$
Compressibility $[m^{-1}lt^2]$
Compression, modulus of, *cf.* stress.
Concentration, mass, *cf.* mass concentration.
Concentration, volume, *cf.* density.
Conductivity, electrical mass $[\epsilon\, m^{-1}l^3t^{-1}]$; $[\mu^{-1}m^{-1}l^{\frac{1}{2}}]$
Conductivity, thermal, *cf.* thermal conductivity.
Conductivity, volume $[\epsilon t^{-1}]$; $[\mu^{-1}l^{-2}t]$
Current, electrical $[\epsilon^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{3}{2}}t^{-2}]$; $[\mu^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-1}]$
Density $[ml^{-3}]$ or $[mv^{-1}]$
Dielectric constant $[\epsilon]$; $[\mu^{-1}l^{-2}t^2]$
Dielectric strength $[\epsilon^{-\frac{1}{2}}m^{\frac{1}{2}}l^{-\frac{1}{2}}t^{-1}]$; $[\mu^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-2}]$
Diffusion, coefficient of $[l^2t^{-1}]$
Displacement, total electric, *cf.* charge.
Electrical current, *cf.* current, electrical.
Electric displacement, total, *cf.* charge.
Electrical inductivity $[\epsilon]$; $[\mu^{-1}l^{-2}t^2]$
Electrical potential, *cf.* potential, electrical.
Electrical quantity, *cf.* charge.
Energy $[ml^2t^{-2}]$
Ettinghausen effect, coefficient of $[\epsilon^{-1}m^{-1}l^{-1}t^4T]$; $[\mu m^{-1}lt^2T]$
Field intensity, magnetic, *cf.* magnetic field intensity.
Field strength, electrical, *cf.* dielectric strength.
Fluidity $[m^{-1}lt]$
Flux of induction, *cf.* charge.
Flux, luminous, *cf.* luminous flux.
Flux of magnetic induction; magnetic flux $[\epsilon^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{3}{2}}]$; $[\mu^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-1}]$
Force $[mlt^{-2}]$
Force, magnetizing, *cf.* magnetizing force.

DIMENSIONAL FORMULAS (Continued)

Force, magnetomotive, *cf.* magnetomotive force.
Force, moment of, *cf.* torque.
Frequency $[t^{-1}]$
Friction, coefficient of skin, *cf.* skin friction, coefficient of.
Hall effect, coefficient of $[\epsilon^{-\frac{1}{2}}m^{-\frac{1}{2}}l^{-\frac{1}{2}}t^{3}]$; $[\mu^{\frac{1}{2}}m^{-\frac{1}{2}}l^{\frac{3}{2}}]$
Heat, *cf.* energy.
Illumination of a surface $[\psi l^{-2}]$
Inductance, electrical $[\epsilon^{-1}l^{-1}t^{2}]$; $[\mu l]$
Induction, flux of, *cf.* charge.
Induction, magnetic, *cf.* magnetic induction.
Inductivity, *cf.* electrical inductivity.
Intensity, luminous, *cf.* luminous intensity.
Intensity of magnetization, *cf.* magnetic induction.
Intensity of radiation, *cf.* radiation, intensity of.
Ionic mobility $[\epsilon^{\frac{1}{2}}m^{-\frac{1}{2}}l^{\frac{3}{2}}]$; $[\mu^{-\frac{1}{2}}m^{-\frac{1}{2}}l^{\frac{3}{2}}t]$
Kinematic viscosity, *cf.* viscosity, kinematic.
Leduc effect, coefficient of $[\epsilon^{-\frac{1}{2}}m^{-\frac{1}{2}}l^{-\frac{1}{2}}t^{2}]$; $[\mu^{\frac{1}{2}}m^{-\frac{1}{2}}l^{\frac{3}{2}}t]$
Length $[l]$
Luminous flux $[\psi]$
Luminous intensity of a source in a given direction $[\psi\omega^{-1}]$
Magnetic field intensity $[\epsilon^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-2}]$; $[\mu^{-\frac{1}{2}}m^{\frac{1}{2}}l^{-\frac{1}{2}}t^{-1}]$
Magnetic flux, *cf.* flux of magnetic induction.
Magnetic induction $[\epsilon^{-\frac{1}{2}}m^{\frac{1}{2}}l^{-\frac{1}{2}}]$; $[\mu^{\frac{1}{2}}m^{\frac{1}{2}}l^{-\frac{1}{2}}t^{-1}]$
Magnetic induction, flux of, *cf.* flux of magnetic induction.
Magnetic permeability $[\mu]$; $[\epsilon^{-1}l^{-2}t^{2}]$
Magnetic potential, *cf.* magnetomotive potential.
Magnetic potential gradient, *cf.* magnetic field intensity.
Magnetic reluctance $[\epsilon l t^{-2}]$; $[\mu^{-1}l^{-1}]$
Magnetism, quantity of, *cf.* flux of magnetic induction.
Magnetizing force, *cf.* magnetic field intensity.
Magnetomotive force $[\epsilon^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-2}]$; $[\mu^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-1}]$
Mass $[m]$
Mass concentration $[m_1m_2^{-1}]$ (where $m_1 = m_2$, is called titer or is denoted as per cent).
Mass conductivity, electrical, *cf.* conductivity, electrical mass.
Mass resistivity, electrical, *cf.* resistivity, electrical mass.
Mobility, ionic, *cf.* ionic mobility.
Modulus, bulk, *cf.* stress.
Modulus of compression, *cf.* stress.
Modulus of rigidity, *cf.* stress.
Modulus, Young's, *cf.* stress.
Moment of a force, *cf.* torque.
Nernst effect, coefficient of $[\epsilon^{-1}lT^{-1}]$; $[\mu l^{2}t^{-1}T^{-1}]$
Peltier coefficient $[\epsilon^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-1}]$; $[\mu^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{3}{2}}t^{-2}]$
Per cent, *cf.* mass concentration.
Permeability, *cf.* magnetic permeability.
Piezoelectric constant $[\epsilon^{\frac{1}{2}}m^{-\frac{1}{2}}l^{\frac{1}{2}}t]$; $[\mu^{-\frac{1}{2}}m^{-\frac{1}{2}}l^{-\frac{1}{2}}t^{2}]$
Pole strength, *cf.* flux of magnetic induction.

DIMENSIONAL FORMULAS (Continued)

Potential, electrical $[\epsilon^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-1}]$; $[\mu^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-2}]$
Potential gradient, *cf.* dielectric strength.
Potential gradient, magnetic, *cf.* magnetic potential gradient.
Potential, magnetic, *cf.* magnetomotive potential.
Power $[ml^2t^{-3}]$
Power, thermoelectric, *cf.* thermoelectric power.
Pressure, *cf.* stress.
Quantity, electrical, *cf.* charge.
Quantity of magnetism, *cf.* flux of magnetic induction.
Radiation, intensity of $[ml^{-3}]$ or $[ml^{-1}t^{-2}]$
Reluctance, magnetic, *cf.* magnetic reluctance.
Resistance, electrical $[\epsilon^{-1}l^{-1}t]$; $[\mu lt^{-1}]$
Resistance, electrical volume $[\epsilon^{-1}t]$; $[\mu l^2t^{-1}]$
Resistivity, electrical mass $[\epsilon^{-1}ml^{-3}t]$; $[\mu ml^{-1}t^{-1}]$
Resistivity, surface, *cf.* resistance, electrical.
Rigidity, modulus of, *cf.* stress.
Rotatory power $[\theta l^{-1}]$
Skin friction, coefficient of $[ml^{-1}t^{-2}]$
Solubility (non-gaseous), *cf.* density.
Specific heat of electricity, *cf.* Thomson effect, coefficient of.
Strength, dielectric, *cf.* dielectric strength.
Strength, electrical field, *cf.* dielectric strength.
Strength, pole, *cf.* flux of magnetic induction.
Stress $[ml^{-1}t^{-2}]$
Surface brightness, *cf.* brightness, surface.
Surface resistivity, *cf.* resistance, electrical.
Surface tension $[mt^{-2}]$
Susceptibility, electrical $[\mu]$; $[\epsilon^{-1}l^{-2}t^2]$
Temperature $[T]$
Tension, *cf.* stress.
Tension, surface, *cf.* surface tension.
Thermal conductivity $[mlt^{-3}T^{-1}]$
Thermoelectric power $[\epsilon^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-1}T^{-1}]$; $[\mu^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-2}T^{-1}]$
Thomson effect, coefficient of $[\epsilon^{-\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-1}T^{-1}]$; $[\mu^{\frac{1}{2}}m^{\frac{1}{2}}l^{\frac{1}{2}}t^{-2}T^{-1}]$
Time $[t]$
Titer, *cf.* mass concentration.
Torque $[ml^2t^{-2}]$
Twist, *cf.* rotatory power.
Velocity $[lt^{-1}]$
Velocity, angular $[\theta t^{-1}]$
Velocity of a process $[t^{-1}]$
Verdet's constant $[\epsilon^{-\frac{1}{2}}m^{-\frac{1}{2}}l^{-\frac{1}{2}}l^2\theta]$; $[\mu^{\frac{1}{2}}m^{-\frac{1}{2}}l^{-\frac{1}{2}}lt\theta]$
Viscosity $[ml^{-1}t^{-1}]$; **viscosity, kinematic** $[l^2t^{-1}]$
Volume $[l^3]$; $[v]$; **volume concentration,** *cf.* density.
Volume conductivity, *cf.* conductivity, volume.
Volume resistance, electrical, *cf.* resistance, electrical volume.
Work, *cf.* energy.
Young's modulus, *cf.* stress.

PROBABLE VALUES OF THE PHYSICAL CONSTANTS

Values as of August 1941. By Raymond T. Birge, *Reviews of Modern Physics*, 13, *233, (1941)*.

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TABLE A. Principal Constants and Ratios †

Velocity of light	c	$= (2.99776 \pm 0.00004) \times 10^{10}$ cm·sec^{-1}
Gravitation constant	G	$= (6.670 \pm 0.005) \times 10^{-8}$ dyne·cm^2·g^{-2}
Liter (=1000 ml)	l	$= 1000.028 \pm 0.002$ cm^3
Volume of ideal gas (0°C, A_0)	V_0	$= (22.4146 \pm 0.0006) \times 10^3$ cm^3·atmos·mole^{-1}
	V_0'	$= 22.4140 \pm 0.0006$ liter·atmos·mole^{-1}
Volume of ideal gas (0°C, A_{45})	V_{45}	$= (22.4157 \pm 0.0006) \times 10^3$ cm^3·atmos·mole^{-1}
	V_{45}'	$= 22.4151 \pm 0.0006$ liter·atmos·mole^{-1}
International ohm (=p abs-ohm)	p	$= 1.00048 \pm 0.00002$
International ampere (=q abs-amp)	q	$= 0.99986 \pm 0.00002$
Atomic weights (*see Table A'*)		
Standard atmosphere	A_0	$= (1.013246 \pm 0.000004) \times 10^6$ dyne·cm^{-2}·atmos^{-1}
45° atmosphere	A_{45}	$= (1.013195 \pm 0.000004) \times 10^6$ dyne·cm^{-2}·atmos^{-1}
Ice-point (absolute scale)	T_0	$= 273.16 \pm 0.01$°K
Joule equivalent	J_{15}	$= 4.1855 \pm 0.0004$ abs-joule·cal$_{15}^{-1}$
Joule equivalent (electrical)	J_{15}'	$= 4.1847 \pm 0.0003$ int-joule·cal$_{15}^{-1}$
Faraday constant		
(1) Chemical scale		
	F	$= 96501.2 \pm 10$ int-coul·g-equiv^{-1}
		$= 96487.7 \pm 10$ abs-coul·g-equiv^{-1}
		$= 9648.7_7 \pm 1.0$ abs. e.m.u·g-equiv^{-1}
	$F' = Fc$	$= (2.89247 \pm 0.00030) \times 10^{14}$ abs. e.s.u·g-equiv^{-1}
(2) Physical scale		
	F	$= 96514.0 \pm 10$ abs-coul·g-equiv^{-1}
		$= 9651.4_0 \pm 1.0$ abs. e.m.u·g-equiv^{-1}
	$F' = Fc$	$= (2.89326 \pm 0.00030) \times 10^{14}$ abs. e.s.u·g-equiv^{-1}
Avogadro number (chemical scale)	N_0	$= (6.0228_3 \pm 0.0011) \times 10^{23}$ mole^{-1}
Electronic charge	$e = F/N_0$	$= (1.60203_3 \pm 0.00034) \times 10^{-20}$ abs. e.m.u.
	$e' = ec$	$= (4.8025_1 \pm 0.0010) \times 10^{-10}$ abs. e.s.u.
Specific electronic charge	e/m	$= (1.7592 \pm 0.0005) \times 10^7$ abs. e.m.u·g^{-1}
	$e'/m = ec/m$	$= (5.2736_6 \pm 0.0015) \times 10^{17}$ abs. e.s.u·g^{-1}
Planck constant	h (*see Table C*),	

TABLE A'. Atomic Weights.

(1) Physical scale ($O^{16} = 16.0000$)

$H^1 = 1.00813 \pm 0.00001_7$ $H^2 = 2.01473 \pm 0.00001_9$

$H = 1.00827_6 \pm 0.00001_7$ (from H^1/H^2 abundance $= 6900 \pm 100$)

$He^4 = 4.00389 \pm 0.00007$

$C^{12} = 12.00386 \pm 0.00004$ $C^{13} = 13.00761 \pm 0.00015$

$C = 12.01465 \pm 0.00023$ (from C^{12}/C^{13} abundance $= 92 \pm 2$)

$N^{14} = 14.00753 \pm 0.00005$ $N^{15} = 15.0049 \pm 0.0002$

$N = 14.01121 \pm 0.00009_5$ (from N^{14}/N^{15} abundance $= 270 \pm 6$)

$O^{16} = 16.0000$ $O^{17} = 17.0045$ $O^{18} = 18.0049$

$O = 16.00435_7 \pm 0.00008_6$ (from abundance $O^{16} : O^{18} : O^{17} = (506 \pm 10) : 1 : (0.204 \pm 0.008)$)

(2) Chemical scale ($O = 16.0000$)

Ratio physical to chemical scale

$r = (16.004357 \pm 0.000086)/16 = 1.000272 \pm 0.000005$

$H^1 = 1.00785_6 \pm 0.00001_8$ (from physical scale)

$H^2 = 2.01418_2 \pm 0.00002_1$ (from physical scale)

$H = 1.00800_2 \pm 0.00001_8$ (from physical scale)

$He^4 = 4.00280 \pm 0.00007$ (from physical scale)

$C = 12.01139 \pm 0.00024$ (from physical scale)

$N = 14.00740 \pm 0.00012$ (from physical scale)

$N = 14.0086 \pm 0.0007$ (direct observation)

$Na = 22.994 \pm 0.003$

$Cl = 35.457 \pm 0.001$

$Ca = 40.080 \pm 0.005$

$Ag = 107.880 \pm 0.002$

$I = 126.915 \pm 0.004$

† Unless otherwise specified, all quantities in these tables that involve the mole or the gram equivalent are on the chemical scale of atomic weights.

PROBABLE VALUES OF THE PHYSICAL CONSTANTS

TABLE B. Additional Quantities Evaluated or Used in Connection with TABLE A

Ratio of e.s.u. to e.m.u. (direct)	c'	$= (2.9971_2 \pm 0.0001) \times 10^{10}$ cm$^{\frac{1}{2}}$·sec$^{-\frac{1}{2}}$·int-ohm$^{\frac{1}{2}}$
		$= (2.9978_4 \pm 0.0001_0) \times 10^{10}$ cm·sec^{-1}
Ratio of e.s.u. to e.m.u. (indirect)	$c' = c$	$= (2.99776 \pm 0.00004) \times 10^{10}$ cm·sec^{-1}
Average density of earth	δ	$= 5.517 \pm 0.004$ g·cm^{-3}
Maximum density of water	$\delta_m(H_2O)$	$= 0.999972 \pm 0.000002$ g·cm^{-3}
Acceleration of gravity (standard)	g_0	$= 980.665$ cm·sec^{-2}
Acceleration of gravity (45°)	g_{45}	$= 980.616$ cm·sec^{-2}
Density of oxygen gas (0°C, A_{45})	L_1	$= 1.42897 \pm 0.00003$ g·liter^{-1}
Limiting density of oxygen gas (0°C, A_{45})	$L_{\lim}$	$= 1.427609 \pm 0.000037$ g·liter^{-1}
Factor converting oxygen (0°C, A_{45}) to ideal gas	$1-\alpha$	$= 1.000953_5 \pm 0.000009_4$
International coulomb ($=q$ abs-coul)	q	$= 0.99986 \pm 0.00002$
International gauss ($=q$ abs-gauss)		
International henry ($=p$ abs-henry)	p	$= 1.00048 \pm 0.00002$
International volt ($=pq$ abs-volt)	pq	$= 1.00034 \pm 0.00003$
International joule ($=pq^2$ abs-joule)	pq^2	$= 1.00020 \pm 0.00004_5$
Specific gravity of Hg (0°C, A_0) referred to air-free water at maximum density	ρ_0	$= 13.59542 \pm 0.00005$
Density of Hg (0°C, A_0)	D_0	$= 13.59504_0 \pm 0.00005_7$ g·cm^{-3}
Electrochemical equivalents (chemical scale)		
silver (apparent)	E^*_{Ag}	$= 1.11800 \times 10^{-3}$ g·int-coul^{-1}
(corrected)	E_{Ag}	$= (1.11807 \pm 0.00012) \times 10^{-3}$ g·abs-coul^{-1}
iodine (apparent)	E^*_I	$= (1.315026 \pm 0.000025) \times 10^{-3}$ g·int-coul^{-1}
(corrected)	E_I	$= (1.31535 \pm 0.00014) \times 10^{-3}$ g·abs-coul^{-1}
Effective calcite grating space (18°C.), Siegbahn system	d_{18}''	$= 3.02904 \times 10^{-8}$ cm
True calcite grating space (20°C.), Siegbahn system	d_{20}'	$= 3.02951_2 \times 10^{-8}$ cm
True calcite grating space (20°C.), c.g.s. system	d_{20}	$= (3.03567_4 \pm 0.00018) \times 10^{-8}$ cm
Ratio of grating and Siegbahn scales of wavelengths	λ_0/λ_a	$= 1.002034 \pm 0.000060$
Density of calcite (20°C.)	ρ	$= 2.71029 \pm 0.00003$ g·cm^{-3}
Structural constant of calcite (20°C.)	ϕ	$= 1.09594 \pm 0.00001$
Molecular weight of calcite (chemical scale)	M	$= 100.091_4 \pm 0.005$
Rydberg constant for hydrogen (H^1)	R_H	$= 109677.581_2 \pm 0.007_5$ cm^{-1} (I. A. scale)
Rydberg constant for deuterium (H^2)	R_D	$= 109707.419_3 \pm 0.007_5$ cm^{-1} (I. A. scale)
Rydberg constant for helium	R_{He}	$= 109722.263 \pm 0.012$ cm^{-1} (I. A. scale)
Rydberg constant for infinite mass	R_∞	$= 109737.303 \pm 0.017$ cm^{-1} (I. A. scale) or ± 0.05 cm^{-1} (c.g.s. system)

TABLE C. Partial List of Derived Quantities.*

Planck constant

$$h = \left\{ \frac{2\pi^2 c^3 F^5}{R_\infty N_0^5 (e/m)} \right\}^{\frac{1}{3}} = (6.624_2 \pm 0.002_4) \times 10^{-27} \text{ erg·sec}$$

$$h/e = \left\{ \frac{2\pi^2 c^3 F^2}{R_\infty N_0^2 (e/m)} \right\}^{\frac{1}{3}} = (4.1349_0 \pm 0.0007_1) \times 10^{-7} \text{ erg·sec·abs. e.m.u.}^{-1}$$

$$h/e' = h/ec = \left\{ \frac{2\pi^2 F^2}{R_\infty N_0^2 (e/m)} \right\}^{\frac{1}{3}} = (1.3793_3 \pm 0.0002_3) \times 10^{-17} \text{ erg·sec·abs. e.s.u.}^{-1}$$

Atomic weight of electron $E = F/(e/m)$

(physical scale) $= 5.4862_4 \pm 0.0017) \times 10^{-4}$

(chemical scale) $= (5.4847_5 \pm 0.0017) \times 10^{-4}$

Band spectra constant connecting wave number and moment of inertia

$$h/8\pi^2 c = \left\{ \frac{F^5}{256\pi^4 R_\infty N_0^5 (e/m)} \right\}^{\frac{1}{3}} = (27.98_{65} \pm 0.01_0) \times 10^{-40} \text{ g·cm}$$

Boltzmann constant $k = R_0/N_0 = V_0 A_0/T_0 N_0 = (1.38047_4 \pm 0.00026) \times 10^{-16}$ erg·deg^{-1}

Charge in electrolysis of one gram of H $F/H = 9572.1_{73} \pm 1.0$ abs. e.m.u·g^{-1}

Charge in electrolysis of one gram of H^1 $e/M_{H^1} = F/H^1 = 9573.5_{60} \pm 1.0$ abs. e.m.u·g^{-1}

Compton shift at 90° $h/mc = \left\{ \frac{2\pi^2 F^2 (e/m)^2}{R_\infty N_0^2} \right\}^{\frac{1}{3}} = (0.024265_{14} \pm 0.000005_7) \times 10^{-8}$ cm

Energy in ergs of one abs-volt-electron $E_0 = 10^8 e = 10^8 F/N_0 = (1.60203_3 \pm 0.00034) \times 10^{-12}$ erg

PROBABLE VALUES OF THE PHYSICAL CONSTANTS

Energy in calories per mole for one abs-volt-electron per molecule

$$\frac{F(\text{abs. coul. per gram equiv})}{J_{15}(\text{abs. joules per cal})} = 23052.85 \pm 3.2 \text{ cal}_{15} \cdot \text{mole}^{-1}$$

Fine structure constant.... $\alpha = 2\pi(e')^2/hc = \left\{\frac{4\pi R_\infty F(e/m)}{N_0}\right\}^{\frac{1}{3}} = (7.2976_6 \pm 0.0008_6) \times 10^{-3}$

$$1/\alpha = 137.030_2 \pm 0.016$$

$$\alpha^2 = (5.3256 \pm 0.0013) \times 10^{-5}$$

Gas constant per mole..... $R_0 = V_0A_0/T_0 = (8.31436 \pm 0.00038) \times 10^7 \text{ erg} \cdot \text{deg}^{-1} \cdot \text{mole}^{-1}$

$$R_0' = R_0 \cdot 10^{-7}/J_{15} = 1.98646_7 \pm 0.00021 \text{ cal}_{15} \cdot \text{deg}^{-1} \cdot \text{mole}^{-1}$$

$$R_0'' = V_0'/T_0 = (8.20544_7 \pm 0.00037) \times 10^{-2} \text{ liter} \cdot \text{atmos} \cdot \text{deg}^{-1} \cdot \text{mole}^{-1}$$

$$R_0''' = R_0/A_0 = V_0/T_0 = 82.0566_7 \pm 0.0037 \text{ cm}^3 \cdot \text{atmos} \cdot \text{deg}^{-1} \cdot \text{mole}^{-1}$$

also $R_0T_0 = V_0A_0 = (2.27115_0 \pm 0.00006) \times 10^{10} \text{ erg} \cdot \text{mole}^{-1}$

Loschmidt number (0°C, A_0)..... $n_0 = N_0/V_0 = (2.6870_{12} \pm 0.0005_0) \times 10^{19} \text{ atmos}^{-1} \text{ cm}^{-3}$

Magnetic moment of one Bohr magneton..... $\mu_1 = (h/4\pi)(e/m) = \frac{1}{4\pi}\left\{\frac{2\pi^2c^3F^5(e/m)^2}{R_\infty N_0^5}\right\}^{\frac{1}{3}}$

$$= (0.9273_{45} \pm 0.0003_7) \times 10^{-20} \text{ erg} \cdot \text{gauss}^{-1}$$

Magnetic moment per mole for one Bohr magneton per molecule..... $\mu_1 N_0 = \frac{1}{4\pi}\left\{\frac{2\pi^2c^3F^5(e/m)^2}{R_\infty N_0^2}\right\}^{\frac{1}{3}} = 5585.2_4 \pm 1.6 \text{ erg. gauss}^{-1} \cdot \text{mole}^{-1}$

Mass of α-particle..... $M\alpha = (\text{He} - 2E)/N_0 = (6.6442_2 \pm 0.0012) = 10^{-24} \text{ g}$

Mass of atom of unit atomic weight.... $M_0 = 1/N_0 = (1.66035 \pm 0.00031) \times 10^{-24} \text{ g}$

Mass of electron.. $m = e/(e/m) = (F/N_0)/(e/m) = (9.1066_0 \pm 0.0032) \times 10^{-28} \text{ g}$

Mass of H^1 atom..... $M_{H^1} = H^1/N_0 = (1.67339_3 \pm 0.00031) \times 10^{-24} \text{ g}$

Mass of proton..... $M_p = (H^1 - E)/N_0 = (1.67248_2 \pm 0.00031) \times 10^{-24} \text{ g}$

Radiation density constant..... $a = 8\pi^5k^4/15c^3h^3 = \left(\frac{V_0A_0}{T_0}\right)^4 \frac{4\pi^3N_0R_\infty(e/m)}{15c^6F^5}$

$$= (7.569_{42} \pm 0.004_9) \times 10^{-15} \text{ erg} \cdot \text{cm}^{-3} \cdot \text{deg}^{-4}$$

Ratio mass H^1 atom to mass electron..... $M_{H^1}/m = (e/m)(H^1/F) = 1837.5_{61} \pm 0.5_6$

Ratio mass proton to mass electron..... $M_p/m = (e/m)\left(\frac{H^1 - E}{F}\right) = 1836.5_{61} \pm 0.5_6$

Second radiation constant.... $c_2 = hc/k = \frac{c^2T_0}{V_0A_0}\left\{\frac{2\pi^2F^5}{R_\infty N_0^2(e/m)}\right\}^{\frac{1}{3}} = 1.4384_8 \pm 0.0003_4 \text{ cm} \cdot \text{deg}$

Specific charge of α-particle... $2e/M\alpha = \frac{2F}{\text{He} - 2E} = 4822.3_3 \pm 0.5_1 \text{ abs. e.m.u} \cdot \text{g}^{-1}$

Specific charge of proton..... $e/M_p = \frac{F}{H^1 - E} = 9578.7_7 \pm 1.0 \text{ abs. e.m.u} \cdot \text{g}^{-1}$

Stefan-Boltzmann constant..... $\sigma = ac/4 = 2\pi^5k^4/15c^2h^3 = \left(\frac{V_0A_0}{T_0}\right)^4 \frac{\pi^3N_0R_\infty(e/m)}{15(Fc)^5}$

$$= (5.672_{83} \pm 0.003_7) \times 10^{-5} \text{ erg} \cdot \text{cm}^{-2} \cdot \text{deg}^{-4} \cdot \text{sec}^{-1}$$

Wave-length associated with one abs-volt** $\lambda_0 = 10^{-8}c^2(h/e') = \frac{c^2}{10^8}\left\{\frac{2\pi^2F^2}{R_\infty N_0^2(e/m)}\right\}^{\frac{1}{3}} = (12395.4 \pm 2.1) \times 10^{-8} \text{ cm} \cdot \text{abs-volt}$

Wave number associated with one abs-volt $s_0 = 1/\lambda_0 = \frac{10^8}{c^2}\left\{\frac{R_\infty N_0^2(e/m)}{2\pi^2F^2}\right\}^{\frac{1}{3}} = 8067.4_9 \pm 1.4 \text{ cm}^{-1} \cdot \text{abs-volt}^{-1}$

Wien's displacement law constant***..... $A = c_2/4.965114 = 0.28971_8 \pm 0.00007 \text{ cm} \cdot \text{deg}$

Zeeman displacement per gauss..... $(e/m)/4\pi c = (4.6699_1 \pm 0.0013) \times 10^{-5} \text{ cm}^{-1} \cdot \text{gauss}^{-1}$

* In order to be able to calculate, by propagation of errors, the probable error in a derived quantity, it is necessary to express the quantity explicitly in terms of the various fundamental quantities of Table A, or of Table B, and that has been done in each case. Since in this paper e and h are treated as derived quantities, they do not therefore appear in such explicit expressions. But in calculating *numerical* values of derived quantities, the work can often be greatly simplified by using the values of other previously calculated derived quantities—in particular e and h. In order to show how certain derived quantities depend on quantities like e and h, such alternative expressions are given in many cases.

** The factor 10^{-8} was accidentally omitted in G.C. 1929, in the equation for λ_0.

*** The factor 4.965114 is the root of $e^{-\beta} + (\beta/5) - 1 = 0$.

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Abamperes	amperes	10.0000
Abamperes	statampere	2.99796×10^{10}
Abampere-turns	ampere-turns	10
Abampere-turns	gilberts	12.566
Abcoulombs	coulombs (Abs.)	10.0000
Abcoulombs	statcoulombs	2.99796×10^{10}
Abcoulombs/kg.	statcoulombs/dynes	30577
Abcoulombs/pound	statcoulombs/dyne	6.7411×10^{4}
Abfarads	farads (Abs.)	1.0000×10^{9}
Abfarads	microfarads	1×10^{15}
Abfarads	statfarads	8.98776×10^{20}
Abhenries	henries (Abs.)	1.0000×10^{-9}
Abhenries	millihenries	1×10^{-6}
Abhenries	stathenries	1.11263×10^{-21}
Abmhos/cm. cube	megmhos/cm. cube	1000
Abmhos/cm. cube	mhos, International/cm. cube	1.00052×10^{9}
Abmhos/cm. cube	mhos/mil foot	166.2
Abohms	megohms	1×10^{-15}
Abohms	microhms	0.001
Abohms	ohms (Abs.)	1.0000×10^{-9}
Abohms	statohms	1.11263×10^{-21}
Abvolts	microvolts	0.010000
Abvolts	statvolts	3.33560×10^{-1}
Abvolts	volts (Abs.)	1.0000×10^{-8}
Abvolts/cm.	volts (Abs.)/cm.	1.0000×10^{-8}
Abvolts/°F	microvolts/°C	0.018000
Abvolts/inch	volts (Abs.)/cm.	3.9370×10^{-9}
Acre feet	cubic feet	43560
Acre feet	cubic meters	1233.49
Acre feet	gallons (U. S.)	325851
Acres	hectares	0.4047
Acres (British)	roods (British)	4
Acres (British)	square meters	4046.849
Acres (British)	square yards (British)	4840
Acres (U. S.)	ares (sq. dekameters)	40.46873
Acres (U. S.)	hectares (sq. hectometers)	0.4046873
Acres (U. S.)	sq. chains (Gunter's)	10
Acres (U. S.)	sq. feet	43560
Acres (U. S.)	sq. links (Gunter's)	1×10^{5}
Acres (U. S.)	sq. meters	4046.873
Acres (U. S.)	sq. miles	0.0015625
Acres (U. S.)	sq. rods	160
Acres (U S.)	sq. yards	4840
Amperes (Abs.)	abamperes	0.1
Amperes (Abs.)	amperes (International) (a)	1.00007
Amperes (Abs.)	amperes (International) (v)	1.00010
Amperes (Abs.)	faradays/sec.	1.0363×10^{-5}
Amperes (Abs.)	statamperes	2.99796×10^{9}
Amperes (International); (England before 1906)	amperes (International) (v)	0.99870
Amperes (International); (England 1906-1908)	ampere (International) (v)	0.99894
Amperes (International); (England 1909-1910)	amperes (International) (v)	0.99990
Amperes (International); (France before 1911)	amperes (International) (v)	0.9998

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Amperes (International); (Germany before 1911)	amperes (International) (v)	0.99968
Amperes (International); (U. S. before 1911)	amperes (International) (v)	0.99916
Amperes (International) (a); based on deposit of 0.00111800 grams of silver per second	amperes (Abs.)	0.99993
Amperes (International) (v) Defined by international volt and ohm	amperes (Abs.)	0.99990
Ampere-hours (Abs.)	coulombs (Abs.)	3600.0
Ampere-turns	abampere-turns	0.1
Ampere-turns	gilberts	1.2566
Ampere-turns/cm.	gauss	1.2566
Ampere-turns/inch	gauss	0.49474
Angstrom units	inches	3.937×10^{-9}
Angstrom units	meters	1×10^{-10}
Angstrom units	micro-microns	100
Angstrom units	microns	1×10^{-4}
Angstrom units	milli-microns	0.1
Apothecaries' see troy	.....	.....
Ares	acres (U. S.)	0.02471044
Ares	hectares	0.01
Ares	sq. feet	1076.4
Ares	sq. meters	100
Ares	sq. miles	3.8610×10^{-5}
Ares	sq. yards	119.60
Astronomical units	kilometers	1.495×10^{8}
Atmosphere (Normal) is the pressure exerted by 760 mm of mercury having a density 13.5951 g/cm³ where gr. ac. is 980.665 cm/sec²	.....	.....
Atmospheres	bars	1.0133
Atmospheres	cm. of mercury at 0°C	76
Atmospheres	dynes/cm²	1.01325×10^{6}
Atmospheres	feet of water at 39.1°F	33.899
Atmospheres	grams/sq. cm.	1033.3
Atmospheres	inches of mercury at 32°F	29.921
Atmospheres	kg./sq. meter	10333
Atmospheres	microns of mercury	760000
Atmospheres	mm. of mercury	760
Atmospheres	pounds/sq. ft.	2116.32
Atmospheres	pounds/sq. in.	14.696
Atmospheres	tons (short)/sq. ft.	1.0581
Atmospheres	tons (short)/sq. in.	0.0073482
Bags (British)	bushels (British)	3
Bags (British)	cu. meters	0.109107
Bags, cement	pounds of cement	94
Barleycorns (British)	centimeters	0.84667
Barleycorns (British)	inches	1/3
Barrels (British, dry)	cu. meters	0.16366
Barrels (British, dry)	gallons (British)	36
Barrels, cement	pounds of cement	376
Barrels, oil	gallons (U. S.)	42
Barrels (U. S., dry)	bushels	3.281
Barrels (U. S., dry)	cu. inches	7056

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Barrels (cranberry)	cu. inches	5826
Barrels (U. S., dry)	cu. meters	0.11562
Barrels (U. S., dry)	quarts (dry)	105.0
Barrels (U. S., liquid)	cu. meters	0.11924
Barrels (U. S., liquid)	gallons	31.5
Bars	atmospheres	0.98692
Bars	dynes/sq. cm.	1.000×10^{6}
Bars	kg./sq. meter	1.01971×10^{4}
Bars	pounds/sq. inch	14.504
Barye	dynes/sq. cm.	1.000
Board feet	cu. cm.	2359.8
Board feet	cu. feet	1/12
Board feet	cu. inches	144
Board of trade units (England before 1903)	ohms (International)	0.9984
Boiler horse power	B. T. U./hour	33479
Boiler horse power	K. W.	9.803
Bolt (U. S., cloth)	linear feet	120
Bolt (U. S., cloth)	meters	36.576
Bougie decimale	candles (International)	1.0
B. T. U.	calories (gram)	252
B. T. U.	foot poundals	25030
B. T. U.	foot pounds	777.9
B. T. U.	horse-power hours	3.929×10^{-4}
B. T. U.	joules	1055
B. T. U.	kilogram meters	107.565
B. T. U.	liter atmospheres	10.41
B. T. U.	pounds carbon to CO_2	6.88×10^{-3}
B. T. U.	pounds water evaporated from and at 212°F (100°C.)	0.001036
B. T. U./min.	foot pounds/sec.	12.96
B. T. U. (mean)	calories, gram (mean)	251.98
B. T. U. (mean)	calories, kg.	0.25198
B. T. U. (mean)	cubic foot-atmospheres	0.3676
B. T. U. (mean)	ergs	1.0548×10^{10}
B. T. U. (mean)	foot-poundals	25030.7
B. T. U. (mean)	foot pounds	777.98
B. T. U. (mean)	horse-power hours	3.9292×10^{-4}
B. T. U. (mean)	joules (Abs.)	1054.8
B. T. U. (mean)	kilowatt-hours	2.930×10^{-4}
B. T. U. (mean)	kg. meters	107.56
B. T. U. (mean)	liter atmospheres	10.409
B. T. U. (mean)	watt-hours	0.2930
B. T. U. (mean)	watt-seconds	1054.8
B. T. U. (mean)/min.	horse power	0.023575
B. T. U. (mean)/min.	watts (Abs.)	17.580
B. T. U. (mean)/pound	calories, gram (mean)/gram	0.5556
B. T. U. (mean)/pound	joules/gram	2.3255
B. T. U. (mean)/pound/°F	calories, gram/gram/°C	1
B. T. U. (mean)/pound/°F	ioules/gram/°C	4.186
B. T. U. (mean)/sec.	horse power	1.4145
B. T. U. (mean)/sec.	watts (Abs.)	1054.8
B. T. U. (mean)/sq. ft./minute	watts/sq. inch	0.12208
B. T. U. (mean)/sq. ft./minute	kilowatts/sq. ft.	0.17580
B. T. U. (mean)/sq. ft./minute	horse power/sq. ft.	0.023575

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
B. T. U. (mean)/sq. ft./sec. for a temp. gradient of 1°F per inch	calories, gram (15°C)/sq. cm. per sec. for a temp. gradient of 1°C per centimeter	1.2404
B. T. U. (mean)/sq. ft./sec. for a temperature gradient of 1°F/inch	joules (Abs.)/sq. cm./sec. for a temperature gradient of 1°C/cm.	5.191
B. T. U. (60°F)	joules (Abs.)	1054.6
B. T. U. (60°F)/deg. F	calories, gram/deg. C	453.59
B. T. U. (60°F)/deg. F	joules/deg. C	1898.3
B. T. U. (60°F)/sec.	watts (Abs.)	1054.6
B. T. U. (39°F)	joules (Abs.)	1060.4
B. T. U. (39°F)/sec.	watts (Abs.)	1060.4
Buckets (British, dry)	cu. cm.	1.8184×10^{4}
Buckets (British, dry)	gallons (British)	4
Bushels (British, dry)	bags (British)	1/3
Bushels (British, dry)	bushels (U. S.)	1.03205
Bushels (British, dry)	cu. cm.	36369
Bushels (British, dry)	cu. ft.	1.2843
Bushels (British, dry)	cu. inches	2219.3
Bushels (British, dry)	gallons (British)	8
Bushels (British, dry)	liters	36.3677048
Bushels (British, dry)	quarters (British capacity)	0.125
Bushels (U. S., dry)	barrels	0.304785
Bushels (U. S., dry)	bushels (British)	0.968946
Bushels (U. S., dry)	cu. cm.	35239
Bushels (U. S., dry)	cu. ft.	1.2444
Bushels (U. S., dry)	cu. inches	2150.42
Bushels (U. S., dry)	cu. meters	0.035239
Bushels (U. S., dry)	hectoliters	0.35238329
Bushels (U. S., dry)	liters	35.238329
Bushels (U. S., dry)	pecks	4
Bushels (U. S., dry)	pints (dry)	64
Bushels (U. S., dry)	quarts (dry)	32
Bushels (U. S., dry)/acre	hectoliters/hectare	0.870754
Butts (British, dry)	cu. meters	0.57281
Butts (British, dry)	gallons	126
Cable lengths (U. S.; British)	feet	720
Cable lengths (U. S.; British)	meters	219.46
Calories, gram	B. T. U.	3.968×10^{-3}
Calories, gram (mean)	B. T. U. (mean)	3.9685×10^{-3}
Calories, gram (mean)	cu. ft. atmospheres	0.001469
Calories, gram	foot-poundals	99.31
Calories, gram (mean)	foot-poundals	99.334
Calories, gram	foot-pounds	3.087
Calories, gram (mean)	foot-pounds	3.0874
Calories, gram	horse-power hours	1.5591×10^{-6}
Calories, gram (mean)	horse-power hours	1.5593×10^{-6}
Calories, gram	joules	4.185
Calories, gram (15°C)	joules (Abs.)	4.185
Calories, gram (20°C)	joules (Abs.)	4.181
Calories, gram (mean)	joules (Abs.)	4.186
Calories, gram	kilogram-meters	0.4267
Calories, gram (mean)	kilogram-meters	0.42685
Calories, gram	liter-atmospheres	4.130×10^{-2}
Calories, gram (mean)	liter-atmospheres	4.1311×10^{-2}
Calories, gram (mean)	watt hours	0.0011628
Calorie (15°C) seconds	quanta	6.3854×10^{33}
Calories (15°C)/ampere-hour	joules/electromagnetic unit quantity (abcoulomb)	0.011625

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Calories (15°C)/coulomb	joules/abcoulomb	41.850
Calories, gram (15°C)/deg. C	B. T. U. (60°F)/deg. F	0.0022046
Calories, gram (15°C)/deg. C	joules/deg. C	4.185
Calories, gram (mean)/gram	B. T. U. (mean)/pound	1.8
Calories, gram (mean)/gram	joules/gram	4.186
Calories, gram (mean)/gram/deg. C	B. T. U. (60°F)/pound/deg. F	1
Calories, gram (mean)/gram/deg. C	joules/gram/deg. C	4.186
Calorie (15°C)seconds/N_0. #	quanta	1.0535×10^{10}
Calories, gram (15°C)/sq. cm./sec. for a temp. gradient of 1°C/cm.	B. T. U. (mean)/sq. ft./sec. for a temp. gradient of 1°F/inch	0.80620
Calories, gram (15°C)/sq. cm./sec. for a temp. gradient of 1°C/cm.	joules (Abs.)/sq. cm./sec. for a temp. gradient of 1°C/cm.	4.185
Calories, kg. or large (mean)	B. T. U. (mean)	3.9685
Calories, kg. (mean)	calories, gram (mean)	1000
Calories, kg. (mean)	ergs	4.186×10^{10}
Calories, kg. (mean)	foot pounds	3087.4
Calories, kg. (mean)	gram centimeters	4.2686×10^{7}
Calories, kg. (mean)	horse power hours	0.0015593
Calories, kg. (mean)	joules	4186
Calories, kg. (mean)	kg. meters	426.85
Calories, kg. (mean)	K. W. hours	0.0011628
Calories, kg. (mean)	watt hours	1.1628
Calories, kg. (mean)/min.	foot pounds/sec.	51.457
Calories, kg. (mean)/min.	horse power	0.093558
Calories, kg. (mean)/min.	watts	69.769
Calories, kg. (mean)/sec.	kilowatts	4.186
Candles (International)	candles (English sperm)	1 (approx.)
Candles (International)	candles (pentane)	1 (approx.)
Candles (International)	carcel units	0.104 (approx.)
Candles (International)	Hefner units	1.11 (approx.)
Candles (International)	lumens (International)/steradian	1.0000
Candle power (spherical)	lumens	12.566
Candles/sq. cm.	lamberts	3.1416
Candles/sq. cm.	millilamberts	3141.6
Candles/sq. inch	lamberts	0.48695
Candles/sq. inch	millilamberts	486.95
Carats (1877)	grains	3.168
Carats (1877)	milligrams	205.29
Carats (metric)	grams	0.2
Carats (metric)	grains	3.08648
Carcel units	candles (International)	9.6 (approx.)
Centals	pounds	100
Centare cf. sq. meter	.....	.....
Centigrade degrees	Fahrenheit, cf. special table	.....
Centigrade thermal unit (C. T. U.) (15°C)	joules (Abs.)	1898.3
Centimeters	angstrom units	1×10^{8}
Centimeters	feet (British or U. S.)	0.032808
Centimeters	inches (U. S.)	0.393700
Centimeters	lignes (Paris lignes)	4.4330
Centimeters	microns	10000
Centimeters	mils	393.70
Centimeters	yards (British)	0.01093614
Centimeters	yards (U. S.)	0.01093611
Cm. of mercury at 0°C	atmospheres	0.013158

#N_0. = Avogadro's number = number of molecules per gram mole.

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Cm. of mercury at 0°C	dynes/sq. cm.	1.33322×10^{4}
Cm. of mercury at 0°C	feet of water at 39.1°F	0.44604
Cm. of mercury at 0°C	kg./sq. meter	135.95
Cm. of mercury at 0°C	pounds/sq. ft.	27.845
Cm. of mercury at 0°C	pounds/sq. inch	0.19337
Centimeters/sec.	feet/min.	1.9685
Centimeters/sec.	kilometers/hour	0.03600
Centimeters/sec.	meters/min.	0.6000
Centimeters/sec.	miles/hour	0.02237
Centimeters/sec.	miles/min.	3.728×10^{-4}
Centimeters/sec.^{2}	kilometers/hr./sec.	0.036
Centimeters/sec.^{2}	miles/hr./sec.	0.02237
Centimeter dyne cf. erg	.....	.....
Chains (engineers' or Ramden's)	feet	100
Chains (engineers' or Ramden's)	meters	30.4801
Chains (surveyors' or Gunter's)	feet	66
Chains (surveyors' or Gunter's)	furlongs	0.1
Chains (surveyors' or Gunter's)	meters	20.117
Chains (surveyors' or Gunter's)	miles	0.0125
Chains (surveyors' or Gunter's)	rods	4
Chains (surveyors' or Gunter's)	yards	22
Chaldrons (British, dry)	bushels (British)	32 (variable)
Chaldrons (British, dry)	cubic meters	1.1638
Chaldorns (U. S. , dry)	bushels (U. S.)	36
Chaldrons (U. S. ,dry)	cubic meters	1.2686
Cheval-vapeurs	watts	735.499
Cheval-vapeur heure	joules (Abs.)	2.6478×10^{6}
Cheval-vapeur cf. horse power metric	.....	.....
Circles	degrees	360
Circles	radians	6.28319
Circles	signs	12
Circular inches	sq. cm.	5.0671
Circular inches	sq. inches	0.78540
Circular millimeters	sq. millimeters	0.78540
Circular mils	sq. cm.	5.0671×10^{-6}
Circular mils	sq. inches	7.854×10^{-7}
Circular mils	sq. mils	0.78540
Circumferences	degrees	360
Circumferences	grades	400
Circumferences	radians	6.28319
Cloves or customary stones (British)	kilograms	3.6287
Cloves or customary stones (British)	pounds	8
Coombs (British, dry)	bushels (British)	4
Coombe (British, dry)	cubic meters	0.14548
Cords	cord feet	8
Cords	cu. feet	128
Cords	cu. meters	3.625
Cord feet	cords	0.125
Cord feet	cu. feet	16
Coulombs (Abs.)	abcoulombs or electromagnetic cgs units	0.1000
Coulombs (Abs.)	coulombs (International) (v)	1.00010
Coulombs (Abs.)	coulombs (International) (a)	1.00007
Coulombs (Abs.)	electronic charges	6.281×10^{18}
Coulombs (Abs.)	electrostatic cgs units or statcoulombs	2.99796×10^{9}
Coulombs (International) (a)	coulombs (Abs.)	0.99993
Coulombs (International) (v)	coulombs (Abs.)	0.99990

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Coulombs/kg.	statcoulombs/dyne	3057.7
Cubic cm.	board feet	4.2372×10^{-4}
Cubic cm.	bushels (British)	2.7496×10^{-5}
Cubic cm.	bushels (U. S.)	2.83776×10^{-5}
Cubic cm.	cubic ft. (British)	3.531477×10^{-5}
Cubic cm.	cubic ft. (U. S.)	3.531445×10^{-5}
Cubic cm.	cubic inches	0.061023
Cubic cm.	cubic yards	1.3079×10^{-6}
Cubic cm.	drachms (British, fluid)	0.28157
Cubic cm.	drams (U. S., fluid)	0.27053
Cubic cm.	gallons (British)	2.1997×10^{-4}
Cubic cm.	gallons (U. S.)	2.6417×10^{-4}
Cubic cm.	liters	9.9997×10^{-4}
Cubic cm.	minims (British)	16.894
Cubic cm.	minims (U. S.)	16.231
Cubic cm.	ounces (British, fluid)	0.035196
Cubic cm.	ounces (U. S., fluid)	0.033814
Cubic cm.	pints (U. S., dry)	0.0018162
Cubic cm.	pints (U. S., liquid)	0.0021134
Cubic cm.	quarts (U. S., dry)	9.0808×10^{-4}
Cubic cm.	quarts (British, liquid)	8.7988×10^{-4}
Cubic cm.	quarts (U. S., liquid)	0.0010567
Cubic cm. atmospheres (normal)	joules (Abs.)	0.101325
Cubic cm./sec.	cubic ft./min.	0.0021186
Cubic ft. (British)	cubic meters	0.02831677
Cubic ft. (U. S.)	board ft.	12
Cubic ft. (U. S.)	bushels (British)	0.77861
Cubic ft. (U. S.)	bushels (U. S.)	0.80357
Cubic ft. (U. S.)	cords	0.0078125
Cubic ft. (U. S.)	cord feet	0.0625
Cubic ft. (U. S.)	cubic cm.	28317
Cubic ft. (U. S.)	cubic inches	1728
Cubic ft. (U. S.)	cubic meters	0.02831701
Cubic ft. (U. S.)	cubic yards	0.037037
Cubic ft. (U. S.)	gallons (British)	6.229
Cubic ft. (U. S.)	gallons (U. S.)	7.481
Cubic ft. (U. S.)	liters	28.316
Cubic ft. (U. S.)	quarts (U. S., dry)	25.714
Cubic ft. (U. S.)	quarts (U. S., liquid)	29.922
Cubic ft. (U. S.)	register tons (British)	0.01
Cu. ft. atmospheres	B. T. U. (mean)	2.7203
Cu. ft. atmospheres	calories, gram (mean)	680.74
Cu. ft. atmospheres	foot pounds	2116.3
Cu. ft. atmospheres	joules (Abs.)	2869.4
Cu. ft. atmospheres	kg. meters	292.59
Cu. ft. atmospheres	liter atmospheres	28.316
Cu. ft. of common brick	pounds	120
Cu. ft. of water (60°F)	pounds	62.37
Cu. ft./min.	cu. cm./sec.	472.0
Cu. ft./min.	gallons/sec.	0.1247
Cu. ft./min.	liters/sec.	0.4720
Cu. ft./sec.	gallons/min.	448.831
Cu. ft./sec.	liters/min.	1698.96
Cu. ft./sec.	cu. yards/min.	2.22222
Cu. hectometers	cubic meters	1×10^{6}
Cu. inches (U. S.)	board feet	0.00694444
Cu. inches (British)	bushels (British)	4.5081×10^{-4}

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Cu. inches (U. S.)	bushels (U. S.)	4.65025×10^{-4}
Cu. inches (British)	cubic cm.	16.3870253
Cu. inches (U. S.)	cubic cm.	16.387162
Cu. inches (British)	cu. ft. (British)	5.7870×10^{-4}
Cu. inches (U. S.)	cu. ft. (U. S.)	5.78704×10^{-4}
Cu. inches (U. S.)	cubic meters	1.63871×10^{-5}
Cu. inches (U. S.)	cu. yards	2.143347×10^{-5}
Cu. inches (U. S.)	drams (fluid)	4.43322
Cu. inches (British)	gallons (British)	0.003606
Cu. inches (U. S.)	gallons (U. S.)	0.0043290
Cu. inches (U. S.)	liters	0.0163868
Cu. inches (U. S.)	ounces (fluid) (U. S.	0.5541
Cu. inches (British)	pecks (British)	0.0018031
Cu. inches (U. S.)	pecks (U. S.)	0.00186010
Cu. inches (U. S.)	pints (U. S., dry)	0.0297616
Cu. inches (U. S.)	quarts (U. S., dry)	0.0148808
Cu. inches (U. S.)	quarts (U. S., liquid)	0.017316
Cu. kilometers	cubic meters	1×10^{9}
Cubic meters	bushels (U. S.)	28.3776
Cubic meters	cords	0.2759
Cubic meters	cubic cm.	1×10^{6}
Cubic meters	cubic ft. (British)	35.31477
Cubic meters	cubic ft. (U. S.)	35.314445
Cubic meters	cubic inches	61023
Cubic meters	cubic yards (British)	1.307954
Cubic meters	cubic yards (U. S.)	1.3079428
Cubic meters	gallons (U. S.)	264.173
Cubic meters	liters	999.973
Cubic meters	pints (U. S., liquid)	2113.4
Cubic meters	quarts (U. S., liquid)	1056.7
Cubic meters	steres	1
Cu. millimeters	cubic inches	6.1023×10^{-5}
Cu. millimeters	cubic meters	1×10^{-9}
Cu. millimeters	minims (British)	0.016894
Cu. millimeters	minims (U. S.)	0.016231
Cubic yards	cubic cm.	764559.45
Cubic yds. (British)	cubic ft.	27
Cubic yds (U. S.)	cubic ft.	27
Cubic yds. (U. S.)	cubic inches	46656
Cubic yds. (British)	cubic meters	0.76455285
Cubic yds. (U. S.)	cubic meters	0.76455945
Cubic yds. (U. S.)	gallons (British)	168.18
Cubic yds. (U. S.)	gallons (U. S.)	202.0
Cubic yds.	liters	764.54
Cubic yds. (U. S.)	pints (U. S., liquid)	1616
Cubic yds. of sand	pounds	2700
Cubic yds (U. S.)	quarts (U. S., liquid)	807.9
Cubic yds./min.	cubic ft./sec.	0.45
Cubic yds./min.	gallons/sec.	3.367
Cubic yds/min.	liters/sec.	12.74
Cubits	centimeters	45.72009
Cubits	feet	1.5
Cubits	inches	18
Daltons	grams	1.6498×10^{-24}
Daltons	mass of an atom of oxygen	1/16
Days (mean solar)	hours (mean solar)	24
Days (mean solar)	minutes (mean solar)	1440

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Days (mean solar)	seconds (mean solar)	86400
Days (siderial)	seconds (mean solar)	86164
Decigrams	grams	0.1
Decisteres	cubic meters	0.1
Degrees	circumferences	0.00277778
Degrees	minutes	60
Degrees	quadrants	1/90
Degrees	radians	0.0174533
Degrees	revolutions	0.00277778
Degrees	seconds	3600
Degrees centigrade cf. special table	.....	.....
Degrees Fahrenheit cf. special table	.....	.....
Degree/foot	radians/cm.	5.7261×10^{-4}
Degrees/inch	radians/cm.	0.0068714
Degrees/sec.	radians/sec.	0.017453
Degrees/sec.	revolutions/min.	0.1667
Degrees/sec.	revolutions/sec.	0.002778
Degrees Reaumur cf. special table	.....	.....
Dekagrams	grams	10
Drachms (British, fluid)	cubic cm.	3.5515
Drachms (British, fluid)	minims (British)	60
Drachms (British, fluid)	ounces (British, fluid)	0.125
Drachms (U. S., fluid) cf. Drams (U. S., fluid)		
Drams (apothecaries' or troy)	drams (avoirdupois)	2.194286
Drams (apothecaries' or troy)	grains	60
Drams (apothecaries' or troy)	grams	3.8879351
Drams (apothecaries' or troy)	ounces (avoirdupois)	0.1371429
Drams (apothecaries' or troy)	ounces (troy)	0.125
Drams (troy)	pennyweights	2.5
Drams (apothecaries' or troy)	pounds (avoirdupois)	0.008571429
Drams (apothecaries' or troy)	pounds (troy)	1/96
Drams (apothecaries')	scruples	3
Drams (avoirdupois)	drams (apothecaries' or troy)	0.4557292
Drams (avoirdupois)	grains	27.34375
Drams (avoirdupois)	grams	1.771845
Drams (avoirdupois)	milligrams	1771.845
Drams (avoirdupois)	ounces (avoirdupois)	0.0625
Drams (avoirdupois)	ounces (troy)	0.056966146
Drams (avoirdupois)	pennyweights	1.139323
Drams (avoirdupois)	pounds (avoirdupois)	1/256
Drams (avoirdupois)	pounds (troy)	0.0047471788
Drams (avoirdupois)	scruples	1.3671875
Drams (U. S., fluid or apoth.)	cubic cm.	3.6967
Drams (U. S., fluid or apoth.)	cubic inches	0.225570
Drams (U. S., fluid or apoth.)	gills (U. S.)	0.03125
Drams (U. S., fluid or apoth.)	milliliters	3.6966
Drams (U. S., fluid or apoth.)	minims (U. S., fluid)	60
Drams (U. S., fluid or apoth.)	ounces (fluid)	0.125
Drams (U. S., fluid or apoth.)	pints (U. S., liquid)	0.0078125
Drams (U. S., fluid or apoth.)	quarts (U. S., liquid)	0.00390625
Dynes	grains	0.015368
Dynes	grams	0.00101972
Dynes	poundals	7.2332×10^{-5}
Dynes	pounds	2.2481×10^{-6}
Dyne-cm. (torque)	kg.-meters	1.0197×10^{-8}
Dyne-cm. (torque)	poundal-feet	2.3731×10^{-6}
Dyne-cm. (torque)	pound-feet	7.3757×10^{-8}

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Dyne-cm. (torque)	pound-inches	8.8511×10^{-7}
Dynes/cm.	ergs/sq. cm.	1
Dynes/cm.	ergs/sq. millimeter	0.01
Dynes/cm.	milligrams/inch	2.5901
Dynes/cm.	milligrams/millimeter	0.10197
Dynes/sq. cm.	atmospheres	9.8692×10^{-7}
Dynes/sq. cm.	bars	1×10^{-6}
Dynes/sq. cm.	cm. of water at 4°C (39.2° F.)	0.00101974
Dynes/sq. cm.	grams/sq. cm.	0.00101972
Dynes/sq. cm.	inches of mercury at 32°F	2.9530×10^{-5}
Dynes/sq. cm.	inches of water at 39.2° F. (4°C.)	4.0148×10^{-4}
Dynes/sq. cm.	kg./sq. meter	0.0101971
Dynes/sq. cm.	millimeters of mercury	7.5006×10^{-4}
Dynes/sq. cm.	pounds/sq. ft.	0.0020886
Dynes/sq. cm.	pounds/sq. inch	1.4504×10^{-5}
Electromagnetic cgs unit of capacity cf. abfarad	.....	.....
Electromagnetic cgs unit of field strength	gauss (Abs.)	1.0000
Electromagnetic cgs unit of inductance cf. abhenry	.....	.....
Electromagnetic cgs units of megnetic induction	maxwells (Abs.)/sq. cm.	1.00000
Electromagnetic cgs units of magnetic permeability	electrostatic cgs units of magnetic permeability	8.9916×10^{20}
Electromagnetic cgs units of magnetomotive force	gilberts	1.00000
Electromagnetic cgs units of mass resistance	ohm, International-meter-gram	9.9948×10^{-6}
Electromagnetic cgs units of pole strength	maxwells (Abs.)	1.0000
Electromagnetic cgs unit of potential cf. abvolt	.....	.....
Electromagnetic cgs units of reluctance	oersteds (Abs.)	1.0000
Electromagnetic cgs unit of resistance cf. abohm	.....	.....
Electromagnetic ft. lb. sec. units of magnetic permeability	electromagnetic cgs units of magnetic permeability	0.0010764
Electromagnetic ft. lb. sec. units of magnetic permeability	electrostatic cgs units of magnetic permeability	9.6786×10^{17}
Electronic charges	abcoulombs	1.5921×10^{-20}
Electronic charges	coulombs (Abs.)	1.5921×10^{-19}
Electronic charges	statcoulombs	4.774×10^{-10}
Electrons/kg.	statcoulombs/dyne	4.868×10^{-16}
Electrostatic cgs units* of capacity cf. statfarad	.....	.....
Electrostatic cgs unit of charge cf. statcoulomb	.....	.....
Electrostatic cgs units of field strength	gauss (Abs.)	3.33560×10^{-11}
Electrostatic cgs units of Hall effect	electromagnetic cgs units of Hall effect	2.6962×10^{31}

*All electrostatic cgs units are based on the velocity of light in air equal to 2.99796×10^{10} cm./sec.

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Electrostatic cgs unit of inductance cf. stathenry	.....	.....
Electrostatic cgs units of magnetic induction	maxwells (Abs.)/sq. cm.	2.9986×10^{10}
Electrostatic cgs units of magnetomotive force	gilberts (Abs.)	3.33560×10^{-11}
Electrostatic cgs units of mass resistance	ohm, International-meter-gram	8.9869×10^{15}
Electrostatic cgs units of pole strength	maxwells (Abs.)	2.99796×10^{10}
Electrostatic cgs unit of potential cf. statvolt	.....	.....
Electrostatic cgs units of reluctance	oersteds (Abs.)	1.1122×10^{-21}
Electrostatic cgs unit of resistance cf. statohm	.....	.....
Electrostatic ft. lb. sec. units of charge	abcoulombs	117.58
Electrostatic ft. lb. sec. units of charge	coulombs (Abs.)	1.1952×10^{-6}
Electrostatic ft. lb. sec. units of charge	statcoulombs	3583.9
Electrostatic ft. lb. sec. units of magnetic permeability	electrostatic cgs units of magnetic permeability	1.0000
Ells	cm.	114.30
Ells	inches	45
Ems, pica (printing)	cm.	0.42333
Ems, pica (printing)	inches	1/6
Ergs	B. T. U. (mean)	9.4805×10^{-11}
Ergs	calories, gram (mean)	2.3889×10^{-8}
Ergs	calories, kg. (mean)	2.3889×10^{-11}
Ergs	foot poundals	2.3730×10^{-6}
Ergs	foot pounds	7.3756×10^{-8}
Ergs	gram centimeters	0.00101972
Ergs	joules	1×10^{-7}
Ergs	kg. meters	1.0197×10^{-8}
Ergs/sec.	B. T. U. (mean)/min.	5.6883×10^{-9}
Ergs/sec.	calories, kg. (mean)/min.	1.4333×10^{-9}
Ergs/sec.	foot pounds/min.	4.4254×10^{-6}
Ergs/sec.	foot pounds/sec.	7.3756×10^{-8}
Ergs/sec.	horse power	1.3410×10^{-10}
Ergs/sec.	K. W.	1×10^{-10}
Ergs/sec.	watts	1×10^{-7}
Ergs/sq. cm.	dynes/cm.	1
Ergs/sq. cm.	ergs/sq. mm.	0.01
Ergs/sq. mm.	dynes/cm.	100
Ergs/sq. mm.	ergs/sq. cm.	100
Fahrenheit degrees	centigrade, cf. special table	.....
Faradays	coulombs (Abs.)	9.6500×10^{4}
Faradays	coulombs (International) (a)	9.6507×10^{4}
Faradays	coulombs (International) (v)	96510
Faradays/kg.	statcoulombs/dyne	2.9507×10^{8}
Faradays/sec.	amperes (Abs.)	96500
Farads (Abs.)	Abfarads	1×10^{-9}
Farads (Abs.)	farads (International)	1.00052
Farads (Abs.)	microfarads	1×10^{6}
Farads (Abs.)	statfarads	8.98776×10^{11}

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Farads (International)	farads (Abs.)	0.99948
Fathoms	feet	6
Fathoms	meters	1.828804
Feet (British)	cm.	30.47997
Feet (British)	paces (British)	0.4
Feet (U. S.)	centimeters	30.48006096
Feet (U. S.)	chains (Gunter's)	0.0151515
Feet (U. S.)	fathoms	1/6
Feet (U. S.)	furlongs	0.00151515
Feet (U. S.)	inches (U. S.)	12
Feet (U. S.)	meters	0.3048006096
Feet (U. S.)	miles (nautical)	1.6447×10^{-4}
Feet (U. S.)	miles (statute)	1.893939×10^{-4}
Feet (U. S.)	rods	0.0606061
Feet (U. S.)	wave lengths of red line of cadmium	473404
Feet (U. S.)	yards (U. S.)	1/3
Feet of water at 39.2° F. (4°C)	atmospheres	0.029499
Feet of water at 39.2° F. (4°C)	inches of mercury at 32° F. (0°C)	0.88265
Feet of water at 39.2° F. (4°C)	kg./sq. meter	304.79
Feet of water at 39.2° F. (4°C)	pounds/sq. inch	0.43352
Feet of water at 39.2° F. (4°C)	pounds/sq. foot	62.427
Feet/min.	cm./sec.	0.508001
Feet/min.	kilometers/hour	0.01829
Feet/min.	meters/sec.	0.00508001
Feet/min.	miles/hour	0.011364
Feet/sec.	kilometers/hour	1.0973
Feet/sec.	knots (per hour)	0.5921
Feet/sec.	meters/min.	18.29
Feet/sec.	miles/hour	0.6818
Feet/sec.	miles/min.	0.011364
Feet/sec.^{2}	kilometers/hour/sec.	1.0973
Firkins (British)	gallons (British)	9
Firkins (British)	liters	40 914
Firkins (U. S.)	gallons (U. S.)	9
Firkins (U. S.)	liters	34.068
Fluid ounce cf. ounce, fluid	.....	.....
Foot (paris) cf. pied	.....	.....
Foot candles	lumen incident/sq. ft.	1
Foot candles	lumens/sq. meter	10.764
Foot candles	lux	10.764
Foot candles	milliphots	1.0764
Foot poundals	B. T. U. (mean)	3.9951×10^{-5}
Foot poundals	calories, gram (mean)	0.010067
Foot poundals	ergs	4.21402×10^{5}
Foot poundals	joules	0.0421402
Foot poundals	kg. meters	0.0042972
Foot poundals	liter atmospheres (normal)	4.1588×10^{-4}
Foot pounds	B. T. U. (mean)	0.0012854
Foot pounds	calories, gram (mean)	0.32389
Foot pounds	calories, kg. (mean)	3.2389×10^{-4}
Foot pounds	cu. ft. atmospheres	4.7253×10^{-4}
Foot pounds	ergs	1.35582×10^{7}
Foot pounds	foot poundals	32.174
Foot pounds	gram cm.	1.3825×10^{4}
Foot pounds	horse power hours	5.0505×10^{-7}
Foot pounds	joules (Abs.)	1.35582
Foot pounds	kg. meters	0.138255

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Foot pounds	K. W. hours	3.7662×10^{-7}
Foot pounds	liter atmospheres	0.013381
Foot pounds	watt hours	3.7661×10^{-4}
Foot pounds/min.	B. T. U. (mean)/min.	0.0012854
Foot pounds/min.	calories, kg. (mean)/min.	3.2389×10^{-4}
Foot pounds/min.	foot pounds/sec.	0.016667
Foot pounds/min.	horse power	3.0303×10^{-5}
Foot pounds/min.	horse power (metric)	3.0723×10^{-5}
Foot pounds/min.	K. W.	2.2597×10^{-5}
Foot pounds/min.	watts	0.022597
Foot pounds/sec.	B. T. U. (mean)/min.	0.077124
Foot pounds/ sec.	calories, kg., (mean)/min.	0.0194334
Foot pounds/sec.	horse power	0.0018182
Foot pounds/sec.	K. W.	0.00135582
Foot pounds/sec.	watts (Abs.)	1.35582
Force de cheval cf. horse power, metric	.....	.....
Furlongs	chains (Gunter's)	10
Furlongs	meters	201.168
Furlongs	miles (U. S.)	0.125
Furlongs	rods	40
Furlongs	yards	220
Gallons (British)	barrels (British, dry)	0.027778
Gallons (British)	bushels (British, dry)	0.125
Gallons (British)	cubic cm.	4546.0858
Gallons (British)	cubic feet	0.16054
Gallons (British)	cubic inches	277.41
Gallons (British)	gallons (U. S.)	1.20094
Gallons (British)	gills (British)	32
Gallons (British)	liters	4.5459631
Gallons (British)	ounces (British, fluid)	160
Gallons (British)	pecks (British)	0.5
Gallons (British)	pints (British, liquid)	8
Gallons (British)	pounds (avoirdupois) of water at 62° F (16.7° C.)	10
Gallons (British)	quarts (British, liquid)	4
Gallons, Imperial cf. gallons, British	.....	.....
Gallons (U. S.)	barrels (U. S., liquid)	0.031746
Gallons (U. S.)	cubic cm.	3785.4
Gallons (U. S.)	cubic feet	0.13368
Gallons (U. S.)	cubic inches	231
Gallons (U. S.)	cubic meters	0.0037854
Gallons (U. S.)	cubic yards	0.004951
Gallons (U. S.)	gallons (British)	0.83268
Gallons (U. S.)	gills (U. S.)	32
Gallons (U. S.)	liters	3.78533
Gallons (U. S.)	minims	61440
Gallons (U. S.)	ounces (U. S., fluid)	128
Gallons (U. S.)	pints (U. S., liquid)	8
Gallons (U. S.)	pounds (avoirdupois) of water at 62° F. (16.7° C.)	8.3378
Gallons (U. S.)	quarts (U. S., liquid)	4
Gallons (U. S.,) water/min.	tons water/24 hours	6.0086
Gallons (U. S.)/min.	cu. ft./hour	8.0208
Gallons (U. S.)/min.	cu. ft./sec.	0.002228
Gallons (U. S.)/min.	liters/sec.	0.06308
Gallons (U. S.)/sec.	cubic yards/min.	0.29706
Gammas	gauss	1.0000×10^{-5}

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Gauss (Abs.)	ampere turns/cm.	0.79580
Gauss (Abs.)	ampere turns/inch	2.0213
Gauss (Abs.)	electromagnetic cgs units of field strength	1.0000
Gauss (Abs.)	electrostatic cgs units of field strength	2.99859×10^{10}
Gauss (Abs.)	gammas	1×10^{5}
Gauss (Abs.)	gauss (International) (a)	1.00007
Gauss (Abs.)	gauss (International) (v)	1.00010
Gauss (Abs.)	gilberts/cm.	1.00
Gauss (Abs.)	lines/sq. inch	6.452
Gauss (International) (a)	gauss (Abs.)	0.99993
Gauss (International) (v)	gauss (Abs.)	0.99990
Geepound cf. slug	.....	.....
Gilberts (Abs.)	abampere turns	0.07958
Gilberts (Abs.)	ampere turns	0.7958
Gilberts (Abs.)	gilberts (International) (a)	1.00007
Gilberts (Abs.)	gilberts (International) (v)	1.00010
Gilberts (International) (a)	gilberts (Abs.)	0.99993
Gilberts (International) (v)	gilberts (Abs.)	0.99990
Gilberts/cm.	gauss	1.0000
Gills (British)	cubic cm.	142.07
Gills (British)	gallons (British)	0.03125
Gills (British)	liters	0.14206
Gills (British)	ounces (British, liquid)	4
Gills (British)	pints (British, liquid)	0.25
Gills (U. S.)	cubic cm.	118.294
Gills (U. S.)	cubic inches	7.21875
Gills (U. S.)	drams (fluid)	32
Gills (U. S.)	gallons (U. S.)	0.03125
Gills (U. S.)	liters	0.118292
Gills (U. S.)	minims	1920
Gills (U. S.)	ounces (U. S., fluid)	4
Gills (U. S.)	pints (U. S., liquid)	0.25
Gills (U. S.)	quarts (U. S., liquid)	0.125
Grades	centesimal minutes	100
Grades	circumferences	0.0025
Grades	degrees	0.9
Grades	radians	0.01570797
Grains	carats (metric)	0.3240
Grains	drams (avoirdupois)	0.03657143
Grains	drams (troy)	0.016667
Grains	dynes	63.5453
Grains	grams	0.064798918
Grains	milligrams	64.798918
Grains	ounces (avoirdupois)	0.0022857
Grains	ounces (troy)	0.0020833
Grains	pennyweights (troy)	0.0416667
Grains	pounds (avoirdupois)	1/7000
Grains	pounds (troy)	1/5760
Grains	scruples	0.05000
Grains/gallon (British)	part per million	14.254
Grains/gallon (U. S.)	parts per million	17.118
Grains/gallon (U. S.)	pounds/million gallons (U. S.)	142.86
Grams	carats (metric)	5
Grams	drams (avoirdupois)	0.564383
Grams	drams (troy)	0.257206

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Grams	dynes	980.665
Grams	grains	15.4324
Grams	micrograms	1×10^{6}
Grams	milligrams	1000
Grams	myriagrams	1×10^{-4}
Grams	ounces (avoirdupois)	0.0352739
Grams	ounces (troy)	0.0321507
Grams	pennyweights	0.6430149
Grams	poundals	0.0709314
Grams	pounds (avoirdupois)	0.00220462
Grams	pounds (troy)	0.00267923
Grams	scruples	0.771618
Grams	tons (metric)	1×10^{-6}
Gram centimeters	B. T. U. (mean)	9.29667×10^{-8}
Gram centimeters	calories, gram (mean)	2.3427×10^{-5}
Gram centimeters	calories, kg. (mean)	2.3427×10^{-8}
Gram centimeters	ergs	980.665
Gram centimeters	foot pounds	7.233×10^{-5}
Gram centimeters	joules (Abs.)	9.80665×10^{-5}
Grams centimeters	kilogram meters	1×10^{-5}
Gram centimeters/sec.	watts (Abs.)	9.80665×10^{-5}
Gram cm.^{2} (moment of inertia)	pound sq. ft.	2.37305×10^{-6}
Gram cm.^{2} (moment of inertia)	pound sq. inch	3.4172×10^{-4}
Grams/cubic cm.	pounds/cu. ft.	62.43
Grams/cubic cm.	pounds/cu. inch	0.03613
Grams/cubic cm.	pounds/gallon (British)	10.0224
Grams/cubic cm.	pounds/gallon (U. S.)	8.3454
Grams/cubic meter	grains/cubic ft.	0.35757
Grams/liter	grains/gallon (U. S.)	58.417
Grams/liter	parts per million	1000
Grams/liter	pounds/cu. foot	0.062427
Grams/liter	pounds/1000 gallons (U. S.)	8.345
Grams/milliliter	grams/cubic cm.	0.999973
Grams/ton (long)	milligrams/kg.	0.9842
Grams/ton (short)	milligrams/kg.	1.1023
Grams/sq. cm.	atmospheres	9.6784×10^{-4}
Grams/sq. cm.	dynes/sq. cm.	980.665
Grams/sq. cm.	kg./sq. meter	10
Grams/sq. cm.	millimeters of mercury at 0°C	0.73556
Grams/sq. cm.	pounds/sq. ft.	2.04817
Grams/sq. cm.	pounds/sq. inch	0.0142234
Gram weight sec./sq. cm.	poises	980.665
Gravity	centimeters/sec.^{2}	980.665
Gravity	feet/sec.^{2}	32.174
Hands	centimeters	10.160
Hands	inches	4
Hectares	acres (British)	2.471058
Hectares	acres (U. S.)	2.471044
Hectares	ares	100
Hectares	sq. ft.	107640
Hectares	sq. meters	10000
Hectares	sq. rods (U. S.)	395.367
Hectares	sq. yards (U. S.)	11959.85
Hectograms	grams	100
Hectograms	ounces (avoirdupois)	3.52739
Hectoliters	bushels (British)	2.7497
Hectoliters	bushels (U. S.)	2.837819

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Hectoliters	liters	100
Hectoliters/hectare	U. S. bushels/acre	1.14843
Hectometers	meters	100
Hectometers	rods	19.8838
Hectometers	yards (British)	109.3614
Hectometers	yards (U. S.)	109.3611
Hectowatts	watts	100
Hefner units	candles (International)	0.90 (approx.)
Hemispheres	spheres	0.5
Hemispheres	spherical right angles	4
Hemispheres	steradians	6.2832
Henries (Abs.)	abhenries	1×10^9
Henries (Abs.)	henries (International)	0.99948
Henries (Abs.)	millihenries	1000
Henries (Abs.)	stathenries	1.11263×10^{-12}
Henries (International)	henries (Abs.)	1.00052
Hogsheads (British)	cubic ft.	10.114
Hogsheads (British)	cubic meters	0.28640
Hogsheads (British)	gallons (British)	63
Hogsheads (U. S.)	cubic ft.	8.42184
Hogsheads (U. S.)	cubic meters	0.23848
Hogsheads (U. S.)	gallons (U. S.)	63
Horse power	B. T. U. (mean)/min.	42.418
Horse power	B. T. U. (mean)/hour	2545.08
Horse power	B. T. U. (mean)/sec.	0.70697
Horse power	calories, kg. (mean)/min.	10.688
Horse power	foot pounds/min.	33000
Horse power	foot pounds/sec.	550
Horse power	horse power (metric)	1.0139
Horse power	K. W. (g=980)	0.7452
Horse power	K. W. (g=980.665)	0.74570
Horse power	pounds carbon to CO_2/hour	0.175
Horse power	pounds water evaporated per hour from and at 212°F. (100°C.)	2.64
Horse power	watts (g=980)	745.2
Horse power	watts (g=980.665)	745.70
Horse power, boiler cf. boiler horse power	.....	.....
Horse power, electrical (U. S. or British)	watts (Abs.)	746.00
Horse power (metric)	foot pounds/min.	32549
Horse power (metric)	horse power (U. S.)	0.98632
Horse power (metric)	kg. meters/sec.	75
Horse power hours	B. T. U. (mean)	2545.08
Horse power hours	calories, kg. (mean)	641.304
Horse power hours	foot pounds	1.9800×10^6
Horse power hours	joules (Abs.)	2.6845×10^6
Horse power hours	kg. meters	2.7374×10^5
Horse power hours	K. W. hours	0.7457
Horse power hours	pounds carbon to CO_2	0.175
Horse power hours	pounds water evaporated from and at 212°F. (100°C.)	2.64
Horse power hours	pounds water raised from 62°F. to 212°F.	17.0
Horse power hours	watt hours	745.7
Horse power hours, electrical (U. S. or British)	joules (Abs.)	2.6856×10^6

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Hours (mean solar)	days (mean solar)	0.041667
Hours (mean solar)	minutes (mean solar)	60
Hours (mean solar)	seconds (mean solar)	3600
Hours (mean solar)	weeks	0.0059524
Hundredweights (long)	kilograms	50.8023
Hundredweights (long)	pounds	112
Hundredweights (long)	tons (long)	0.05
Hundredweights (short)	kilograms	45.3592
Hundredweights (short)	ounces (avoirdupois)	1600
Hundredweights (short)	pounds	100
Hundredweights (short)	tons (metric)	0.0453592
Hundredweights (short)	tons (long)	0.0446429
Inches (British)	centimeters	2.539998
Inches (British)	spans	1/9
Inches (British)	yards (British)	1/36
Inches (U. S.)	angstrom units	2.5400×10^{8}
Inches (U. S.)	centimeters	2.540005
Inches (U. S.)	chains (Gunter's)	0.00126263
Inches (U. S.)	feet (U. S.)	1/12
Inches (U. S.)	links (Gunter's)	0.126263
Inches (U. S.)	miles	1.57828×10^{-5}
Inches (U. S.)	mils	1000
Inches (U. S.)	points (printers' type)	72
Inches (U. S.)	rods	0.00505051
Inches (U. S.)	wave length of the red line of cadmium	39450.45
Inches (U. S.)	yards	1/36
Inches of mercury at 32°F	atmospheres	0.033421
Inches of mercury at 32°F	dynes/sq. cm.	3.38639×10^{4}
Inches of mercury at 32°F	feet of water at 39.1°F	1.13299
Inches of mercury at 32°F	kg./sq. meter	345.31
Inches of mercury at 32°F	pounds/sq. ft.	70.727
Inches of mercury at 32°F	pounds/sq. inch	0.49116
Inches of water at 39.2°F. (4°C.)	atmospheres	0.0024583
Inches of water at 39.2°F. (4°C.)	dynes/sq. cm.	2490.82
Inches of water at 39.2°F. (4°C.)	inches of mercury	0.073554
Inches of water at 39.2°F. (4°C.)	kg./sq. meter	25.399
Inches of water at 39.2°F. (4°C.)	ounces/sq. inch	0.57818
Inches of water at 39.2°F. (4°C.)	pounds/sq. ft.	5.2022
Inches of water at 39.2°F. (4°C.)	pounds/sq. inch	0.036136
Inch, Paris cf. pouce	.....	.....
International annealed copper standard (20°C)	micromhos/cm. cube	0.5800
Joules (Abs.)	B. T. U. (mean)	9.480×10^{-4}
Joules (Abs.)	calories, gram (mean)	0.23889
Joules (Abs.)	calories, gram (15°C)	0.23895
Joules (Abs.)	calories, gram (20°C)	0.23918
Joules (Abs.)	calories, kg. (mean)	2.3889×10^{-4}
Joules (Abs.)	cubic foot atmospheres	3.485×10^{-4}
Joules (Abs.)	ergs	1×10^{7}
Joules (Abs.)	foot poundals	23.730
Joules (Abs.)	foot pounds	0.73756
Joules (Abs.)	gram centimeters	1.0197×10^{4}
Joules (Abs.)	horse power hours	3.72508×10^{-7}
Joules (Abs.)	joules (International) (v)	0.999680
Joules (Abs.)	kg. meters	0.101972
Joules (Abs.)	K. W. hours	2.77778×10^{-7}

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Joules (Abs.)	liter atmospheres	0.0098689
Joules (Abs.)	watt hours	2.77778×10^{-4}
Joules (Abs.)	watt seconds	1.0
Joules (International) (v)	joules (Abs.)	1.00032
Joules /abcoulombs/deg. F	joules/coulomb/deg.C	0.1800
Joules (Abs.)/ampere hour	joules/abcoulomb	0.0027778
Joules (Abs.)/ampere hour	joules/statcoulombs	9.2636×10^{-14}
Joules/coulomb	joules/abcoulomb	10.000
Joules/coulomb/deg. F	joules/coulomb/deg. C	1.8000
Joules/deg. C	B. T. U. (60°F)/deg. F	5.2679×10^{-4}
Joules/deg. C	calories, gram/deg. C	0.23889
Joules/electron	joules/abcoulomb	6.2811×10^{19}
Joules/electron/deg. C	joules/coulombs/deg. C	6.2811×10^{18}
Joules/faraday	joules/abcoulomb	1.0363×10^{-4}
Joules/faraday/deg. C	joules/coulomb/deg. C	1.0363×10^{-5}
Joules/gram	B. T. U. (mean)/pound	0.43006
Joules/gram	calories, gram (mean)/gram	0.23889
Joules/gram/deg. C	B. T. U. (mean)/pound/deg. F	0.23889
Joules/gram/deg. C	calories, gram (mean)/gram/deg. C	0.23889
Joules/statcoulomb/deg. C	joules/coulomb/deg. C	2.9986×10^{9}
Joules/statcoulomb/deg. F	joules/coulomb/deg. C	5.3975×10^{9}
Joules /sq.cm./sec. for a temperature gradient of 1°C/cm.	B. T. U./sq. ft./sec. for a temperature gradient of 1°F/inch	0.1926
Joules/sq. cm./sec. for a temperature gradient of 1°C/cm.	calories, gram (15°C)/sq. cm./sec. for a temperature gradient of 1°C/cm.	0.23895
Joule seconds	quanta	1.5258×10^{33}
Joule seconds/N_0 #	quanta	2.5173×10^{9}
Karats (1 of gold to 24 of mixture)	milligrams/gram	41.667
Kilderkins (British)	cubic meters	0.081830
Kilderkins (British)	gallons (British)	18
Kilograms	drams (avoirdupois)	564.383
Kilograms	drams (troy)	257.206
Kilograms	dynes	9.80665×10^{5}
Kilograms	grains	15432.4
Kilograms	grams	1000
Kilograms	hundredweights (long)	0.0196841
Kilograms	hundredweights (short)	0.022046223
Kilograms	ounces (avoirdupois)	35.273957
Kilograms	ounces (troy)	32.150742
Kilograms	pennyweights	643.0149
Kilograms	poundals	70.9314
Kilograms	pounds (avoirdupois)	2.204622341
Kilograms	pounds (troy)	2.6792285
Kilograms	scruples	771.618
Kilograms	tons (long)	9.84207×10^{-4}
Kilograms	tons (metric)	0.001
Kilograms	tons (short)	0.0011023112
Kg. cm.^{2} (moment of inertia)	pounds ft.^{2}	0.00237305
Kg. cm.^{2} (moment of inertia)	pounds in.^{2}	0.341719
Kg. meters	B. T. U. (mean)	0.00929667
Kg. meters	calories, gram (mean)	2.3427
Kg. meters	cu. ft. atmospheres	0.0034177
Kg. meters	ergs	9.80665×10^{7}
Kg. meters	foot poundals	232.71
Kg. meters	foot pounds	7.2330

#N_0 = Avogrado's number = number of molecules per gram mole.

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Kg. meters	gram centimeters	1×10^{5}
Kg. meters	horse power hours	3.6529×10^{-6}
Kg. meters	joules (Abs.)	9.80665
Kg. meters	K. W. hours	2.72407×10^{-6}
Kg. meters	liter atmospheres	0.096781
Kg. meters	watt hours	0.00272407
Kg. meters/sec.	watts (Abs.)	9.80665
Kg. meters (torque)	dyne cm.	9.8066×10^{7}
Kilograms/cu. meter	grams/cubic cm.	0.001
Kilograms/cubic meter	pounds/cu. ft.	0.06243
Kilograms/cu. meter	pounds/cu. inch	3.613×10^{-5}
Kilograms/meter	pounds/foot	0.67197
Kilograms/sq. cm.	centimeters of mercury at 0°C	73.556
Kilograms/sq. cm.	pounds/sq. inch	14.223
Kilograms/sq. meter	atmospheres	9.6777×10^{-5}
Kilograms/sq. meter	dynes/sq. cm.	98.0665
Kilograms/sq. meter	feet of water	0.0032809
Kilograms/sq. meter	grams/sq. cm.	0.1
Kilograms/sq. meter	inches of mercury	0.0028959
Kilograms/sq. meter	millimeters of mercury	0.073556
Kilograms/sq. meter	pounds/sq. ft.	0.204817
Kilograms/sq. meter	pounds/sq. inch	0.00142234
Kilograms/sq. mm.	dynes/sq. cm.	9.80665×10^{7}
Kilograms/sq. mm.	tons (short)/sq. in.	0.71117
Kilolines	maxwells	1000
Kiloliters	cu. ft.	35.317
Kiloliters	cu. meters	1.000027
Kiloliters	cu. yards	1.3080
Kiloliters	gallons (U. S., liquid)	264.18
Kiloliters	liters	1000
Kilometers	centimeters	1×10^{5}
Kilometers	feet	3280.83
Kilometers	light years	1.0567×10^{-13}
Kilometers	meters	1000
Kilometers	miles (nautical)	0.539593
Kilometers	miles (U. S.)	0.6213699495
Kilometers	myriameters	0.1
Kilometers	yards	1093.6
Kilometers/hour	centimeters/sec.	27.7778
Kilometers/hour	feet/min.	54.68
Kilometers/hour	feet/sec.	0.9113
Kilometers/hour	knots (per hour)	0.5396
Kilometers/hour	meters/min.	16.667
Kilometers/hour	meters/sec.	0.27778
Kilometers/hour/sec.	centimeters/sec.^{2}	27.778
Kilometers/hour/sec.	feet/sec.^{2}	0.9113
Kilometers/hour/sec.	meters/sec.^{2}	0.27778
Kilometers/min.	centimeters/sec.	1666.7
Kilometers/min.	miles/hour	37.2822
Kilowatt hours	B. T. U. (mean)	3413.0
Kilowatt hours	calories, gram (mean)	8.6001×10^{5}
Kilowatt hours	foot pounds	2.6552×10^{6}
Kilowatt hours	horse power hours	1.3410
Kilowatt hours	joules (Abs.)	3.6000×10^{6}
Kilowatt hours	kg. meters	3.6709×10^{5}
Kilowatt hours	pounds carbon to CO_2	0.235

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Kilowatt hours	pounds water evaporated from and at 212°F. (100°C.)	3.53
Kilowatt hours	pounds water raised from 62°F. (16.7°C.) to 212°F. (100°C.)	22.75
Kilowatt hours	watt hours	1000
Kilowatts	B. T. U. (mean)/min.	56.884
Kilowatts	B. T. U. (mean)/hour	3413.04
Kilowatts	B. T. U. (mean)/sec.	0.948068
Kilowatts	calories, kg. (mean)/min.	14.3334
Kilowatts	calories, kg. (mean)/sec.	0.23889
Kilowatts	foot pounds/hour	2.6552×10^6
Kilowatts	foot pounds/min.	44254
Kilowatts	foot pounds/sec.	737.56
Kilowatts	horse power	1.3410
Kilowatts	horse power (metric)	1.3596
Kilowatts	pounds carbon to CO_2/hour	0.2275
Kilowatts	pounds water evaporated per hour from and at 212°F. (100°C.)	3.53
Kilowatts	watts	1000
Knot as a unit of length cf. nautical mile	.....	.....
Knots (per hour)	centimeters/sec.	51.479
Knots (per hour)	feet/hour	6080.20
Knots (per hour)	feet/sec.	1.6889
Knots (per hour)	kilometers/hour	1.85325
Knots (per hour)	miles/hour	1.15155
Lamberts	candles/sq. cm.	0.3183
Lamberts	candles/sq. inch	2.054
Lamberts	lumens emitted/sq. cm. of a perfectly diffusing surface	1
Lasts (British)	bushels (British)	80 (variable)
Lasts (British)	cu. meters	2.9095
Leagues (nautical)	kilometers	5.55975
Leagues (nautical)	nautical miles	3
Leagues (statute)	kilometers	4.82804
Leagues (statute)	statute miles	3
Light years	kilometers	9.4637×10^{12}
Light years	miles	5.88×10^{12}
Lignes (Paris lines)	centimeters	0.225583
Lignes (Paris lines)	pouces (Paris inches)	1/12
Lines (British, obsolete)	centimeters	0.21167
Lines (British, obsolete)	inches	1/12
Lines	maxwells (Abs.)	1.0000
Lines/sq. cm.	gauss	1.0
Lines/sq. inch	gauss	0.1550
Links (engineers' or Ramden's)	chains (engineers')	0.01
Links (engineers' or Ramden's)	feet	1
Links (surveyors' or Gunter's)	centimeters	20.11684
Links (surveyors' or Gunter's)	chains (Gunter's)	0.01
Links (surveyors' or Gunter's)	feet	0.66
Links (surveyors' or Gunter's)	inches	7.92
Links (surveyors' or Gunter's)	rods	0.04000
Links (surveyors' or Gunter's)	miles	1.2500×10^{-4}
Links (surveyors' or Gunter's)	yards	0.22
Liter atmospheres (normal)	B. T. U. (mean)	0.096064
Liter atmospheres (normal)	calories, gram (mean)	24.206
Liter atmospheres (normal)	cu. ft. atmospheres	0.035316

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Liter atmospheres (normal)	foot poundals	2404.5
Liter atmospheres (normal)	foot pounds	74.735
Liter atmospheres (normal)	horse power hours	3.7745×10^{-5}
Liter atmospheres (normal)	joules (Abs.)	101.328
Liter atmospheres (normal)	kg. meters	10.333
Liter atmospheres (lat. 45°, g 980.616)	joules (Abs.)	101.323
Liters	bushels (British)	0.027497
Liters	bushels (U. S.)	0.028378
Liters	cubic cm.	1000.027
Liters	cubic ft.	0.035316
Liters	cubic inches	61.025
Liters	cubic meters	0.001000027
Liters	cubic yards	0.0013080
Liters	drams (U. S., fluid)	270.5179
Liters	gallons (British)	0.219976
Liters	gallons (U. S.)	0.26417762
Liters	gills (British)	7.03923
Liters	gills (U. S.)	8.45368
Liters	ounces (British, fluid)	35.196
Liters	ounces (U. S., fluid)	33.8143
Liters	pecks (British)	0.109988
Liters	pecks (U. S.)	0.113512
Liters	pints (British, liquid)	1.7598
Liters	pints (U. S., dry)	1.816192
Liters	pints (U. S., liquid)	2.11336
Liters	quarts (British, liquid)	0.87990
Liters	quarts (U. S., dry)	0.908096
Liters	quarts (U. S., liquid)	1.056681869
Liters/cm./day	sq. cm. /sec.	0.011574
Liters/min.	cu. ft./sec.	5.886×10^{-4}
Liters/min.	gallons/sec.	0.004403
Liters/sec.	cu. ft./min.	2.11896
Liters/sec.	gallons (U. S.)/min.	15.8507
Liters/sec.	cu. yards/min.	0.07848
Lumens	watts	0.001496
Lumens/sq. cm./steradian	lamberts	3.1416
Lumens/sq. ft.	foot candles	1
Lumens/sq. ft.	lumens/sq. meter	10.764
Lumens/sq. ft./steradian	millilamberts	3.3816
Lumens/sq. meter	foot candles or lumens/sq. ft.	0.092902
Lumens/sq. meter	phots	1×10^{-4}
Lux	foot candles	0.092902
Lux	lumens/sq. meter	1.000
Lux	milliphots	0.1
Lux	phots	1×10^{-4}
Maxwells (Abs.)	electrostatic cgs units of pole strength	3.3356×10^{-11}
Maxwells (Abs.)	maxwells (International) (a)	0.99955
Maxwells (Abs.)	maxwells (International) (v)	0.99958
Maxwells (International) (a)	maxwells (Abs.)	1.00045
Maxwells (Internaticnal) (a)/cm.^{2}	maxwells (Abs.)/cm.^{2}	1.00045
Maxwells (International) (v)	maxwells (Abs.)	1.00042
Maxwells (International) (v)/cm.^{2}	maxwells (Abs.)/cm.^{2}	1.00042
Maxwells/sq. in.	maxwells/sq. cm.	0.1550
Megalergs	ergs	1×10^6
Megalines	maxwells	1×10^6

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Megameters	meters	1×10^{6}
Megmhos	abmohs	0.001
Megmhos/cm. cube	megmhos/inch cube	2.540
Megmhos/cm. cube	microhms^{-1}/cm. cube	1
Megmhos/cm. cube	mhos/mil foot	0.1662
Megmhos/inch cube	megmhos/cm. cube	0.39370
Megmhos/inch cube	microhms^{-1}/inch cube	1
Megohms	ohms	1×10^{6}
Mercury at 0°C	grams /cubic cm.	13.5951
Meter candles	lumens/sq. meter	1.000
Meter kilograms cf. kg. meters	.....	.....
Meters	angstrom units	1×10^{10}
Meters	centimeters	100
Meters	chains (Gunter's)	0.0497096
Meters	fathoms	0.54681
Meters	feet (British)	3.280843
Meters	feet (U. S.)	3.280833333
Meters	furlongs	0.00497096
Meters	inches (British)	39.370113
Meters	inches (U. S.)	39.3700
Meters	kilometers	0.001
Meters	links (Gunter's)	4.970960
Meters	megameters	1×10^{-6}
Meters	miles (nautical)	5.39593×10^{-4}
Meters	miles (statute)	6.2137×10^{-4}
Meters	millimicrons	1×10^{9}
Meters	millionth microns	1×10^{12}
Meters	pieds (French feet)	3.07834
Meters	rods (U. S.)	0.198838
Meters	wave lengths of the red line of cadmium	1.55316412×10^{6}
Meters	yards (British)	1.093614
Meters	yards (U. S.)	1.093611
Meters/min.	centimeters/sec.	1.6667
Meters/min.	feet/ sec.	0.05468
Meters/min.	kilometers/hour	0.06
Meters/min.	miles/hour	0.03728
Meters/sec.	feet/min.	196.8
Meters/sec.	kilometers/hour	3.6000
Meters/sec.	kilometers/min.	0.060000
Meters/sec.	miles/hour	2.2369
Meters/sec.	miles/min.	0.03728
Meters/sec.^{2}	kilometers/hour/sec.	3.6
Meters/sec.^{2}	miles/hour/sec.	2.2369
Metric carat cf. carat, metric	.....	.....
Metric horsepower cf. horse power, metric	.....	.....
Metric ton cf. ton, metric	.....	.....
Mho centimeter cube	ohm^{-1} centimeter^{-1}	1
Mhos, International/cm. cube	mhos (Abs.)/cm. cube	0.99948
Microfarads	abfarads	1×10^{-15}
Microfarads	farads	1×10^{-6}
Microfarads	statfarads	8.98776×10^{5}
Micrograms	grams	1×10^{-6}
Micrograms	milligrams	0.001
Microhms	abohms	1000
Microhms	megohms	1×10^{-12}

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Microhms	ohms	1×10^{-6}
Microhms	statohms	1.11263×10^{-18}
Microliters	liters	1×10^{-6}
Micromicrofarads	farads	1×10^{-12}
Micro-microns or millionth micron	angstrom units	0.01
Micro-microns	centimeters	1×10^{-10}
Micro-microns	meters	1×10^{-12}
Microns	angstrom units	1×10^{4}
Microns	centimeters	1×10^{-4}
Microns	inches	3.937×10^{-5}
Microns	meters	1×10^{-6}
Microns	millimeters	0.001
Microns	millimicrons or micro-millimeters	1000
Microns	mils	0.039370
Microvolts	abvolts	100
Microvolts	volts	1.000×10^{-6}
Microvolts/deg. F	microvolts/deg. C	1.8000
Miles (British)	kilometers	1.60934
Miles (nautical)	feet	6080.20
Miles (nautical)	kilometers	1.85325
Miles (nautical)	leagues (nautical)	1/3
Miles (nautical)	miles (U. S., statute)	1.1516
Miles (nautical)	yards	2026.73
Miles (U. S., statute)	chains (Gunter's)	80
Miles (U. S., statute)	furlongs	8
Miles (U. S., statute)	inches	63360
Miles (U. S., statute)	feet	5280
Miles (U. S., statute)	kilometers	1.609347219
Miles (U. S., statute)	light years	1.691×10^{-13}
Miles (U. S., statute)	links (Gunter's)	8000
Miles (U. S., statute)	meters	1609.35
Miles (U. S., statute)	miles (nautical)	0.86836
Miles (U. S., statute)	myriameters	0.160935
Miles (U. S., statute)	rods	320
Miles (U. S., statute)	yards	1760
Miles/hour	centimeters/sec.	44.7041
Miles/hour	feet/min.	88
Miles/hour	feet/sec.	1.4667
Miles/hour	knots (per hour)	0.8684
Miles /hour	meters/min.	26.82
Miles/hour	miles/min.	0.0166667
Miles/hour/min.	centimeters/sec.^{2}	0.74507
Miles/hour/sec.	centimeters/sec.^{2}	44.704
Miles/hour/sec.	feet/sec.^{2}	1.4667
Miles/hour/sec.	meters/sec.^{2}	0.44704
Miles/min.	centimeters/sec.	2682.2
Miles/min.	feet/sec.	88
Miles/min.	knots (per hour)	52.1016
Millier cf. ton (metric)	.....	.....
Milligrams	carats (metric)	0.005
Milligrams	grains	0.01543236
Milligrams	drams (avoirdupois)	5.64383×10^{-4}
Milligrams	drams (troy)	2.57206×10^{-4}
Milligrams	grams	0.001
Milligrams	kilograms	1×10^{-6}
Milligrams	ounces (avoirdupois)	3.52739×10^{-5}
Milligrams	ounces (troy)	3.215074×10^{-5}

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Milligrams	pennyweights	6.43015×10^{-4}
Milligrams	pounds (avoirdupois)	2.2046×10^{-6}
Milligrams	pounds (troy)	2.67923×10^{-6}
Milligrams	scruples	7.71618×10^{-4}
Milligrams/assay ton or one troy ounce/2000 pounds avoirdupois	milligrams/kilogram	34.286
Milligrams/inch	dynes/cm.	0.38609
Milligrams/kilogram	ounces (avoirdupois)/short ton	0.0320
Milligrams/kilogram	pounds (avoirdupois)/short ton	0.0020
Milligrams/liter	parts per million	1.0
Milligrams/millimeter	dynes/cm.	9.80665
Millihenries	abhenries	1×10^{6}
Millihenries	henries	0.001
Millihenries	stathenries	1.11263×10^{-15}
Millilamberts	lumens emitted/sq. ft. with perfect diffusion	0.929
Milliliters	cubic cm.	1.000027
Milliliters	cubic inches	0.061025
Milliliters	drams (U. S., fluid)	0.2705179
Milliliters	gills (U. S.)	0.00845368
Milliliters	liters	0.001
Milliliters	minims (U. S.)	16.2311
Milliliters	ounces (British, fluid)	0.035196
Milliliters	ounces (U. S., fluid)	0.0338147
Millimeters	centimeters	0.1
Millimeters	inches (British)	0.0393701
Millimeters	inches (U. S.)	0.0393700
Millimeters	meters	0.001
Millimeters	microns	1000
Millimeters	mils	39.37
Millimeters of mercury at 0°C	atmospheres	0.00131579
Millimeters of mercury at 0°C	dynes/sq. cm.	1333.22
Millimeters of mercury at 0°C	grams/sq. cm.	1.3595
Millimeters of mercury at 0°C	kilograms/sq. meter	13.595
Millimeters of mercury at 0°C	microns of mercury at 0°C	1000
Millimeters of mercury at 0°C	pounds /sq. ft.	2.7845
Millimeters of mercury at 0°C	pounds /sq. inch	0.019337
Millimicrons or micro-millimeters	angstrom units	10
Millimicrons	centimeters	1×10^{-7}
Millimicrons	meters	1×10^{-9}
Millimicrons	microns	0.001
Million gallons (U. S.)/day	cubic feet/sec.	1.54723
Milliphots	foot candles	0.92902
Milliphots	phots	0.001
Mils	centimeters	0.00254001
Mils	inches	0.001
Mils	microns	25.4001
Miner's inches	cubic ft./min.	1.2 to 1.53
Minims (British)	cubic cm.	0.059192
Minims (U. S., fluid)	cubic cm.	0.061612
Minims (U. S.)	cubic mm.	61.612
Minims (U. S.)	drams (U. S., fluid)	1/60
Minims (U. S.)	gallons (U. S.)	1.6276×10^{-5}
Minims (U. S.)	gills (U. S.)	5.20833×10^{-4}
Minims (U. S.)	milliliters	0.0616102
Minims (U. S.)	ounces (U. S., fluid)	1/480
Minims (U. S.)	pints (U. S., liquid)	1.30208×10^{-4}

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Minutes (angle)	degrees	1/60
Minutes (angle)	quadrants	1.85185×10^{-4}
Minutes (angle)	radians	2.90888×10^{-4}
Minutes (angle)	seconds	60
Minutes (time)	days	6.94444×10^{-4}
Minutes (time)	hours	1/60
Minutes (time)	seconds	60
Minutes (time)	weeks	9.9206×10^{-5}
Minutes/cm.	radians/cm.	2.9089×10^{-4}
Months (lunar)	days, hours, minutes	29d., 12hr., 44m.
Months (mean calender)	days	30.4202
Months (mean calender)	hours	730.085
Months (mean calender)	minutes	43805.1
Months (mean calender)	seconds	2.6283×10^{6}
Myriagrams	grams	10000
Myriagrams	kilograms	10
Myriagrams	pounds (avoirdupois)	22.04622
Myriameters	kilometers	10
Myriameters	meters	10000
Myriameters	miles	6.21370
Nails (British)	centimeters	5.715
Nails (British)	inches	2.25
Noggins (British)	cubic cm.	142.07
Noggins (British)	gallons (British)	1/32
Oersteds (Abs.)	oersteds (International)	1.00052
Oersteds (International)	oersteds (Abs.)	0.99948
Ohm-mile-pounds	ohm-meter-grams	1.7513×10^{-4}
Ohms (Abs.)	abohms	1×10^{9}
Ohms (Abs.)	megohms (Abs.)	1×10^{-6}
Ohms (Abs.)	microhms (Abs.)	1×10^{6}
Ohms (Abs.)	ohms (International)	0.99948
Ohms (Abs.)	statohms	1.11263×10^{-12}
Ohms (International)	Board of trade units, (England before 1903)	1.00016
Ohms (International)	ohms (Abs.)	1.00052
Ohms (International)	siemens unit	1.0630
Ohms (International) (France before 1911)	ohms (International)	0.9999
Ohms, "legal" (England, 1884)	ohms (International)	0.99718
Ounces (avoirdupois)	drams (avoirdupois)	16
Ounces (avoirdupois)	drams (troy or apoth.)	7.29166
Ounces (avoirdupois)	grains	437.5
Ounces (avoirdupois)	grams	28.349527
Ounces (avoirdupois)	hundredweights (short)	6.25×10^{-4}
Ounces (avoirdupois)	ounces (troy or apoth.)	0.9114583
Ounces (avoirdupois)	pennyweights	18.22917
Ounces (avoirdupois)	pounds (avoirdupois)	1/16
Ounces (avoirdupois)	pounds (troy)	0.075954861
Ounces (avoirdupois)	scruples	21.875
Ounces (avoirdupois)	tons (long)	2.790179×10^{-5}
Ounces (avoirdupois)	tons (metric)	2.83495×10^{-5}
Ounces (avoirdupois)	tons (short)	3.125×10^{-5}
Ounces (avoirdupois)/ton (long)	milligrams/kg.	27.9018
Ounces (avoirdupois)/ton (short)	milligrams/kg.	31.2500
Ounces (avoirdupois)/sq. in.	dynes/sq. cm.	4309.2
Ounces (British, fluid)	cubic cm.	28.4130

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Ounces (British, fluid)	drachms (British, fluid)	8
Ounces (British, fluid)	gallons (British)	0.006250
Ounces (British, fluid)	minims (British)	480
Ounces (troy or apoth.)	drams (avoirdupois)	17.55428
Ounces (troy or apoth.)	drams (troy or apoth.)	8
Ounces (troy or apoth.)	grains	480
Ounces (troy or apoth.)	grams	31.103481
Ounces (troy or apoth.)	milligrams	31103.481
Ounces (troy or apoth.)	ounces (avoirdupois)	1.09714
Ounces (troy)	pennyweights	20
Ounces (troy or apoth.)	pounds (avoirdupois)	0.06857143
Ounces (troy or apoth.)	pounds (troy)	1/12
Ounces (troy or apoth.)	scruples	24
Ounces (troy or apoth.)	tons (short)	3.42857×10^{-5}
Ounces (U. S., fluid)	cubic cm.	29.5737
Ounces (U. S., fluid)	cubic inches	1.80469
Ounces (U. S., fluid)	drams (fluid)	8
Ounces (U. S., fluid)	gallons (U. S.)	1/128
Ounces (U. S., fluid)	gills (U. S.)	0.25
Ounces (U. S., fluid)	liters	0.0295729
Ounces (U. S., fluid)	milliliters	29.5729
Ounces (U. S., fluid)	minims (U. S.)	480
Ounces (U. S., fluid)	pints (U. S., liquid)	1/16
Ounces (U. S., fluid)	quarts (U. S., liquid)	0.03125
Paces	centimeters	76.2
Paces	feet	2.5
Paces	inches	30
Palms (British)	centimeters	7.62
Palms (British)	inches	3
Parsecs	kilometers	3.084×10^{13}
Parsecs	miles	1.9163×10^{13}
Parts per million	grains per gallon (U. S.)	0.0584
Parts per million	grains/gallon (British)	0.07016
Parts per million	pounds/million gallons (U. S.)	8.345
Pecks (British)	cubic inches	554.6
Pecks (British)	gallons (British)	2
Pecks (British)	liters	9.091901
Pecks (U. S.)	bushels	0.25
Pecks (U. S.)	cubic inches	537.605
Pecks (U. S.)	liters	8.809582
Pecks (U. S.)	pints (dry)	16
Pecks (U. S.)	quarts (dry)	8
Pennyweights	drams (avoirdupois)	0.8777143
Pennyweights	grains	24
Pennyweights	grams	1.55517
Pennyweights	milligrams	1555.17
Pennyweights	ounces (avoirdupois)	0.0548571
Pennyweights	ounces (troy)	0.05
Pennyweights	pounds (avoirdupois)	0.003428571
Pennyweights	pounds (troy)	0.00416667
Perch (British and U. S.) cf. rod	.....	.....
Perches (Masonry)	cubic ft.	24.75
Phots	lumens incident/sq. cm.	1
Phots	lumens/sq. meter	10000
Phots	lux	10000
Phots	milliphots	1000
Pieds (French feet)	meters	0.32485

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Pieds (French feet)	Paris inches	12
Pieds (French feet)	toises (French)	1/6
Pints (British, liquid)	cubic cm.	568.26
Pints (British, liquid)	gallons (British)	0.125
Pints (British, liquid)	gills (British)	4
Pints (British, liquid)	quarts (British)	0.5
Pints (U. S., dry)	bushels (U. S.)	0.015625
Pints (U. S., dry)	cubic cm.	550.61
Pints (U. S., dry)	cubic inches	33.6003
Pints (U. S., dry)	liters	0.550599
Pints (U. S., dry)	pecks (U. S.)	0.0625
Pints (U. S., dry)	quarts (U. S., dry)	0.5
Pints (U. S., liquid)	cubic cm.	473.179
Pints (U. S., liquid)	cubic feet	0.016711
Pints (U. S., liquid)	cubic inches	28.875
Pints (U. S., liquid)	cubic yards	6.1881×10^{-4}
Pints (U. S., liquid)	drams (fluid)	128
Pints (U. S., liquid)	gallons (U. S.)	0.125
Pints (U. S., liquid)	gills	4
Pints (U. S., liquid)	liters	0.473168
Pints (U. S., liquid)	minims (U. S.)	7680
Pints (U. S., liquid)	ounces (U. S., fluid)	16
Pints (U. S., liquid)	quarts (U. S., liquid)	0.5
Plank's quanta	erg seconds	6.554×10^{-27}
Points (Printers' type)	centimeters	0.035278
Points (Printers' type)	inches	0.0138889
Poise cm. cubed/gram	sq. cm./sec.	1.000
Poise feet cubed/pound	sq. cm./sec.	62.43
Poise inch cubed/gram	sq. cm./sec.	16.387
Poises	grams/cm./sec.	1.000
Pole (British) cf. rod	.....	.....
Pottles (British)	cubic cm.	2273.04
Pottles (British)	gallons (British)	0.5
Pouces (Paris inches)	centimeters	2.70700
Pouces (Paris inches)	lignes or Paris lines	12
Pouces (Paris inches)	pieds (Paris feet)	0.083333
Poundals	dynes	1.3825×10^{4}
Poundal feet (torque)	dyne cm.	4.2140×10^{5}
Poundals	grams	14.098
Poundals	pounds	0.031081
Pounds (avoirdupois)	cubic inches of water at 4°C and 760 mm mercury press.	27.6873
Pounds (avoirdupois)	drams (avoirdupois)	256
Pounds (avoirdupois)	drams (troy)	116.6667
Pounds (avoirdupois)	dynes	4.44852×10^{5}
Pounds (avoirdupois)	grains	7000
Pounds (avoirdupois)	grams	453.5924277
Pounds (avoirdupois)	hundredweights (long)	0.00892857
Pounds (avoirdupois)	hundredweights (short)	0.01
Pounds (avoirdupois)	kilograms	0.4535924277
Pounds (avoirdupois)	ounces (avoirdupois)	16
Pounds (avoirdupois)	ounces (troy)	14.5833
Pounds (avoirdupois)	pennyweights	291.6667
Pounds	pounJals	32.174
Pounds (avoirdupois)	pounds (troy)	1.2152778
Pounds (avoirdupois)	scruples	350.0000
Pounds (avoirdupois)	tons (long)	4.464286×10^{-4}

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Pounds (avoirdupois)	tons (metric)	4.5359243×10^{-4}
Pounds (avoirdupois)	tons (short)	5×10^{-4}
Pounds (troy)	drams (avoirdupois)	210.6514
Pounds (troy)	drams (troy)	96
Pounds (troy)	grains	5760
Pounds (troy)	grams	373.2418
Pounds (troy)	kilograms	0.3732418
Pounds (troy)	ounces (avoirdupois)	13.165714
Pounds (troy)	ounces (troy)	12
Pounds (troy)	pennyweights	240
Pounds (troy)	pounds (avoirdupois)	0.822857
Pounds (troy)	scruples	288
Pounds (troy)	tons (long)	3.6735×10^{-4}
Pounds (troy)	tons (metric)	3.7324×10^{-4}
Pounds (troy)	tons (short)	4.1143×10^{-4}
Pounds of carbon to CO_2	B. T. U.	14544
Pounds of carbon to CO_2	cubic ft. illuminating gas burned	21
Pounds of carbon to CO_2	foot pounds	11315000
Pounds of carbon to CO_2	horse power hours	5.71
Pounds of carbon to CO_2	kilowatt hours	4.26
Pounds of carbon to CO_2	pounds anthracite coal burned	1.11
Pounds of carbon to CO_2	pounds dry wood burned	2.5
Pounds of carbon to CO_2	pounds water evaporated from and at 212°F. (100°C.)	15
Pounds of water (62°F.)	cubic feet	0.016033
Pounds of water	cubic inches	27.68
Pounds of water	gallons (U. S.)	0.1198
Pounds of water evaporated from and at 212°F. (100°C.)	B. T. U.	965.7
Pounds of water evaporated from and at 212°F. (100°C.)	foot pounds	751300
Pounds of water evaporated from and at 212°F. (100°C.)	horse power hours	0.379
Pounds of water evaporated from and at 212°F. (100°C.)	joules	1019000
Pounds of water evaporated from and at 212°F. (100°C.)	kilowatt hours	0.283
Pounds of water evaporated from and at 212°F. (100°C.)	kilogram meters	103900
Pounds of water evaporated from and at 212°F. (100°C.)	pounds carbon to CO_2	0.0664
Pounds/cu. inch	grams/cu. cm.	27.68
Pounds/foot	kg./meter	1.48816
Pounds/inch	grams/centimeter	178.6
Pounds/sq. ft. (moment of inertia)	grams/sq. cm.	4.2140×10^{5}
Pounds/sq. ft. (moment of inertia)	kg./sq. cm.	421.40
Pounds/sq. ft. (moment of inertia)	pounds/sq. inch	144
Pound feet (torque)	dyne cm.	1.3558×10^{7}
Pounds/sq. inch (moment of inertia)	grams/sq. cm.	2926.4
Pounds/sq. inch (moment of inertia)	kg./sq. cm.	2.9264
Pounds/sq. inch (moment of inertia)	pounds/sq. ft.	0.00694444
Pound inches (torque)	dyne cm.	1.1298×10^{6}
Pounds of water/min.	cubic ft./min.	0.016021
Pounds of water/minute	cu. ft./sec.	2.670×10^{-4}
Pounds/cu. ft.	grams/cubic cm.	0.016018
Pounds/cu. ft.	kg./cubic meter	16.018
Pounds/cu. ft.	pounds/cubic inch	5.787×10^{-4}

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Pounds/cubic inch	grams/cubic cm.	27.6800
Pounds/cu. inch	kg./cu. meter	2.768×10^4
Pounds/gallon (British)	grams/cubic cm.	0.099776
Pounds/gallon (U. S.)	grams/cubic cm.	0.119826
Pounds/circular mil foot	grams/cubic cm.	2.93696×10^6
Pounds/sq. ft.	atmospheres	4.7252×10^{-4}
Pounds/sq. ft.	bars	4.7880×10^{-4}
Pounds/sq. ft.	dynes/sq. cm.	478.78
Pounds/sq. ft.	feet of water at 39.1°F	0.016018
Pounds/sq. ft.	grams/sq. cm.	0.48824
Pounds/sq. ft.	kg./sq. meter	4.8824
Pounds/sq. ft.	mm. of mercury at 0°C	0.35913
Pounds/sq. ft.	pound/sq. inch	0.0069445
Pounds/sq. inch	atmospheres	0.068046
Pounds/sq. inch	bars	0.068947
Pounds/sq. inch	cm. of mercury at 0°C	5.1715
Pounds/sq. inch	dynes/sq. cm.	68946
Pounds/sq. inch	feet of water at 39.1°F	2.3066
Pounds/sq. inch	grams/sq. cm.	70.307
Pounds/sq. inch	inches of mercury at 32°F	2.0360
Pounds/sq. inch	inches of water at 39.2°F. (4°C)	27.673
Pounds/sq. inch	kg./sq. cm.	0.070307
Pounds/sq. inch	kg./sq. meter	703.07
Pounds/sq. inch	millimeters of mercury	51.715
Pounds/sq. inch	pounds/sq. ft.	144
Pounds/sq. inch	tons (short)/sq. inch	5×10^{-4}
Pounds (avoirdupois)/ton (short)	milligrams/kg	500
Pound weight sec./sq. ft.	poises	478.8
Pound weight sec./sq. inch	poises	6.895×10^4
Puncheons (British)	cubic meters	0.31823
Puncheons (British)	gallons (British)	70
Puncheons (British)	wine gallons	84
Quadrants	degrees	90
Quadrants	minutes	5400
Quadrants	radians	1.57080
Quarterns (British, dry)	cubic cm.	2273.1
Quarterns (British, dry)	gallons	0.5
Quarterns (British, liquid)	cubic cm.	142.07
Quarterns (British, liquid)	gallons (British)	0.03125
Quarters (British, capacity)	bushels (British)	8
Quarters (British, capacity)	liters	290.94
Quarters (British, linear) cf. span	.....	.....
Quarters (British, mass)	pounds	25 or 28
Quarters (U. S., mass)	pounds	500 or 560
Quarts (British, liquid)	cubic cm.	1136.521
Quarts (British, liquid)	gallons (British)	4
Quarts (British, liquid)	liters	1.13650
Quarts (British, liquid)	pints (British, liquid)	2
Quarts (U. S., dry)	bushels (U. S.)	0.03125
Quarts (U. S., dry)	cubic cm.	1101.23
Quarts (U. S., dry)	cubic ft.	0.038889
Quarts (U. S., dry)	cubic inches	67.2006
Quarts (U. S., dry)	liters	1.10120
Quarts (U. S., dry)	pecks (U. S.)	0.125
Quarts (U. S., dry)	pints (dry)	2
Quarts (U. S., liquid)	cubic cm.	946.358
Quarts (U. S., liquid)	cubic inches	57.749

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Quarts (U. S., liquid)	cubic ft.	0.033420
Quarts (U. S., liquid)	drams (fluid)	256.00
Quarts (U. S., liquid)	gallons (U. S.)	0.25
Quarts (U. S., liquid)	gills (U. S.)	8
Quarts (U. S., liquid)	liters	0.946333
Quarts (U. S., liquid)	ounces (fluid, U. S.)	32
Quarts (U. S., liquid)	pints (U. S., liquid)	2
Quintals (metric)	hundredweights (long)	1.96841
Quintals (metric)	kilograms	100
Quintals (metric)	pounds (avoirdupois)	220.46
Quintals (U. S. or British)	pounds	100 or 112
Quires	sheets	24
Radians	circumferences	0.15916
Radians	degrees	57.29578
Radians	degrees, min., sec.	57°, 17′, 44.8″
Radians	minutes	3437.75
Radians	quadrants	0.637
Radians	revolutions	0.15916
Radians	seconds	206265
Radians/cm.	degrees/cm.	57.296
Radians/cm.	degrees/foot	1746.4
Radians/cm.	degrees/inch	145.53
Radians/cm.	minutes/cm.	3437.75
Radians/sec.	revolutions/min.	9.549
Radians/sec.^{2}	revolutions/min.^{2}	572.96
Radians/sec.^{2}	revolutions/min./sec.	9.549
Reams	sheets	480
Register tons (British)	cubic feet (British)	100
Register tons (British)	cubic meters	2.8317
Revolutions	degrees	360
Revolutions	quadrants	4
Revolutions	radians	6.2832
Revolutions/day	radians/sec.	7.2722×10^{-5}
Revolutions/min.	degrees/sec.	6
Revolutions/min.	radians/sec.	0.10472
Revolutions/min.^{2}	radians/sec.^{2}	0.0017453
Revolutions/min.^{2}	revolutions/sec.^{2}	2.778×10^{-4}
Revolutions/min./sec.	radians/sec.^{2}	0.10420
Revolutions/sec.^{2}	revolutions/min.^{2}	3600
Rods (British, volume)	cubic ft.	1000
Rods (British, volume)	cubic meters	28.317
Rods (Surveyors' measure)	chains (Gunter's)	0.25
Rods (Surveyors' measure)	feet	16.5
Rods (Surveyors' measure)	furlongs	0.025
Rods (Surveyors' measure)	inches	198
Rods (Surveyors' measure)	links (Gunter's)	25
Rods (Surveyors' measure)	meters	5.029216
Rods (Surveyors' measure)	miles	0.003125
Rods (Surveyors' measure)	perches	1
Rods (Surveyors' measure)	yards	5.5
Roods (British)	acres	0.25
Roods (British)	ares	10.117
Roods (British)	sq. perches	40
Roods (British)	sq. yards	1210
Ropes (British)	feet	20
Ropes (British)	meters	6.0960
Sacks (British)	bushels (British)	3

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Sacks (British)	cubic meters	0.10911
Scruples (apothecary)	drams (avoirdupois)	0.7314286
Scruples	drams (troy or apothecary)	0.33333
Scruples	grains	20
Scruples	grams	1.2959784
Scruples	milligrams	1295.9784
Scruples	ounces (avoirdupois)	0.0457143
Scruples	ounces (troy or apothecary)	0.0416667
Scruples	pennyweights	0.833333
Scruples	pounds (avoirdupois)	0.00285714
Scruples	pounds (troy or apothecary)	0.003472222
Seams (British)	bushels (British)	8
Seams (British)	cubic meters	0.29095
Seconds	minutes	1/60
Seconds (angle)	degrees	2.77778×10^{-4}
Seconds (angle)	radians	4.84814×10^{-6}
Seconds (time, sidereal)	seconds (mean, solar)	0.997270
Siemens units	ohms (International)	0.94073
Signs	degrees	30
Skeins	feet	360
Skeins	meters	109.728
Slugs	geepounds	1
Slugs	kilograms	14.594
Slugs	pounds	32.174
Slugs/cu. ft.	grams/cubic cm.	0.5154
Space, entire (solid angle)	steradians	12.5664
Spans	centimeters	22.86005
Spans	fathoms	0.125
Spans	inches	9
Spans	yards	0.25
Spheres (solid angle)	hemispheres	2
Spheres (solid angle)	steradians	12.5664
Spherical right angles	hemispheres	0.25
Spherical right angles	spheres	0.125
Spherical right angles	steradians	1.5708
Square cm.	circular millimeters	127.32
Square cm.	circular mils	197350
Square cm.	sq. chains	2.47107×10^{-7}
Square cm.	sq. decimeters	0.01
Square cm.	sq. ft.	0.0010764
Sq. cm.	sq. inches	0.15500
Sq. cm.	sq. links (Gunter's)	0.00247107
Sq. cm.	sq. meters	1×10^{-4}
Sq. cm.	sq. millimeters	100
Sq. cm.	sq. mils	155000
Sq. cm.	sq. rods	3.95367×10^{-6}
Sq. cm.	sq. yards	1.1960×10^{-4}
Sq. cm.-cm.^{2} (moment of area)	sq. in.-in.^{2}	0.024025
Sq. cm./day	sq. cm./sec.	1.1574×10^{-5}
Sq. chains (Gunter's)	acres	0.1
Sq. chains (Gunter's)	sq. feet	4356
Sq. chains (Gunter's)	sq. inches	627264
Sq. chains (Gunter's)	sq. links (Gunter's)	1×10^4
Sq. chains (Gunter's)	sq. meters	404.689
Sq. chains (Gunter's)	sq. miles	1.5625×10^{-4}
Sq. chains (Gunter's)	sq. rods	16
Sq. chains (Gunter's)	sq. yards	484

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Sq. decimeters	sq. cm.	100
Sq. decimeters	sq. inches	15.500
Sq. decimeters	sq. meters	0.01
Sq. degrees	steradians	3.0462×10^{-4}
Sq. dekameters	acres (U. S.)	0.02471044
Sq. dekameters	sq. meters	100
Sq. dekameters	sq. yards	119.60
Sq. feet (British)	sq. meters	0.09290289
Sq. feet (U. S.)	acres	2.29568×10^{-5}
Sq. feet (U. S.)	ares	9.290341×10^{-4}
Sq. feet	sq. cm.	929.0341
Sq. feet (U. S.)	sq. chains (Gunter's)	2.29568×10^{-4}
Sq. feet (U. S.)	sq. inches	144
Sq. feet (U. S.)	sq. links (Gunter's)	2.29568
Sq. feet (U. S.)	sq. meters	0.09290341
Sq. feet (U. S.)	sq. miles	3.58701×10^{-8}
Sq. feet (U. S.)	sq. rods	0.00367309
Sq. feet (U. S.)	sq. yards (U. S.)	1/9
Sq. foot-ft.^{2} (moment of area)	sq. in.-in.^{2}	20736
Sq. hectometers	acres (British)	2.471058
Sq. hectometers	acres (U. S.)	2.471044
Sq. inches (U. S.)	circular mils	1273240
Sq. inches (British)	sq. cm.	6.4515898
Sq. inches (U. S.)	sq. cm.	6.4516258
Sq. inches (U. S.)	sq. chains (Gunter's)	1.59423×10^{-4}
Sq. inches (U. S.)	sq. feet (U. S.)	1/144
Sq. inches (U. S.)	sq. links (Gunter's)	0.0159423
Sq. inches (U. S.)	sq. meters	6.4516258×10^{-4}
Sq. inches (U. S.)	sq. mils	1×10^6
Sq. inches (U. S.)	sq. yards (U. S.)	1/1296
Sq. in.-in.^{2} (moment of area)	sq. cm.-cm.^{2}	41.623
Sq. in.-in.^{2} (moment of area)	sq. ft.-ft.^{2}	4.8225×10^{-5}
Sq. in./sec.	sq. cm./sec.	6.4516
Sq. kilometers	acres (British)	247.1058
Sq. kilometers	acres (U. S.)	247.1044
Sq. kilometers	sq. feet	1.0764×10^7
Sq. kilometers	sq. meters	1×10^6
Sq. kilometers	sq. miles (U. S.)	0.3861006
Sq. kilometers	sq. yards	1.1960×10^6
Sq. links (Gunter's)	acres (U. S.)	1×10^{-5}
Sq. links (Gunter's)	sq. cm.	404.68
Sq. links (Gunter's)	sq. chains (Gunter's)	1×10^{-4}
Sq. links (Gunter's)	sq. feet	0.4356
Sq. links (Gunter's)	sq. inches	62.7264
Sq. links (Gunter's)	sq. meters	0.040468
Sq. links (Gunter's)	sq. rods	0.0016
Sq. links (Gunter's)	sq. yards	0.0484
Sq. meters	acres (British)	2.471058×10^{-4}
Sq. meters	acres (U. S.)	2.471044×10^{-4}
Sq. meters	ares	0.01
Sq. meters	sq. cm.	1×10^4
Sq. meters	sq. chains (Gunter's)	0.00247107
Sq. meters	sq. feet (British)	10.76390
Sq. meters	sq. feet (U. S.)	10.76387
Sq. meters	sq. inches	1550.0
Sq. meters	sq. kilometers	1×10^{-6}
Sq. meters	sq. links (Gunter's)	24.7107

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Sq. meters	sq. millimeters	1×10^{6}
Sq. meters	sq. miles	3.8610×10^{-7}
Sq. meters	sq. rods	0.0395367
Sq. meters	sq. yards (British)	1.195992
Sq. meters	sq. yards (U. S.)	1.195985
Sq. miles	acres	640
Sq. miles	sq. chains (Gunter's)	6400
Sq. miles	sq. feet	2.78784×10^{7}
Sq. miles	sq. kilometers	2.589998
Sq. miles	sq. meters	2589998
Sq. miles	sq. rods	102400
Sq. miles	sq. yards	3.0976×10^{6}
Sq. millimeters	circular millimeters	1.27324
Sq. millimeters	circular mils	1973.5
Sq. millimeters	sq. cm.	0.01
Sq. millimeters	sq. inches	0.0015500
Sq. millimeters	sq. meters	1×10^{-6}
Sq. millimeters	sq. mils	1550.0
Sq. mils	circular mils	1.27324
Sq. mils	sq. cm.	6.4516×10^{-6}
Sq. mils	sq. inches	1×10^{-6}
Sq. mils	sq. millimeters	6.4516×10^{-4}
Sq. perches (British and U. S.) cf. sq. rods	.....	.....
Sq. poles (British)	sq. yards	30.25
Sq. rods	acres	0.00625
Sq. rods	sq. chains (Gunter's)	0.0625
Sq. rods	sq. feet	272.25
Sq. rods	sq. inches	39204
Sq. rods	sq. links (Gunter's)	625
Sq. rods	sq. meters	25.293
Sq. rods	sq. miles	9.765625×10^{-6}
Sq. rods	sq. yards	30.25
Sq. yards (British)	acres (British)	2.0661×10^{-4}
Sq. yards (British)	roods (British)	8.2645×10^{-4}
Sq. yards (British)	sq. meters	0.836126
Sq. yards (U. S.)	acres (U. S.)	2.06612×10^{-4}
Sq. yards (U. S.)	ares	0.0083613
Sq. yards (U. S.)	sq. cm.	8361.31
Sq. yards (U. S.)	sq. chains (Gunter's)	0.00206612
Sq. yards (U. S.)	sq. feet	9
Sq. yards (U. S.)	sq. inches	1296
Sq. yards (U. S.)	sq. links (Gunter's)	20.6612
Sq. yards (U. S.)	sq. meters	0.83613
Sq. yards (U. S.)	sq. miles	3.22831×10^{-7}
Sq. yards (U. S.)	sq. rods	0.0330579
Statamperes	abamperes	3.33560×10^{-11}
Statamperes	amperes (Abs.)	3.33560×10^{-10}
Statcoulombs	abcoulombs	3.33560×10^{-11}
Statcoulombs	coulombs (Abs.)	3.33560×10^{-10}
Statcoulombs	electronic charges	2.0947×10^{9}
Statcoulombs/kg.	statcoulombs/dyne	1.0197×10^{-6}
Statcoulombs/pound	statcoulombs/dyne	2.2481×10^{-6}
Statfarads (or centimeters)	abfarads	1.11263×10^{-21}
Statfarads	farads (Abs.)	1.11263×10^{-12}
Statfarads	microfarads	1.11263×10^{-6}
Stathenries	abhenries	8.98776×10^{20}

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Stathenries	henries (Abs.)	8.98776×10^{11}
Stathenries	millihenries	8.98776×10^{14}
Statmhos	mohs, International/cm. cube	1.11263×10^{-12}
Statohms	abohms	8.98776×10^{20}
Statohms	ohms (Abs.)	8.98776×10^{11}
Statvolts	abvolts	2.99796×10^{10}
Statvolts	volts (Abs.)	299.796
Statvolts/cm.	volts (Abs.)/cm.	299.796
Statvolts/deg. C	microvolts (Abs.)/deg. C	2.9986×10^{8}
Statvolts/deg. F	microvolts (Abs.)/deg. C	5.3975×10^{8}
Statvolts/inch	volts/cm.	118.05
Steradians	hemispheres	0.15916
Steradians	solid angles	0.07958
Steradians	spheres	0.07958
Steradians	spherical right angles	0.63664
Steradians	sq. degrees	3282.8
Steres	cubic meters	1
Steres	liters	999.973
Stones (British)	kilograms	6.3503
Stones (British)	pounds (avoirdupois)	14
Strikes (British)	bushels (British)	2
Strikes (British)	cubic meters	0.072738
Toises (French)	meters (legal 1799)	1.9490365
Toises (French)	meters (measured 1887)	1.949090
Toises (French)	Paris feet	6
Tonne cf. ton (metric)	.....	.....
Tons (long)	dynes	9.9640×10^{8}
Tons (long)	hundredweights (short)	22.400
Tons (long)	kilograms	1016.0470
Tons (long)	ounces (avoirdupois)	35840
Tons (long)	pounds (avoirdupois)	2240
Tons (long)	pounds (troy)	2722.22
Tons (long)	tons (metric)	1.0160470
Tons (long)	tons (short)	1.12000
Tons (long)/sq. foot	dynes/sq. cm.	10.7251×10^{5}
Tons (long)/sq. inch	dynes/sq. cm.	1.5444×10^{8}
Tons (long)/sq. inch	kilograms/sq. mm.	1.5755
Tons (metric)	grams	1×10^{6}
Tons (metric)	hundredweights (short)	22.046223
Tons (metric)	kilograms	1000
Tons (metric)	ounces (avoirdupois)	35273.96
Tons (metric)	pounds (avoirdupois)	2204.62
Tons (metric)	pounds (troy)	2679.23
Tons (metric)	tons (long)	0.984207
Tons (metric)	tons (short)	1.10231
Tons (short)	dynes	8.8964×10^{8}
Tons (short)	hundredweights (short)	20
Tons (short)	kilograms	907.1846
Tons (short)	ounces (avoirdupois)	32000
Tons (short)	ounces (troy)	29166.66
Tons (short)	pounds (avoirdupois)	2000
Tons (short)	pounds (troy)	2430.56
Tons (short)	tons (long)	0.892857
Tons (short)	tons (metric)	0.907185
Tons (short) of water/24 hours	cu. ft./hour	1.3349
Tons (short) of water/24 hrs.	gallons (U. S.)/min.	0.16643
Tons (short)/sq. ft.	atmospheres	0.94509

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Tons (short)/sq. ft.	dynes/sq. cm.	9.5760×10^5
Tons (short)/sq. ft.	kg./sq. meter	9764.8
Tons (short)/sq. ft.	pounds/sq. inch	13.8889
Tons (short)/sq. inch	dynes/sq. cm.	1.3789×10^8
Tons (short)/sq. inch	kg./sq. meter	1406131
Tons (short)/sq. inch	kg./sq. mm.	1.406131
Tons (short)/24 hours	pounds/hour	83.333
Townships (U. S.)	acres	23040
Townships (U. S.)	sq. kilometers	93.240
Townships (U. S.)	sq. miles	36
Tuns	gallons	252
Volts (Abs.)	abvolts	1×10^8
Volts/deg. C	joules/coulomb/deg. C	1.0000
Volts	microvolts	1×10^6
Volts (Abs.)	statvolts	0.0033356
Volts (Abs.)	volts (International) (a)	0.99955
Volts (Abs.)	volts (International) (v)	0.99958
Volts (International) (a) based on international ohm and ampere	volts (Abs.)	1.00045
Volts (International) (v) based on the electromotive force of a Weston cell as 1.0183 volts at 20°C	volts (Abs.)	1.00042
Volts (International) England before 1906	volts (International) (v)	0.99870
Volts (International) England 1906-1908	volts (International) (v)	0.99894
Volts (International) England 1909-1910	volts (International) (v)	0.99990
Volts (International) Germany and France before 1911	volts (International) (v)	0.99968
Volts (International) U. S. before 1911	volts (International) (v)	0.99916
Volt cm./ampere gauss (Abs.)	electromagnetic cgs units of Hall effect	1.0000×10^9
Volt electronic charge sec.	quanta	2.4292×10^{14}
Volt faraday sec.	quanta	1.4724×10^{39}
Volt inch/ampere gauss (Abs.)	electromagnetic cgs units of Hall effect	2.5400×10^9
Volt seconds	maxwells	1×10^8
Watt hours	B. T. U. (mean)	3.4130
Watt hours	calories, gram (mean)	860.01
Watt hours	calories, kg. (mean)	0.86001
Watt hours	foot pounds	2655.3
Watt hours	horse power hours	0.0013410
Watt hours	joules	3600
Watt hours	kg. meters	367.09
Watt hours	K. W. hours	0.001
Watts (Abs.)	B. T. U. (mean)/hour	3.41304
Watts (Abs.)	B. T. U. (mean)/min.	0.056884
Watts (Abs.)	calories, kg. (mean)/min.	0.014333
Watts (Abs.)	ergs/sec.	1×10^7
Watts (Abs.)	foot pounds/min.	44.254
Watts (Abs.)	foot pounds/sec.	0.73756
Watts (Abs.)	horse power	0.0013410
Watts (Abs.)	horse power (metric)	0.0013596
Watts (Abs.)	joules/sec.	1
Watts (Abs.)	K. W.	0.001

A TABLE OF CONVERSION FACTORS

To convert from	To	Multiply by
Watts (International) (v)	watts (Abs.)	1.00032
Watts of max. visibility radiation	lumens	668
Watts/sq. in.	B. T. U./sq. ft./minute	8.1913
Watts/sq. in.	foot pounds /sq. ft./minute	6372.6
Watts/sq. in.	horse power/sq. ft.	0.19310
Webers	maxwells	1×10^8
Weeks	hours	168
Weeks	minutes	10080
Weeks	seconds	604800
Weys (British, capacity)	bushels (British)	40 (variable)
Weys (British, mass)	pounds	252 (variable)
Yards (British)	centimeters	91.43992
Yards (British)	meters	0.9143992
Yards (British)	poles (British)	0.181818
Yards (British)	quarters (British, linear)	4
Yards (British)	wave lengths of the red line of cadmium	1420212
Yards (U. S.)	centimeters	91.440183
Yards (U. S.)	chains (Gunter's)	0.0454545
Yards (U. S.)	feet	3
Yards (U. S.)	furlongs	1/220
Yards (U. S.)	inches	36
Yards (U. S.)	links (Gunter's)	4.54545
Yards (U. S.)	meters	0.91440183
Yards (U. S.)	miles	5.68182×10^{-4}
Yards (U. S.)	rods	0.181818
Years (leap)	days	366
Years (leap)	hours	8784
Years (sidereal)	days (mean solar)	365.256
Years (sidereal)	hours (mean solar)	8766.144
Years (tropical, mean solar)	days	365.2422
Years (tropical, mean solar)	hours (mean solar)	8765.8128
Years (tropical, mean solar)	seconds (mean solar)	3.15569×10^7

TABLE OF PRESSURE CONVERSIONS

Compiled by F. M. Whitacre.

Expressed in → / Pounds per sq. inch	Pounds per sq. foot	Inches of mercury	Millimeters of mercury	Centimeters of mercury	Feet of water	Inches of water
Based on → 14.7	2116.8	29.92	760.0	76.0	33.91	406.9
1.0	144.0	2.036	51.706	5.1706	2.307	27.68
0.00694	1.0	0.01413	0.359	0.0359	0.01602	0.19224
0.4913	70.75	1.0	25.40	2.54	1.1322	13.59
0.01934	2.785	0.03937	1.0	0.10	0.0446	0.5352
0.1934	27.85	0.3937	10.0	1.0	0.446	5.352
0.433	62.40	0.8819	22.40	2.24	1.0	12.00
0.03611	5.20	0.0735	1.866	0.1866	0.0833	1.0

TANK AND PIPE CAPACITIES

VERTICAL TANKS

Cf. McCrea, *News Ed., Ind. Eng. Chem. 18, 451 (1940)* by permission.

Cylindrical tanks of diameter D and depth d in inches:

(1) Gallons $= (0.00340 \times D^2) \times d$
(2) Liters $= (0.01288 \times D^2) \times d$

Rectangular tanks of base area A and depth d in inches:

(1) Gallons $= (0.00433 \times A) \times d$
(2) Liters $= (0.0164 \times A) \times d$

For any one tank the expression within the parentheses is a constant. The constant multiplied by any liquid depth gives the liquid contents. This is particularly advantageous in setting a gauge for fluctuating volumes.

HORIZONTAL CYLINDRICAL TANKS

Cf. Davis, *Chemist Analyst 25, No. 4, p. 87 (1936)* by permission.

The volume of liquid contents in a cylindrical tank resting upon its side in a horizontal position is equal to the product of the length of the tank multiplied by the area of the "wetted" portion of an end. This area is that of a segment of a circle and is $\frac{1}{2}R^2(\theta - \sin\theta)$ where θ in radians, is equal to $2\cos^{-1}[(R-d)/R]$ and where R is the radius of the circle and d is the depth of the segment as in figure 1a.

Figure 1b on the following page can be used for converting percentage diameter to percentage volume.

Example. To find the liquid contents of a cylindrical tank 6 ft., 8 in. (6⅔ ft. = 20/3 ft. = 80 in.) in diameter and 10 ft. long resting upon its side in a horizontal position with liquid contents to a depth of 24 inches.

The total volume of this tank is $\frac{1}{4}\pi(20/3)^2 \times 10 = 349$ cu. ft. The liquid depth is 24/80 or 30% of the diameter. On figure 1b, opposite 30% on the diameter scale is read 25% on the volume scale. This means that the liquid contents are 25% of 349 cu. ft. or 87.3 cu. ft.

Example. To find the depth of liquid when this same tank contains 241 cu. ft. of liquid contents.

Two hundred and forty-one cu. ft. is 241/349 or 69% of the total capacity of the tank. Reference to figure 1b shows that 69% of the volume corresponds to 65.0% of the diameter. This means that 241 cu. ft. of liquid will show a depth of 65% of 80 inches or 52.0 inches.

PIPES

Cf. Schaphorst, *News Ed., Ind. Eng. Chem. 18, 109 (1940)* by permission.

Figure 2 on the following page can be used to find the volume in U. S. gallons of any given length of all the standard pipe sizes from ⅛ inch to 15 inches. In this figure, line A shows the standard pipe sizes, line B shows lengths of pipe from 0.1 to 800,000 feet, and line C shows volumes from 1 to 1000 gallons. A straight line through the pipe size on line A and through the length of pipe on line B will intersect line C at the number of gallons contained. Thus, the broken line in the figure is representative of a 2½-inch pipe (on A) of 400 feet length (on B) which intersects C at 100 gallons, the capacity of the pipe line. In the same manner, knowing any of two other variables, the third may be found. Even values lying at points beyond the limits of the figure may be found, as for example: To determine the volume of a ½-inch pipe 1 foot long, a straight line is run through the ½-inch point on A and the 10,000-point on B. The intersection on C shows 160 gallons which is the capacity of a pipe 10,000 feet in length. By merely dividing this capacity by 10,000 will give 0.016 gallons as the volume of a 1 foot length.

For conversion of U. S. Gallons into other units of capacity, see special table of *Conversion Factors.*

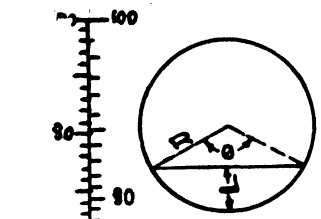


Fig.1a

Figure 1b

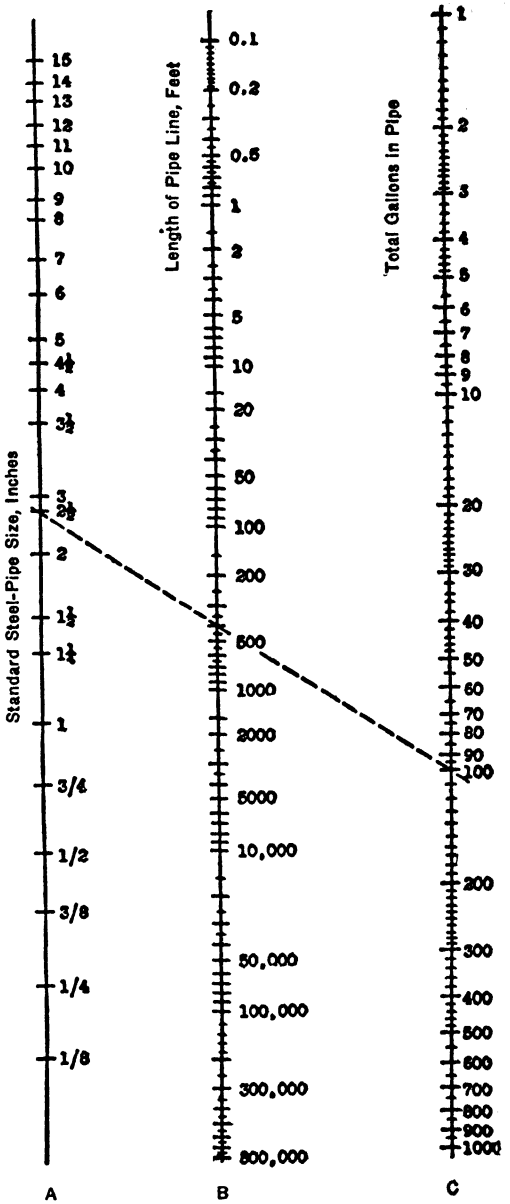


Figure 2

CONVERSION OF WEIGHINGS IN AIR TO WEIGHINGS IN VACUO

If the mass of a substance in air is M_f, its density D_m, the density of weights used in making the weighing D_w, and the density* of air D_a, the true mass of the substance is vacuo, M_{vac} is

$$M_{vac} = M_f + D_a M_f \left(\frac{1}{D_m} - \frac{1}{D_w} \right)$$

For most purposes it is sufficient to assume a density of 8.4 for brass weights, and a density of 0.0012 for air under ordinary conditions. The equation then becomes

$$M_{vac} = M_f + 0.0012 M_f \left(\frac{1}{D_m} - \frac{1}{8.4} \right)$$

This table which follows gives the values of k (buoyancy reduction factor), which is the correction necessary because of the buoyant effect of the air upon the object weighed; the table is computed for air with the density of 0.0012; m is the weight in grams of the object when weighed in air; weight of object reduced to "in vacuo" $= m + \frac{km}{1000}$

Density of object weighed	Buoyancy reduction factor, k			
	Brass weights, density =8.4	Pt or Pt-Ir weights, density =21.5	Al or quartz weights, density =2.7	Gold weights, density =17
0.2	5.89	5.98	5.58	5.97
0.3	3.87	3.96	3.56	3.95
0.4	2.87	2.95	2.55	2.94
0.5	2.26	2.35	1.95	2.34
0.6	1.86	1.95	1.55	1.93
0.7	1.57	1.66	1.26	1.65
0.75	1.46	1.55	1.15	1.53
0.80	1.36	1.45	1.05	1.43
0.82	1.32	1.41	1.01	1.39
0.84	1.29	1.37	0.98	1.36
0.86	1.25	1.34	0.94	1.33
0.88	1.22	1.31	0.91	1.29
0.90	1.19	1.28	0.88	1.26
0.92	1.16	1.25	0.85	1.24
0.94	1.13	1.22	0.82	1.21
0.96	1.11	1.20	0.80	1.18
0.98	1.08	1.17	0.77	1.16
1.00	1.06	1.15	0.75	1.13
1.02	1.03	1.12	0.72	1.11
1.04	1.01	1.10	0.70	1.08
1.06	0.99	1.08	0.68	1.06
1.08	0.97	1.06	0.66	1.04
1.10	0.95	1.04	0.64	1.02
1.12	0.93	1.02	0.62	1.00
1.14	0.91	1.00	0.60	0.98
1.16	0.89	0.98	0.58	0.96
1.18	0.87	0.96	0.56	0.95
1.20	0.86	0.95	0.55	0.93
1.25	0.82	0.91	0.51	0.89
1.30	0.78	0.87	0.47	0.85
1.35	0.75	0.83	0.44	0.82
1.40	0.71	0.80	0.40	0.79
1.50	0.66	0.74	0.35	0.73
1.6	0.61	0.69	0.30	0.68
1.7	0.56	0.65	0.25	0.64
1.8	0.52	0.61	0.21	0.60
1.9	0.49	0.58	0.18	0.56
2.0	0.46	0.54	0.15	0.53
2.2	0.40	0.49	0.09	0.48
2.4	0.36	0.44	0.05	0.43

*See special table: *Specific Gravity of Air.*

CONVERSION OF WEIGHINGS IN AIR TO WEIGHINGS IN VACUO

Density of object weighed	Buoyancy reduction factor, k			
	Brass weights, density = 8.4	Pt or Pt-Ir weights, density = 21.5	Al or quartz weights density = 2.7	Gold weights, density = 17
2.6	0.32	0.41	0.01	0.39
2.8	0.29	0.37	−0.02	0.36
3.0	0.26	0.34	−0.05	0.33
3.5	0.20	0.29	−0.11	0.27
4	0.16	0.24	−0.15	0.23
5	0.10	0.18	−0.21	0.17
6	0.06	0.14	−0.25	0.13
7	0.03	0.12	−0.28	0.10
8	0.01	0.09	−0.30	0.08
9	−0.01	0.08	−0.32	0.06
10	−0.02	0.06	−0.33	0.05
12	−0.04	0.04	−0.35	0.03
14	−0.06	0.03	−0.37	0.02
16	−0.07	0.02	−0.38	0.00
18	−0.08	0.01	−0.39	0.00
20	−0.08	0.00	−0.39	−0.01
22	−0.09	0.00	−0.40	−0.02

USE OF COINS AS WEIGHTS

(Approximate values for United States coins.)

One 50¢ piece = 12.5 grams = 200 grains (avoir.)
One 25¢ piece = 6.25 grams = 100 grains (avoir.)
One 10¢ piece = 2.5 grams = 40 grains (avoir.)
One 5¢ piece = 5 grams = 80 grains (avoir.)
One 1¢ piece = 3.1 grams = 50 grains (avoir.)
One 10¢ piece + two 50¢ pieces = 27.5 grams = 440 grains, or approximately one ounce; i. e. 437.5 grains.

HOUSEHOLD UNITS

(Approximate values.)

1 Pint = 2 cups = 0.47 liter
1 Cup = 16 tablespoons = 0.5 pint = 237 ml
1 Tablespoon = 3 teaspoons = 15 ml
1 Teaspoon = 4.9 ml

FACTORS FOR REDUCING GAS VOLUMES TO NORMAL

Examples:—(a) 20 cc of dry gas at 22°C. and 730 mm = 20×0.8888 = 17.78 cc at 0°C. and 760 mm. (b) 20 cc of a gas over water at 22° and 730 mm = 20× (factor corrected for aqueous tension; i.e. 730−19.8 or 710.2 mm) = 20cc of dry

Pressure mm of mercury	Temperature °C.							
	10°	11°	12°	13°	14°	15°	16°	17°
700	0.8885	0.8854	0.8823	0.8792	0.8761	0.8731	0.8701	0.8671
702	0.8910	0.8879	0.8848	0.8816	0.8786	0.8755	0.8725	0.8695
704	0.8935	0.8904	0.8873	0.8841	0.8811	0.8780	0.8750	0.8719
706	0.8961	0.8929	0.8898	0.8867	0.8836	0.8805	0.8774	0.8744
708	0.8986	0.8954	0.8923	0.8892	0.8861	0.8830	0.8799	0.8769
710	0.9012	0.8980	0.8948	0.8917	0.8886	0.8855	0.8824	0.8794
712	0.9037	0.9005	0.8973	0.8942	0.8911	0.8880	0.8849	0.8818
714	0.9062	0.9030	0.8999	0.8967	0.8936	0.8905	0.8874	0.8843
716	0.9088	0.9056	0.9024	0.8992	0.8961	0.8930	0.8899	0.8868
718	0.9113	0.9081	0.9049	0.9017	0.8986	0.8955	0.8924	0.8893
720	0.9138	0.9106	0.9074	0.9042	0.9011	0.8980	0.8948	0.8918
722	0.9164	0.9132	0.9099	0.9068	0.9036	0.9004	0.8973	0.8942
724	0.9189	0.9157	0.9125	0.9093	0.9061	0.9029	0.8998	0.8967
726	0.9215	0.9182	0.9150	0.9118	0.9086	0.9054	0.9023	0.8992
728	0.9240	0.9207	0.9175	0.9143	0.9111	0.9079	0.9048	0.9017
730	0.9265	0.9233	0.9200	0.9168	0.9136	0.9104	0.9073	0.9041
732	0.9291	0.9258	0.9225	0.9193	0.9161	0.9129	0.9098	0.9066
734	0.9316	0.9283	0.9251	0.9218	0.9186	0.9154	0.9122	0.9091
736	0.9341	0.9309	9.9276	0.9243	0.9211	0.9179	0.9147	0.9116
738	0.9367	0.9334	0.9301	0.9268	0.9236	0.9204	0.9172	0.9140
740	0.9392	0.9359	0.9326	0.9294	0.9261	0.9229	0.9197	0.9165
742	0.9418	0.9384	0.9351	0.9319	0.9286	0.9254	0.9222	0.9190
744	0.9443	0.9410	0.9377	0.9344	0.9311	0.9279	0.9247	0.9215
746	0.9468	0.9435	0.9402	0.9369	0.9336	0.9304	0.9272	0.9240
748	0.9494	0.9460	0.9427	0.9394	0.9361	0.9329	0.9296	0.9264
750	0.9519	0.9486	0.9452	0.9419	0.9386	0.9354	0.9321	0.9289
752	0.9545	0.9511	0.9478	0.9444	0.9411	0.9379	0.9346	0.9314
754	0.9570	0.9536	0.9503	0.9469	0.9436	0.9404	0.9371	0.9339
756	0.9595	0.9562	0.9528	0.9495	0.9461	0.9429	0.9396	0.9363
758	0.9621	0.9587	0.9553	0.9520	0.9486	0.9453	0.9421	0.9388
760	0.9646	0.9612	0.9578	0.9545	0.9511	0.9478	0.9446	0.9413
762	0.9672	0.9637	0.9604	0.9570	0.9537	0.9503	0.9470	0.9438
764	0.9697	0.9663	0.9629	0.9595	0.9562	0.9528	0.9495	0.9462
766	0.9722	0.9688	0.9654	0.9620	0.9587	0.9553	0.9520	0.9487
768	0.9748	0.9713	0.9679	0.9645	0.9612	0.9578	0.9545	0.9512
770	0.9773	0.9739	0.9704	0.9670	0.9637	0.9603	0.9570	0.9537
772	0.9798	0.9764	0.9730	0.9696	0.9662	0.9628	0.9595	0.9562
774	0.9824	0.9790	0.9755	0.9721	0.9687	0.9654	0.9620	0.9587
776	0.9850	0.9815	0.9781	0.9746	0.9712	0.9679	0.9645	0.9612
778	0.9875	0.9840	0.9806	0.9772	0.9737	0.9704	0.9670	0.9637
780	0.9900	0.9866	0.9831	0.9797	0.9763	0.9729	0.9695	0.9662

Aqueous Tension of Pure Water, Potassium

Deg. C.	10°	11°	12°	13°	14°	15°	16°	17°
H_2O	9.2	9.8	10.5	11.2	12.0	12.8	13.6	14.5
10KOH:100H_2O	8.6	9.2	9.8	10.5	11.2	11.9	12.7	13.6
20KOH:100H_2O	8.0	8.6	9.2	9.8	10.4	11.1	11.8	12.6
30KOH:100H_2O	7.3	7.8	8.3	8.9	9.5	10.1	10.8	11.5
40KOH:100H_2O	6.5	6.9	7.4	7.9	8.4	9.0	9.6	10.2
Satd. Aq. NaCl	6.9	7.4	7.9	8.5	9.1	9.7	10.3	11.0

TEMPERATURE (°C.) AND PRESSURE (760 mm Hg)

gas at 22° and 710.2 mm = 20 × 0.86465 = 17.29 cc at 0°C. and 760 mm. Weight in milligrams of 1cc of gas at N. T. P.:—acetylene, 1.173; carbon dioxide, 1.9769; hydrogen, 0.0899; nitric oxide (NO), 1.3402; nitrogen, 1.25057; oxygen, 1.42904.

Temperature °C								Pressure mm of mercury
18°	19°	20°	21°	22°	23°	24°	25°	
0.8641	0.8611	0.8582	0.8553	0.8524	0.8495	0.8466	0.8438	700
0.8665	0.8635	0.8605	0.8576	0.8547	0.8518	0.8489	0.8461	702
0.8689	0.8660	0.8630	0.8601	0.8571	0.8542	0.8514	0.8485	704
0.8714	0.8684	0.8654	0.8625	0.8596	0.8567	0.8538	0.8509	706
0.8739	0.8709	0.8679	0.8649	0.8620	0.8591	0.8562	0.8533	708
0.8763	0.8733	0.8703	0.8674	0.8644	0.8615	0.8586	0.8557	710
0.8788	0.8758	0.8728	0.8698	0.8669	0.8639	0.8610	0.8581	712
0.8813	0.8783	0.8753	0.8723	0.8693	0.8664	0.8634	0.8605	714
0.8837	0.8807	0.8777	0.8747	0.8717	0.8688	0.8659	0.8630	716
0.8862	0.8832	0.8802	0.8772	0.8742	0.8712	0.8683	0.8654	718
0.8887	0.8856	0.8826	0.8796	0.8766	0.8736	0.8707	0.8678	720
0.8912	0.8881	0.8851	0.8820	0.8791	0.8761	0.8731	0.8702	722
0.8936	0.8906	0.8875	0.8845	0.8815	0.8785	0.8755	0.8726	724
0.8961	0.8930	0.8900	0.8869	0.8839	0.8809	0.8780	0.8750	726
0.8986	0.8955	0.8924	0.8894	0.8864	0.8834	0.8804	0.8774	728
0.9010	0.8979	0.8949	0.8918	0.8888	0.8858	0.8828	0.8798	730
0.9035	0.9004	0.8973	0.8943	0.8912	0.8882	0.8852	0.8822	732
0.9060	0.9029	0.8998	0.8967	0.8937	0.8906	0.8876	0.8847	734
0.9084	0.9053	0.9022	0.8991	0.8961	0.8931	0.8901	0.8871	736
0.9109	0.9078	0.9047	0.9016	0.8985	0.8955	0.8925	0.8895	738
0.9134	0.9102	0.9071	0.9040	0.9010	0.8979	0.8949	0.8919	740
0.9158	0.9127	0.9096	0.9065	0.9034	0.9003	0.8973	0.8943	742
0.9183	0.9152	0.9120	0.9089	0.9058	0.9028	0.8997	0.8967	744
0.9208	0.9176	0.9145	0.9114	0.9083	0.9052	0.9021	0.8991	746
0.9232	0.9201	0.9169	0.9138	0.9107	0.9076	0.9046	0.9015	748
0.9257	0.9225	0.9194	0.9163	0.9131	0.9101	0.9070	0.9039	750
0.9282	0.9250	0.9218	0.9187	0.9156	0.9125	0.9094	0.9063	752
0.9306	0.9275	0.9243	0.9211	0.9180	0.9149	0.9118	0.9088	754
0.9331	0.9299	0.9267	0.9236	0.9204	0.9173	0.9142	0.9112	756
0.9356	0.9324	0.9292	0.9260	0.9229	0.9198	0.9167	0.9136	758
0.9381	0.9348	0.9316	0.9285	0.9253	0.9222	0.9191	0.9160	760
0.9405	0.9373	0.9341	0.9309	0.9278	0.9246	0.9215	0.9184	762
0.9430	0.9398	0.9365	0.9334	0.9302	0.9270	0.9239	0.9208	764
0.9455	0.9422	0.9390	0.9358	0.9326	0.9295	0.9263	0.9232	766
0.9479	0.9447	0.9414	0.9382	0.9351	0.9319	0.9287	0.9256	768
0.9504	0.9471	0.9439	0.9407	0.9375	0.9343	0.9312	0.9280	770
0.9530	0.9497	0.9465	0.9432	0.9400	0.9368	0.9337	0.9305	772
0.9554	0.9522	0.9489	0.9457	0.9425	0.9393	0.9361	0.9330	774
0.9579	0.9546	0.9514	0.9481	0.9449	0.9417	0.9385	0.9354	776
0.9604	0.9571	0.9538	0.9506	0.9473	0.9441	0.9410	0.9378	778
0.9628	0.9595	0.9563	0.9530	0.9498	0.9466	0.9434	0.9402	780

Hydroxide Solutions and Saturated Salt Solution.

18°	19°	20°	21°	22°	23°	24°	25°	Deg. C.
15.5	16.5	17.5	18.7	19.8	21.1	22.4	23.8	H_2O
14.5	15.4	16.4	17.4	18.5	19.7	20.9	22.2	10KOH:100H_2O
13.4	14.3	15.2	16.2	17.2	18.3	19.5	20.7	20KOH:100H_2O
12.3	13.3	13.9	14.8	15.8	16.8	17.8	18.9	30KOH:100H_2O
10.9	11.6	12.4	13.2	14.0	14.9	15.8	16.8	40KOH:100H_2O
11.7	12.4	13.2	14.1	15.0	15.9	16.9	17.9	Satd. Aq. NaCl

CONVERSION OF THERMOMETER SCALES

The following abbreviations are used: F, degrees Fahrenheit; C, degrees Centigrade; R, degrees Reaumur; A.K, degrees Kelvin; A.R, degrees Rankine; Z, degrees on any scale; (f. p.)"Z", the freezing point of water on the Z scale; (b.p.)"Z", the boiling point of water on the Z scale. Cf. Dodds, *Chemical and Metallurgical Engineering*, Vol. 38, p. 476 (1931).

$$\frac{F-32}{180}=\frac{C}{100}=\frac{R}{80}=\frac{A_K-273}{100}=\frac{A_R-460}{180}=\frac{Z-(f.p.)\text{"Z"}}{(b.p.)\text{"Z"}-(f.p.)\text{"Z"}}$$

Examples: (1) To find the Fahrenheit temperature corresponding to −20°C:

$$\frac{F-32}{180}=\frac{C}{100}\text{ or }\frac{F-32}{180}=\frac{-20}{100};\text{ i.e., }-20°C=-4°F$$

(2) To find the Reaumur temperature corresponding to 20°F:

$$\frac{F-32}{180}=\frac{R}{80}\text{ or }\frac{20-32}{180}=\frac{R}{80};\text{ i.e., }20°F=-5.33°R$$

(3) To find the correct temperature on a thermometer reading 80°C and which shows a reading of −0.30°C in melting ice and 99.0°C. in steam at 760mm pressure:

$$\frac{C}{100}=\frac{Z-(f.p.)\text{"Z"}}{(b.p.)\text{"Z"}-(f.p.)\text{"Z"}}=\frac{80-(-0.30)}{99.0-(0.30)};\text{ i.e., }C=80.87°\text{ (corrected)}$$

The reading of any inaccurate thermometer can be corrected and converted in this manner into a reading on any of the other scales; thus, in the example (3) above, to convert into a Fahrenheit scale:

$$\frac{F-32}{180}=\frac{80-(-0.30)}{99\,0-(-0.30)};\text{ i.e., }F=177.56°\text{ (corrected)}$$

Centigrade to Fahrenheit

Formula: (°C×9/5)+32=°F Examples: (1) To convert 60°C to °F, (60×9/5)+32=140°F
(2) To convert −20°C to °F, (−20×9/5)+32=−4°F
(See also special table)

Centigrade to Reaumur

Formula: °C×4/5=°R Examples: (1) To convert 40°C to °R, 40×4/5=32°R
(2) To convert −30°C to °R, −30×4/5=−24°R

Centigrade to Centigrade Absolute or Kelvin

Formula: °C+273.1=°K Examples: (1) To convert 20°C to °K, 20+273.1=293.1°K
(2) To convert −20°C to °K, −20+273.1=253.1°K

Fahrenheit to Centigrade

Formula: (°F−32)×5/9=°C Examples: (1) To convert 140°F to °C, (140−32)×5/9=60°C
(2) To convert −76°F to °C, (−76−32)×5/9=−60°C
(See also special table)

Fahrenheit to Reaumur

Formula: (°F−32)×4/9=°R Examples: (1) To convert 41°F to °R, (41−32)×4/9=4°R
(2) To convert −13°F to °R, (−13−32)×4/9=−20°R

Fahrenheit to Fahrenheit Absolute or Rankine

Formula: °F+459.58=°R′ Examples: (1) To convert 20°F to °R′, 20+459.58=479.58°R′
(2) To convert −20°F to °R′, −20+459.58=439.58°R′

Reaumur to Centigrade

Formula: °R×5/4=°C Examples: (1) To convert 32°R to °C, 32×5/4=40°C
(2) To convert −24°R to °C, −24×5/4=−30°C

Reaumur to Fahrenheit

Formula: (°R×9/4)+32=°F Examples: (1) To convert 8°R to °F, (8×9/4)+32=50°F
(2) To convert −8°R to °F, (−8×9/4)+32=14°F
(3) To convert −20°R to °F, (−20×9/4)+32=−13°F

TEMPERATURE CONVERSION TABLES

The column of figures in bold and which is headed "Reading in °F. or °C. to be converted" refers to the temperature either in degrees Fahrenheit or Centigrade which it is desired to convert into the other scale. If converting from Fahrenheit degrees to Centigrade degrees the equivalent temperature will be found in the column headed "°C." while if converting from degrees Centigrade to degrees Fahrenheit, the equivalent temperature will be found in the column headed "°F." This arrangement is very similar to that of Sauveur and Boylston, copyrighted 1920 and is published with their permission.

°F.	Reading in °F. or °C. to be converted	°C.
.....	−458	−272.22
.....	−456	−271.11
.....	−454	−270.00
.....	−452	−268.89
.....	−450	−267.78
.....	−448	−266.67
.....	−446	−265.56
.....	−444	−264.44
.....	−442	−263.33
.....	−440	−262.22
.....	−438	−261.11
.....	−436	−260.00
.....	−434	−258.89
.....	−432	−257.78
.....	−430	−256.67
.....	−428	−255.56
.....	−426	−254.44
.....	−424	−253.33
.....	−422	−252.22
.....	−420	−251.11
.....	−418	−250.00
.....	−416	−248.89
.....	−414	−247.78
.....	−412	−246.67
.....	−410	−245.56
.....	−408	−244.44
.....	−406	−243.33
.....	−404	−242.22
.....	−402	−241.11
.....	−400	−240.00
.....	−398	−238.89
.....	−396	−237.78
.....	−394	−236.67
.....	−392	−235.56
.....	−390	−234.44
.....	−388	−233.33
.....	−386	−232.22
.....	−384	−231.11
.....	−382	−230.00
.....	−380	−228.89
.....	−378	−227.78
.....	−376	−226.67
.....	−374	−225.56
.....	−372	−224.44
.....	−370	−223.33
.....	−368	−222.22
.....	−366	−221.11
.....	−364	−220.00
.....	−362	−218.89
.....	−360	−217.78

°F.	Reading in °F. or °C. to be converted	°C.
.....	−358	−216.67
.....	−356	−215.56
.....	−354	−214.44
.....	−352	−213.33
.....	−350	−212.22
.....	−348	−211.11
.....	−346	−210.00
.....	−344	−208.89
.....	−342	−207.78
.....	−340	−206.67
.....	−338	−205.56
.....	−336	−204.44
.....	−334	−203.33
.....	−332	−202.22
.....	−330	−201.11
.....	−328	−200.00
.....	−326	−198.89
.....	−324	−197.78
.....	−322	−196.67
.....	−320	−195.56
.....	−318	−194.44
.....	−316	−193.33
.....	−314	−192.22
.....	−312	−191.11
.....	−310	−190.00
.....	−308	−188.89
.....	−306	−187.78
.....	−304	−186.67
.....	−302	−185.56
.....	−300	−184.44
.....	−298	−183.33
.....	−296	−182.22
.....	−294	−181.11
.....	−292	−180.00
.....	−290	−178.89
.....	−288	−177.78
.....	−286	−176.67
.....	−284	−175.56
.....	−282	−174.44
.....	−280	−173.33
.....	−278	−172.22
.....	−276	−171.11
.....	−274	−170.00
−457.6	−272	−168.89
−454.0	−270	−167.78
−450.4	−268	−166.67
−446.8	−266	−165.56
−443.2	−264	−164.44
−439.6	−262	−163.33
−436.0	−260	−162.22

TEMPERATURE CONVERSION TABLES

°F.	Reading in °F. or °C. to be converted	°C.
−432.4	−258	−161.11
−428.8	−256	−160.00
−425.2	−254	−158.89
−421.6	−252	−157.78
−418.0	−250	−156.67
−414.4	−248	−155.56
−410.8	−246	−154.44
−407.2	−244	−153.33
−403.6	−242	−152.22
−400.0	−240	−151.11
−396.4	−238	−150.00
−392.8	−236	−148.89
−389.2	−234	−147.78
−385.6	−232	−146.67
−382.0	−230	−145.56
−378.4	−228	−144.44
−374.8	−226	−143.33
−371.2	−224	−142.22
−367.6	−222	−141.11
−364.0	−220	−140.00
−360.4	−218	−138.89
−356.8	−216	−137.78
−353.2	−214	−136.67
−349.6	−212	−135.56
−346.0	−210	−134.44
−342.4	−208	−133.33
−338.8	−206	−132.22
−335.2	−204	−131.11
−331.6	−202	−130.00
−328.0	−200	−128.89
−324.4	−198	−127.78
−320.8	−196	−126.67
−317.2	−194	−125.56
−313.6	−192	−124.44
−310.0	−190	−123.33
−306.4	−188	−122.22
−302.8	−186	−121.11
−299.2	−184	−120.00
−295.6	−182	−118.89
−292.0	−180	−117.78
−288.4	−178	−116.67
−284.8	−176	−115.56
−281.2	−174	−114.44
−277.6	−172	−113.33
−274.0	−170	−112.22
−270.4	−168	−111.11
−266.8	−166	−110.00
−263.2	−164	−108.89
−259.6	−162	−107.78
−256.0	−160	−106.67
−252.4	−158	−105.56
−248.8	−156	−104.44
−245.2	−154	−103.33
−241.6	−152	−102.22
−238.0	−150	−101.11
−234.4	−148	−100.00
−230.8	−146	−98.89
−227.2	−144	−97.78
−223.6	−142	−96.67
−220.0	−140	−95.56

°F.	Reading in °F. or °C. to be converted	°C.
−216.4	−138	−94.44
−212.8	−136	−93.33
−209.2	−134	−92.22
−205.6	−132	−91.11
−202.0	−130	−90.00
−198.4	−128	−88.89
−194.8	−126	−87.78
−191.2	−124	−86.67
−187.6	−122	−85.56
−184.0	−120	−84.44
−180.4	−118	−83.33
−176.8	−116	−82.22
−173.2	−114	−81.11
−169.6	−112	−80.00
−166.0	−110	−78.89
−162.4	−108	−77.78
−158.8	−106	−76.67
−155.2	−104	−75.56
−151.6	−102	−74.44
−148.0	−100	−73.33
−144.4	−98	−72.22
−140.8	−96	−71.11
−137.2	−94	−70.00
−133.6	−92	−68.89
−130.0	−90	−67.78
−126.4	−88	−66.67
−122.8	−86	−65.56
−119.2	−84	−64.44
−115.6	−82	−63.33
−112.0	−80	−62.22
−108.4	−78	−61.11
−104.8	−76	−60.00
−101.2	−74	−58.89
−97.6	−72	−57.78
−94.0	−70	−56.67
−90.4	−68	−55.56
−86.8	−66	−54.44
−83.2	−64	−53.33
−79.6	−62	−52.22
−76.0	−60	−51.11
−72.4	−58	−50.00
−68.8	−56	−48.89
−65.2	−54	−47.78
−61.6	−52	−46.67
−58.0	−50	−45.56
−54.4	−48	−44.44
−50.8	−46	−43.33
−47.2	−44	−42.22
−43.6	−42	−41.11
−40.0	−40	−40.00
−36.4	−38	−38.89
−32.8	−36	−37.78
−29.2	−34	−36.67
−25.6	−32	−35.56
−22.0	−30	−34.44
−18.4	−28	−33.33
−14.8	−26	−32.22
−11.2	−24	−31.11
−7.6	−22	−30.00
−4.0	−20	−28.89

TEMPERATURE CONVERSION TABLES

°F.	Reading in °F. or °C to be converted	°C.
−0.4	−18	−27.78
+3.2	−16	−26.67
+6.8	−14	−25.56
+10.4	−12	−24.44
+14.0	−10	−23.33
+17.6	−8	−22.22
+19.4	−7	−21.67
+21.2	−6	−21.11
+23.0	−5	−20.56
+24.8	−4	−20.00
+26.6	−3	−19.44
+28.4	−2	−18.89
+30.2	−1	−18.33
+32.0	±0	−17.78
+33.8	+1	−17.22
+35.6	+2	−16.67
+37.4	+3	−16.11
+39.2	+4	−15.56
+41.0	+5	−15.00
+42.8	+6	−14.44
+44.6	+7	−13.89
+46.4	+8	−13.33
+48.2	+9	−12.78
+50.0	+10	−12.22
+51.8	+11	−11.67
+53.6	+12	−11.11
+55.4	+13	−10.56
+57.2	+14	−10.00
+59.0	+15	−9.44
+60.8	+16	−8.89
+62.6	+17	−8.33
+64.4	+18	−7.78
+66.2	+19	−7.22
+68.0	+20	−6.67
+69.8	+21	−6.11
+71.6	+22	−5.56
+73.4	+23	−5.00
+75.2	+24	−4.44
+77.0	+25	−3.89
+78.8	+26	−3.33
+80.6	+27	−2.78
+82.4	+28	−2.22
+84.2	+29	−1.67
+86.0	+30	−1.11
+87.8	+31	−0.56
+89.6	+32	±0.00
+91.4	+33	+0.56
+93.2	+34	+1.11
+95.0	+35	+1.67
+96.8	+36	+2.22
+98.6	+37	+2.78
+100.4	+38	+3.33
+102.2	+39	+3.89
+104.0	+40	+4.44
+105.8	+41	+5.00
+107.6	+42	+5.56
+109.4	+43	+6.11
+111.2	+44	+6.67
+113.0	+45	+7.22
+114.8	+46	+7.78

°F.	Reading in °F. or °C. to be converted	°C.
+116.6	+47	+8.33
+118.4	+48	+8.89
+120.2	+49	+9.44
+122.0	+50	+10.00
+123.8	+51	+10.56
+125.6	+52	+11.11
+127.4	+53	+11.67
+129.2	+54	+12.22
+131.0	+55	+12.78
+132.8	+56	+13.33
+134.6	+57	+13.89
+136.4	+58	+14.44
+138.2	+59	+15.00
+140.0	+60	+15.56
+141.8	+61	+16.11
+143.6	+62	+16.67
+145.4	+63	+17.22
+147.2	+64	+17.78
+149.0	+65	+18.33
+150.8	+66	+18.89
+152.6	+67	+19.44
+154.4	+68	+20.00
+156.2	+69	+20.56
+158.0	+70	+21.11
+159.8	+71	+21.67
+161.6	+72	+22.22
+163.4	+73	+22.78
+165.2	+74	+23.33
+167.0	+75	+23.89
+168.8	+76	+24.44
+170.6	+77	+25.00
+172.4	+78	+25.56
+174.2	+79	+26.11
+176.0	+80	+26.67
+177.8	+81	+27.22
+179.6	+82	+27.78
+181.4	+83	+28.33
+183.2	+84	+28.89
+185.0	+85	+29.44
+186.8	+86	+30.00
+188.6	+87	+30.56
+190.4	+88	+31.11
+192.2	+89	+31.67
+194.0	+90	+32.22
+195.8	+91	+32.78
+197.6	+92	+33.33
+199.4	+93	+33.89
+201.2	+94	+34.44
+203.0	+95	+35.00
+204.8	+96	+35.56
+206.6	+97	+36.11
+208.4	+98	+36.67
+210.2	+99	+37.22
+212.0	+100	+37.78
+213.8	+101	+38.33
+215.6	+102	+38.89
+217.4	+103	+39.44
+219.2	+104	+40.00
+221.0	+105	+40.56
+222.8	+106	+41.11

TEMPERATURE CONVERSION TABLES

°F.	Reading in °F. or °C. to be converted	°C.
+224.6	+107	+41.67
+226.4	+108	+42.22
+228.2	+109	+42.78
+230.0	+110	+43.33
+231.8	+111	+43.89
+233.6	+112	+44.44
+235.4	+113	+45.00
+237.2	+114	+45.56
+239.0	+115	+46.11
+240.8	+116	+46.67
+242.6	+117	+47.22
+244.4	+118	+47.78
+246.2	+119	+48.33
+248.0	+120	+48.89
+249.8	+121	+49.44
+251.6	+122	+50.00
+253.4	+123	+50.56
+255.2	+124	+51.11
+257.0	+125	+51.67
+258.8	+126	+52.22
+260.6	+127	+52.78
+262.4	+128	+53.33
+264.2	+129	+53.89
+266.0	+130	+54.44
+267.8	+131	+55.00
+269.6	+132	+55.56
+271.4	+133	+56.11
+273.2	+134	+56.67
+275.0	+135	+57.22
+276.8	+136	+57.78
+278.6	+137	+58.33
+280.4	+138	+58.89
+282.2	+139	+59.44
+284.0	+140	+60.00
+285.8	+141	+60.56
+287.6	+142	+61.11
+289.4	+143	+61.67
+291.2	+144	+62.22
+293.0	+145	+62.78
+294.8	+146	+63.33
+296.6	+147	+63.89
+298.4	+148	+64.44
+300.2	+149	+65.00
+302.0	+150	+65.56
+303.8	+151	+66.11
+305.6	+152	+66.67
+307.4	+153	+67.22
+309.2	+154	+67.78
+311.0	+155	+68.33
+312.8	+156	+68.89
+314.6	+157	+69.44
+316.4	+158	+70.00
+318.2	+159	+70.56
+320.0	+160	+71.11
+321.8	+161	+71.67
+323.6	+162	+72.22
+325.4	+163	+72.78
+327.2	+164	+73.33
+329.0	+165	+73.89
+330.8	+166	+74.44

°F.	Reading in °F. or °C. to be converted	°C.
+332.6	+16.	+75.00
+334.4	+168	+75.56
+336.2	+169	+76.11
+338.0	+170	+76.67
+339.8	+171	+77.22
+341.6	+172	+77.78
+343.4	+173	+78.33
+345.2	+174	+78.89
+347.0	+175	+79.44
+348.8	+176	+80.00
+350.6	+177	+80.56
+352.4	+178	+81.11
+354.2	+179	+81.67
+356.0	+180	+82.22
+357.8	+181	+82.78
+359.6	+182	+83.33
+361.4	+183	+83.89
+363.2	+184	+84.44
+365.0	+185	+85.00
+366.8	+186	+85.56
+368.6	+187	+86.11
+370.4	+188	+86.67
+372.2	+189	+87.22
+374.0	+190	+87.78
+375.8	+191	+88.33
+377.6	+192	+88.89
+379.4	+193	+89.44
+381.2	+194	+90.00
+383.0	+195	+90.56
+384.8	+196	+91.11
+386.6	+197	+91.67
+388.4	+198	+92.22
+390.2	+199	+92.78
+392.0	+200	+93.33
+393.8	+201	+93.89
+395.6	+202	+94.44
+397.4	+203	+95.00
+399.2	+204	+95.56
+401.0	+205	+96.11
+402.8	+206	+96.67
+404.6	+207	+97.22
+406.4	+208	+97.78
+408.2	+209	+98.33
+410.0	+210	+98.89
+411.8	+211	+99.44
+413.6	+212	+100.00
+415.4	+213	+100.56
+417.2	+214	+101.11
+419.0	+215	+101.67
+420.8	+216	+102.22
+422.6	+217	+102.78
+424.4	+218	+103.33
+426.2	+219	+103.89
+428.0	+220	+104.44
+431.6	+222	+105.56
+435.2	+224	+106.67
+438.8	+226	+107.78
+442.4	+228	+108.89
+446.0	+230	+110.00
+449.6	+232	+111.11

TEMPERATURE CONVERSION TABLES

°F.	Reading in °F. or °C. to be converted	°C.
+453.2	+234	+112.22
+456.8	+236	+113.33
+460.4	+238	+114.44
+464.0	+240	+115.56
+467.6	+242	+116.67
+471.2	+244	+117.78
+474.8	+246	+118.89
+478.4	+248	+120.00
+482.0	+250	+121.11
+485.6	+252	+122.22
+489.2	+254	+123.33
+492.8	+256	+124.44
+496.4	+258	+125.56
+500.0	+260	+126.67
+503.6	+262	+127.78
+507.2	+264	+128.89
+510.8	+266	+130.00
+514.4	+268	+131.11
+518.0	+270	+132.22
+521.6	+272	+133.33
+525.2	+274	+134.44
+528.8	+276	+135.56
+532.4	+278	+136.67
+536.0	+280	+137.78
+539.6	+282	+138.89
+543.2	+284	+140.00
+546.8	+286	+141.11
+550.4	+288	+142.22
+554.0	+290	+143.33
+557.6	+292	+144.44
+561.2	+294	+145.56
+564.8	+296	+146.67
+568.4	+298	+147.78
+572.0	+300	+148.89
+575.6	+302	+150.00
+579.2	+304	+151.11
+582.8	+306	+152.22
+586.4	+308	+153.33
+590.0	+310	+154.44
+593.6	+312	+155.56
+597.2	+314	+156.67
+600.8	+316	+157.78
+604.4	+318	+158.89
+608.0	+320	+160.00
+611.6	+322	+161.11
+615.2	+324	+162.22
+618.8	+326	+163.33
+622.4	+328	+164.44
+626.0	+330	+165.56
+629.6	+332	+166.67
+633.2	+334	+167.78
+636.8	+336	+168.89
+640.4	+338	+170.00
+644.0	+340	+171.11
+647.6	+342	+172.22
+651.2	+344	+173.33
+654.8	+346	+174.44
+658.4	+348	+175.56
+662.0	+350	+176.67
+665.6	+352	+177.78

°F.	Reading in °F. or °C. to be converted	°C.
+669.2	+354	+178.89
+672.8	+356	+180.00
+676.4	+358	+181.11
+680.0	+360	+182.22
+683.6	+362	+183.33
+687.2	+364	+184.44
+690.8	+366	+185.56
+694.4	+368	+186.67
+698.0	+370	+187.78
+701.6	+372	+188.89
+705.2	+374	+190.00
+708.8	+376	+191.11
+712.4	+378	+192.22
+716.0	+380	+193.33
+719.6	+382	+194.44
+723.2	+384	+195.56
+726.8	+386	+196.67
+730.4	+388	+197.78
+734.0	+390	+198.89
+737.6	+392	+200.00
+741.2	+394	+201.11
+744.8	+396	+202.22
+748.4	+398	+203.33
+752.0	+400	+204.44
+755.6	+402	+205.56
+759.2	+404	+206.67
+762.8	+406	+207.78
+766.4	+408	+208.89
+770.0	+410	+210.00
+773.6	+412	+211.11
+777.2	+414	+212.22
+780.8	+416	+213.33
+784.4	+418	+214.44
+788.0	+420	+215.56
+791.6	+422	+216.67
+795.2	+424	+217.78
+798.8	+426	+218.89
+802.4	+428	+220.00
+806.0	+430	+221.11
+809.6	+432	+222.22
+813.2	+434	+223.33
+816.8	+436	+224.44
+820.4	+438	+225.56
+824.0	+440	+226.67
+827.6	+442	+227.78
+831.2	+444	+228.89
+834.8	+446	+230.00
+838.4	+448	+231.11
+842.0	+450	+232.22
+845.6	+452	+233.33
+849.2	+454	+234.44
+852.8	+456	+235.56
+856.4	+458	+236.67
+860.0	+460	+237.78
+863.6	+462	+238.89
+867.2	+464	+240.00
+870.8	+466	+241.11
+874.4	+468	+242.22
+878.0	+470	+243.33
+881.6	+472	+244.44

TEMPERATURE CONVERSION TABLES

°F.	Reading in °F. or °C. to be converted	°C.
+885.2	+474	+245.56
+888.8	+476	+246.67
+892.4	+478	+247.78
+896.0	+480	+248.89
+899.6	+482	+250.00
+903.2	+484	+251.11
+906.8	+486	+252.22
+910.4	+488	+253.33
+914.0	+490	+254.44
+917.6	+492	+255.56
+921.2	+494	+256.67
+924.8	+496	+257.78
+928.4	+498	+258.89
+932.0	+500	+260.00
+935.6	+502	+261.11
+939.2	+504	+262.22
+942.8	+506	+263.33
+946.4	+508	+264.44
+950.0	+510	+265.56
+953.6	+512	+266.67
+957.2	+514	+267.78
+960.8	+516	+268.89
+964.4	+518	+270.00
+968.0	+520	+271.11
+971.6	+522	+272.22
+975.2	+524	+273.33
+978.8	+526	+274.44
+982.4	+528	+275.56
+986.0	+530	+276.67
+989.6	+532	+277.78
+993.2	+534	+278.89
+996.8	+536	+280.00
+1000.4	+538	+281.11
+1004.0	+540	+282.22
+1007.6	+542	+283.33
+1011.2	+544	+284.44
+1014.8	+546	+285.56
+1018.4	+548	+286.67
+1022.0	+550	+287.78
+1025.6	+552	+288.89
+1029.2	+554	+290.00
+1032.8	+556	+291.11
+1036.4	+558	+292.22
+1040.0	+560	+293.33
+1043.6	+562	+294.44
+1047.2	+564	+295.56
+1050.8	+566	+296.67
+1054.4	+568	+297.78
+1058.0	+570	+298.89
+1061.6	+572	+300.00
+1065.2	+574	+301.11
+1068.8	+576	+302.22
+1072.4	+578	+303.33
+1076.0	+580	+304.44
+1079.6	+582	+305.56
+1083.2	+584	+306.67
+1086.8	+586	+307.78
+1090.4	+588	+308.89
+1094.0	+590	+310.00
+1097.6	+592	+311.11

°F.	Reading in °F. or °C. to be converted	°C.
+1101.2	+594	+312.22
+1104.8	+596	+313.33
+1108.4	+598	+314.44
+1112.0	+600	+315.56
+1115.6	+602	+316.67
+1119.2	+604	+317.78
+1122.8	+606	+318.89
+1126.4	+608	+320.00
+1130.0	+610	+321.11
+1133.6	+612	+322.22
+1137.2	+614	+323.33
+1140.8	+616	+324.44
+1144.4	+618	+325.56
+1148.0	+620	+326.67
+1151.6	+622	+327.78
+1155.2	+624	+328.89
+1158.8	+626	+330.00
+1162.4	+628	+331.11
+1166.0	+630	+332.22
+1169.6	+632	+333.33
+1173.2	+634	+334.44
+1176.8	+636	+335.56
+1180.4	+638	+336.67
+1184.0	+640	+337.78
+1187.6	+642	+338.89
+1191.2	+644	+340.00
+1194.8	+646	+341.11
+1198.4	+648	+342.22
+1202.0	+650	+343.33
+1205.6	+652	+344.44
+1209.2	+654	+345.56
+1212.8	+656	+346.67
+1216.4	+658	+347.78
+1220.0	+660	+348.89
+1223.6	+662	+350.00
+1227.2	+664	+351.11
+1230.8	+666	+352.22
+1234.4	+668	+353.33
+1238.0	+670	+354.44
+1241.6	+672	+355.56
+1245.2	+674	+356.67
+1248.8	+676	+357.78
+1252.4	+678	+358.89
+1256.0	+680	+360.00
+1259.6	+682	+361.11
+1263.2	+684	+362.22
+1266.8	+686	+363.33
+1270.4	+688	+364.44
+1274.0	+690	+365.56
+1277.6	+692	+366.67
+1281.2	+694	+367.78
+1284.8	+696	+368.89
+1288.4	+698	+370.00
+1292.0	+700	+371.11
+1295.6	+702	+372.22
+1299.2	+704	+373.33
+1302.8	+706	+374.44
+1306.4	+708	+375.56
+1310.0	+710	+376.67
+1313.6	+712	+377.78

TEMPERATURE CONVERSION TABLES

°F.	Reading in °F. or °C. to be converted	°C.
+1317.2	+714	+378.89
+1320.8	+716	+380.00
+1324.4	+718	+381.11
+1328.0	+720	+382.22
+1331.6	+722	+383.33
+1335.2	+724	+384.44
+1338.8	+726	+385.56
+1342.4	+728	+386.67
+1346.0	+730	+387.78
+1349.6	+732	+388.89
+1353.2	+734	+390.00
+1356.8	+736	+391.11
+1360.4	+738	+392.22
+1364.0	+740	+393.33
+1367.6	+742	+394.44
+1371.2	+744	+395.56
+1374.8	+746	+396.67
+1378.4	+748	+397.78
+1382.0	+750	+398.89
+1385.6	+752	+400.00
+1389.2	+754	+401.11
+1392.8	+756	+402.22
+1396.4	+758	+403.33
+1400.0	+760	+404.44
+1403.6	+762	+405.56
+1407.2	+764	+406.67
+1410.8	+766	+407.78
+1414.4	+768	+408.89
+1418.0	+770	+410.00
+1421.6	+772	+411.11
+1425.2	+774	+412.22
+1428.8	+776	+413.33
+1432.4	+778	+414.44
+1436.0	+780	+415.56
+1439.6	+782	+416.67
+1443.2	+784	+417.78
+1446.8	+786	+418.89
+1450.4	+788	+420.00
+1454.0	+790	+421.11
+1457.6	+792	+422.22
+1461.2	+794	+423.33
+1464.8	+796	+424.44
+1468.4	+798	+425.56
+1472.0	+800	+426.67
+1475.6	+802	+427.78
+1479.2	+804	+428.89
+1482.8	+806	+430.00
+1486.4	+808	+431.11
+1490.0	+810	+432.22
+1493.6	+812	+433.33
+1497.2	+814	+434.44
+1500.8	+816	+435.56
+1504.4	+818	+436.67
+1508.0	+820	+437.78
+1511.6	+822	+438.89
+1515.2	+824	+440.00
+1515.8	+826	+441.11
+1522.4	+828	+442.22
+1526.0	+830	+443.33
+1529.6	+832	+444.44

°F.	Reading in °F. or °C. to be converted	°C.
+1533.2	+834	+445.56
+1536.8	+836	+446.67
+1540.4	+838	+447.78
+1544.0	+840	+448.89
+1547.6	+842	+450.00
+1551.2	+844	+451.11
+1554.8	+846	+452.22
+1558.4	+848	+453.33
+1562.0	+850	+454.44
+1565.6	+852	+455.56
+1569.2	+854	+456.67
+1572.8	+856	+457.78
+1576.4	+858	+458.89
+1580.0	+860	+460.00
+1583.6	+862	+461.11
+1587.2	+864	+462.22
+1590.8	+866	+463.33
+1594.4	+868	+464.44
+1598.0	+870	+465.56
+1601.6	+872	+466.67
+1605.2	+874	+467.78
+1608.8	+876	+468.89
+1612.4	+878	+470.00
+1616.0	+880	+471.11
+1619.6	+882	+472.22
+1623.2	+884	+473.33
+1626.8	+886	+474.44
+1630.4	+888	+475.56
+1634.0	+890	+476.67
+1637.6	+892	+477.78
+1641.2	+894	+478.89
+1644.8	+896	+480.00
+1648.4	+898	+481.11
+1652.0	+900	+482.22
+1655.6	+902	+483.33
+1659.2	+904	+484.44
+1662.8	+906	+485.56
+1666.4	+908	+486.67
+1670.0	+910	+487.78
+1673.6	+912	+488.89
+1677.2	+914	+490.00
+1680.8	+916	+491.11
+1684.4	+918	+492.22
+1688.0	+920	+493.33
+1691.6	+922	+494.44
+1695.2	+924	+495.56
+1698.8	+926	+496.67
+1702.4	+928	+497.78
+1706.0	+930	+498.89
+1709.6	+932	+500.00
+1713.2	+934	+501.11
+1716.8	+936	+502.22
+1720.4	+938	+503.33
+1724.0	+940	+504.44
+1727.6	+942	+505.56
+1731.2	+944	+506.67
+1734.8	+946	+507.78
+1738.4	+948	+508.89
+1742.0	+950	+510.00
+1745.6	+952	+511.11

TEMPERATURE CONVERSION TABLES

°F.	Reading in °F. or °C. to be converted	°C.
+1749.2	+954	+512.22
+1752.8	+956	+513.33
+1756.4	+958	+514.44
+1760.0	+960	+515.56
+1763.6	+962	+516.67
+1767.2	+964	+517.78
+1770.8	+966	+518.89
+1774.4	+968	+520.00
+1778.0	+970	+521.11
+1781.6	+972	+522.22
+1785.2	+974	+523.33
+1788.8	+976	+524.44
+1792.4	+978	+525.56
+1796.0	+980	+526.67
+1799.6	+982	+527.78
+1803.2	+984	+528.89
+1806.8	+986	+530.00
+1810.4	+988	+531.11
+1814.0	+990	+532.22
+1817.6	+992	+533.33
+1821.2	+994	+534.44
+1824.8	+996	+535.56
+1828.4	+998	+536.67
+1832.0	+1000	+537.78
+1850.0	+1010	+543.33
+1868.0	+1020	+548.89
+1886.0	+1030	+554.44
+1904.0	+1040	+560.00
+1922.0	+1050	+565.56
+1940.0	+1060	+571.11
+1958.0	+1070	+576.67
+1976.0	+1080	+582.22
+1994.0	+1090	+587.78
+2012.0	+1100	+593.33
+2030.0	+1110	+598.89
+2048.0	+1120	+604.44
+2066.0	+1130	+610.00
+2084.0	+1140	+615.56
+2102.0	+1150	+621.11
+2120.0	+1160	+626.67
+2138.0	+1170	+632.22
+2156.0	+1180	+637.78
+2174.0	+1190	+643.33
+2192.0	+1200	+648.89
+2210.0	+1210	+654.44
+2228.0	+1220	+660.00
+2246.0	+1230	+665.56
+2264.0	+1240	+671.11
+2282.0	+1250	+676.67
+2300.0	+1260	+682.22
+2318.0	+1270	+687.78
+2336.0	+1280	+693.33
+2354.0	+1290	+698.89
+2372.0	+1300	+704.44
+2390.0	+1310	+710.00
+2408.0	+1320	+715.56
+2426.0	+1330	+721.11
+2444.0	+1340	+726.67
+2462.0	+1350	+732.22
+2480.0	+1360	+737.78

°F.	Reading in °F. or C°. to be converted	°C.
+2498.0	+1370	+743.33
+2516.0	+1380	+748.89
+2534.0	+1390	+754.44
+2552.0	+1400	+760.00
+2570.0	+1410	+765.56
+2588.0	+1420	+771.11
+2606.0	+1430	+776.67
+2624.0	+1440	+782.22
+2642.0	+1450	+787.78
+2660.0	+1460	+793.33
+2678.0	+1470	+798.89
+2696.0	+1480	+804.44
+2714.0	+1490	+810.00
+2732.0	+1500	+815.56
+2750.0	+1510	+821.11
+2768.0	+1520	+826.67
+2786.0	+1530	+832.22
+2804.0	+1540	+837.78
+2822.0	+1550	+843.33
+2840.0	+1560	+598.89
+2858.0	+1570	+854.44
+2876.0	+1580	+860.00
+2894.0	+1590	+865.56
+2912.0	+1600	+871.11
+2930.0	+1610	+876.67
+2948.0	+1620	+882.22
+2966.0	+1630	+887.78
+2984.0	+1640	+893.33
+3002.0	+1650	+898.89
+3020.0	+1660	+904.44
+3038.0	+1670	+910.00
+3056.0	+1680	+915.56
+3074.0	+1690	+921.11
+3092.0	+1700	+926.67
+3110.0	+1710	+932.22
+3128.0	+1720	+937.78
+3146.0	+1730	+943.33
+3164.0	+1740	+948.89
+3182.0	+1750	+954.44
+3200.0	+1760	+960.00
+3218.0	+1770	+965.56
+3236.0	+1780	+971.11
+3254.0	+1790	+976.67
+3272.0	+1800	+982.22
+3290.0	+1810	+987.78
+3308.0	+1820	+993.33
+3326.0	+1830	+998.89
+3344.0	+1840	+1004.4
+3362.0	+1850	+1010.0
+3380.0	+1860	+1015.6
+3398.0	+1870	+1021.1
+3416.0	+1880	+1026.7
+3434.0	+1890	+1032.2
+3452.0	+1900	+1037.8
+3470.0	+1910	+1043.3
+3488.0	+1920	+1048.9
+3506.0	+1930	+1054.4
+3524.0	+1940	+1060.0
+3542.0	+1950	+1065.6
+3560.0	+1960	+1071.1

TEMPERATURE CONVERSION TABLES

°F.	Reading in °F. or °C. to be converted	°C.
+3578.0	+1970	+1076.7
+3596.0	+1980	+1082.2
+3614.0	+1990	+1087.8
+3632.0	+2000	+1093.3
+3650.0	+2010	+1098.9
+3668.0	+2020	+1104.4
+3686.0	+2030	+1110.0
+3704.0	+2040	+1115.6
+3722.0	+2050	+1121.1
+3740.0	+2060	+1126.7
+3758.0	+2070	+1132.2
+3776.0	+2080	+1137.8
+3794.0	+2090	+1143.3
+3812.0	+2100	+1148.9
+3830.0	+2110	+1154.4
+3848.0	+2120	+1160.0
+3866.0	+2130	+1165.6
+3884.0	+2140	+1171.1
+3902.0	+2150	+1176.7
+3920.0	+2160	+1182.2
+3938.0	+2170	+1187.8
+3956.0	+2180	+1193.3
+3974.0	+2190	+1198.9
+3992.0	+2200	+1204.4
+4010.0	+2210	+1210.0
+4028.0	+2220	+1215.6
+4046.0	+2230	+1221.1
+4064.0	+2240	+1226.7
+4082.0	+2250	+1232.2
+4100.0	+2260	+1237.8
+4118.0	+2270	+1243.3
+4136.0	+2280	+1248.9
+4154.0	+2290	+1254.4
+4172.0	+2300	+1260.0
+4190.0	+2310	+1265.6
+4208.0	+2320	+1271.1
+4226.0	+2330	+1276.7
+4244.0	+2340	+1282.2
+4262.0	+2350	+1287.8
+4280.0	+2360	+1293.3
+4298.0	+2370	+1298.9
+4316.0	+2380	+1304.4
+4334.0	+2390	+1310.0
+4352.0	+2400	+1315.6
+4370.0	+2410	+1321.1
+4388.0	+2420	+1326.7
+4406.0	+2430	+1332.2
+4424.0	+2440	+1337.8
+4442.0	+2450	+1343.3
+4460.0	+2460	+1348.9
+4478.0	+2470	+1354.4
+4496.0	+2480	+1360.0
+4514.0	+2490	+1365.6
+4532.0	+2500	+1371.1
+4550.0	+2510	+1376.7
+4568.0	+2520	+1382.2
+4586.0	+2530	+1387.8

°F.	Reading in °F. or °C. to be converted	°C.
+4604.0	+2540	+1393.3
+4622.0	+2550	+1398.9
+4640.0	+2560	+1404.4
+4658.0	+2570	+1410.0
+4676.0	+2580	+1415.6
+4694.0	+2590	+1421.1
+4712.0	+2600	+1426.7
+4730.0	+2610	+1432.2
+4748.0	+2620	+1437.8
+4766.0	+2630	+1443.3
+4784.0	+2640	+1448.9
+4802.0	+2650	+1454.4
+4820.0	+2660	+1460.0
+4838.0	+2670	+1465.6
+4856.0	+2680	+1471.1
+4874.0	+2690	+1476.7
+4892.0	+2700	+1482.2
+4910.0	+2710	+1487.8
+4928.0	+2720	+1493.3
+4946.0	+2730	+1498.9
+4964.0	+2740	+1504.4
+4982.0	+2750	+1510.0
+5000.0	+2760	+1515.6
+5018.0	+2770	+1521.1
+5036.0	+2780	+1526.7
+5054.0	+2790	+1532.2
+5072.0	+2800	+1537.8
+5090.0	+2810	+1543.3
+5108.0	+2820	+1548.9
+5126.0	+2830	+1554.4
+5144.0	+2840	+1560.0
+5162.0	+2850	+1565.6
+5180.0	+2860	+1571.1
+5198.0	+2870	+1576.7
+5216.0	+2880	+1582.2
+5234.0	+2890	+1587.8
+5252.0	+2900	+1593.3
+5270.0	+2910	+1598.9
+5288.0	+2920	+1604.4
+5306.0	+2930	+1610.0
+5324.0	+2940	+1615.6
+5342.0	+2950	+1621.1
+5360.0	+2960	+1626.7
+5378.0	+2970	+1632.2
+5396.0	+2980	+1637.8
+5414.0	+2990	+1643.3
+5432.0	+3000	+1648.9
+5450.0	+3010	+1654.4
+5468.0	+3020	+1660.0
+5486.0	+3030	+1665.6
+5504.0	+3040	+1671.1
+5522.0	+3050	+1676.7
+5540.0	+3060	+1682.2
+5558.0	+3070	+1687.8
+5576.0	+3080	+1693.3
+5594.0	+3090	+1698.9
+5612.0	+3100	+1704.4

HYDROMETER CONVERSION TABLES

This table gives the relation between density (C.G.S.) and degrees on the Baumé and Twaddell scales. The Twaddell scale is never used for densities less than unity. See also section on *Hydrometers*.

Density	Degrees Baumé Bu. Stand. Scale	Degrees Baumé A.P.I. Scale
0.600	103.33	104.33
0.605	101.40	102.38
0.610	99.51	100.47
0.615	97.64	98.58
0.620	95.81	96.73
0.625	94.00	94.90
0.630	92.22	93.10
0.635	90.47	91.33
0.640	88.75	89.59
0.645	87.05	87.88
0.650	85.38	86.19
0.655	83.74	84.53
0.660	82.12	82.89
0.665	80.52	81.28
0.670	78.95	79.69
0.675	77.41	78.13
0.680	75.88	76.59
0.685	74.38	75.07
0.690	72.90	73.57
0.695	71.43	72.10
0.700	70.00	70.64
0.705	68.57	69.21
0.710	67.18	67.80
0.715	65.80	66.40
0.720	64.44	65.03
0.725	63.10	63.67
0.730	61.78	62.34
0.735	60.48	61.02
0.740	59.19	59.72
0.745	57.92	58.43
0.750	56.67	57.17
0.755	55.43	55.92
0.760	54.21	54.68
0.765	53.01	53.47
0.770	51.82	52.27
0.775	50.65	51.08
0.780	49.49	49.91
0.785	48.34	48.75
0.790	47.22	47.61
0.795	46.10	46.49
0.800	45.00	45.38
0.805	43.91	44.28
0.810	42.84	43.19
0.815	41.78	42.12
0.820	40.73	41.06
0.825	39.70	40.02
0.830	38.68	38.98
0.835	37.66	37.96
0.840	36.67	36.95
0.845	35.68	35.96
0.850	34.71	34.97
0.855	33.74	34.00
0.860	32.79	33.03
0.865	31.85	32.08
0.870	30.92	31.14
0.875	30.00	30.21
0.880	29.09	29.30
0.885	28.19	28.39
0.890	27.30	27.49
0.895	26.42	26.60
0.900	25.56	25.72
0.905	24.70	24.85
0.910	23.85	23.99
0.915	23.01	23.14
0.920	22.17	22.30
0.925	21.35	21.47
0.930	20.54	20.65
0.935	19.73	19.84
0.940	18.94	19.03
0.945	18.15	18.24
0.950	17.37	17.45
0.955	16.60	16.67
0.960	15.83	15.90
0.965	15.08	15.13
0.970	14.33	14.38
0.975	13.59	13.63
0.980	12.86	12.89
0.985	12.13	12.15
0.990	11.41	11.43
0.995	10.70	10.71
1.000	10.00	10.00

DENSITIES GREATER THAN UNITY

Density	Degrees Baumé Bu. Stand. Scale	Degrees Twaddell
1.00	0.00	0
1.01	1.44	2
1.02	2.84	4
1.03	4.22	6
1.04	5.58	8
1.05	6.91	10
1.06	8.21	12
1.07	9.49	14
1.08	10.78	16
1.09	11.97	18
1.10	13.18	20
1.11	14.37	22
1.12	15.54	24
1.13	16.68	26
1.14	17.81	28
1.15	18.91	30
1.16	20.00	32
1.17	21.07	34
1.18	22.12	36
1.19	23.15	38
1.20	24.17	40
1.21	25.16	42
1.22	26.15	44
1.23	27.11	46
1.24	28.06	48
1.25	29.00	50
1.26	29.92	52
1.27	30.83	54
1.28	31.72	56
1.29	32.60	58
1.30	33.46	60
1.31	34.31	62

HYDROMETER CONVERSION TABLES

Density	Degrees Baumé Bu. Stand. Scale	Degrees Twaddell
1.32	35.15	64
1.33	35.98	66
1.34	36.79	68
1.35	37.59	70
1.36	38.38	72
1.37	39.16	74
1.38	39.93	76
1.39	40.68	78
1.40	41.43	80
1.41	42.16	82
1.42	42.89	84
1.43	43.60	86
1.44	44.31	88
1.45	45.00	90
1.46	45.68	92
1.47	46.36	94
1.48	47.03	96
1.49	47.68	98
1.50	48.33	100
1.51	48.97	102
1.52	49.60	104
1.53	50.23	106
1.54	50.84	108
1.55	51.45	110
1.56	52.05	112
1.57	52.64	114
1.58	53.23	116
1.59	53.80	118
1.60	54.38	120
1.61	54.94	122
1.62	55.49	124
1.63	56.04	126
1.64	56.58	128
1.65	57.12	130
1.66	57.65	132

Density	Degrees Baumé Bu. Stand. Scale	Degrees Twaddell
1.67	58.17	134
1.68	58.69	136
1.69	59.20	138
1.70	59.71	140
1.71	60.20	142
1.72	60.70	144
1.73	61.18	146
1.74	61.67	148
1.75	62.14	150
1.76	62.61	152
1.77	63.08	154
1.78	63.54	156
1.79	63.99	158
1.80	64.44	160
1.81	64.89	162
1.82	65.31	164
1.83	65.77	166
1.84	66.20	168
1.85	66.62	170
1.86	67.04	172
1.87	67.46	174
1.88	67.87	176
1.89	68.28	178
1.90	68.68	180
1.91	69.08	182
1.92	69.48	184
1.93	69.87	186
1.94	70.26	188
1.95	70.64	190
1.96	71.02	192
1.97	71.40	194
1.98	71.77	196
1.99	72.14	198
2.00	72.50	200

CONVERSION TABLE FOR QUEVENNE AND NEW YORK BOARD OF HEALTH LACTOMETER READINGS TO SPECIFIC GRAVITY

New York Board of Health Lactometer	Specific Gravity	Quevenne Lactometer
60	1.0174	17.4
61	1.0177	17.7
62	1.0180	18.0
63	1.0183	18.3
64	1.0186	18.6
65	1.0188	18.8
66	1.0191	19.1
67	1.0194	19.4
68	1.0197	19.7
69	1.0200	20.0
70	1.0203	20.3
71	1.0206	20.6
72	1.0209	20.9
73	1.0212	21.2
74	1.0215	21.5
75	1.0217	21.7
76	1.0220	22.0
77	1.0223	22.3
78	1.0226	22.6
79	1.0229	22.9
80	1.0232	23.2
81	1.0235	23.5
82	1.0238	23.8
83	1.0241	24.1
84	1.0244	24.4
85	1.0246	24.6
86	1.0249	24.9
87	1.0252	25.2
88	1.0255	25.5
89	1.0258	25.8

New York Board of Health Lactometer	Specific Gravity	Quevenne Lactometer
90	1.0261	26.1
91	1.0264	26.4
92	1.0267	26.7
93	1.0270	27.0
94	1.0273	27.3
95	1.0276	27.6
96	1.0278	27.8
97	1.0281	28.1
98	1.0284	28.4
99	1.0287	28.7
100	1.0290	29.0
101	1.0293	29.3
102	1.0296	29.6
103	1.0299	29.9
104	1.0302	30.2
105	1.0305	30.5
106	1.0307	30.7
107	1.0310	31.0
108	1.0313	31.3
109	1.0316	31.6
110	1.0319	31.9
111	1.0322	32.2
112	1.0325	32.5
113	1.0328	32.8
114	1.0331	33.1
115	1.0334	33.4
116	1.0336	33.6
117	1.0339	33.9
118	1.0342	34.2
119	1.0345	34.5

VISCOSITY CONVERSION TABLE

Poise = c. g. s. unit of absolute viscosity. Centipoise = 0.01 poise.
Stoke = c. g. s. unit of kinematic viscosity. Centistoke = 0.01 stoke.
Centipoises = centistokes × density (at temperature under consideration).
Reyn (1 lb. sec. per sq. in.) = 69 × 10^5 centipoises.

CENTISTOKES TO SAYBOLT, REDWOOD AND ENGLER UNITS

Cf. *Jour. Inst. Pet. Tech., Vol. 22, p. 21 (1936); Reports of A. S. T. M. Committee D-2, 1936 and 1937.*

Centistokes	Saybolt Seconds at			Redwood Seconds at			Engler Degrees at all Temps.
	100°F.	130°F.	210°F.	70°F.	140°F.	200°F.	
2.0	32.6	32.7	32.8	30.2	31.0	31.2	1.14
3.0	36.0	36.1	36.3	32.7	33.5	33.7	1.22
4.0	39.1	39.2	39.4	35.3	36.0	36.3	1.31
5.0	42.3	42.4	42.6	37.9	38.5	38.9	1.40
6.0	45.5	45.6	45.8	40.5	41.0	41.5	1.48
7.0	48.7	48.8	49.0	43.2	43.7	44.2	1.56
8.0	52.0	52.1	52.4	46.0	46.4	46.9	1.65
9.0	55.4	55.5	55.8	48.9	49.1	49.7	1.75
10	58.8	58.9	59.2	51.7	52.0	52.6	1.84
11	62.3	62.4	62.7	54.8	55.0	55.6	1.93
12	65.9	66.0	66.4	57.9	58.1	58.8	2.02
14	73.4	73.5	73.9	64.4	64.6	65.3	2.22
16	81.1	81.3	81.7	71.0	71.4	72.2	2.43
18	89.2	89.4	89.8	77.9	78.5	79.4	2.64
20	97.5	97.7	98.2	85.0	85.8	86.9	2.87
22	106.0	106.2	106.7	92.4	93.3	94.5	3.10
24	114.6	114.8	115.4	99.9	100.9	102.2	3.34
26	123.3	123.5	124.2	107.5	108.6	110.0	3.58
28	132.1	132.4	133.0	115.3	116.5	118.0	3.82
30	140.9	141.2	141.9	123.1	124.4	126.0	4.07
32	149.7	150.0	150.8	131.0	132.3	134.1	4.32
34	158.7	159.0	159.8	138.9	140.2	142.2	4.57
36	167.7	168.0	168.9	146.9	148.2	150.3	4.83
38	176.7	177.0	177.9	155.0	156.2	158.3	5.08
40	185.7	186.0	187.0	163.0	164.3	166.7	5.34
42	194.7	195.1	196.1	171.0	172.3	175.0	5.59
44	203.8	204.2	205.2	179.1	180.4	183.3	5.85
46	213.0	213.4	214.5	187.1	188.5	191.7	6.11
48	222.2	222.6	223.8	195.2	196.6	200.0	6.37
50	231.4	231.8	233.0	203.3	204.7	208.3	6.63
60	277.4	277.9	279.3	243.5	245.3	250.0	7.90
70	323.4	324.0	325.7	283.9	286.0	291.7	9.21
80	369.6	370.3	372.2	323.9	326.6	333.4	10.53
90	415.8	416.6	418.7	364.4	367.4	375.0	11.84
100*	462.0	462.9	465.2	404.9	408.2	416.7	13.16

* At higher values use the same ratio as above for 100 centistokes; *e.g.*, 102 centistokes = 102 × 4.620 Saybolt seconds at 100°F.

To obtain the Saybolt Universal viscosity equivalent to a kinematic viscosity determined at *t*°F., multiply the equivalent Saybolt Universal viscosity at 100°F. by 1 + (t − 100) 0.000064; *e.g.*, 10 centistokes at 210°F are equivalent to 58.8 × 1.0070, or 59.2 Saybolt Universal seconds at 210°F.

CHEMICAL

Compiled by Byron A. Soule,

Year	Am. Chem. J.*	Am. J. Sci.	Analyst	Ann.	Ann. chim. phys.	Ber.	Bull. soc. chim.	C.A.	Chem. News
1880	2	3, 19-20	5	200-5	5, 19-21	13	2, 33-4		41-2
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3	4-5	25-6	8	216-21	28-30	16	39-40		47-8
4	5-6	27-8	9	222-6	6, 1-3	17	41-2		49-50
1885	6-7	29-30	10	227-31	4-6	18	43-4		51-2
6	7-8	31-2	11	232-6	7-9	19	45-6		53-4
7	9	33-4	12	237-42	10-12	20	47-8		55-6
8	10	35-6	13	243-9	13-15	21	49-50		57-8
9	11	37-8	14	250-5	16-18	22	3, 1-2		59-60
1890	12	39-40	15	256-60	19-21	23	3-4		61-2
1	13	41-2	16	261-6	22-4	24	5-6		63-4
2	14	43-4	17	267-71	25-7	25	7-8		65-6
3	15	45-6	18	272-7	28-30	26	9-10		67-8
4	16	47-8	19	278-83	7, 1-3	27	11-12		69-70
1895	17	49-50	20	284-8	4-6	28	13-14		71-2
6	18	4, 1-2	21	289-93	7-9	29	15-16		73-4
7	19	3-4	22	294-8	10-12	30	17-18		75-6
8	20	5-6	23	299-303	13-15	31	19-20		77-8
9	21-2	7-8	24	304-9	16-18	32	21-2		79-80
1900	23-4	9-10	25	310-13	19-21	33	23-4		81-2
1	25-6	11-12	26	314-19	22-4	34	25-6		83-4
2	27-8	13-14	27	320-5	25-7	35	27-8		85-6
3	29-30	15-16	28	326-9	28-30	36	29-30		87-8
4	31-2	17-18	29	330-7	8, 1-3	37	31-2		89-90
1905	33-4	4, 19-20	30	338-43	4-6	38	33-4		91-2
6	35-6	21-2	31	344-50	7-9	39	35-6		93-4
7	37-8	23-4	32	351-7	10-12	40	4, 1-2	1	95-6
8	39-40	25-6	33	358-63	13-15	41	3-4	2	97-8
9	41-2	27-8	34	364-71	16-18	42	5-6	3	99-100
1910	43-4	29-30	35	372-7	19-21	43	7-8	4	101-2
11	45-6	31-2	36	378-85	22-4	44	9-10	5	103-4
12	47-8	33-4	37	386-94	25-7	45	11-12	6	105-6
13	49-50	35-6	38	395-401	28-30	46	13-14	7	107-8
14	.....	37-8	39	402-6	9, 1-2	47	15-16	8	109-10
1915	Combined	39-40	40	407-10	3-4	48	17-18	9	111-12
16	with	41-2	41	411	5-6	49	19-20	10	113-14
17	J. Am.	43-4	42	412-13	7-8	50	21-2	11	115-16
18	Chem.	45-6	43	414-17	9-10	51	23-4	12	117
19	Soc. in 1914	47-8	44	418-19	11-12	52	25-6	13	118-19
1920		49-50	45	420-1	13-14	53	27-8	14	120-1
1		5, 1-2	46	422-5	15-16	54	29-30	15	122-3
2		3-4	47	426-9	17-18	55	31-2	16	124-5
3		5-6	48	430-4	19-20	56	33-4	17	126-7
4		7-8	49	435-40	10, 1-2	57	35-6	18	128-9
1925		9-10	50	441-5	3-4	58	37-8	19	130-1
6		11-12	51	446-50	5-6	59	39-40	20	132-3
7		13-14	52	451-9	7-8	60	41-2	21	134-5
8		15-16	53	460-7	9-10	61	43-4	22	136-7
9		17-18	54	468-76	11-12	62	45-6	23	138-9
1930		19-20	55	477-84	13-14	63	47-8	24	140-1
1		21-2	56	485-92	15-16	64	49-50	25	142-3
2		23-4	57	493-99	17-18	65	51-2	26	144-5
3		25-6	58	500-8	19-20	66	53-4	27	**
4		27-	59	509-	21-	67	55-	28	

*Title abbreviations are those used by Chemical Abstracts.
**Ceased publication Oct. 1932

JOURNALS

University of Michigan.

Chem. Zentr.	Chem. Ztg.	Compt. rend.	Gazz. chim. ital.	Ind. Eng. Chem.	J. Am. Chem. Soc.	J. Biol. Chem.	J. Chem. Soc.	J. chim. phys.	Year
3, 11	4	90-1	10		2		37-8		1880
12	5	92-3	11		3		39-40		1
13	6	94-5	12		4		41-2		2
14	7	96-7	13		5		43-4		3
15	8	98-9	14		6		45-6		4
16	9	100-1	15		7		47-8		1885
17	10	102-3	16		8		49-50		6
18	11	104-5	17		9		51-2		7
19	12	106-7	18		10		53-4		8
4, 1(60)	13	108-9	19		11		55-6		9
2(61)	14	110-11	20		12		57-8		1890
3(62)	15	112-13	21		13		59-60		1
4(63)	16	114-15	22		14		61-2		2
5(64)	17	116-17	23		15		63-4		3
6(65)	18	118-19	24		16		65-6		4
7(66)	19	120-1	25		17		67-8		1895
8(67)	20	122-3	26		18		69-70		6
5, 1(68)	21	124-5	27		19		71-2		7
2(69)	22	126-7	28		20		73-4		8
3(70)	23	128-9	29		21		75-6		9
4(71)	24	130-1	30		22		77-8		1900
5(72)	25	132-3	31		23		79-80		1
6(73)	26	134-5	32		24		81-2		2
7(74)	27	136-7	33		25		83-4	1	3
8(75)	28	138-9	34		26		85-6	2	4
5, 9(76)	29	140-1	35		27	1	87-8	3	1905
10(77)	30	142-3	36		28	1-2	89-90	4	6
11(78)	31	144-5	37		29	2-3	91-2	5	7
12(79)	32	146-7	38		30	4-5	93-4	6	8
13(80)	33	148-9	39	1	31	6-7	95-6	7	9
14(81)	34	150-1	40	2	32	7-8	97-8	8	1910
15(82)	35	152-3	41	3	33	9-10	99-100	9	11
16(83)	36	154-5	42	4	34	11-13	101-2	10	12
17(84)	37	156-7	43	5	35	14-16	103-4	11	13
18(85)	38	158-9	44	6	36	17-19	105-6	12	14
19(86)	39	160-1	45	7	37	20-3	107-8	13	1915
20(87)	40	162-3	46	8	38	24-8	109-10	14	16
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22(89)	42	166-7	48	10	40	33-6	113-14	16	18
6, 1(90)	43	168-9	49	11	41	37-40	115-16	17	19
2(91)	44	170-1	50	12	42	41-5	117-18	18	1920
3(92)	45	172-3	51	13	43	46-9	119-20	19	1
4(93)	46	174-5	52	14	44	50-4	121-2	20	2
5(94)	47	176-7	53	15	45	55-8	123-4	20	3
6(95)	48	178-9	54	16	46	59-62	125-6	21	4
7(96)	49	180-1	55	17	47	63-6	127-8	22	1925
97	50	182-3	56	18	48	67-71	1926	23	6
98	51	184-5	57	19	49	72-5	1927	24	7
99	52	186-7	58	20	50	76-80	1928	25	8
100	53	188-9	59	21	51	81-4	1929	26	9
101	54	190-1	60	22	52	85-9	1930	27	1930
102	55	192-3	61	23	53	90-4	1931	28	1
103	56	194-5	62	24	54	94-9	1932	29	2
104	57	196-7	63	25	55	100-	1933	30	3
105	58	198-	64	26	56		1934	31	4

Year	J. Phys. Chem.	J. prakt. Chem.	J. Russ. Phys. Chem. Soc.	J. Soc. Chem. Ind.	J. Soc. Dyers Colourists	Kolloid Beihefte	Kolloid Z.	Monatsh.	Nature	Proc. Roy. Soc. (London) Phil. Mag.	(A)
1880		N.F.*21-2	12					1	21-3	5, 9-10	30-1
1		23-4	13					2	23-5	11-12	31-3
2		25-6	14	1				3	25-7	13-14	33-4
3		27-8	15	2				4	27-9	15-16	34-6
4		29-30	16	3				5	29-31	17-18	36-8
1885		31-2	17	4	1			6	31-3	19-20	38-9
6		33-4	18	5	2			7	33-5	21-2	40-1
7		35-6	19	6	3			8	35-7	23-4	42-3
8		37-8	20	7	4			9	37-9	25-6	43-5
9		39-40	21	8	5			10	39-41	27-8	45-7
1890		41-2	22	9	6			11	41-3	29-30	47-9
1		43-4	23	10	7			12	43-5	31-2	49-50
2		45-6	24	11	8			13	45-7	33-4	50-2
3		47-8	25	12	9			14	47-9	35-6	52-4
4		49-50	26	13	10			15	49-51	37-8	55-7
1895		51-2	27	14	11			16	51-3	39-40	57-9
6	1	53-4	28	15	12			17	53-5	41-2	59-60
7	1	55-6	29	16	13			18	55-7	43-4	60-2
8	2	57-8	30	17	14			19	57-9	45-6	62-4
9	3	59-60	31	18	15			20	59-61	47-8	64-6
1900	4	61-2	32	19	16			21	61-3	49-50	66-7
1	5	63-4	33	20	17			22	63-5	6, 1-2	68-9
2	6	65-6	34	21	18			23	65-7	3-4	69-70
3	7	67-8	35	22	19			24	67-9	5-6	71-2
4	8	69-70	36	23	20			25	69-71	7-8	72-4
1905	9	71-2	37	24	21			26	71-3	9-10	74-6
6	10	73-4	38	25	22		1	27	73-5	11-12	77-8
7	11	75-6	39	26	23		1-2	28	75-7	13-14	78-80
8	12	77-8	40	27	24		2-3	29	77-9	15-16	80-1
9	13	79-80	41	28	25	1	4-5	30	79-82	17-18	82-3
1910	14	81-2	42	29	26	1-2	6-7	31	82-5	19-20	83-4
11	15	83-4	43	30	27	2-3	8-9	32	85-8	21-2	84-6
12	16	85-6	44	31	28	3-4	10-11	33	88-90	23-4	86-7
13	17	87-8	45	32	29	4-5	12-13	34	90-2	25-6	88-9
14	18	89-90	46	33	30	5-6	14-15	35	92-4	27-8	89-90
1915	19	91-2	47	34	31	7	16-17	36	94-6	29-30	91-2
16	20	93-4	48	35	32	8	18-19	37	96-8	31-2	92-3
17	21	95-6	49	36	33	9	20-1	38	98-100	33-4	93-4
18	22	97-8	50	37	34	9-10	22-3	39	100-2	35-6	94-5
19	23	99	51	38	35	10-11	24-5	40	102-4	37-8	95-6
1920	24	100	51-2	39	36	12-13	26-7	41	104-6	39-40	96-8
1	25	101-2	53	40	37	13-14	28-9	42	106-8	41-2	98-100
2	26	103-5	54-5	41	38	15-16	30-1	43	109-10	43-4	100-2
3	27	105-6		42	39	17-18	32-3	44	111-12	45-6	102-4
4	28	107-8		43	40	19-20	34-5	45	113-14	47-8	105-6
1925	29	109-11	56-7	44	41	21	36-7	46	115-16	49-50	107-9
6	30	112-14	58	45	42	22	38-40	47	117-18	7, 1-2	110-13
7	31	115-17	59	46	43	23-5	41-3	48	119-20	3-4	113-17
8	32	118-20	60	47	44	26-7	44-6	49-50	121-2	5-6	117-21
9	33	121-4	61	48	45	28-30	47-9	51-4	123-4	7-8	122-6
1930	34	124-8	62	49	46	30-1	50-3	55-6	125-6	9-10	126-30
1	35	129-31	63 (N.S.1)	50	47	32-4	54-7	57-8	127-8	11-12	130-4
2	36	132-5	64	51	48	34-7	58-61	59-60	129-30	13-14	134-8
3	37	136-8	65	52	49	37-9	61-5	61-2	131-2	15-16	138-42
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*For the whole numbers add 108 since there were 108 volumes in the first series.

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Rec. trav. chim.	Science	Trans. Electro-chem. Soc.	Trans. Faraday Soc.	Trans. Roy. Soc. (London) (A)	Z. anal. Chem.	Z. angew. Chem.	Z. anorg. allgem. Chem.	Z. Elektro-chem.	Z. Physik. Chem.	Year
				171	19					1880
				172	20					1
1, 1				173	21					2
2	1-2			174	22					3
3	3-4			175	23					4
4	5-6			....	24					1885
5	7-8			176-7	25					6
6	9-10			177	26				1	7
7	11-12			178	27	1			2	8
8	13-14			179	28	2			3-4	9
9	15-16			180	29	3			5-6	1890
10	17-18			181	30	4			7-8	1
11	19-20			182	31	5	1-2		9-10	2
12	21-2			183	32	6	3-4		11-12	3
13	23			184-5	33	7	5-7	1	13-15	4
14	N.S. 1-2			185-6	34	8	8-10	1-2	16-18	1895
15	3-4			186, 188	35	9	11-12	2-3	19-21	6
2, 1(16)	5-6			187, 189	36	10	13-15	3-4	22-4	7
2(17)	7-8			190-1	37	11	16-18	4-5	25-7	8
3(18)	9-10			192	38	12	19-21	5-6	28-31	9
4(19)	11-12			193-4	39	13	22-5	6-7	32-5	1900
5(20)	13-14			195-7	40	14	26-8	7	36-8	1
6(21)	15-16	1-2		198-9	41	15	29-32	8	39-41	2
7(22)	17-18	3-4		200-1	42	16	33-36	9	42-6	3
8(23)	19-20	5-6		202-3	43	17	37-42	10	47-50	4
9(24)	21-2	7-8	1	204	44	18	43-7	11	51-4	1905
10(25)	23-4	9-10	1-2	205-6	45	19	48-51	12	54-6	6
11(26)	25-6	11-12	2-3	207	46	20	52-5	13	57-60	7
12(27)	27-8	13-14	3-4	207-9	47	21	56-60	14	61-4	8
13(28)	29-30	15-16	4-5	209-10	48	22	61-4	15	65-9	9
14(29)	31-2	17-18	5-6	210	49	23	65-8	16	70-4	1910
15(30)	33-4	19-20	6-7	210-11	50	24	69-72	17	75-7	11
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3, 2(32)	37-8	23-4	9	212-13	52	26	79-83	19	81-6	13
3(33)	39-40	25-6	10	213-14	53	27	84-9	20	86-8	14
4-5(34-5)	41-2	27-8	10-11	215-16	54	28	90-3	21	89-90	1915
6(36)	43-4	29-30	11-12	216-17	55	29	94-8	22	91-2	16
7(37)	45-6	31-2	12-13	217	56	30	99-101	23	92	17
7(37)	47-8	33-4	13	217	57	31	102-4	24	92-3	18
8(38)	49-50	35-6	14-15	218-19	58	32	105-8	25	93	19
4, 1(39)	51-2	37-8	15-16	220	59	33	109-14	26	94-6	1920
2(40)	53-4	39-40	16-17	221	60	34	115-19	27	97-9	1
3(41)	55-6	41-2	17-18	222	61	35	120-5	28	100-3	2
4(42)	57-8	43-4	18-19	223	62-3	36	126-31	29	103-7	3
5(43)	59-60	45-6	19-20	224	64-5	37	132-141	30	108-14	4
6(44)	61-2	47-8	20-1	225	65-7	38	141-150	31	114-18	1925
7(45)	63-4	49-50	21-2	226	67-9	39	150-9	32	119-24	6
8(46)	65-6	51-2	23	226-7	70-2	40	159-68	33	125-31	7
9(47)	67-8	53-4	24	227-8	73-5	41	168-77	34	131-9	8
10(48)	69-70	55-6	25	228	76-8	42	177-86	35	140-5	9
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12(50)	73-4	59-60	27	230	83-7	44	195-204	37	152-7	1
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THREE HUNDRED YEAR CALENDAR

1753 to 2052

To find the day of the week:—First find the year in the table and then in the same horizontal column to the right find the month where the number is given which refers to the corresponding column of days in the table which follows.

Example:—To find the day of the week corresponding to Armistice Day, November 11, 1918 find the year 1918 and in the horizontal column to the right under November is the figure 5 which refers to column 5 which is the calendar for November of 1918 which shows that November 11, 1918 was on Monday.

	January	February	March	April	May	June	July	August	September	October	November	December
1761 1767 1778 1789 1795 1801 1807 1818 1829 1835 1846 1857 1863 1874 1885 1891 1903 1914 1925 1931 1942 1953 1959 1970 1981 1987 1998 2009 2015 2026 2037 2043	4	7	7	3	5	1	3	6	2	4	7	2
1762 1773 1779 1790 1802 1813 1819 1830 1841 1847 1858 1869 1875 1886 1897 1909 1915 1926 1937 1943 1954 1965 1971 1982 1993 1999 2010 2021 2027 2038 2049	5	1	1	4	6	2	4	7	3	5	1	3
1757 1763 1774 1785 1791 1803 1814 1825 1831 1842 1853 1859 1870 1881 1887 1898 1910 1921 1927 1938 1949 1955 1966 1977 1983 1994 2005 2011 2022 2033 2039 2050	6	2	2	5	7	3	5	1	4	6	2	4
1754 1765 1771 1782 1793 1799 1805 1811 1822 1833 1839 1850 1861 1867 1878 1889 1895 1901 1907 1918 1929 1935 1946 1957 1963 1974 1985 1991 2002 2013 2019 2030 2041 2047	2	5	5	1	3	6	1	4	7	2	5	7
1755 1766 1777 1783 1794 1800 1806 1817 1823 1834 1845 1851 1862 1873 1879 1890 1902 1913 1919 1930 1941 1947 1958 1969 1975 1986 1997 2003 2014 2025 2031 2042	3	6	6	2	4	7	2	5	1	3	6	1
1758 1769 1775 1786 1797 1809 1815 1826 1837 1843 1854 1865 1871 1882 1893 1899 1905 1911 1922 1933 1939 1950 1961 1967 1978 1989 1995 2006 2017 2023 2034 2045 2051	7	3	3	6	1	4	6	2	5	7	3	5
1753 1759 1770 1781 1787 1798 1810 1821 1827 1838 1849 1855 1866 1877 1883 1894 1900 1906 1917 1923 1934 1945 1951 1962 1973 1979 1990 2001 2007 2018 2029 2035 2046	1	4	4	7	2	5	7	3	6	1	4	6
Leap Years												
1764 1792 1804 1832 1860 1888 1928 1956 1984 2012 2040	7	3	4	7	2	5	7	3	6	1	4	6
1768 1796 1808 1836 1864 1892 1904 1932 1960 1988 2016 2044	5	1	2	5	7	3	5	1	4	6	2	4
1772 1812 1840 1868 1896 1908 1936 1964 1992 2020 2048	3	6	7	3	5	1	3	6	2	4	7	2
1776 1816 1844 1872 1912 1940 1968 1996 2024 2052	1	4	5	1	3	6	1	4	7	2	5	7
1780 1820 1848 1876 1916 1944 1972 2000 2028	6	2	3	6	1	4	6	2	5	7	3	5
1756 1784 1824 1852 1880 1920 1948 1976 2004 2032	4	7	1	4	6	2	4	7	3	5	1	3
1760 1788 1828 1856 1884 1924 1952 1980 2008 2036	2	5	6	2	4	7	2	5	1	3	6	1

TWO HUNDRED YEAR CALENDAR

1	2	3	4	5	6	7
Monday 1	Tuesday 1	Wednesday 1	Thursday 1	Friday 1	Saturday 1	SUNDAY 1
Tuesday 2	Wednesday 2	Thursday 2	Friday 2	Saturday 2	SUNDAY 2	Monday 2
Wednesday 3	Thursday 3	Friday 3	Saturday 3	SUNDAY 3	Monday 3	Tuesday 3
Thursday 4	Friday 4	Saturday 4	SUNDAY 4	Monday 4	Tuesday 4	Wednesday 4
Friday 5	Saturday 5	SUNDAY 5	Monday 5	Tuesday 5	Wednesday 5	Thursday 5
Saturday 6	SUNDAY 6	Monday 6	Tuesday 6	Wednesday 6	Thursday 6	Friday 6
SUNDAY 7	Monday 7	Tuesday 7	Wednesday 7	Thursday 7	Friday 7	Saturday 7
Monday 8	Tuesday 8	Wednesday 8	Thursday 8	Friday 8	Saturday 8	SUNDAY 8
Tuesday 9	Wednesday 9	Thursday 9	Friday 9	Saturday 9	SUNDAY 9	Monday 9
Wednesd. 10	Thursday 10	Friday 10	Saturday 10	SUNDAY 10	Monday 10	Tuesday 10
Thursday 11	Friday 11	Saturday 11	SUNDAY 11	Monday 11	Tuesday 11	Wednesd. 11
Friday 12	Saturday 12	SUNDAY 12	Monday 12	Tuesday 12	Wednesd. 12	Thursday 12
Saturday 13	SUNDAY 13	Monday 13	Tuesday 13	Wednesd. 13	Thursday 13	Friday 13
SUNDAY 14	Monday 14	Tuesday 14	Wednesd. 14	Thursday 14	Friday 14	Saturday 14
Monday 15	Tuesday 15	Wednesd. 15	Thursday 15	Friday 15	Saturday 15	SUNDAY 15
Tuesday 16	Wednesd. 16	Thursday 16	Friday 16	Saturday 16	SUNDAY 16	Monday 16
Wednesd. 17	Thursday 17	Friday 17	Saturday 17	SUNDAY 17	Monday 17	Tuesday 17
Thursday 18	Friday 18	Saturday 18	SUNDAY 18	Monday 18	Tuesday 18	Wednesd. 18
Friday 19	Saturday 19	SUNDAY 19	Monday 19	Tuesday 19	Wednesd. 19	Thursday 19
Saturday 20	SUNDAY 20	Monday 20	Tuesday 20	Wednesd. 20	Thursday 20	Friday 20
SUNDAY 21	Monday 21	Tuesday 21	Wednesd. 21	Thursday 21	Friday 21	Saturday 21
Monday 22	Tuesday 22	Wednesd. 22	Thursday 22	Friday 22	Saturday 22	SUNDAY 22
Tuesday 23	Wednesd. 23	Thursday 23	Friday 23	Saturday 23	SUNDAY 23	Monday 23
Wednesd. 24	Thursday 24	Friday 24	Saturday 24	SUNDAY 24	Monday 24	Tuesday 24
Thursday 25	Friday 25	Saturday 25	SUNDAY 25	Monday 25	Tuesday 25	Wednesd. 25
Friday 26	Saturday 26	SUNDAY 26	Monday 26	Tuesday 26	Wednesd. 26	Thursday 26
Saturday 27	SUNDAY 27	Monday 27	Tuesday 27	Wednesd. 27	Thursday 27	Friday 27
SUNDAY 28	Monday 28	Tuesday 28	Wednesd. 28	Thursday 28	Friday 28	Saturday 28
Monday 29	Tuesday 29	Wednesd. 29	Thursday 29	Friday 29	Saturday 29	SUNDAY 29
Tuesday 30	Wednesd. 30	Thursday 30	Friday 30	Saturday 30	SUNDAY 30	Monday 30
Wednesd. 31	Thursday 31	Friday 31	Saturday 31	SUNDAY 31	Monday 31	Tuesday 31

APPENDIX

MATHEMATICAL TABLES AND FORMULAS

COMPILED BY

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PART ONE

Formulas and Theorems from Elementary Mathematics

I. ALGEBRA

1. Fundamental Laws.

(*a*) Commutative law: $a + b = b + a,\ ab = ba.$

(*b*) Associative law: $a + (b + c) = (a + b) + c,\ a(bc) = (ab)c.$

(*c*) Distributive law: $a(b + c) = ab + ac.$

2. Laws of Exponents.

$a^x \cdot a^y = a^{x+y},\quad (ab)^x = a^x \cdot b^x,\quad (a^x)^y = a^{xy}.$

$a^0 = 1 \text{ if } a \neq 0,\quad a^{-x} = \frac{1}{a^x},\quad \frac{a^x}{a^y} = a^{x-y}.$

$a^{\frac{x}{y}} = \sqrt[y]{a^x},\quad a^{\frac{1}{y}} = \sqrt[y]{a}.$

3. Operations with Zero.

$a - a = 0,\quad a \cdot 0 = 0 \cdot a = 0.$

If $a \neq 0,\ \frac{0}{a} = 0,\ 0^a = 0,\ a^0 = 1.$ (Division by zero undefined.)

4. Complex Numbers (a number of the form $a + bi$, where a and b are real).

$i = \sqrt{-1},\quad i^2 = -1,\quad i^3 = -i,\quad i^4 = 1,\quad i^5 = i,$ etc.

$a + bi = c + di,$ if and only if $a = c,\ b = d.$

$(a + bi) + (c + di) = (a + c) + (b + d)i.$

$(a + bi)\,(c + di) = (ac - bd) + (ad + bc)i.$

$$\frac{a+bi}{c+di} = \frac{(a+bi)\,(c-di)}{(c+di)\,(c-di)} = \frac{ac+bd}{c^2+d^2} + \frac{bc-ad}{c^2+d^2}\,i.$$

5. Laws of Logarithms (See explanation of Table 1).

If M, N, b are positive numbers and $b \neq 1$:

$$\log_b MN = \log_b M + \log_b N, \qquad \log_b \frac{M}{N} = \log_b M - \log_b N,$$

$$\log_b M^p = p \cdot \log_b M, \qquad \log_b \sqrt[q]{M} = \frac{1}{q} \cdot \log_b M,$$

$$\log_b\left(\frac{1}{M}\right) = -\log_b M, \qquad \log_b b = 1, \quad \log_b 1 = 0.$$

Change of base of Logarithms ($c \neq 1$):

$$\log_b M = \log_c M \cdot \log_b c = \frac{\log_c M}{\log_c b}.$$

6. Binomial Theorem (n a positive integer).

$$(a+b)^n = a^n + na^{n-1}b + \frac{n(n-1)}{2!}a^{n-2}b^2 + \frac{n(n-1)(n-2)}{3!}a^{n-3}b^3 + \cdots + nab^{n-1} + b^n$$

where

$$n! = \underline{|n} = 1 \cdot 2 \cdot 3 \cdot \cdots \cdot (n-1)n.$$

7. Expansions and Factors.

$$(a \pm b)^2 = a^2 \pm 2ab + b^2.$$

$$(a \pm b)^3 = a^3 \pm 3a^2 b + 3ab^2 \pm b^3.$$

$$(a+b+c)^2 = a^2 + b^2 + c^2 + 2ab + 2ac + 2bc.$$

$$a^2 - b^2 = (a-b)(a+b).$$

$$a^3 - b^3 = (a-b)(a^2 + ab + b^2).$$

$$a^3 + b^3 = (a+b)(a^2 - ab + b^2).$$

$$a^n - b^n = (a-b)(a^{n-1} + a^{n-2}b + \cdots + b^{n-1}).$$

$a^n - b^n = (a+b)(a^{n-1} - a^{n-2}b + \cdots - b^{n-1})$, for n an even integer.

$a^n + b^n = (a+b)(a^{n-1} - a^{n-2}b + \ldots + b^{n-1})$, for n an odd integer.

$$a^4 + a^2b^2 + b^4 = (a^2 + ab + b^2)(a^2 - ab + b^2).$$

8. Ratio and Proportion.

If $a : b = c : d$ or $\frac{a}{b} = \frac{c}{d}$, then $ad = bc$, $\frac{a}{c} = \frac{b}{d}$.

If $\frac{a}{b} = \frac{c}{d} = \frac{e}{f} = \cdots = k$, then

$$k = \frac{a + c + e + \cdots}{b + d + f + \cdots} = \frac{pa + qc + re + \cdots}{pb + qd + rf + \cdots}.$$

9. Constant Factor of Proportionality (or Variation), k.

If y varies directly as x, or y is proportional to x,

$$y = kx.$$

If y varies inversely as x, or y is inversely proportional to x,

$$y = \frac{k}{x}.$$

If y varies jointly as x and z,

$$y = kxz.$$

If y varies directly as x and inversely as z,

$$y = \frac{kx}{z}.$$

10. Arithmetic Progression.

$$a, \quad a + d, \quad a + 2d, \quad a + 3d, \cdots.$$

If a is the first term, d the common difference, n the number of terms, l the last term and s the sum of n terms,

$$l = a + (n - 1)\,d, \quad s = \frac{n}{2}(a + l).$$

The *arithmetic mean* of a and b is $(a + b)/2$.

11. Geometric Progression.

$$a, \; ar, \; ar^2, \; ar^3, \cdots.$$

If a is the first term, r the common ratio, n the number of terms, l the last term, and S_n the sum of n terms,

$$l = ar^{n-1}, \quad S_n = a\left(\frac{r^n - 1}{r - 1}\right) = \frac{rl - a}{r - 1}.$$

If $r^2 < 1$, S_n approaches the limit S_∞ as n increases without limit,

$$S_\infty = \frac{a}{1 - r}.$$

The *geometric mean* of a and b is $\sqrt{ab}$.

12. Harmonic Progression. A sequence of numbers whose reciprocals form an arithmetic progression is called an *harmonic* progression. Thus,

$$\frac{1}{a}, \quad \frac{1}{a+d}, \quad \frac{1}{a+2d}, \cdots.$$

The *harmonic mean* of a and b is $2ab/(a+b)$.

13. Permutations. Each different arrangement of all or a part of a set of things is called a *permutation.* The number of permutations of n things taken r at a time is

$$_nP_r = n(n-1)(n-2)\cdots(n-r+1) = \frac{n!}{(n-r)!},$$

where

$$n! = n(n-1)(n-2)\cdots(1).$$

14. Combinations. Each of the groups or relations which can be made by taking part or all of a set of things, without regard to the arrangement of the things in a group, is called a *combination.* The number of combinations of n things taken r at a time is

$$_nC_r = \binom{n}{r} = \frac{_nP_r}{r!} = \frac{n(n-1)\cdots(n-r+1)}{r(r-1)\cdots(1)} = \frac{n!}{r!(n-r)!}.$$

15. Probability. If an event may occur in p ways, and may fail in q ways, all ways being equally likely, the *probability* of its occurrence is $p/(p+q)$, and that of its failure to occur is $q/(p+q)$.

16. Remainder Theorem (See §30). If the polynomial $f(x)$ is divided by $(x-a)$, the remainder is $f(a)$. Hence, if a is a root of the equation $f(x) = 0$, then $f(x)$ is divisible by $(x-a)$.

17. Determinants. The determinant D of order n,

$$D = \begin{vmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ a_{n1} & a_{n2} & \cdots & a_{nn} \end{vmatrix},$$

is defined to be the sum

$$\Sigma\,(\pm)\, a_{1i}\, a_{2j}\, a_{3k} \cdots a_{nl}$$

of $n!$ terms, the sign in a given term being taken plus or minus according as the number of inversions (of the numbers $1, 2, 3, \cdots, n$) in the corresponding sequence $i, j, k, \cdots, l$, is even or odd.

The *cofactor* A_{ij} of the element a_{ij} is defined to be the product of $(-1)^{i+j}$ by the determinant obtained from D by deleting the ith row and the jth column.

The following theorems are true:

(*a*) If the corresponding rows and columns of D be interchanged, D is unchanged.

(*b*) If any two rows (or columns) of D be interchanged, D is changed to $-D$.

(*c*) If any two rows (or columns) are alike, then $D = 0$.

(*d*) If each element of a row (or column) of D be multiplied by m, the new determinant is equal to mD.

(*e*) If to each element of a row (or column) is added m times the corresponding element in another row (or column), D is unchanged.

(*f*) $D = a_{1j} A_{1j} + a_{2j} A_{2j} + \cdots + a_{nj} A_{nj}, \quad j = 1, 2, \cdots, n.$

(*g*) $0 = a_{1k} A_{1j} + a_{2k} A_{2j} + \cdots + a_{nk} A_{nj}$, if $j \neq k$.

(*h*) The solution of the system of equations

$$a_{i1} x_1 + a_{i2} x_2 + \cdots + a_{in} x_n = c_i, \quad i = 1, 2, \cdots, n,$$

is unique if $D \neq 0$. The solution is given by the equations

$$Dx_1 = C_1, \qquad Dx_2 = C_2, \cdots, \qquad Dx_n = C_n,$$

where C_k is what D becomes when the elements of its kth column are replaced by $c_1, c_2, \ldots, c_n$, respectively.

Example 1.

$$\begin{vmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{vmatrix} = a_{11} \begin{vmatrix} a_{22} & a_{23} \\ a_{32} & a_{33} \end{vmatrix} - a_{12} \begin{vmatrix} a_{21} & a_{23} \\ a_{31} & a_{33} \end{vmatrix} + a_{13} \begin{vmatrix} a_{21} & a_{22} \\ a_{31} & a_{32} \end{vmatrix}$$

$$= a_{11}(a_{22} a_{33} - a_{32} a_{23}) - a_{12}(a_{21} a_{33} - a_{31} a_{23}) + a_{13}(a_{21} a_{32} - a_{31} a_{22}).$$

Example 2. Find the values of x_1, x_2, x_3, which satisfy the system

$$\begin{aligned} 2x_1 + x_2 - 2x_3 &= -6, \\ x_1 + x_2 + x_3 &= 2, \\ -x_1 - 2x_2 + 3x_3 &= 12. \end{aligned}$$

By 17(*h*), we find

$$x_1 = \frac{\begin{vmatrix} -6 & 1 & -2 \\ 2 & 1 & 1 \\ 12 & -2 & 3 \end{vmatrix}}{\begin{vmatrix} 2 & 1 & -2 \\ 1 & 1 & 1 \\ -1 & -2 & 3 \end{vmatrix}} = \frac{8}{8} = 1; \quad x_2 = \frac{\begin{vmatrix} 2 & -6 & -2 \\ 1 & 2 & 1 \\ -1 & 12 & 3 \end{vmatrix}}{\begin{vmatrix} 2 & 1 & -2 \\ 1 & 1 & 1 \\ -1 & -2 & 3 \end{vmatrix}} = \frac{-16}{8} = -2; \quad x_3 = \frac{\begin{vmatrix} 2 & 1 & -6 \\ 1 & 1 & 2 \\ -1 & -2 & 12 \end{vmatrix}}{\begin{vmatrix} 2 & 1 & -2 \\ 1 & 1 & 1 \\ -1 & -2 & 3 \end{vmatrix}} = 3.$$

Interest, Annuities, Sinking Funds.

In this section, n is the number of years, and r the rate of interest expressed as a decimal.

18. Amount. The amount (A_n) of a principal (P) placed at a rate of interest (r) for n years is given as follows.

At simple interest: $A_n = P(1+ nr)$.

At interest compounded annually:* $A_n = P(1 + r)^n$.

At interest compounded q times a year: $A_n = P\left(1 + \frac{r}{q}\right)^{nq}$.

19. Nominal and Effective Rates. The rate of interest quoted in describing a given variety of compound interest is called the *nominal rate.* The rate per year at which principal grows under this investment is called the *effective rate.* The effective rate (i) corresponding to the rate (r), compounded q times a year on a principal of P dollars, is:

$$i = \left(1 + \frac{r}{q}\right)^q - 1.$$

20. Present Value. The present value (P) of an amount A_n due in n years at rate r.

At simple interest: $P = \frac{A_n}{1 + nr}$.

At interest compounded annually:† $P = \frac{A_n}{(1 + r)^n}$.

At interest compounded q times a year: $P = \frac{A_n}{\left(1 + \frac{r}{q}\right)^{nq}}$.

21. True Discount. The true discount is:

$$D = A_n - P.$$

22. Annuity. A fixed sum of money paid at regular intervals is called an *annuity.*

23. Amount of an Annuity.‡ The amount of an annuity (N) of P dollars per annum for n years, beginning one year hence, at rate r, compounded annually, is:

$$N = P \cdot \frac{(1 + r)^n - 1}{r}.$$

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* See Table XIX. † See Table XX ‡ See Table XXI.

24. Present Value of an Annuity.* The present value (P) of an annuity of N dollars payable annually for n years, beginning a year hence, drawing interest at rate (r), interest compounded annually is:

$$P = N \cdot \frac{(1 + r)^n - 1}{r(1 + r)^n}.$$

25. Amount of a Sinking Fund. The amount (S) of a sinking fund created by a fixed investment (N) placed annually at compound interest (r) for a term of n years, the first investment being made at end of first year, is:

$$S = N \cdot \frac{(1 + r)^n - 1}{r}.$$

26. Fixed Investment. The amount (N) that must be placed annually (end of the year) at compound interest (r) for a term of n years to create a sinking fund (S), is:

$$N = S \cdot \frac{r}{(1 + r)^n - 1}.$$

Algebraic Equations†

27. Quadratic Equations. If

$$ax^2 + bx + c = 0, \quad a \neq 0,$$

then

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$

If a, b, c are real and

if $b^2 - 4ac > 0$, the roots are real and unequal.

if $b^2 - 4ac = 0$, the roots are real and equal.

if $b^2 - 4ac < 0$, the roots are imaginary.

28. Cubic Equations. The cubic equation

$$y^3 + py^2 + qy + r = 0,$$

may be reduced by the substitution

$$y = \left(x - \frac{p}{3}\right)$$

* See Table XXII.

† For linear equations, see § 17.

to the normal form

$$x^3 + ax + b = 0,$$

where

$$a = \frac{1}{3}(3q - p^2), \quad b = \frac{1}{27}(2p^3 - 9pq + 27r),$$

which has the solutions $x_1, x_2, x_3,$

$$x_1 = A + B, \quad x_2, \quad x_3 = -\frac{1}{2}(A + B) \pm \frac{i\sqrt{3}}{2}(A - B),$$

where

$$i^2 = -1, \quad A = \sqrt[3]{-\frac{b}{2} + \sqrt{\frac{b^2}{4} + \frac{a^3}{27}}}, \quad B = \sqrt[3]{-\frac{b}{2} - \sqrt{\frac{b^2}{4} + \frac{a^3}{27}}}.$$

If p, q, r are real, and

if $\frac{b^2}{4} + \frac{a^3}{27} > 0,$ there are one real root and two conjugate imaginary roots,

if $\frac{b^2}{4} + \frac{a^3}{27} = 0,$ there are three real roots of which two are equal,

if $\frac{b^2}{4} + \frac{a^3}{27} < 0,$ there are three real and unequal roots.

If

$$\frac{b^2}{4} + \frac{a^3}{27} < 0,$$

the above formulas are impractical. The real roots are,

$$x_k = \mp 2\sqrt{-\frac{a}{3}}\cos\left(\frac{\phi}{3} + 120° K\right), \quad K = 0, 1, 2.$$

where

$$\cos\phi = \sqrt{\frac{b^2}{4} \div \left(-\frac{a^3}{27}\right)},$$

and where the upper signs are to be used if b is positive and the lower signs if b is negative.

If

$$\frac{b^2}{4} + \frac{a^3}{27} > 0,$$

the real root is,

$$x = \pm 2\sqrt{\frac{a}{3}}\operatorname{ctn} 2\phi,$$

where ϕ and ψ are to be computed from

$$\operatorname{ctn} 2\psi = \sqrt{\frac{b^2}{4} \div \frac{a^3}{27}}, \quad \tan \phi = \sqrt[3]{\tan \psi},$$

and where the upper sign is to be used if b is positive and the lower sign if b is negative.

If

$$\frac{b^2}{4} + \frac{a^3}{27} = 0,$$

the roots are,

$$x = \mp 2\sqrt{-\frac{a}{3}}, \quad \pm\sqrt{-\frac{a}{3}}, \quad \pm\sqrt{-\frac{a}{3}},$$

where the upper sign is to be used if b is positive, and the lower sign if b is negative.

29. Biquadratic (Quartic) Equation. The quartic equation

$$y^4 + py^3 + qy^2 + ry + s = 0$$

may be reduced to the form

$$x^4 + ax^2 + bx + c = 0$$

by the substitution

$$y = \left(x - \frac{p}{4}\right).$$

Let l, m, and n, denote the roots of the resolvent cubic

$$t^3 + \left(\frac{a}{2}\right)t^2 + \left(\frac{a^2 - 4c}{16}\right)t - \frac{b^2}{64} = 0.$$

The required roots of the reduced quartic are,

$$x_1 = \pm(-\sqrt{l} - \sqrt{m} - \sqrt{n}); \quad x_2 = \pm(-\sqrt{l} + \sqrt{m} + \sqrt{n});$$

$$x_3 = \pm(\sqrt{l} - \sqrt{m} + \sqrt{n}); \quad x_4 = \pm(\sqrt{l} + \sqrt{m} - \sqrt{n});$$

where the upper signs are to be used if b is positive, and the lower signs if b is negative.

30. General Equations of the nth degree.

$$P \equiv a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \cdots + a_{n-1}x + a_n = 0.$$

If $n > 4$, there is no formula which gives the roots of this general equation. The following methods may be used to advantage:

(*a*) *Roots by factors.* By trial, find a number r such that $x = r$, satisfies the equation, that is, such that

$$a_0r^n + a_1r^{n-1} + a_2r^{n-2} + \cdots + a_{n-1}r + a_n = 0.$$

Then $(x-r)$ is a factor of the left hand member P of the equation. Divide P by $(x-r)$ leaving an equation of degree one less than that of the original equation. Next, proceed in the same manner with the reduced equation. (All integer roots of $P = 0$ are divisors of a_n.)

(*b*) *Roots by Approximation.* If for $x = a$ and $x = b$, the left member, P, of the equation has opposite signs, then a root lies between a and b. By repeated application of this principle, real roots to any desired degree of accuracy may be obtained.

(*c*) *Descartes' Rule.* The number of positive real roots of an equation with real coefficients is either equal to the number of its variations of sign or is less than that number by a positive even integer. A root of multiplicity m is here counted as m roots.

31. The Equation $x^n = a$. The n roots of this equation are:

$$x = \sqrt[n]{a}\left(\cos\frac{2k\pi}{n} + \sqrt{-1}\sin\frac{2k\pi}{n}\right), \text{ if } a > 0,$$

$$x = \sqrt[n]{-a}\left(\cos\frac{(2k+1)\pi}{n} + \sqrt{-1}\sin\frac{(2k+1)\pi}{n}\right), \text{ if } a < 0,$$

where k takes successively the values $0, 1, 2, 3, \cdots, n-1$.

31b. Stirling's Formula. For large values of n,

$$\sqrt{2n\pi}\,(n/e)^n < n! < \sqrt{2n\pi}\,(n/e)^n\,[1 + 1/(12n-1)],$$

where $\pi = 3.14159\cdots$, $e = 2.71828\cdots$.

$$\log n! \doteqdot (n + \tfrac{1}{2})\log n - n\log e + \log\sqrt{2\pi}.$$

II. ELEMENTARY GEOMETRY

Let a, b, c, d, and s denote lengths, A denote areas, and V denote volumes.

32. Triangle (see §65).

$A = bh/2$, where b denotes the base and h the altitude.

33. Rectangle.

$A = ab$, where a and b denote the lengths of the sides.

34. Parallelogram (opposite sides parallel).

$A = ah = ab \sin\theta$, where a and b denote the sides, h the altitude and θ the angle between the sides.

35. Trapezoid (four sides, two parallel).

$A = \frac{1}{2}h(a + b)$, where a and b are the sides and h the altitude.

36. Regular Polygon of n Sides (Fig. 1., See §37).

$$A = \frac{1}{4}n \cdot a^2 \operatorname{ctn} \frac{180^\circ}{n},$$ where a is length of side.

$$R = \frac{a}{2} \cdot \csc \frac{180^\circ}{n},$$ where R is radius of circumscribed circle.

$$r = \frac{a}{2} \cdot \operatorname{ctn} \frac{180^\circ}{n},$$ where r is radius of inscribed circle.

$$\alpha = \frac{360^\circ}{n} = \frac{2\pi}{n}$$ radians,

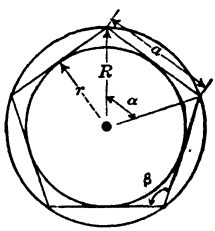


Fig. 1

$$\beta = \left(\frac{n-2}{n}\right) \cdot 180^\circ = \left(\frac{n-2}{n}\right)\pi$$ radians where α and β are the angles indicated in Fig. 1.

$$a = 2r \cdot \tan\frac{\alpha}{2} = 2R \cdot \sin\frac{\alpha}{2}.$$

37. Circle (Fig. 2).

Let C = circumference,
R = radius,
D = diameter,
A = area,
S = length of arc subtended by θ,
l = chord subtended by arc S,
h = rise,
θ = central angle in radians.

$C = 2\pi R = \pi D, \quad \pi = 3.14159 \cdots .$

$S = R\theta = \frac{1}{2}D\theta = D \cos^{-1} \frac{d}{R}.$

$l = 2\sqrt{R^2 - d^2} = 2R \sin \frac{\theta}{2} = 2d \tan \frac{\theta}{2}.$

$d = \frac{1}{2}\sqrt{4R^2 - l^2} = R \cos \frac{\theta}{2} = \frac{1}{2} l \operatorname{ctn} \frac{\theta}{2}.$

$h = R - d.$

$\theta = \frac{S}{R} = \frac{2S}{D} = 2 \cos^{-1} \frac{d}{R} = 2 \tan^{-1} \frac{l}{2d} = 2 \sin^{-1} \frac{l}{D}.$

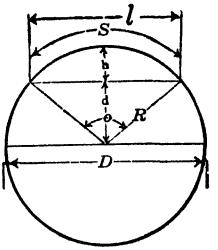


Fig. 2

A (circle) $= \pi R^2 = \frac{1}{4}\pi D^2.$

A (sector) $= \frac{1}{2} Rs = \frac{1}{2} R^2\theta.$

A (segment) $= A$ (sector) $- A$ (triangle) $= \frac{1}{2} R^2 (\theta - \sin \theta)$

$$= R^2 \cos^{-1} \frac{(R-h)}{R} - (R-h) \sqrt{2Rh - h^2}.$$

Perimeter of a n-side regular polygon inscribed in a circle

$$= 2n R \sin \frac{\pi}{n}.$$

Area of inscribed polygon $= \frac{1}{2} nR^2 \sin \frac{2\pi}{n}.$

Perimeter of a n-side regular polygon circumscribed about a circle

$$= 2nR \tan \frac{\pi}{n}.$$

Area of circumscribed polygon $= nR^2 \tan \frac{\pi}{n}.$

Radius of circle inscribed in a triangle of sides a, b, and c is

$$r = \sqrt{\frac{(s-a)(s-b)(s-c)}{s}}, \quad s = \tfrac{1}{2}(a+b+c).$$

Radius of circle circumscribed about a triangle is

$$R = \frac{abc}{4\sqrt{s(s-a)(s-b)(s-c)}}.$$

38. Ellipse (See §84).

$$\text{Perimeter} = \pi(a+b)\left[1+\frac{1}{4}\left(\frac{a-b}{a+b}\right)^2+\frac{1}{64}\left(\frac{a-b}{a+b}\right)^4+\cdots\right].$$

$A = \pi ab$, where a and b are lengths of semi-major and semi-minor axes respectively.

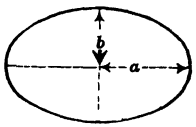


Fig. 3

39. Parabola (See §83).

$$A = 2ld/3.$$

$$\text{Height of } d_1 = \frac{d}{l^2}(l^2 - l_1^2).$$

$$\text{Width of } l_1 = l\sqrt{\frac{d-d_1}{d}}$$

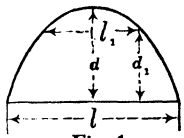


Fig. 4

$$\text{Length of arc} = l\left[1+\frac{2}{3}\left(\frac{2d}{l}\right)^2-\frac{2}{5}\left(\frac{2d}{l}\right)^4+\cdots\right].$$

40. Catenary, Cycloid, etc. (See §91 to §101).

41. Area by Approximation. If $y_0, y_1, y_2, \cdots, y_n$ be the lengths of a series of equally spaced parallel chords, and if h be their distant apart, the area enclosed by boundary is given approximately by any one of the following formulae:

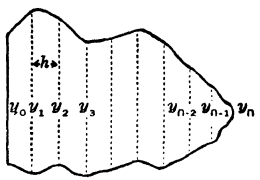


Fig. 5

$$A_T = h\left[\tfrac{1}{2}(y_0 + y_n) + y_1 + y_2 + \cdots + y_{n-1}\right]. \quad \text{(Trapezoidal Rule.)}$$

$$A_D = h\left[0.4(y_0 + y_n) + 1.1(y_1 + y_{n-1}) + y_2 + y_3 + \cdots + y_{n-2}\right]. \quad \text{(Durand's Rule.)}$$

$$A_S = \tfrac{1}{3}h\left[(y_0 + y_n) + 4(y_1 + y_3 + \cdots + y_{n-1}) + 2(y_2 + y_4 + \cdots + y_{n-2})\right]. \quad (n \text{ even, Simpson's Rule.})$$

In general, A_S gives the most accurate approximation.

The greater the value of n, the greater the accuracy of approximation.

42. Cube.

$V = a^3$; $d = a\sqrt{3}$; total surface area $= 6a^2$, where a is length of side and d is length of diagonal.

43. Rectangular Parallelopiped.

$V = abc$; $d = \sqrt{a^2 + b^2 + c^2}$; total surface area $= 2(ab + bc + ca)$, where a, b, and c are the lengths of the sides and d is length of diagonal.

44. Prism or Cylinder.

$V =$ (area of base) $\cdot$ (altitude).

Lateral area = (perimeter of right section) $\cdot$ (lateral edge).

45. Pyramid or Cone.

$V = \frac{1}{3}$ (area of base) $\cdot$ (altitude).

Lateral area of regular pyramid
$= \frac{1}{2}$ (perimeter of base) $\cdot$ (slant height).

46. Frustum of Pyramid or Cone.

$V = \frac{1}{3}(A_1 + A_2 + \sqrt{A_1 \cdot A_2})\ h$, where h is the altitude and A_1 and A_2 are the areas of the bases.

Lateral area of a regular figure
$= \frac{1}{2}$ (sum of perimeters of base) $\cdot$ (slant height).

47. Area of Surface and Volume of Regular Polyhedra of edge l.

Name	Type of Surface	Area of Surface	Volume
Tetrahedron	4 equilateral triangles	$1.73205l^2$	$0.11785l^3$
Hexahedron (cube)	6 squares	$6.00000l^2$	$1.00000l^3$
Octahedron	8 equilateral triangles	$3.46410l^2$	$0.47140l^3$
Dodecahedron	12 pentagons	$20.64578l^2$	$7.66312l^3$
Icosahedron	20 equilateral triangles	$8.66025l^2$	$2.18170l^3$

48. Sphere.

A (sphere) $= 4\pi R^2 = \pi D^2$.
A (zone) $= 2\pi Rh = \pi Dh$.
V (sphere) $= \frac{4}{3}\pi R^3 = \frac{1}{6}\pi D^3$.
V (spherical sector) $= \frac{2}{3}\pi R^2 h = \frac{1}{6}\pi D^2 h$.
V (spherical segment of one base) $= \frac{1}{6}\pi h_1 (3r_1^2 + h_1^2)$.
V (spherical segment of two bases) $= \frac{1}{6}\pi h(3r_1^2 + 3r_2^2 + h^2)$.
A (lune) $= 2R^2\theta$, where θ is angle in radians of lune.

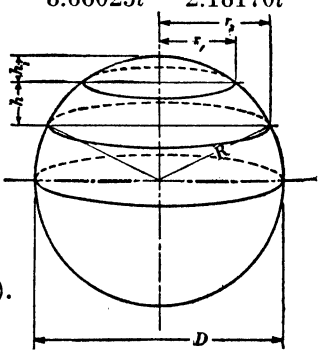


Fig. 6

49. Solid Angle (ψ). The solid angle (ψ) at any point P subtended by a surface S is equal to the area (A) of the portion of the surface of a sphere of unit radius, center at P, which is cut out by a conical surface, with vertex at P, passing through the perimeter of S.

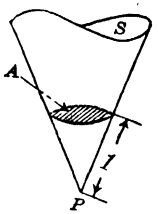


Fig. 7

The unit solid angle (ψ) is called the *steradian.*

The total solid angle about a point is 4π *steradians.*

50. Ellipsoid.

$V = \frac{4}{3}\pi abc$, where a, b, and c are the lengths of the semi-axes.

51. Torus.

$V = 2\pi^2 Rr^2$,

Area of surface $= (S) = 4\pi^2 Rr$.

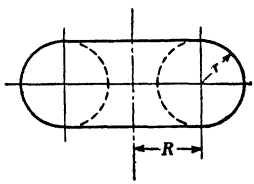


Fig. 8

III. TRIGONOMETRY

52. Angle. If two lines intersect, one line may be rotated about their point of intersection through the *angle* which they form until it coincides with the other line.

The angle is said to be *positive* if the rotation is counterclockwise, and *negative*, if clockwise.

A complete revolution of a line is a rotation through an angle of 360°. Thus,

A *degree* is 1/360 of the plane angle about a point.

A *radian* is the angle subtended at the center of a circle by an arc whose length is equal to that of the radius.

$$180° = \pi \text{ radians}; \quad 1° = \frac{\pi}{180} \text{ radians}; \quad 1 \text{ rad.} = \frac{180}{\pi} \text{ degrees.}$$

53. Trigonometric Functions of an Angle α.

Let α be any angle whose initial side lies on the positive x-axis and whose vertex is at the origin, and (x, y) be any point on the terminal side of the angle. (x is positive if measured along OX to the right, from the y-axis; and negative, if measured along OX' to the left from the y-axis. Likewise, y is positive if measured parallel to OY, and negative if measured parallel to OY'.) Let r be the positive distance from the origin to the point. The trigonometric functions of an angle are defined as follows:

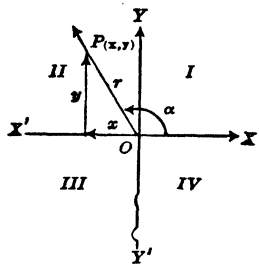


Fig. 9

sine α	=	sin α	=	$\frac{y}{r}$	.
cosine α	=	cos α	=	$\frac{x}{r}$	.
tangent α	=	tan α	=	$\frac{y}{x}$	.
cotangent α	=	ctn α = cot α	=	$\frac{x}{y}$	.
secant α	=	sec α	=	$\frac{r}{x}$	.
cosecant α	=	csc α	=	$\frac{r}{y}$	.
exsecant α	=	exsec α	=	sec α -1	.
versine α	=	vers α	=	$1 - \cos \alpha$	.
coversine α	=	covers α	=	$1 - \sin \alpha$	.
haversine α	=	hav α	=	$\frac{1}{2}$ vers α	.

54. Signs of the Functions.

Quadrant	sin	cos	tan	ctn	sec	csc
I	+	+	+	+	+	+
II	+	−	−	−	−	+
III	−	−	+	+	−	−
IV	−	+	−	−	+	−

55. Functions of 0°, 30°, 45°, 60°, 90°, 180°, 270°, 360°.

	0°	30°	45°	60°	90°	180°	270°	360°
sin	0	$\frac{1}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{\sqrt{3}}{2}$	1	0	−1	0
cos	1	$\frac{\sqrt{3}}{2}$	$\frac{\sqrt{2}}{2}$	$\frac{1}{2}$	0	−1	0	1
tan	0	$\frac{\sqrt{3}}{3}$	1	$\sqrt{3}$	∞	0	∞	0
ctn	∞	$\sqrt{3}$	1	$\frac{\sqrt{3}}{3}$	0	∞	0	∞
sec	1	$\frac{2\sqrt{3}}{3}$	$\sqrt{2}$	2	∞	−1	∞	1
csc	∞	2	$\sqrt{2}$	$\frac{2\sqrt{3}}{3}$	1	∞	−1	∞

56. Variations of the Functions.

Quadrant	sin	cos	tan	ctn	sec	csc
I	$0\to+1$	$+1\to0$	$0\to+\infty$	$+\infty\to0$	$+1\to+\infty$	$+\infty\to+1$
II	$+1\to0$	$0\to-1$	$-\infty\to0$	$0\to-\infty$	$-\infty\to-1$	$+1\to+\infty$
III	$0\to-1$	$-1\to0$	$0\to+\infty$	$+\infty\to0$	$-1\to-\infty$	$-\infty\to-1$
IV	$-1\to0$	$0\to+1$	$-\infty\to0$	$0\to-\infty$	$+\infty\to+1$	$-1\to-\infty$

57. Functions of Angles in any Quadrant in Terms of Angles in First Quadrant.

	$-\alpha$	$90°\pm\alpha$	$180°\pm\alpha$	$270°\pm\alpha$	$n(360)°\pm\alpha$
sin	$-\sin\alpha$	$+\cos\alpha$	$\mp\sin\alpha$	$-\cos\alpha$	$\pm\sin\alpha$
cos	$+\cos\alpha$	$\mp\sin\alpha$	$-\cos\alpha$	$\pm\sin\alpha$	$+\cos\alpha$
tan	$-\tan\alpha$	$\mp\operatorname{ctn}\alpha$	$\pm\tan\alpha$	$\mp\operatorname{ctn}\alpha$	$\pm\tan\alpha$
ctn	$-\operatorname{ctn}\alpha$	$\mp\tan\alpha$	$\pm\operatorname{ctn}\alpha$	$\mp\tan\alpha$	$\pm\operatorname{ctn}\alpha$
sec	$+\sec\alpha$	$\mp\csc\alpha$	$-\sec\alpha$	$\mp\csc\alpha$	$+\sec\alpha$
csc	$-\csc\alpha$	$+\sec\alpha$	$\mp\csc\alpha$	$-\sec\alpha$	$\pm\csc\alpha$

n denotes any integer.

For example: $\tan(270° + \alpha) = -\operatorname{ctn}\alpha$.

58. Fundamental Identities.

$$\sin\alpha = \frac{1}{\csc\alpha};\quad \cos\alpha = \frac{1}{\sec\alpha};\quad \tan\alpha = \frac{1}{\operatorname{ctn}\alpha} = \frac{\sin\alpha}{\cos\alpha}.$$

$$\csc\alpha = \frac{1}{\sin\alpha};\quad \sec\alpha = \frac{1}{\cos\alpha};\quad \operatorname{ctn}\alpha = \frac{1}{\tan\alpha} = \frac{\cos\alpha}{\sin\alpha}.$$

$$\sin^2\alpha + \cos^2\alpha = 1;\quad 1 + \tan^2\alpha = \sec^2\alpha;\quad 1 + \operatorname{ctn}^2\alpha = \csc^2\alpha.$$

$$\sin 2\alpha = 2\sin\alpha\cos\alpha,$$

$$\cos 2\alpha = 2\cos^2\alpha - 1 = 1 - 2\sin^2\alpha = \cos^2\alpha - \sin^2\alpha,$$

$$\tan 2\alpha = \frac{2\tan\alpha}{1 - \tan^2\alpha},$$

$$\sin 3\alpha = 3\sin\alpha - 4\sin^3\alpha,$$

$$\cos 3\alpha = 4\cos^3\alpha - 3\cos\alpha,$$

$$\sin n\alpha = 2\sin(n-1)\alpha\cdot\cos\alpha - \sin(n-2)\alpha,$$

$$\cos n\alpha = 2\cos(n-1)\alpha\cdot\cos\alpha - \cos(n-2)\alpha,$$

$$\sin(\alpha \pm \beta) = \sin\alpha\cos\beta \pm \cos\alpha\sin\beta,$$

$$\cos(\alpha \pm \beta) = \cos\alpha\cos\beta \mp \sin\alpha\sin\beta,$$

$$\tan(\alpha \pm \beta) = \frac{\tan\alpha \pm \tan\beta}{1 \mp \tan\alpha\tan\beta}.$$

$$\sin\alpha + \sin\beta = 2\sin\tfrac{1}{2}(\alpha+\beta)\cdot\cos\tfrac{1}{2}(\alpha-\beta),$$

$$\sin\alpha - \sin\beta = 2\cos\tfrac{1}{2}(\alpha+\beta)\cdot\sin\tfrac{1}{2}(\alpha-\beta),$$

$$\cos\alpha + \cos\beta = 2\cos\tfrac{1}{2}(\alpha+\beta)\cdot\cos\tfrac{1}{2}(\alpha-\beta),$$

$$\cos\alpha - \cos\beta = -2\sin\tfrac{1}{2}(\alpha+\beta)\cdot\sin\tfrac{1}{2}(\alpha-\beta).$$

$$\sin\frac{\alpha}{2} = \pm\sqrt{\frac{1-\cos\alpha}{2}},$$ positive if $\frac{\alpha}{2}$ in I or II quadrants, negative otherwise.

$$\cos\frac{\alpha}{2} = \pm\sqrt{\frac{1+\cos\alpha}{2}},$$ positive if $\frac{\alpha}{2}$ in I or IV, negative otherwise.

$$\tan\frac{\alpha}{2} = \frac{1-\cos\alpha}{\sin\alpha} = \frac{\sin\alpha}{1+\cos\alpha} = \pm\sqrt{\frac{1-\cos\alpha}{1+\cos\alpha}},$$ positive if $\frac{\alpha}{2}$ in I or III, negative otherwise.

$$\sin^2\alpha = \tfrac{1}{2}(1 - \cos 2\alpha);\qquad \cos^2\alpha = \tfrac{1}{2}(1 + \cos 2\alpha).$$

$$\sin^3\alpha = \tfrac{1}{4}(3\sin\alpha - \sin 3\alpha);\quad \cos^3\alpha = \tfrac{1}{4}(\cos 3\alpha + 3\cos\alpha).$$

$$\sin\alpha\sin\beta = \tfrac{1}{2}\cos(\alpha-\beta) - \tfrac{1}{2}\cos(\alpha+\beta),$$

$$\cos\alpha\cos\beta = \tfrac{1}{2}\cos(\alpha-\beta) + \tfrac{1}{2}\cos(\alpha+\beta),$$

$$\sin\alpha\cos\beta = \tfrac{1}{2}\sin(\alpha+\beta) + \tfrac{1}{2}\sin(\alpha-\beta).$$

59. Equivalent Expressions for sin α, cos α, tan α, etc.

Function	Sin α	Cos α	Tan α	Ctn α	Sec α	Csc α
Sin α	Sin α	$\pm\sqrt{1-\cos^2\alpha}$	$\dfrac{\tan\alpha}{\pm\sqrt{1+\tan^2\alpha}}$	$\dfrac{1}{\pm\sqrt{1+\operatorname{ctn}^2\alpha}}$	$\dfrac{\pm\sqrt{\sec^2\alpha-1}}{\sec\alpha}$	$\dfrac{1}{\csc\alpha}$
Cos α	$\pm\sqrt{1-\sin^2\alpha}$	cos α	$\dfrac{1}{\pm\sqrt{1+\tan^2\alpha}}$	$\dfrac{\operatorname{ctn}\alpha}{\pm\sqrt{1+\operatorname{ctn}^2\alpha}}$	$\dfrac{1}{\sec\alpha}$	$\dfrac{\pm\sqrt{\csc^2\alpha-1}}{\csc\alpha}$
Tan α	$\dfrac{\sin\alpha}{\pm\sqrt{1-\sin^2\alpha}}$	$\dfrac{\pm\sqrt{1-\cos^2\alpha}}{\cos\alpha}$	tan α	$\dfrac{1}{\operatorname{ctn}\alpha}$	$\pm\sqrt{\sec^2\alpha-1}$	$\dfrac{1}{\pm\sqrt{\csc^2\alpha-1}}$
Ctn α	$\dfrac{\pm\sqrt{1-\sin^2\alpha}}{\sin\alpha}$	$\dfrac{\cos\alpha}{\pm\sqrt{1-\cos^2\alpha}}$	$\dfrac{1}{\tan\alpha}$	ctn α	$\dfrac{1}{\pm\sqrt{\sec^2\alpha-1}}$	$\pm\sqrt{\csc^2\alpha-1}$
Sec α	$\dfrac{1}{\pm\sqrt{1-\sin^2\alpha}}$	$\dfrac{1}{\cos\alpha}$	$\pm\sqrt{1+\tan^2\alpha}$	$\dfrac{\pm\sqrt{1+\operatorname{ctn}^2\alpha}}{\operatorname{ctn}\alpha}$	sec α	$\dfrac{\csc\alpha}{\pm\sqrt{\csc^2\alpha-1}}$
Csc α	$\dfrac{1}{\sin\alpha}$	$\dfrac{1}{\pm\sqrt{1-\cos^2\alpha}}$	$\dfrac{\pm\sqrt{1+\tan^2\alpha}}{\tan\alpha}$	$\pm\sqrt{1+\operatorname{ctn}^2\alpha}$	$\dfrac{\sec\alpha}{\pm\sqrt{\sec^2\alpha-1}}$	csc α

Note: The quadrant in which α terminates determines the sign to be used. See previous table of signs.

60. Inverse or Anti-trigonometric Functions. The complete solution of the equation $x = \sin y$ is

$$y = (-1)^n \sin^{-1} x + n(180°), \quad -\pi/2 \leqq \sin^{-1} x \leqq \pi/2,$$

where $\sin^{-1} x$ is the principal value of the angle whose sine is x.

Likewise, if $x = \cos y$,

$$y = \pm \cos^{-1} x + n(360°), \quad 0 \leqq \cos^{-1} x \leqq \pi.$$

If $x = \tan y$,

$$y = \tan^{-1} x + n(180°), \quad -\pi/2 \leqq \tan^{-1} x \leqq \pi/2.$$

Similar relations hold for $x = \operatorname{ctn} y$, $x = \sec y$, $x = \csc y$.

61. Certain Relations Among Inverse Functions. If the inverse functions are restricted as in §60, the following formulae hold:

$$\sin^{-1} a = \cos^{-1}\sqrt{1-a^2} = \tan^{-1}\frac{a}{\sqrt{1-a^2}} = \operatorname{ctn}^{-1}\frac{\sqrt{1-a^2}}{a}$$

$$= \sec^{-1}\frac{1}{\sqrt{1-a^2}} = \csc^{-1}\frac{1}{a}.$$

$$\cos^{-1} a = \sin^{-1}\sqrt{1-a^2} = \tan^{-1}\frac{\sqrt{1-a^2}}{a} = \operatorname{ctn}^{-1}\frac{a}{\sqrt{1-a^2}}$$

$$= \sec^{-1}\frac{1}{a} = \csc^{-1}\frac{1}{\sqrt{1-a^2}}.$$

$$\tan^{-1} a = \sin^{-1}\frac{a}{\sqrt{1+a^2}} = \cos^{-1}\frac{1}{\sqrt{1+a^2}} = \operatorname{ctn}^{-1}\frac{1}{a}$$

$$= \sec^{-1}\sqrt{1+a^2} = \csc^{-1}\frac{\sqrt{1+a^2}}{a}.$$

$$\operatorname{ctn}^{-1} a = \tan^{-1}\frac{1}{a}; \quad \sec^{-1} a = \cos^{-1}\frac{1}{a}; \quad \csc^{-1} a = \sin^{-1}\frac{1}{a}.$$

62. Solution of Trigonometric Equations. To solve a trigonometric equation, reduce the given equation, by means of the relations expressed in §58 to §60 inclusive, to an equation containing only a single function of a single angle. Solve the resulting equation by algebraic methods (§30) for the remaining function, and from this find the values of the angle, by §57 and Table V. All these values should then be tested in the original equation, discarding those which do not satisfy it.

63. Relations Between Sides and Angles of Plane Triangles. Let a, b, c, denote the sides and α, β, γ, the corresponding opposite angles with

$2s = a + b + c$; r = radius of inscribed circle;

A = area; R = radius of circumscribed circle;

h_b = altitude on side b.

$\alpha + \beta + \gamma = 180°$.

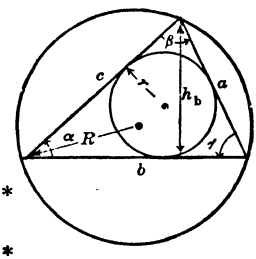


Fig. 10

$$\frac{a}{\sin\alpha} = \frac{b}{\sin\beta} = \frac{c}{\sin\gamma}. \quad \text{(Law of Sines).}$$

$$\frac{a+b}{a-b} = \frac{\tan\frac{1}{2}(\alpha+\beta)}{\tan\frac{1}{2}(\alpha-\beta)}. \quad \text{(Law of Tangents).*}$$

$$a^2 = b^2 + c^2 - 2bc\cos\alpha. \quad \text{(Law of Cosines).*}$$

$$a = b\cos\gamma + c\cos\beta.*$$

$$\cos\alpha = \frac{b^2+c^2-a^2}{2bc},* \quad \sin\alpha = \frac{2}{bc}\sqrt{s(s-a)(s-b)(s-c)}.*$$

$$\sin\frac{\alpha}{2} = \sqrt{\frac{(s-b)(s-c)}{bc}}, \quad *\cos\frac{\alpha}{2} = \sqrt{\frac{s(s-a)}{bc}};*$$

$$\tan\frac{\alpha}{2} = \sqrt{\frac{(s-b)(s-c)}{s(s-a)}} = \frac{r}{s-a},* \text{ where } r = \sqrt{\frac{(s-a)(s-b)(s-c)}{s}}.*$$

$$A = \tfrac{1}{2}bh_b* = \tfrac{1}{2}ab\sin\gamma* = \frac{a^2\sin\beta\sin\gamma}{2\sin\alpha}*$$

$$= \sqrt{s(s-a)(s-b)(s-c)} = rs.$$

$$R = \frac{a}{2\sin\alpha}* = \frac{abc}{4A}. \qquad h_b = c\sin\alpha* = a\sin\gamma* = \frac{2rs}{b}$$

*Two more formulas may be obtained by replacing a by b, b by c, c by a, α by β, β by γ, γ by α.

64. Solution of a Right Triangle. Given one side and any acute angle α, or any two sides, to find the remaining parts.

$$a = \sqrt{(c+b)(c-b)} = c\sin\alpha = b\tan\alpha.$$

$$b = \sqrt{(c+a)(c-a)} = c\cos\alpha = \frac{a}{\tan\alpha}.$$

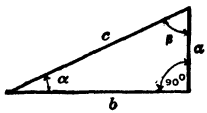


Fig. 11

$$\sin\alpha = \frac{a}{c},\quad \cos\alpha = \frac{b}{c},\quad \tan\alpha = \frac{a}{b},\quad \beta = 90° - \alpha.$$

$$c = \frac{a}{\sin\alpha} = \frac{b}{\cos\alpha} = \sqrt{a^2+b^2}.$$

$$A = \tfrac{1}{2}ab = \frac{a^2}{2\tan\alpha} = \frac{b^2\tan\alpha}{2} = \frac{c^2\sin 2\alpha}{4}.$$

65. Solution of Oblique Triangles (Fig. 12). The formulas of the preceding section §63 will suffice to solve any oblique triangle. Use the trigonometric tables for numerical work. We give one method. Solutions should be checked by some other method.

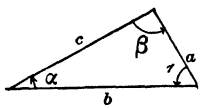


Fig. 12

(*a*) Given any two sides b and c and included angle α.

$$\tfrac{1}{2}(\beta+\gamma) = 90° - \tfrac{1}{2}\alpha;\quad \tan\tfrac{1}{2}(\beta-\gamma) = \frac{b-c}{b+c}\tan\tfrac{1}{2}(\beta+\gamma);$$

$$\beta = \tfrac{1}{2}(\beta+\gamma) + \tfrac{1}{2}(\beta-\gamma);\quad \gamma = \tfrac{1}{2}(\beta+\gamma) - \tfrac{1}{2}(\beta-\gamma);\quad a = \frac{b\sin\alpha}{\sin\beta}.$$

(*b*) Given any two angles α and β, and any side c.

$$\gamma = 180° - (\alpha+\beta);\quad a = \frac{c\sin\alpha}{\sin\gamma};\quad b = \frac{c\sin\beta}{\sin\gamma}.$$

(*c*) Given any two sides a and c, and an angle opposite one of these, say α.

$$\sin\gamma = \frac{c\sin\alpha}{a},\quad \beta = 180° - (\alpha+\gamma),\quad b = \frac{a\sin\beta}{\sin\alpha}.$$

This case may have two sets of solutions, for γ may have two values, $\gamma_1 < 90°$ and $\gamma_2 = 180° - \gamma_1 > 90°$. If $\alpha + \gamma_2 > 180°$, use only γ_1.

(*d*) Given the three sides a, b, and c.

$$s = \tfrac{1}{2}(a+b+c),\quad r = \sqrt{\frac{(s-a)(s-b)(s-c)}{s}}.$$

$$\tan\tfrac{1}{2}\alpha = \frac{r}{s-a},\quad \tan\tfrac{1}{2}\beta = \frac{r}{s-b},\quad \tan\tfrac{1}{2}\gamma = \frac{r}{s-c}$$

Spherical Trigonometry

66. The Right Spherical Triangle. Let O be the center of sphere and a, b, c the sides of a right triangle with opposite angles $\alpha, \beta,$ and $\gamma = 90°$, respectively, the sides being measured by the angle subtended at the center of the sphere.

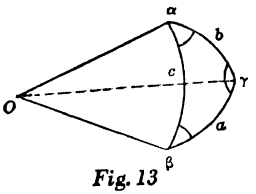


Fig. 13

$$\sin a = \sin \alpha \cdot \sin c, \qquad \sin b = \sin \beta \cdot \sin c.$$
$$\sin a = \tan b \cdot \operatorname{ctn} \beta, \qquad \sin b = \tan a \cdot \operatorname{ctn} \alpha.$$
$$\cos \alpha = \cos a \cdot \sin \beta, \qquad \cos \beta = \cos b \cdot \sin \alpha.$$
$$\cos \alpha = \tan b \cdot \operatorname{ctn} c, \qquad \cos \beta = \tan a \cdot \operatorname{ctn} c.$$
$$\cos c = \operatorname{ctn} \alpha \cdot \operatorname{ctn} \beta, \qquad \cos c = \cos a \cdot \cos b.$$

67. Napier's Rules of Circular Parts (See Fig. 14). Let the five quantities a, b, co–α (complement of α), co–c, co–β, be arranged in order as indicated in the figure. If we denote any one of these quantities a *middle* part, then two of the other parts are *adjacent* to it, and the other two parts are *opposite* to it. The above formulas may be remembered by means of the following rules:

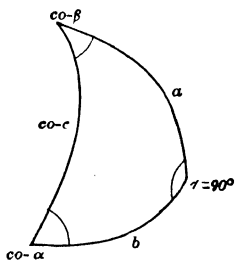


Fig. 14

(*a*) *The sine of a middle part is equal to the product of the tangents of the adjacent parts.*

(*b*) *The sine of a middle part is equal to the product of the cosines of the opposite parts.*

68. The Oblique Spherical Triangle. Let a, b, c denote the sides and α, β, γ the corresponding opposite angles of the spherical triangle, Δ its area, E its spherical excess, R the radius of the sphere upon which the triangle lies, and α', β', γ', a, b, c the corresponding parts of the polar triangle.

$$0° < a + b + c < 360°, \qquad 180° < \alpha + \beta + \gamma < 540°.$$
$$\alpha = 180° - a', \qquad \beta = 180° - b', \qquad \gamma = 180° - c',$$
$$a = 180° - \alpha', \qquad b = 180° - \beta', \qquad c = 180° - \gamma'.$$

$$\frac{\sin\alpha}{\sin a} = \frac{\sin\beta}{\sin b} = \frac{\sin\gamma}{\sin c}. \quad \text{(Law of Sines).}$$

$$\cos a = \cos b \cdot \cos c + \sin b \cdot \sin c \cdot \cos\alpha.$$
$$\cos\alpha = -\cos\beta \cdot \cos\gamma + \sin\beta \cdot \sin\gamma \cdot \cos a. \quad \text{(Law of Cosines)}$$

$$\tan\frac{\alpha}{2} = \sqrt{\frac{\sin(s-b)\cdot\sin(s-c)}{\sin s\cdot\sin(s-a)}}, \text{ where } s = \tfrac{1}{2}(a+b+c).$$

$$\tan\frac{a}{2} = \sqrt{\frac{-\cos\sigma\cdot\cos(\sigma-\alpha)}{\cos(\sigma-\beta)\cdot\cos(\sigma-\gamma)}}, \text{ where } \sigma = \tfrac{1}{2}(\alpha+\beta+\gamma).$$

$$\frac{\sin\frac{1}{2}(\alpha+\beta)}{\sin\frac{1}{2}(\alpha-\beta)} = \frac{\tan\frac{1}{2}c}{\tan\frac{1}{2}(a-b)}, \quad \frac{\cos\frac{1}{2}(\alpha+\beta)}{\cos\frac{1}{2}(\alpha-\beta)}, = \frac{\tan\frac{1}{2}c}{\tan\frac{1}{2}(a+b)}.$$

$$\frac{\sin\frac{1}{2}(a+b)}{\sin\frac{1}{2}(a-b)} = \frac{\operatorname{ctn}\frac{1}{2}\gamma}{\tan\frac{1}{2}(\alpha-\beta)}, \quad \frac{\cos\frac{1}{2}(a+b)}{\cos\frac{1}{2}(a-b)}, = \frac{\operatorname{ctn}\frac{1}{2}\gamma}{\tan\frac{1}{2}(\alpha+\beta)}.$$

$$\tan\frac{E}{4} = \sqrt{\tan\tfrac{1}{2}s\cdot\tan\tfrac{1}{2}(s-a)\cdot\tan\tfrac{1}{2}(s-b)\cdot\tan\tfrac{1}{2}(s-c)}$$

$$\Delta = \frac{\pi R^2 \cdot E}{180} \qquad \alpha+\beta+\gamma - 180° = E.$$

*Hyperbolic Functions**

69. Definitions (For definition of e see §108).

Hyperbolic sine of x $= \sinh x = \frac{1}{2}(e^x - e^{-x})$;

Hyperbolic cosine of x $= \cosh x = \frac{1}{2}(e^x + e^{-x})$;

Hyperbolic tangent of $x = \tanh x = \dfrac{e^x - e^{-x}}{e^x + e^{-x}}$;

$$\operatorname{csch} x = \frac{1}{\sinh x}; \qquad \operatorname{sech} x = \frac{1}{\cosh x}; \qquad \operatorname{ctnh} x = \frac{1}{\tanh x}.$$

*For derivatives and integrals of Hyperbolic functions see §108 and §121.

70. Inverse or Anti-Hyperbolic Functions (See §60).

If $x = \sinh y$, then y is the *inverse hyperbolic sine* of x, written $y = \sinh^{-1} x$ or arc sinh x.

$$\sinh^{-1} x = \log_e(x + \sqrt{x^2 + 1}), \quad \cosh^{-1} x = \log_e(x + \sqrt{x^2 - 1}),$$

$$\tanh^{-1} x = \tfrac{1}{2} \log_e \left(\frac{1 + x}{1 - x}\right), \quad \operatorname{ctnh}^{-1} x = \tfrac{1}{2} \log_e \left(\frac{x + 1}{x - 1}\right),$$

$$\operatorname{sech}^{-1} x = \log_e \left(\frac{1 + \sqrt{1 - x^2}}{x}\right), \quad \operatorname{csch}^{-1} x = \log_e \left(\frac{1 + \sqrt{1 + x^2}}{x}\right).$$

71. Certain Relations among Hyperbolic Functions.

$$\sinh(-x) = -\sinh x, \qquad \cosh^2 x - \sinh^2 x = 1,$$
$$\cosh(-x) = \cosh x, \qquad \operatorname{sech}^2 x + \tanh^2 x = 1,$$
$$\tanh(-x) = -\tanh x, \qquad \operatorname{csch}^2 x - \operatorname{ctnh}^2 x = -1.$$

$$\tanh(x) = \frac{\sinh x}{\cosh x}$$

$$\sinh(x \pm y) = \sinh x \cosh y \pm \cosh x \sinh y.$$
$$\cosh(x \pm y) = \cosh x \cosh y \pm \sinh x \sinh y.$$
$$\sinh 2x = 2 \sinh x \cdot \cosh x, \qquad \cosh 2x = \cosh^2 x + \sinh^2 x.$$

$$2 \sinh^2 \frac{x}{2} = \cosh x - 1, \qquad 2 \cosh^2 \frac{x}{2} = \cosh x + 1.$$

72. Hyperbolic Functions of Complex Quantities, Connection with Circular Functions.

$$\sin x = -\tfrac{1}{2} i (e^{ix} - e^{-ix}) = -i \sinh ix, \quad i^2 = -1.$$
$$\cos x = \tfrac{1}{2} (e^{ix} + e^{-ix}) = \cosh ix.$$
$$\sinh iy = i \sin y, \quad \cosh iy = \cos y, \quad \tanh iy = i \tan y.$$
$$\sinh(x \pm iy) = \sinh x \cdot \cos y \pm i \cosh x \sin y.$$
$$\cosh(x \pm iy) = \cosh x \cdot \cos y \pm i \sinh x \cdot \sin y.$$
$$\sinh(x + 2i\pi) = \sinh x, \qquad \cosh(x + 2i\pi) = \cosh x.$$
$$\sinh(x + i\pi) = -\sinh x, \qquad \cosh(x + i\pi) = -\cosh x.$$
$$\sinh(x + \tfrac{1}{2} i\pi) = i \cosh x, \qquad \cosh(x + \tfrac{1}{2} i\pi) = i \sinh x.$$

$$\log_e(x \pm iy) = \tfrac{1}{2} \log_e(x^2 + y^2) \pm i \arctan \frac{y}{x}.$$

IV. ANALYTIC GEOMETRY

73. Rectangular Coördinates. Let $X'X$ (x–axis) and $Y'Y$ (y–axis) be two perpendicular lines meeting in the point O called the origin. The point P (x, y) in the plane of the x and y axes is fixed by the distances x (abscissa) and y (ordinate) from $Y'Y$ and $X'X$, respectively, to P. x is positive to the right and negative to the left of the y–axis, and y is positive above and negative below the x–axis.

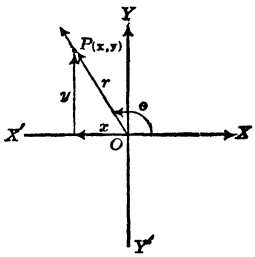


Fig. 15

74. Polar Coördinates. Let OX (initial line) be a fixed line in the plane and O (pole or origin) a point on this line. The position of any point P (r, θ) in the plane is determined by the distance r (radius vector) from O to the point together with the angle (vectorial angle) measured from OX to OP. θ is positive if measured counter-clockwise, negative if measured clockwise, r is positive if measured along the terminal side of θ and negative if measured along the terminal side of θ produced through the pole.

75. Relations between Rectangular and Polar Coördinates (See §113).

$$\begin{cases} x = r\cos\theta, \\ y = r\sin\theta, \end{cases} \qquad \begin{cases} r = \sqrt{x^2 + y^2}, \\ \theta = \tan^{-1}\dfrac{y}{x}, \end{cases} \qquad \begin{cases} \sin\theta = \dfrac{y}{\sqrt{x^2 + y^2}}, \\ \cos\theta = \dfrac{x}{\sqrt{x^2 + y^2}}, \end{cases}$$

76. Points and Slopes.

Let $P_1(x_1, y_1)$ and $P_2(x_2, y_2)$ be any two points, and α_1 be the angle measured counter-clockwise from OX to P_1P_2:

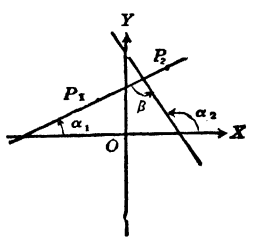


Fig. 16

Distance between P_1 and $P_2 = P_1P_2$

$$= d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.$$

Slope of $P_1P_2 = \tan\alpha_1 = m = \dfrac{y_2 - y_1}{x_2 - x_1}.$

Point dividing P_1P_2 in the ratio $m_1 : m_2$ is $\left(\frac{m_1x_2+m_2x_1}{m_1+m_2}, \frac{m_1y_2+m_2y_1}{m_1+m_2}\right)$.

Mid-point of P_1P_2 is $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$.

The angle β between lines of slopes m_1 and m_2, respectively, is given by $$\tan\beta = \frac{m_2 - m_1}{1 + m_1m_2}.$$

Two lines of slopes m_1 and m_2 are perpendicular if $m_2 = -\frac{1}{m_1}$, and parallel if $m_1 = m_2$.

77. Area of Triangle. If the vertices are the points (x_1, y_1), (x_2, y_2), (x_3, y_3), then the area is equal to the numerical value of

$$\frac{1}{2}\begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix} = \tfrac{1}{2}(x_1y_2 - x_1y_3 + x_2y_3 - x_2y_1 + x_3y_1 - x_3y_2).$$

78. Locus and Equation. The set of all points which satisfy a given condition is called the *locus* of that condition. An *equation* is called the equation of the locus if it is satisfied by the coördinates of every point on the locus and by no other points. There are three common representations of the locus by means of equations:

(*a*) *Rectangular equation* which involves the rectangular coördinates (x, y).

(*b*) *Polar equation* which involves the polar coördinates (r, θ).

(*c*) *Parametric equations* which expresses x and y or r and θ in terms of a third independent variable called a parameter.

79. Transformation of Coördinates. To transform an equation or a curve from one system of coördinates in x, y, to another such system in x', y', substitute for each variable its value in terms of variables of the new system.

(*a*) *Rectangular System. Old axes parallel to new axes.*

The coördinates of new origin in terms of old system are (h, k).

$$\begin{cases} x = x' + h, \\ y = y' + k. \end{cases}$$

(*b*) *Rectangular System. Old origin coincident with new origin and the x'-axis making an angle θ with the x-axis.*

$$\begin{cases} x = x' \cdot \cos\theta - y' \cdot \sin\theta, \\ y = x' \cdot \sin\theta + y' \cdot \cos\theta. \end{cases}$$

(*c*) *Rectangular System. Old axes not parallel with new. New origin at (h, k) in old system.*

$$\begin{cases} x = x' \cdot \cos\theta - y' \cdot \sin\theta + h, \\ y = x' \cdot \sin\theta + y' \cdot \cos\theta + k. \end{cases}$$

80. Straight Line. The equations of the straight line may assume the following forms:

(*a*) $y = mx + b$. (m = slope, b = intercept on y-axis.)

(*b*) $y - y_1 = m(x - x_1)$. [m = slope, line passes through point (x_1, y_1).]

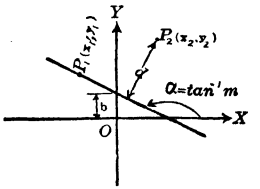


Fig. 17

(*c*) $\dfrac{y - y_1}{x - x_1} = \dfrac{y_2 - y_1}{x_2 - x_1}$. [line passes thru points (x_1, y_1) and (x_2, y_2).]

(*d*) $\dfrac{x}{a} + \dfrac{y}{b} = 1$. (a and b are the intercepts on x and y-axes, respectively.)

(*e*) $x\cos\alpha + y\sin\alpha = p$. (normal form. p is distance from origin to the line, α is angle which normal to the line makes with x-axis.)

(*f*) $Ax + By + C = 0$. (general form. slope $= -A \div B$).

To reduce $Ax + By + C = 0$ to normal form (*e*), divide by $\pm\sqrt{A^2 + B^2}$, where the sign of the radical is taken opposite to that of C when $C \neq 0$.

The distance from the line $Ax + By + C = 0$ to the point $P_2(x_2, y_2)$ is:

$$d = \frac{Ax_2 + By_2 + C}{\pm\sqrt{A^2 + B^2}}.$$

81. Circle (See §37). General equation of circle with radius R and center at (h, k) is:

$$(x - h)^2 + (y - k)^2 = R^2.$$

82. Conic. The locus of a point (P) which moves so that its distance from a fixed point (focus) bears a constant ratio e (eccentricity) to its distance from a fixed straight line (directrix) is a conic.

If d is the distance from focus to directrix,

$x^2 + y^2 = e^2 (d + x)^2$.

$r = \dfrac{de}{1 - e \cos \theta}$.

If $e = 1$, the conic is a *parabola*; if $e > 1$, a *hyperbola*; and if $e < 1$, an *ellipse*.

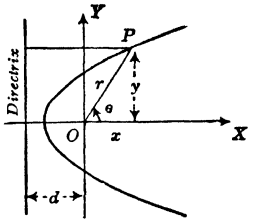


Fig. 18

83. Parabola (See §39). $e = 1$.

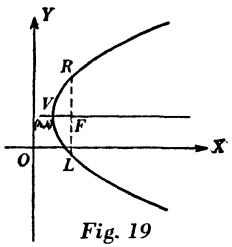


Fig. 19

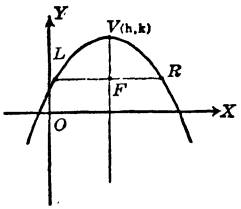


Fig. 20

(*a*) $(y - k)^2 = 4a(x - h)$. Vertex at (h, k), axis $\| OX$. (*Fig.* 19.)

(*b*) $(x - h)^2 = 4a(y - k)$. Vertex at (h, k), axis $\| OY$. (*Fig.* 20.)

Distance from vertex to focus $= VF = a$.

Latus rectum $= LR = 4a$.

84. Ellipse (See §38). $e < 1$.

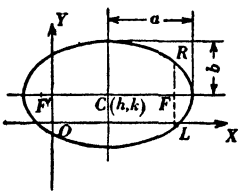


Fig. 21

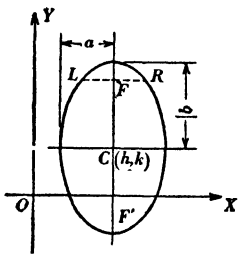


Fig. 22

$\dfrac{(x - h)^2}{a^2} + \dfrac{(y - k)^2}{b^2} = 1$. Center at (h, k), axes $\| OX, OY$.

	$a>b$, (*Fig.* 21)	$a<b$, (*Fig.* 22)
Major axis	$2a$	$2b$
Minor axis	$2b$	$2a$
Distance from center to either focus	$\sqrt{a^2-b^2}$	$\sqrt{b^2-a^2}$
Eccentricity, e	$\frac{\sqrt{a^2-b^2}}{a}$	$\frac{\sqrt{b^2-a^2}}{b}$
Latus rectum	$\frac{2b^2}{a}$	$\frac{2a^2}{b}$
Sum of distances from any point P on ellipse to the foci, $PF'+PF$	$2a$	$2b$

85. Hyperbola. $e > 1$.

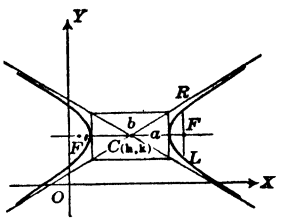


Fig. 23

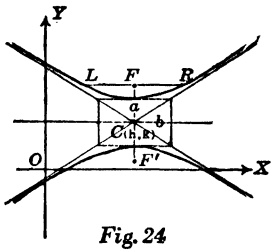


Fig. 24

(*a*) $\frac{(x-h)^2}{a^2} - \frac{(y-k)^2}{b^2} = 1$. Center at (h,k), transverse axis $\| OX$.
Slopes of asymptotes $= \pm b/a$. (Fig. 23.)

(*b*) $\frac{(y-k)^2}{a^2} - \frac{(x-h)^2}{b^2} = 1$. Center at (h,k), transverse axis $\| OY$.
Slopes of asymptotes $= \pm a/b$. (Fig. 24.)

Transverse axis $= 2a$. Conjugate axis $= 2b$.
Distance from center to either focus $= \sqrt{a^2+b^2}$.
Difference of distances of any point on hyperbola from the foci $= 2a$.

Eccentricity $= e = \frac{\sqrt{a^2+b^2}}{a}$.

Latus Rectum $= 2b^2/a$.

86. Sine Wave.

$y = a \sin(bx + c)$.

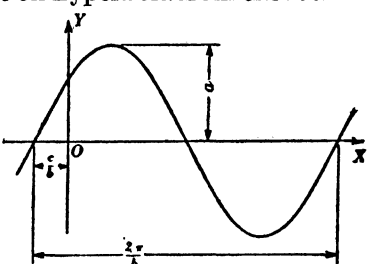


Fig. 25

$y = a \cos (bx + c') = a \sin (bx + c)$, where $c = c' + \frac{\pi}{2}$.

$y = p \sin bx + q \cos bx = a \sin (bx + c)$,

where $c = \tan^{-1}\left(\frac{q}{p}\right)$, $a = \sqrt{p^2 + q^2}$.

a = amplitude = maximum height of wave.

$\frac{2\pi}{b}$ = wave length = distance from any point on wave to the corresponding point on the next wave.

$x = -\frac{c}{b}$ = phase, indicates a point on x-axis from which the positive half of the wave starts.

87. Trigonometric Curves.

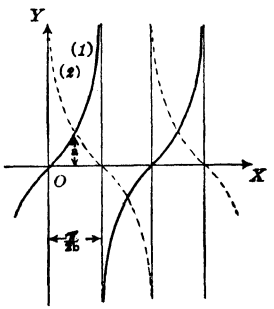


Fig. 26

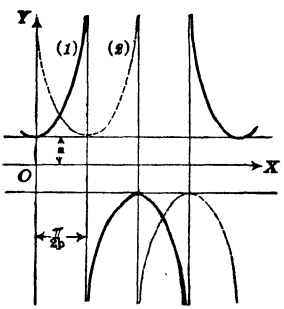


Fig. 27

(1) $y = a \tan bx$ or $x = \frac{1}{b} \tan^{-1}\left(\frac{y}{a}\right)$. (1) $y = a \sec bx$ or $x = \frac{1}{b} \sec^{-1}\left(\frac{y}{a}\right)$.

(2) $y = a \operatorname{ctn} bx$ or $x = \frac{1}{b} \operatorname{ctn}^{-1}\left(\frac{y}{a}\right)$. (2) $y = a \csc bx$ or $x = \frac{1}{b} \csc^{-1}\left(\frac{y}{a}\right)$.

88. Logarithmic and Exponential Curves.

Logarithmic Curve

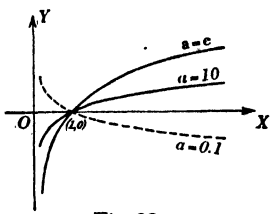


Fig. 28

$y = \log_a x$ or $x = a^y$.

Exponential Curve

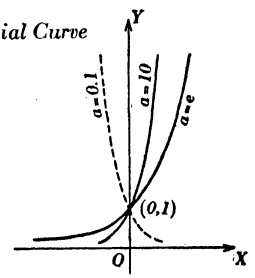


Fig. 29

$y = a^x$ or $x = \log_a y$.

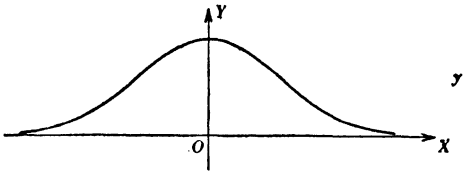


Fig. 30

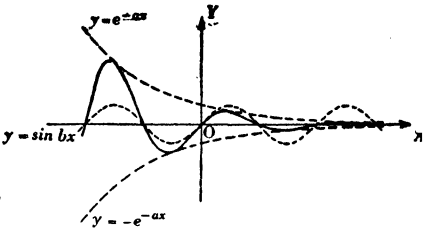


Fig. 31

89. Probability Curve (Fig. 30). $y = e^{-x^2}$

90. Oscillatory Wave of Decreasing Amplitude (Fig. 31).

$$y = e^{-ax} \sin bx.$$

91. Catenary (Fig. 32).

$$y = \frac{a}{2}\left(e^{\frac{x}{a}} + e^{-\frac{x}{a}}\right).$$

A curve made by a cord of uniform weight suspended freely between two points. (See §69.)

Length of arc $= s = l\left[1 + \frac{2}{3}\left(\frac{2d}{l}\right)^2\right]$

approximately, if d is small in comparison with l.

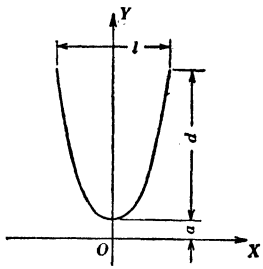


Fig. 32

92. Cycloid (Fig. 33). $\begin{cases} x = a(\phi - \sin\phi). \\ y = a(1 - \cos\phi). \end{cases}$

A curve described by a point on the circumference of circle which rolls along a fixed straight line.

Area one arch $= 3\pi a^2$.

Length of arc of one arch $= 8a$.

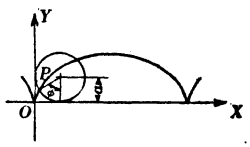


Fig. 33

93. Prolate and Curtate Cycloid. $\begin{cases} x = a\phi - b\sin\phi, \\ y = a - b\cos\phi. \end{cases}$

A curve described by a point on a circle at a distance b from the center of the circle of radius a which rolls along a fixed straight line.

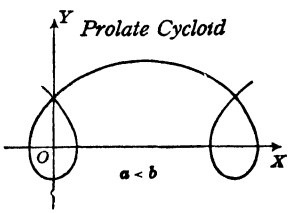


Fig. 34

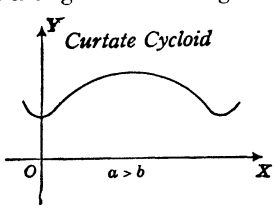


Fig. 35

94. Epicycloid (Fig. 36).

$$\begin{cases} x = (a+b)\cos\phi - a\cos\left(\dfrac{a+b}{a}\phi\right), \\ y = (a+b)\sin\phi - a\sin\left(\dfrac{a+b}{a}\phi\right). \end{cases}$$

A curve described by a point on the circumference of a circle which rolls along the outside of a fixed circle.

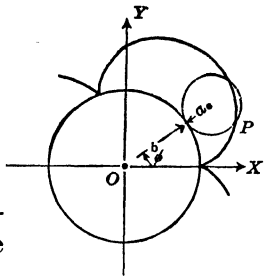


Fig. 36

95. Cardioid (Fig. 37).

$$r = a(1 + \cos\theta).$$

An epicycloid in which both circles have same radii is called a cardioid.

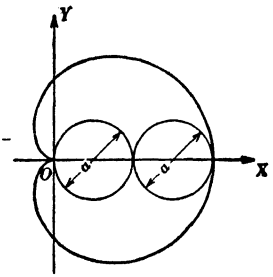


Fig. 37

96. Hypocycloid.

$$\begin{cases} x = (a-b)\cos\phi + b\cos\left(\dfrac{a-b}{b}\phi\right), \\ y = (a-b)\sin\phi - b\sin\left(\dfrac{a-b}{b}\phi\right). \end{cases}$$

A curve described by a point on the circumference of a circle which rolls along the inside of a fixed circle.

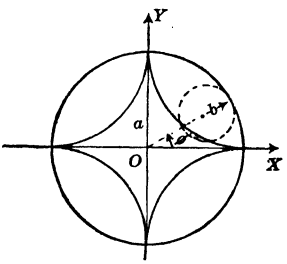


Fig. 38

97. Hypocycloid of four cusps (Fig. 38).

$x^{\frac{2}{3}} + y^{\frac{2}{3}} = a^{\frac{2}{3}}$.

$x = a\cos^3\phi$, $y = a\sin^3\phi$.

The radius of fixed circle is four times the radius of rolling circle.

98. Involute of the Circle (Fig. 39).

$$\begin{cases} x = a\cos\phi + a\phi\sin\phi, \\ y = a\sin\phi - a\phi\cos\phi. \end{cases}$$

A curve generated by the end of a string which is kept taut while being unwound from a circle.

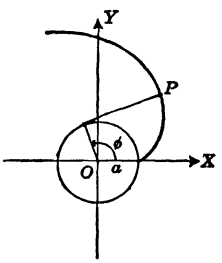


Fig. 39

99. Lemniscate (Fig. 40).

$r^2 = 2\,a^2 \cos 2\,\theta.$

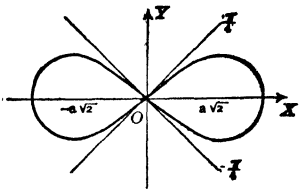


Fig. 40

100. N-Leaved Rose (Fig. 41).

(1) $r = a \sin n\theta$

(2) $r = a \cos n\theta.$

If n is an odd integer there are n leaves, and if n is even, $2n$ leaves, of which the figure shows one.

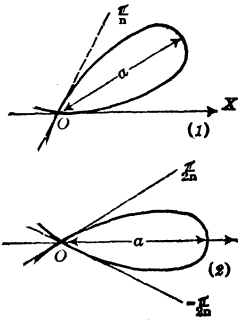


Fig. 41

101. Spirals.

Archimedian

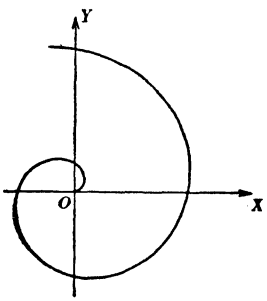


Fig. 42

$r = a\theta.$

Hyperbolic

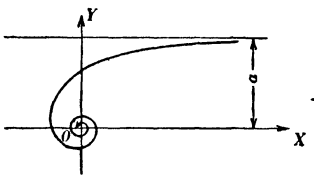


Fig. 43

$r\,\theta = a.$

Logarithmic

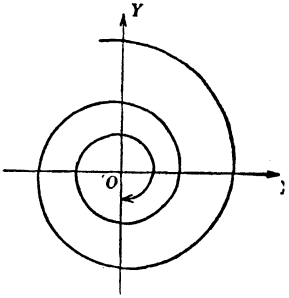


Fig. 44

$r = e^{a\theta}$ or $a\theta = \log_e r.$

Solid Analytic Geometry

102. Coördinates (Fig. 45).

(*a*) *Rectangular system.* The position of a point P (x, y, z) in space is fixed by its three distances x, y, and z from three coördinate planes XOY, XOZ, ZOY, which are mutually perpendicular and meet in a point O (origin).

(*b*) *Cylindrical system.* The position of any point P (r, θ, z) is fixed by (r, θ), the polar coördinates of the projection of P in the XOY plane, and by z, its distance from the XOY plane.

(c) *Spherical (or polar or geographical) system.* The position of any point $P(\rho, \theta, \phi)$ is fixed by the distance $\rho = \overline{OP}$, the angle $\theta = \angle XOM$, and the angle $\phi = \angle ZOP$. θ is called the *longitude* and ϕ the *co-latitude.*

The following relations exist between the three coördinates systems:

$$\begin{cases} x = \rho \sin\phi \cos\theta, \\ y = \rho \sin\phi \sin\theta, \\ z = \rho \cos\phi. \end{cases} \qquad \begin{cases} r = \rho \sin\phi, \\ z = \rho \cos\phi. \end{cases} \qquad \begin{cases} \rho = \sqrt{r^2 + z^2}, \\ \cos\phi = \dfrac{z}{\sqrt{r^2 + z^2}}. \end{cases}$$

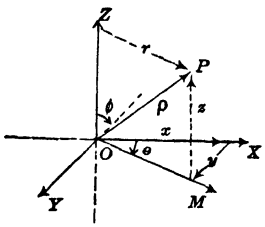


Fig. 45

103. Points, Lines, and Planes. Distance between two points $P_1(x_1, y_1, z_1)$ and $P_2(x_2, y_2, z_2)$, is

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}.$$

Direction cosines of a line are the cosines of the angles α, β, γ which the line or any parallel line makes with the coördinate axes.

The direction cosines of the line segment $P_1(x_1, y_1, z_1)$ to $P_2(x_2, y_2, z_2)$ are:

$$\cos\alpha = \frac{x_2 - x_1}{d}, \quad \cos\beta = \frac{y_2 - y_1}{d}, \quad \cos\gamma = \frac{z_2 - z_1}{d}.$$

If $\cos\alpha : \cos\beta : \cos\gamma = a : b : c$, then

$$\cos\alpha = \frac{a}{\sqrt{a^2 + b^2 + c^2}}, \cos\beta = \frac{b}{\sqrt{a^2 + b^2 + c^2}}, \cos\gamma = \frac{c}{\sqrt{a^2 + b^2 + c^2}}.$$

$$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1.$$

Angle θ between two lines, whose direction angles are α_1, β_1, γ_1, and α_2, β_2, γ_2, is given by

$$\cos\theta = \cos\alpha_1 \cos\alpha_2 + \cos\beta_1 \cos\beta_2 + \cos\gamma_1 \cos\gamma_2.$$

Equation of a plane is

$$Ax + By + Cz + D = 0,$$

where A, B, C are proportional to the direction cosines of a normal (a line perpendicular to the plane) to the plane.

Angle between two planes is the angle between their normals.

Equation of a straight line through the point P_1 (x_1, y_1, z_1) is

$$\frac{x - x_1}{a} = \frac{y - y_1}{b} = \frac{z - z_1}{c},$$

where a, b, c are proportional to direction cosines of line.

104. Figures in Three Dimensions.

*Plane**

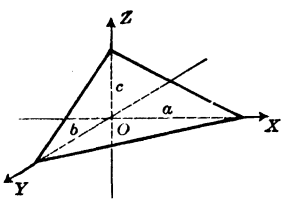


Fig. 46

$$\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1.$$

*Elliptic Cylinder**

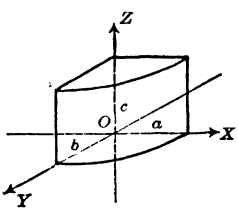


Fig. 47

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1.$$

*Sphere**

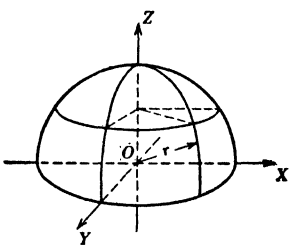


Fig. 48

$$x^2 + y^2 + z^2 = r^2.$$

Ellipsoid

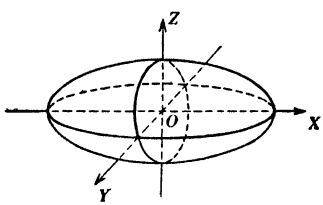


Fig. 49

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1.$$

*Only a portion of the figure is shown.

Elliptic Paraboloid

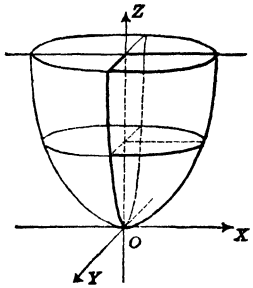


Fig. 50

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = cz.$$

Portion of Cone

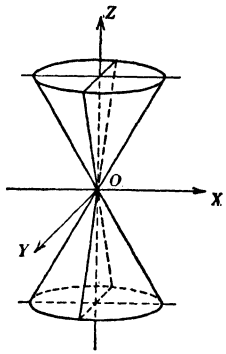


Fig. 51

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = 0.$$

Hyperboloid of One Sheet

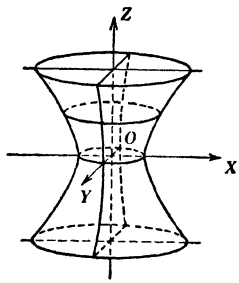


Fig. 52

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{z^2}{c^2} = 1.$$

Hyperboloid of Two Sheets

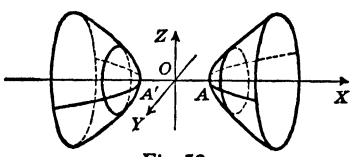


Fig. 53

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} - \frac{z^2}{c^2} = 1.$$

Hyperbolic Paraboloid

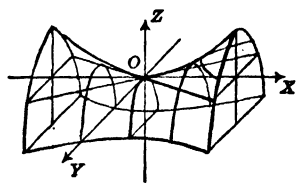


Fig. 54

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = cz.$$

V. DIFFERENTIAL CALCULUS

105. Definition of Function. A variable y is said to be a *function* of the variable x, if, for every x, (taken at will on its range), y is determined. The symbols $f(x)$, $F(x)$, $g(x)$, $\phi(x)$, etc., are used to represent various functions of x. The symbol $f(a)$ represents the value of $f(x)$ when $x = a$.

106. Definition of Derivative and Notation. Let $y = f(x)$ be a single-valued (continuous) function of x. Let Δx be any increment (increase or decrease) given to x, and let Δy be the corresponding increment in y. The *derivative* of y with respect to x is the limit, (if it exists), of the ratio of Δy to Δx as Δx approaches zero in any manner whatsoever; that is,

$$\frac{dy}{dx} = \lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} = \lim_{\Delta x \to 0} \frac{f(x+\Delta x) - f(x)}{\Delta x} = f'(x) = D_x y = y'.$$

Higher derivatives are defined as follows:

$$\frac{d^2y}{dx^2} = \frac{d}{dx}\left(\frac{dy}{dx}\right) = \frac{d}{dx} f'(x) = f''(x). \qquad \text{(2nd derivative.)}$$

$$\frac{d^3y}{dx^3} = \frac{d}{dx}\left(\frac{d^2y}{dx^2}\right) = \frac{d}{dx} f''(x) = f'''(x). \qquad \text{(3rd derivative.)}$$

$$\frac{d^ny}{dx^n} = \frac{d}{dx}\left(\frac{d^{n-1}y}{dx^{n-1}}\right) = \frac{d}{dx} f^{(n-1)}(x) = f^{(n)}(x). \qquad \text{(}n\text{th derivative.)}$$

The symbol $f^{(n)}(a)$ represents the value of $f^{(n)}(x)$ when $x = a$.

107. Certain Relations among Derivatives.

If $x = f(y)$, then $\dfrac{dy}{dx} = 1 \div \dfrac{dx}{dy}$.

If $y = f(u)$, and $u = F(x)$, then $\dfrac{dy}{dx} = \dfrac{dy}{du} \cdot \dfrac{du}{dx}$.

If $x = f(\alpha)$, $y = \phi(\alpha)$, then

$$\frac{dy}{dx} = \frac{\phi'(\alpha)}{f'(\alpha)}, \quad \frac{d^2y}{dx^2} = \frac{f'(\alpha)\cdot\phi''(\alpha) - \phi'(\alpha)\cdot f''(\alpha)}{[f'(\alpha)]^3}.$$

108. Table of Derivatives. In this table, u and v represent functions of x; a, n, e represent constants ($e = 2.7183\cdots$), and all angles are measured in radians.

$$\frac{d}{dx}(x) = 1. \qquad \frac{d}{dx}(a) = 0.$$

$$\frac{d}{dx}(u \pm v \pm \cdots) = \frac{du}{dx} \pm \frac{dv}{dx} \pm \cdots.$$

$$\frac{d}{dx}(au) = a\frac{du}{dx}. \qquad \frac{d}{dx}(uv) = u\frac{dv}{dx} + v\frac{du}{dx}.$$

$$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}. \qquad \frac{d}{dx}\sin u = \cos u\frac{du}{dx}.$$

$$\frac{d}{dx}(u^n) = nu^{n-1}\frac{du}{dx}. \qquad \frac{d}{dx}\cos u = -\sin u\frac{du}{dx}.$$

$$\frac{d}{dx}\log_a u = \frac{\log_a e}{u}\frac{du}{dx}. \qquad \frac{d}{dx}\tan u = \sec^2 u\frac{du}{dx}.$$

$$\frac{d}{dx}\log_e u = \frac{1}{u}\frac{du}{dx}. \qquad \frac{d}{dx}\operatorname{ctn} u = -\csc^2 u\frac{du}{dx}.$$

$$\frac{d}{dx}a^u = a^u \cdot \log_e a \cdot \frac{du}{dx}. \qquad \frac{d}{dx}\sec u = \sec u\tan u\frac{du}{dx}.$$

$$\frac{d}{dx}e^u = e^u\frac{du}{dx}. \qquad \frac{d}{dx}\csc u = -\csc u\operatorname{ctn} u\frac{du}{dx}.$$

$$\frac{d}{dx}u^v = vu^{v-1}\frac{du}{dx} + u^v\log_e u\frac{dv}{dx}. \qquad \frac{d}{dx}\operatorname{vers} u = \sin u\frac{du}{dx}$$

$$\lim_{x\to 0}\frac{\sin x}{x} = 1, \lim_{x\to 0}(1+x)^{1/x} = e = 2.71828\cdots = 1+1+\frac{1}{2!}+\frac{1}{3!}+\cdots.$$

$$\frac{d}{dx}\sin^{-1} u = \frac{1}{\sqrt{1-u^2}}\frac{du}{dx}, \qquad \frac{-\pi}{2} \leqq \sin^{-1} u \leqq \frac{\pi}{2}.$$

$$\frac{d}{dx}\cos^{-1} u = -\frac{1}{\sqrt{1-u^2}}\frac{du}{dx}, \qquad 0 \leqq \cos^{-1} u \leqq \pi.$$

$$\frac{d}{dx}\tan^{-1} u = \frac{1}{1+u^2}\frac{du}{dx}. \qquad \frac{d}{dx}\operatorname{ctn}^{-1} u = -\frac{1}{1+u^2}\frac{du}{dx}.$$

$$\frac{d}{dx}\sec^{-1} u = \frac{1}{u\sqrt{u^2-1}}\frac{du}{dx}, \quad -\pi \leqq \sec^{-1} u < -\frac{\pi}{2}, \quad 0 \leqq \sec^{-1} u < \frac{\pi}{2}.$$

$$\frac{d}{dx}\csc^{-1} u = -\frac{1}{u\sqrt{u^2-1}}\frac{du}{dx}, \quad -\pi < \csc^{-1} u \leqq -\frac{\pi}{2}, \; 0 < \csc^{-1} u \leqq \frac{\pi}{2}.$$

$$\frac{d}{dx}\operatorname{vers}^{-1} u = \frac{1}{\sqrt{2u-u^2}}\frac{du}{dx}, \qquad 0 \leqq \operatorname{vers}^{-1} u \leqq \pi.$$

$$\frac{d}{dx}\sinh u = \cosh u \frac{du}{dx}. \qquad \frac{d}{dx}\cosh u = \sinh u \frac{du}{dx}.$$

$$\frac{d}{dx}\tanh u = \operatorname{sech}^2 u \frac{du}{dx}. \qquad \frac{d}{dx}\operatorname{ctnh} u = -\operatorname{csch}^2 u \frac{du}{dx}.$$

$$\frac{d}{dx}\operatorname{sech} u = -\operatorname{sech} u \tanh u \frac{du}{dx}. \qquad \frac{d}{dx}\operatorname{csch} u = -\operatorname{csch} u \operatorname{ctnh} u \frac{du}{dx}.$$

$$\frac{d}{dx}\sinh^{-1} u = \frac{1}{\sqrt{u^2+1}}\frac{du}{dx}. \qquad \frac{d}{dx}\cosh^{-1} u = \frac{1}{\sqrt{u^2-1}}\frac{du}{dx}, \; u>1$$

$$\frac{d}{dx}\tanh^{-1} u = \frac{1}{1-u^2}\frac{du}{dx}. \qquad \frac{d}{dx}\operatorname{ctnh}^{-1} u = -\frac{1}{u^2-1}\frac{du}{dx}.$$

$$\frac{d}{dx}\operatorname{sech}^{-1} u = -\frac{1}{u\sqrt{1-u^2}}\frac{du}{dx}, \; u>0. \qquad \frac{d}{dx}\operatorname{csch}^{-1} u = -\frac{1}{u\sqrt{u^2+1}}\frac{du}{dx}.$$

109. Slope of a Curve. Equation of Tangent and Normal (Rectangular Coördinates). The slope of the curve $y = f(x)$ at the point $P(x, y)$ is defined as the slope of the tangent line to the curve at P.

Slope $= m = \tan\alpha = \dfrac{dy}{dx} = f'(x)$.

Slope at $x = x_1$ is $m_1 = f'(x_1)$.

Equation of *tangent line* to curve at $P_1(x_1, y_1)$ is

$$y - y_1 = m_1(x - x_1).$$

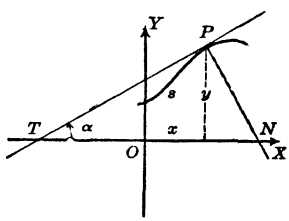


Fig. 55

Equation of *normal line* to curve at $P_1(x_1, y_1)$ is

$$y - y_1 = -\frac{1}{m_1}(x - x_1).$$

Angle (θ) *of intersection of two curves* whose slopes are m_1 and m_2 at the common point is given by

$$\tan\theta = \frac{m_2 - m_1}{1 + m_1 m_2}.$$

110. Differential. If $y = f(x)$, Δx is an increment of x, and $f'(x)$ is the derivative of $f(x)$ with respect to x, then the differential of x equals the increment of x, or $dx = \Delta x$; and the differential of y, dy, is the product of $f'(x)$ and the increment of x;

$$dy = f'(x)dx = \frac{df(x)}{dx}dx = \frac{dy}{dx}dx, \quad \text{and } f'(x) = \frac{dy}{dx}.$$

If $x = f(t)$, $y = \phi(t)$, then $dx = f'(t)\,dt$ and $dy = \phi'(t)\,dt$.

Every derivative formula has a corresponding differential formula. For example, from Table of §108,

$$d(\sin u) = \cos u \cdot du; \qquad d(u \cdot v) = u\,dv + v\,du.$$

111. Maximum and Minimum Values of a Function. A *maximum* (*minimum*) value of a function $f(x)$ in the interval (a, b) is a value of the function which is greater (less) than the values of the function in the immediate vicinity.

The values of x which give a maximum or minimum value to $y = f(x)$ are found by solving the equations $f'(x) = 0$ or ∞. If a be a root of $f'(x) = 0$ and if $f''(a) < 0$, $f(a)$ is a maximum; if $f''(a) > 0$, $f(a)$ is a minimum. If $f''(a) = 0$, $f'''(a) \neq 0$, $f(a)$ is neither a maximum or a minimum, but if $f''(a) = f'''(a) = 0$, $f(a)$ is maximum or minimum according as $f^{IV}(a) \lesseqgtr 0$.

In general, if the first derivative which does not vanish for $x = a$ is of an odd order, $f(a)$ is neither a maximum or a minimum; but if it is of an even order, the $2n$th, say, then $f(a)$ is a maximum or minimum according as $f^{(2n)}(a) \lesseqgtr 0$.

To find the largest or smallest values of a function in an interval (a, b), find $f(a)$, $f(b)$ and compare with the maximum and minimum values as found in the interval.

112. Points of Inflection of a Curve. The curve is said to have a *point of inflection* at $x = a$ if $f''(a) = 0$ and $f''(x) < 0$ on one side of $x = a$ and $f''(x) > 0$ on the other side of $x = a$. Wherever $f''(x) < 0$, the curve is *concave downward*, and wherever $f''(x) > 0$, the curve is *concave upward*.

113. Derivative of Arc Length. Radius of Curvature (See §75, §107, §126). Let s be the length of arc measured along the curve $y = f(x)$, [or in polar coördinates $r = \phi(\theta)$], from some fixed point to any point $P(x, y)$, and α be the angle of inclination of the tangent line at P with OX. Then

$$\frac{dx}{ds} = \cos\alpha = \frac{1}{\sqrt{1 + \left(\frac{dy}{dx}\right)^2}}, \quad \frac{dy}{ds} = \sin\alpha = \frac{1}{\sqrt{1 + \left(\frac{dx}{dy}\right)^2}},$$

$$ds = \sqrt{dx^2 + dy^2} = \sqrt{1 + \left(\frac{dy}{dx}\right)^2} \cdot dx = \sqrt{1 + \left(\frac{dx}{dy}\right)^2} \cdot dy.$$

$$ds = \sqrt{dr^2 + r^2 d\theta^2} = \sqrt{r^2 + \left(\frac{dr}{d\theta}\right)^2} \cdot d\theta = \sqrt{1 + r^2\left(\frac{d\theta}{dr}\right)^2} \cdot dr.$$

If $x = r\cos\theta$, $y = r\sin\theta$,
$dx = \cos\theta \cdot dr - r\sin\theta \cdot d\theta$, $dy = \sin\theta \cdot dr + r\cos\theta \cdot d\theta$.

The *radius* of *curvature* R at any point $P(x, y)$ of the curve $y = f(x)$ is

$$R = \frac{ds}{d\alpha} = \frac{\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{\frac{3}{2}}}{\left(\frac{d^2y}{dx^2}\right)} = \frac{\{1 + [f'(x)]^2\}^{\frac{3}{2}}}{f''(x)},$$

$$R = \frac{\left[r^2 + \left(\frac{dr}{d\theta}\right)^2\right]^{\frac{3}{2}}}{r^2 + 2\left(\frac{dr}{d\theta}\right)^2 - r\frac{d^2r}{d\theta^2}}.$$

The *curvature* (K) at (x, y) is $K = \frac{1}{R}$.

The *center* of *curvature* corresponding to the point (x_1, y_1) on $y = f(x)$ is (h, k), where

$$h = x_1 - \frac{f'(x_1)\{1 + [f'(x_1)]^2\}}{f''(x_1)},$$

$$k = y_1 + \frac{1 + [f'(x_1)]^2}{f''(x_1)}.$$

114. Theorem of the Mean. Rolle's Theorem. If $y = f(x)$ and its derivative $f'(x)$ be continuous on the interval (a, b), there exists a value of x somewhere between a and b such that

$$f(b) = f(a) + (b - a) f'(x_1), \quad a < x_1 < b.$$

Rolle's Theorem is a special case of the Theorem of the Mean with $f(a) = f(b) = 0$; i. e., there exists at least one value of x between a and b for which $f'(x_1) = 0$.

115. Evaluation of Indeterminate Forms. If $f(x)$ and $F(x)$ be two continuous functions of x having continuous derivatives, $f'(x)$ and $F'(x)$, then:

(*a*) If $\lim_{x \to a} f(x) = 0$ and $\lim_{x \to a} F(x) = 0$, and $\lim_{x \to a} F'(x) \neq 0$,

[or if $\lim_{x \to a} f(x) = \lim_{x \to a} F(x) = \infty$], then

$$\lim_{x \to a} \frac{f(x)}{F(x)} = \lim_{x \to a} \frac{f'(x)}{F'(x)}.$$

(*b*) If $\lim_{x \to a} f(x) = 0$ and $\lim_{x \to a} F(x) = \infty$, [i.e. $F(x)$ becomes infinite as x approaches a as a limit], then $\lim_{x \to a} [f(x) \cdot F(x)]$ may often be determined by writing

$$f(x) \cdot F(x) = \frac{f(x)}{1/F(x)},$$

thus expressing the functions in the form of (*a*).

(*c*) If $\lim_{x \to a} f(x) = \infty$ and $\lim_{x \to a} F(x) = \infty$, then $\lim_{x \to a} [f(x) - F(x)]$ may often be determined by writing

$$f(x) - F(x) = \frac{1/F(x) - 1/f(x)}{1/[f(x) \cdot F(x)]},$$

and using (*a*).

(*d*) The $\lim_{x \to a} \left[f(x)^{F(x)} \right]$ may frequently be evaluated upon writing

$$f(x)^{F(x)} = e^{F(x) \cdot \log_e f(x)}.$$

When one factor of the last exponent approaches zero and the other becomes infinite, the exponent is of the type considered in (*b*).

Thus we are led to the indeterminate forms which are symbolized by

$$0/0,\ {}^{\infty}/_{\infty},\ 0^0,\ 1^{\infty},\ \infty^0.$$

116. Taylor's and Maclaurin's Theorem. Any function (continuous and having derivatives) may, in general, be expanded into a *Taylor's Series*,

$$f(x) = f(a) + f'(a)\cdot\frac{(x-a)}{1!} + f''(a)\cdot\frac{(x-a)^2}{2!} + f'''(a)\cdot\frac{(x-a)^3}{3!} + \cdots + f^{(n-1)}(a)\cdot\frac{(x-a)^{n-1}}{(n-1)!} + R_n,$$

where a is any quantity for which $f(a), f'(a), f''(a), \cdots$ are finite.

If the series is to be used for approximating $f(x)$ for some value of x, then a should be picked so that the difference $(x-a)$ is numerically very small, and thus only a few terms of the series need be used. The remainder, after n terms, is $R_n = f^{(n)}(x_1)\cdot(x-a)^n/n!$, where x_1 lies between a and x. R_n gives the limits of error in using n terms of the series for the approximation of the function.

$$n! = \underline{|n} = 1\cdot 2\cdot 3\cdot 4\cdot\cdots\cdot n.$$

If $a = 0$, the above series is called *Maclaurin's Series.*

$$f(x) = f(0) + f'(0)\frac{x}{1!} + f''(0)\frac{x^2}{2!} + f'''(0)\frac{x^3}{3!} + \cdots + f^{(n-1)}(0)\frac{x^{n-1}}{(n-1)!} + R_n.$$

117. Series. The following series may be obtained through the expansion of the functions by Taylor's or Maclaurin's Theorems. The expressions following a series indicate the region of convergence of the series, that is, the values of x for which R_n approaches zero as n becomes infinite, so that an approximation of the function may be obtained by using a number of terms of the series. If the region of convergence is not indicated, the series converges for all finite values of x. $(n! = 1\cdot 2\cdot 3\cdots n)$. $\mathrm{Log}_e u \equiv \mathrm{Log}\, u$.

(*a*) *Binomial Series.*

$$(a + x)^n = a^n + na^{n-1}x + \frac{n(n-1)}{2!}a^{n-2}x^2 + \frac{n(n-1)(n-2)}{3!}a^{n-3}x^3 + \cdots, \quad x^2 < a^2.$$

If n is a positive integer, the series consists of $(n + 1)$ terms; otherwise, the number of terms is infinite.

$$(a - bx)^{-1} = \frac{1}{a}\left(1 + \frac{bx}{a} + \frac{b^2x^2}{a^2} + \frac{b^3x^3}{a^3} \cdots\right), \quad b^2x^2 < a^2.$$

(*b*) *Exponential, Logarithmic, and Trigonometric Series.**

$$e = 1 + \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \frac{1}{4!} + \cdots.$$

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \cdots.$$

$$a^x = 1 + x \log a + \frac{(x \log a)^2}{2!} + \frac{(x \log a)^3}{3!} + \cdots.$$

$$e^{-x^2} = 1 - x^2 + \frac{x^4}{2!} - \frac{x^6}{3!} + \frac{x^8}{4!} - \cdots.$$

$$\log x = (x-1) - \tfrac{1}{2}(x-1)^2 + \tfrac{1}{3}(x-1)^3 - \cdots, \qquad 0 < x \leqq 2.$$

$$\log x = \frac{x-1}{x} + \frac{1}{2}\left(\frac{x-1}{x}\right)^2 + \frac{1}{3}\left(\frac{x-1}{x}\right)^3 + \cdots, \qquad x > \frac{1}{2}.$$

$$\log x = 2\left[\frac{x-1}{x+1} + \frac{1}{3}\left(\frac{x-1}{x+1}\right)^3 + \frac{1}{5}\left(\frac{x-1}{x+1}\right)^5 + \cdots\right], \qquad x > 0.$$

$$\log (1 + x) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \cdots.$$

$$\log (a + x) = \log a + 2\left[\frac{x}{2a+x} + \frac{1}{3}\left(\frac{x}{2a+x}\right)^3 + \frac{1}{5}\left(\frac{x}{2a+x}\right)^5 + \cdots\right], \quad a > 0, \; -a < x < +\infty.$$

$$\log\left(\frac{1+x}{1-x}\right) = 2\left(x + \frac{x^3}{3} + \frac{x^5}{5} + \frac{x^7}{7} + \cdots\right), \qquad x^2 < 1.$$

$$\log\left(\frac{x+1}{x-1}\right) = 2\left[\frac{1}{x} + \frac{1}{3}\left(\frac{1}{x}\right)^3 + \frac{1}{5}\left(\frac{1}{x}\right)^5 + \frac{1}{7}\left(\frac{1}{x}\right)^7 + \cdots\right], \quad x^2 > 1.$$

$$\log\left(\frac{x+1}{x}\right) = 2\left[\frac{1}{2x+1} + \frac{1}{3(2x+1)^3} + \frac{1}{5(2x+1)^5} + \cdots\right], \quad x > 0.$$

* $\log u \equiv \log_e u$.

$$\log (x + \sqrt{1+x^2}) = x - \frac{1}{2}\frac{x^3}{3} + \frac{1\cdot 3}{2\cdot 4}\frac{x^5}{5} - \frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6}\frac{x^7}{7} + \cdots, \quad x^2 < 1.$$

$$\sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \cdots.$$

$$\cos x = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!} + \cdots.$$

$$\tan x = x + \frac{x^3}{3} + \frac{2x^5}{15} + \frac{17x^7}{315} + \frac{62x^9}{2835} + \cdots, \quad x^2 < \frac{\pi^2}{4}.$$

$$\sin^{-1} x = x + \frac{x^3}{6} + \frac{1}{2}\cdot\frac{3}{4}\cdot\frac{x^5}{5} + \frac{1}{2}\cdot\frac{3}{4}\cdot\frac{5}{6}\cdot\frac{x^7}{7} + \cdots, \quad x^2 < 1.$$

$$\tan^{-1} x = x - \frac{1}{3}x^3 + \frac{1}{5}x^5 - \frac{1}{7}x^7 + \cdots, \quad x^2 < 1.$$

$$= \frac{\pi}{2} - \frac{1}{x} + \frac{1}{3x^3} - \frac{1}{5x^5} + \cdots, \quad x^2 > 1.$$

$$\log \sin x = \log x - \frac{x^2}{6} - \frac{x^4}{180} - \frac{x^6}{2835} - \cdots, \quad x^2 < \pi^2.$$

$$\log \cos x = -\frac{x^2}{2} - \frac{x^4}{12} - \frac{x^6}{45} - \frac{17x^8}{2520} - \cdots, \quad x^2 < \frac{\pi^2}{4}.$$

$$\log \tan x = \log x + \frac{x^2}{3} + \frac{7x^4}{90} + \frac{62x^6}{2835} + \cdots, \quad x^2 < \frac{\pi^2}{4}.$$

$$e^{\sin x} = 1 + x + \frac{x^2}{2!} - \frac{3x^4}{4!} - \frac{8x^5}{5!} - \frac{3x^6}{6!} + \cdots.$$

$$e^{\cos x} = e\left(1 - \frac{x^2}{2!} + \frac{4x^4}{4!} - \frac{31x^6}{6!} + \cdots\right).$$

$$e^{\tan x} = 1 + x + \frac{x^2}{2!} + \frac{3x^3}{3!} + \frac{9x^4}{4!} + \frac{37x^5}{5!} + \cdots, \quad x^2 < \frac{\pi^2}{4}.$$

$$\sinh x = x + \frac{x^3}{3!} + \frac{x^5}{5!} + \frac{x^7}{7!} + \cdots.$$

$$\cosh x = 1 + \frac{x^2}{2!} + \frac{x^4}{4!} + \frac{x^6}{6!} + \cdots.$$

$$\tanh x = x - \frac{x^3}{3} + \frac{2x^5}{15} - \frac{17x^7}{315} + \cdots.$$

$$\sinh^{-1} x = x - \frac{1}{2}\frac{x^3}{3} + \frac{1\cdot 3}{2\cdot 4}\frac{x^5}{5} - \frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6}\frac{x^7}{7} + \cdots, \quad x^2 < 1.$$

$$\sinh^{-1} x = \log 2x + \frac{1}{2}\frac{1}{2x^2} - \frac{1\cdot 3}{2\cdot 4}\frac{1}{4x^4} + \frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6}\frac{1}{6x^6} \cdots, \quad x > 1.$$

$$\cosh^{-1} x = \log 2x - \frac{1}{2}\frac{1}{2x^2} - \frac{1\cdot 3}{2\cdot 4}\frac{1}{4x^4} - \frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6}\frac{1}{6x^6} - \cdots.$$

$$\tanh^{-1} x = x + \frac{x^3}{3} + \frac{x^5}{5} + \frac{x^7}{7} + \cdots, \quad x^2 < 1.$$

118. Partial Derivatives. Differentials. If $z = f(x, y)$, is a function of two variables, then the derivative of z with respect to x, as x varies while y remains constant, is called the *first partial derivative of z with respect to x* and is denoted by $\frac{\partial z}{\partial x}$. Similarly, the derivative of z with respect to y, as y varies while x remains constant, is called the *first partial derivative of z with respect to y* and is denoted by $\frac{\partial z}{\partial y}$.

Similarly, if $z = f(x, y, u, \cdots)$, then the first derivative of z with respect to x, as x varies while y, u, $\cdots$ remain constant, is called the first partial of z with respect to x and is denoted by $\frac{\partial z}{\partial x}$. Likewise, the second partial derivatives are defined as indicated below:

$$\frac{\partial^2 z}{\partial x^2} = \frac{\partial}{\partial x}\left(\frac{\partial z}{\partial x}\right); \quad \frac{\partial^2 z}{\partial y^2} = \frac{\partial}{\partial y}\left(\frac{\partial z}{\partial y}\right); \quad \frac{\partial^2 z}{\partial x\,\partial y} = \frac{\partial}{\partial x}\left(\frac{\partial z}{\partial y}\right) = \frac{\partial}{\partial y}\left(\frac{\partial z}{\partial x}\right) = \frac{\partial^2 z}{\partial y\,\partial x}.$$

If $z = f(x, y, \cdots, u)$, and $x, y, \cdots, u$ are functions of a single variable t, then

$$\frac{dz}{dt} = \frac{\partial z}{\partial x}\frac{dx}{dt} + \frac{\partial z}{\partial y}\frac{dy}{dt} + \cdots + \frac{\partial z}{\partial u}\frac{du}{dt},$$

$$dz = \frac{\partial z}{\partial x}dx + \frac{\partial z}{\partial y}dy + \cdots + \frac{\partial z}{\partial u}du,$$

If $F(x, y, z, \cdots, u) = 0$, then $\frac{\partial F}{\partial x}dx + \frac{\partial F}{\partial y}dy + \cdots + \frac{\partial F}{\partial u}du = 0.$

119. Surfaces. Space Curves (See Analytic Geometry §97-8.) The *tangent plane* to the surface $F(x, y, z) = 0$ at the point (x_1, y_1, z_1) on the surface is

$$(x - x_1)\left(\frac{\partial F}{\partial x}\right)_1 + (y - y_1)\left(\frac{\partial F}{\partial y}\right)_1 + (z - z_1)\left(\frac{\partial F}{\partial z}\right)_1 = 0,$$

where $\left(\frac{\partial F}{\partial x}\right)_1$ is the value of $\frac{\partial F}{\partial x}$ at (x_1, y_1, z_1), etc.

The equations of the *normal* to the surface at (x_1, y_1, z_1) are

$$\frac{x - x_1}{\left(\frac{\partial F}{\partial x}\right)_1} = \frac{y - y_1}{\left(\frac{\partial F}{\partial y}\right)_1} = \frac{z - z_1}{\left(\frac{\partial F}{\partial z}\right)_1}.$$

The *direction cosines* of the normal to the surface at the point (x_1, y_1, z_1) are proportional to

$$\left(\frac{\partial F}{\partial x}\right)_1, \left(\frac{\partial F}{\partial y}\right)_1, \left(\frac{\partial F}{\partial z}\right)_1.$$

Given the *space* curve $x = x(t)$, $y = y(t)$, $z = z(t)$. The direction cosines of the tangent line to the curve at any point are proportional to

$$\frac{dx}{dt}, \frac{dy}{dt}, \frac{dz}{dt}, \text{ or to } dx, dy, dz.$$

The equations of the *tangent line* to the curve at (x_1, y_1, z_1) on the curve are

$$\frac{x - x_1}{\left(\frac{dx}{dt}\right)_1} = \frac{y - y_1}{\left(\frac{dy}{dt}\right)_1} = \frac{z - z_1}{\left(\frac{dz}{dt}\right)_1},$$

where $\left(\frac{dx}{dt}\right)_1$ is the value of $\frac{dx}{dt}$ at (x_1, y_1, z_1), etc.

VI. INTEGRAL CALCULUS

120. Definition of Indefinite Integral. $F(x)$ is said to be an *indefinite integral of* $f(x)$, if the derivative of $F(x)$ is $f(x)$, or the differential of $F(x)$ is $f(x)dx$; symbolically:

$$F(x) = \int f(x)dx \text{ if } \frac{dF(x)}{dx} = f(x), \text{ or } dF(x) = f(x)dx.$$

In general: $\int f(x)dx = F(x) + C$, where C is an arbitrary constant.

121. Fundamental Theorems on Integrals. Short Table of Integrals.* (u and v denote functions of x; a, b and C denote constants).

1. $\int df(x) = f(x) + C.$

2. $d\int f(x)dx = f(x)dx.$

3. $\int 0 \cdot dx = C.$

4. $\int a f(x)\, dx = a\int f(x)\, dx.$

5. $\int (u \pm v)dx = \int udx \pm \int vdx.$

6. $\int u\, dv = uv - \int v\, du.$

7. $\int \frac{u\, dv}{dx}\, dx = uv - \int v \frac{du}{dx}\, dx.$

8. $\int f(y)dx = \int \frac{f(y)dy}{\frac{dy}{dx}}.$

9. $\int u^n\, du = \frac{u^{n+1}}{n+1} + C,\ n \neq -1.$

10. $\int \frac{du}{u} = \log_e u + C.$

11. $\int e^u\, du = e^u + C.$

12. $\int b^u\, du = \frac{b^u}{\log_e b} + C.$

13. $\int \sin u\, du = -\cos u + C.$

14. $\int \cos u\, du = \sin u + C.$

*See §14R.

15. $\int \tan u\, du = \log_e \sec u + C = -\log_e \cos u + C.$

16. $\int \operatorname{ctn} u\, du = \log_e \sin u + C = -\log_e \csc u + C.$

17. $\int \sec u\, du = \log_e(\sec u + \tan u) + C = \log_e \tan\left(\frac{u}{2} + \frac{\pi}{4}\right) + C.$

18. $\int \csc u\, du = \log_e(\csc u - \operatorname{ctn} u) + C = \log_e \tan \frac{u}{2} + C.$

19. $\int \sin^2 u\, du = \frac{1}{2}u - \frac{1}{2}\sin u \cos u + C.$

20. $\int \cos^2 u\, du = \frac{1}{2}u + \frac{1}{2}\sin u \cos u + C.$

21. $\int \sec^2 u\, du = \tan u + C.$

22. $\int \csc^2 u\, du = -\operatorname{ctn} u + C.$

23. $\int \tan^2 u\, du = \tan u - u + C.$

24. $\int \operatorname{ctn}^2 u\, du = -\operatorname{ctn} u - u + C.$

25. $\int \frac{du}{u^2 + a^2} = \frac{1}{a}\tan^{-1}\frac{u}{a} + C.$

26. $\int \frac{du}{u^2 - a^2} = \frac{1}{2a}\log_e\left(\frac{u-a}{u+a}\right) + C = -\frac{1}{a}\operatorname{ctnh}^{-1}\left(\frac{u}{a}\right) + C$, if $u^2 > a^2$,

$= \frac{1}{2a}\log_e\left(\frac{a-u}{a+u}\right) + C = -\frac{1}{a}\tanh^{-1}\left(\frac{u}{a}\right) + C$, if $u^2 < a^2$.

27. $\int \frac{du}{\sqrt{a^2 - u^2}} = \sin^{-1}\left(\frac{u}{a}\right) + C.$

28. $\int \frac{du}{\sqrt{u^2 \pm a^2}} = \log_e\left(u + \sqrt{u^2 \pm a^2}\right)^* + C.$

*See footnote on page 50.

29. $\int \frac{du}{\sqrt{2au - u^2}} = \cos^{-1}\left(\frac{a-u}{a}\right) + C.$

30. $\int \frac{du}{u\sqrt{u^2 - a^2}} = \frac{1}{a}\sec^{-1}\left(\frac{u}{a}\right) + C = \frac{1}{a}\cos^{-1}\frac{a}{u} + C.$

31. $\int \frac{du}{u\sqrt{a^2 \pm u^2}} = -\frac{1}{a}\log_e\left(\frac{a + \sqrt{a^2 \pm u^2}}{u}\right)^* + C.$

32. $\int \sqrt{a^2 - u^2}\cdot du = \frac{1}{2}\left(u\sqrt{a^2 - u^2} + a^2 \sin^{-1}\frac{u}{a}\right) + C.$

33. $\int \sqrt{u^2 \pm a^2}\,du = \frac{1}{2}\left[u\sqrt{u^2 \pm a^2} \pm a^2 \log_e\left(u + \sqrt{u^2 \pm a^2}\right)\right]^* + C.$

34. $\int \sinh u\,du = \cosh u + C.$

35. $\int \cosh u\,du = \sinh u + C.$

36. $\int \tanh u\,du = \log_e(\cosh u) + C.$

37. $\int \operatorname{ctnh} u\,du = \log_e(\sinh u) + C.$

38. $\int \operatorname{sech} u\,du = \sin^{-1}(\tanh u) + C.$

39. $\int \operatorname{csch} u\,du = \log_e\left(\tanh\frac{u}{2}\right) + C.$

40. $\int \operatorname{sech} u \cdot \tanh u \cdot du = -\operatorname{sech} u + C.$

41. $\int \operatorname{csch} u \cdot \operatorname{ctnh} u \cdot du = -\operatorname{csch} u + C.$

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* $\log_e\left(\frac{u+\sqrt{u^2+a^2}}{a}\right) = \sinh^{-1}\left(\frac{u}{a}\right)$; $\log_e\left(\frac{a+\sqrt{a^2-u^2}}{u}\right) = \operatorname{sech}^{-1}\left(\frac{u}{a}\right)$;

$\log_e\left(\frac{u+\sqrt{u^2-a^2}}{a}\right) = \cosh^{-1}\left(\frac{u}{a}\right)$; $\log_e\left(\frac{a+\sqrt{a^2+u^2}}{u}\right) = \operatorname{csch}^{-1}\left(\frac{u}{a}\right)$.

Definite Integrals

122. Definition of Definite Integral. Let $f(x)$ be continuous for the interval from $x = a$ to $x = b$ inclusive. Divide this interval into n equal parts by the points $a, x_1, x_2, \cdots, x_{n-1}, b$ such that $\Delta x = (b - a)/n$. The definite integral of $f(x)$ with respect to x between the limits $x = a$ to $x = b$ is

$$\int_a^b f(x)\,dx = \lim_{n\to\infty} [f(a)\Delta x + f(x_1)\Delta x + f(x_2)\Delta x + \cdots + f(x_{n-1})\Delta x].$$

$$\int_a^b f(x)\,dx = \left[\int f(x)\,dx\right]_a^b = \Big[F(x)\Big]_a^b = F(b) - F(a),$$

where $F(x)$ is a function whose derivative with respect to x is $f(x)$.

123. Approximate Values of Definite Integral. Approximate values of the above definite integral are given by the rules of §41, where $y_0, y_1, y_2, \cdots, y_{n-1}, y_n$ are the values of $f(x)$ for $x = a, x_1, x_2, \cdots, x_{n-1}, b$, respectively, and $h = (b - a)/n$.

124. Some Fundamental Theorems.

$$\int_a^b [f_1(x) + f_2(x) + \cdots + f_n(x)]\,dx = \int_a^b f_1(x)\,dx + \int_a^b f_2(x)\,dx + \cdots + \int_a^b f_n(x)\,dx.$$

$$\int_a^b kf(x)\,dx = k\int_a^b f(x)\,dx, \quad \text{if } k \text{ is a constant.}$$

$$\int_a^b f(x)\,dx = -\int_b^a f(x)\,dx.$$

$$\int_a^b f(x)\,dx = \int_a^c f(x)\,dx + \int_c^b f(x)\,dx.$$

$$\int_a^b f(x)\,dx = (b - a)\,f(x_1), \quad \text{where } x_1 \text{ lies between } a \text{ and } b.$$

$$\int_a^\infty f(x)\,dx = \lim_{t\to\infty}\int_a^t f(x)\,\mathrm{dx}.$$

$$\int_{-\infty}^b f(x)\,dx = \lim_{t\to\infty}\int_{-t}^b f(x)\,dx.$$

$$\int_{-\infty}^{+\infty} f(x)\,dx = \int_{-\infty}^{c} f(x)dx + \int_{c}^{\infty} f(x)dx.$$

If $f(x)$ has a singular point* at $x = b$, $b \neq a$,

$$\int_a^b f(x)dx = \lim_{e \to 0} \int_a^{b-e} f(x)dx.$$

The mean value of the function $f(x)$ on the interval (a, b) is

$$\frac{1}{b-a}\int_a^b f(x)dx.$$

Some Applications of the Definite Integral

125. Plane Area. The area bounded by $y = f(x)$, $y = 0$, $x = a$, $x = b$, where y has the same sign for all values of x between a and b, is

$$A = \int_a^b f(x)\,dx, \quad dA = f(x)\,dx.$$

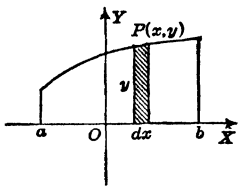


Fig. 56

The area bounded by the curve $r = f(\theta)$ and the two radii $\theta = \alpha$, $\theta = \beta$, is

$$A = \frac{1}{2}\int_\alpha^\beta [f(\theta)]^2\,d\theta, \quad dA = \frac{1}{2}r^2 \cdot d\theta.$$

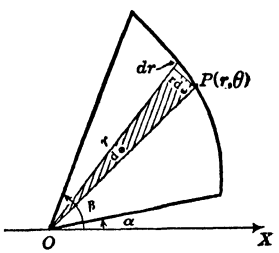


Fig. 57

126. Length of Arc (See §113). The length (s) of arc of a plane curve $f(x, y) = 0$ from the point (a, c) to the point (b, d) is

$$s = \int_a^b \sqrt{1 + \left(\frac{dy}{dx}\right)^2} \cdot dx = \int_c^d \sqrt{1 + \left(\frac{dx}{dy}\right)^2} \cdot dy.$$

If the equation of the curve is $x = f(t)$, $y = f(t)$, the length of arc from $t = a$ to $t = b$ is

$$s = \int_a^b \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2} \cdot dt.$$

*For example, when $\lim_{x \to b} f(x) = \infty$.

If the equation of the curve is $r = f(\theta)$, then

$$s = \int_{\theta_1}^{\theta_2} \sqrt{r^2 + \left(\frac{dr}{d\theta}\right)^2} \cdot d\theta = \int_{r_1}^{r_2} \sqrt{r^2 \left(\frac{d\theta}{dr}\right)^2 + 1} \cdot dr.$$

127. Volume by Parallel Sections. If the plane perpendicular to the x-axis at $(x, 0, 0)$ cuts from a given solid a section whose area is $A(x)$, then the volume of that part of the solid between $x = a$ and $x = b$ is

$$\int_a^b A(x)dx.$$

128. Volume of Revolution. The volume of a solid of revolution generated by revolving that portion of the curve $y = f(x)$ between $x = a$ and $x = b$

(*a*) about the x-axis is $\pi \int_a^b y^2\, dx$;

(*b*) about the y-axis is $\pi \int_c^d x^2\, dy$, where c and d are the values of y corresponding to the values a and b of x.

129. Area of Surface of Revolution. The area of the surface of a solid of revolution generated by revolving the curve $y = f(x)$ between $x = a$ and $x = b$

(*a*) about the x-axis is $2\pi \int_a^b y \sqrt{1 + \left(\frac{dy}{dx}\right)^2} \cdot dx$,

(*b*) about the y-axis is $2\pi \int_a^b x \sqrt{1 + \left(\frac{dx}{dy}\right)^2} \cdot dy$.

130. Plane Areas by Double Integration.

(*a*) Rectangular coördinates,

$$A = \int_a^b \int_{\varphi(x)}^{f(x)} dy\, dx \text{ or } \int_c^d \int_{\xi(y)}^{\Psi(y)} dx\, dy;$$

(*b*) Polar coördinates,

$$A = \int_{\theta_1}^{\theta_2} \int_{f_1(\theta)}^{f_2(\theta)} r\, dr\, d\theta \text{ or } \int_{r_1}^{r_2} \int_{\phi_1(r)}^{\phi_2(r)} r\, d\theta\, dr.$$

131. Volumes by Double Integration. *If* $z=f(x,y)$,

$$V = \int_a^b \int_{\phi(x)}^{\Psi(x)} f(x,y)\, dy\, dx \quad \text{or} \quad \int_c^d \int_{\alpha(y)}^{\beta(y)} f(x,y)\, dx\, dy.$$

132. Volumes by Triple Integration (see §102).

(*a*) Rectangular coördinates,

$$V = \int\int\int dx\, dy\, dz;$$

(*b*) Cylindrical coördinates,

$$V = \int\int\int r\, dr\, d\theta\, dz;$$

(*c*) Spherical coördinates,

$$V = \int\int\int \rho^2 \sin\phi\, d\theta\, d\phi\, d\rho.$$

where the limits of integration must be supplied. Other formulas may be obtained by changing the order of integration.

Area of Surface $z = f(x, y)$

$$A = \int\int \sqrt{\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 + 1}\ \cdot\ dy\, dx,$$

where the limits of integration must be supplied.

133. Mass.* The mass of a body of density δ is

$$m = \int dm, \quad dm = \delta \cdot dA, \quad \text{or} \quad \delta \cdot ds, \quad \text{or} \quad \delta \cdot dV, \quad \text{or} \quad \delta \cdot dS,$$

where dA, ds, dV, dS are, respectively, the elements of area, length, volume, surface of §125 to §132.

134. Density.* If δ is a variable (or constant) density (mass per unit of element), and $\bar{\delta}$ is the mean density of a solid of volume V, then

$$\bar{\delta} = \frac{\int \delta\, dV}{\int dV}$$

*The limits of integration are to be supplied

135. Moment.* The moments M_{yz}, M_{xz}, M_{xy}, of a mass m with respect to the coordinate planes (as indicated by the subscripts) are

$$M_{yz} = \int x\, dm, \quad M_{xz} = \int y\, dm, \quad M_{xy} = \int z\, dm.$$

136. Centroid of Mass or Center of Gravity.* The coordinates $(\bar{x}, \bar{y}, \bar{z})$ of the centroid of a mass m are

$$\bar{x} = \frac{\int x\, dm}{\int dm}, \quad \bar{y} = \frac{\int y\, dm}{\int dm}, \quad \bar{z} = \frac{\int z\, dm}{\int dm}.$$

(Note: In the above equations x, y, z are the coordinates of the center of gravity of the element dm.)

137. Centroid of Several Masses. The x-coordinate $(\bar{x})$ of the centroid of several masses $m_1, m_2, \cdots, m_n$, having $\bar{x}_1, \bar{x}_2, \cdots, \bar{x}_n$, respectively as the x-coordinates of their centroids, is

$$\bar{x} = \frac{m_1\bar{x}_1 + m_2\bar{x}_2 + \cdots + m_n\bar{x}_n}{m_1 + m_2 + \cdots + m_n},$$

Similar formulas hold for the other coordinates $\bar{y}$, $\bar{z}$.

138. Moment of Inertia (Second Moment).* The moments of inertia (I):

(*a*) for a plane curve about the x-axis, y-axis, and origin, respectively, are:

$$I_x = \int y^2\, ds, \qquad I_y = \int x^2\, ds, \quad I_0 = \int (x^2 + y^2)\, ds;$$

(*b*) for a plane area about the x-axis, y-axis, and origin, respectively, are:

$$I_x = \int y^2\, dA, \quad I_y = \int x^2\, dA, \quad I_0 = \int (x^2 + y^2)\, dA;$$

(*c*) for a solid of mass m about the yz, xz, xy-planes, x-axis, etc., respectively, are:

$$I_{yz} = \int x^2\, dm, \quad I_{xz} = \int y^2\, dm, \quad I_{xy} = \int z^2\, dm, \quad I_x = I_{xz} + I_{xy}, \quad \text{etc.}$$

*The limits of integration are to be supplied.

139. Radius of Gyration. If I is the moment of inertia of a mass m, and K is the radius of gyration, $I = mK^2$. Similarly for areas, lengths, volumes, etc.

If masses (or areas, etc.) $m_1, m_2, \cdots, m_n$, have respectively the radii of gyration $k_1, k_2, \cdots, k_n$, with respect to a line or plane, then with respect to this line or plane, the several masses taken together have the radius of gyration K, where

$$K^2 = \frac{m_1k^2_1 + m_2k^2_2 + \cdots + m_nk^2_n}{m_1+m_2 + \cdots + m_n}.$$

140. Work. The work W done in moving a particle from $s = a$ to $s = b$ against a force whose component expressed as function of s in the direction of motion is F_s, is

$$W = \int_{s=a}^{s=b} F_s\, ds, \qquad dW = F_s\, ds.$$

141. Pressure. The pressure (p) against an area vertical to the surface of a liquid and between the depths a and b is

$$P = \int_{y=a}^{y=b} wly\, dy, \qquad dp = wly\, dy,$$

where w is the weight of liquid per unit volume, y is the depth beneath surface of liquid of a horizontal element of area, and l is the length of the horizontal element of area expressed in terms of y.

142. Center of Pressure. The depth $\bar{y}$ of the center of pressure against an area vertical to the surface of the liquid and between the depths a and b is

$$\bar{y} = \frac{\int_{y=a}^{y=b} ydp}{\int_{y=a}^{y=b} dp} \cdot \text{ (for } dp \text{ see §141).}$$

VII. TABLE OF INTEGRALS

Certain Elementary Processes

143. To integrate $\int R(x) \cdot dx$, where $R(x)$ is a rational function of x.

Write $R(x)$ in the form of a fraction whose terms are polynomials. If the fraction is improper, (i.e., the degree of the denominator is less than or equal to the degree of the numerator), divide the numerator by the denominator and thus write $R(x)$ as the sum of a quotient $Q(x)$ and a proper fraction $P(x)$. (In a proper fraction the degree of the numerator is less than the degree of the denominator.) The polynomial $Q(x)$ is readily integrated. To integrate $P(x)$ separate it into a sum of partial fractions (as indicated below), and integrate each term of the sum separately.

To separate the proper fraction $P(x)$ into partial fractions, write $P(x) = f(x)/\psi(x)$, where $f(x)$ and $\psi(x)$ are polynomials,

$$\psi(x) = (x-a)^p (x-b)^q (x-c)^r \cdots,$$

and the constants a, b, c, are all different. By algebra, there exist constants $A_1, A_2, \cdots, B_1, B_2, \cdots$, such that

$$\frac{f(x)}{\psi(x)} = \frac{A_1}{(x-a)} + \frac{A_2}{(x-a)^2} + \cdots + \frac{A_p}{(x-a)^p} + \frac{B_1}{(x-b)} + \frac{B_2}{(x-b)^2} + \cdots + \frac{B_q}{(x-b)^q} + \cdots.$$

The separate terms of this sum may be integrated by the formulas

$$\int \frac{dx}{(x-\alpha)^t} = \frac{-1}{(t-1)(x-\alpha)^{t-1}}, \quad t > 1, \qquad \int \frac{dx}{(x-\alpha)} = \log(x-\alpha).$$

If $f(x)$ and $\psi(x)$ have real coefficients and $\psi(x) = 0$ has imaginary roots the above method leads to imaginary quantities. To avoid this, separate $P(x)$ in a different way. As before, corresponding to each p-fold real root a of $\psi(x)$, use the sum

$$\frac{A_1}{(x-a)} + \frac{A_2}{(x-a)^2} + \cdots + \frac{A_p}{(x-a)^p}.$$

To each λ-fold real quadratic factor $x^2 + \alpha x + \beta$ of $\psi(x)$ which does not factor into real linear factors, use, instead of the two sets of terms occurring in the first expansion of $R(x)$ and dependent on the conjugate complex roots of $x^2 + \alpha x + \beta = 0$, sums of the form

$$\frac{D_1 x + E_1}{(x^2 + \alpha x + \beta)} + \frac{D_2 x + E_2}{(x^2 + \alpha x + \beta)^2} + \cdots + \frac{D_\lambda x + E_\lambda}{(x^2 + \alpha x + \beta)^\lambda},$$

where the quantities $D_1, D_2, \cdots, E_1, E_2, \cdots$, are real constants.

These new sums may be separately integrated by means of Integral formulas 149 to 156, etc.

144. To Integrate an Irrational Algebraic Function. If no convenient method of integration is apparent the integration may frequently be performed by means of a change of variable. For example, if R is a rational function of two arguments and n is an integer, then to integrate

(*a*) $\int R\left[x, (ax + b)^{\frac{1}{n}}\right] dx$, let $(ax + b) = y^n$, whence the integral reduces to $\int P(y)\, dy$, where $P(y)$ is a rational function of y and may be integrated as in §143;

(*b*) $\int R\left[x, (x^2 + bx + c)^{\frac{1}{2}}\right] dx$, let $(x^2 + bx + c)^{\frac{1}{2}} = z - x$, reduce R to a rational function of z, and proceed as in §143;

(*c*) $\int R(\sin x, \cos x)\, dx$, let $\tan \frac{x}{2} = t$, whence

$$\sin x = \frac{2t}{1 + t^2}, \quad \cos x = \frac{1 - t^2}{1 + t^2}, \quad dx = \frac{2\, dt}{1 + t^2},$$

reduce R to a rational function of t and proceed as in §143.

145. To Integrate Expressions Containing $\sqrt{a^2 - x^2}$, $\sqrt{x^2 \pm a^2}$. Expressions containing these radicals can frequently be integrated after making the following transformations:

(*a*) if $\sqrt{a^2 - x^2}$ occurs, let $x = a \sin t$;

(*b*) if $\sqrt{x^2 - a^2}$ occurs, let $x = a \sec t$;

(*c*) if $\sqrt{x^2 + a^2}$ occurs, let $x = a \tan t$.

146. To Integrate Expressions Containing Trigonometric Functions. The integration of such functions may frequently be facilitated by the use of the identities of §58.

147. Integration by Parts. The relation

$$\int u\,dv = u\,v - \int v\,du.$$

is often effective in reducing a given integral to one or more simpler integrals.

*Table of Integrals**

148. In the following table, the constant of integration, C, is omitted but should be added to the result of every integration. The letter x represents any variable; u represents any function of x; the remaining letters represent arbitrary constants, unless otherwise indicated; all angles are in radians. **Unless otherwise mentioned $\log_e u \equiv \log u$.**

Expressions Containing $(ax + b)$.

42. $\int (ax+b)^n dx = \dfrac{1}{a\,(n+1)}\,(ax+b)^{n+1},\quad n \neq -1.$

43. $\int \dfrac{dx}{ax+b} = \dfrac{1}{a}\log_e\,(ax+b).$

44. $\int \dfrac{dx}{(ax+b)^2} = -\dfrac{1}{a(ax+b)}.$

45. $\int \dfrac{dx}{(ax+b)^3} = -\dfrac{1}{2a(ax+b)^2}.$

46. $\int x(ax+b)^n\,dx = \dfrac{1}{a^2(n+2)}\,(ax+b)^{n+2} - \dfrac{b}{a^2(n+1)}\,(ax+b)^{n+1},\ n \neq -1,\ -2.$

47. $\int \dfrac{x\,dx}{ax+b} = \dfrac{x}{a} - \dfrac{b}{a^2}\log\,(ax+b).$

48. $\int \dfrac{x\,dx}{(ax+b)^2} = \dfrac{b}{a^2(ax+b)} + \dfrac{1}{a^2}\log\,(ax+b).$

*See §121.

49. $$\int \frac{x\,dx}{(ax+b)^3} = \frac{b}{2a^2(ax+b)^2} - \frac{1}{a^2(ax+b)}.$$

50. $$\int x^2(ax+b)^n dx = \frac{1}{a^3}\left[\frac{(ax+b)^{n+3}}{n+3} - 2b\,\frac{(ax+b)^{n+2}}{n+2} + b^2\frac{(ax+b)^{n+1}}{n+1}\right], \quad n \neq -1, -2, -3.$$

51. $$\int \frac{x^2 dx}{ax+b} = \frac{1}{a^3}\left[\frac{1}{2}(ax+b)^2 - 2b(ax+b) + b^2\log(ax+b)\right].$$

52. $$\int \frac{x^2 dx}{(ax+b)^2} = \frac{1}{a^3}\left[(ax+b) - 2b\log(ax+b) - \frac{b^2}{ax+b}\right].$$

53. $$\int \frac{x^2\,dx}{(ax+b)^3} = \frac{1}{a^3}\left[\log(ax+b) + \frac{2b}{ax+b} - \frac{b^2}{2(ax+b)^2}\right]$$

54. $$\int x^m(ax+b)^n\,dx$$
$$= \frac{1}{a(m+n+1)}\left[x^m(ax+b)^{n+1} - mb\int x^{m-1}(ax+b)^n dx\right],$$
$$= \frac{1}{m+n+1}\left[x^{m+1}(ax+b)^n + nb\int x^m(ax+b)^{n-1}dx\right],$$
$$m > 0,\ m+n+1 \neq 0.$$

55. $$\int \frac{dx}{x(ax+b)} = \frac{1}{b}\log\frac{x}{ax+b}.$$

56. $$\int \frac{dx}{x^2(ax+b)} = -\frac{1}{bx} + \frac{a}{b^2}\log\frac{ax+b}{x}.$$

57. $$\int \frac{dx}{x^3(ax+b)} = \frac{2ax-b}{2b^2x^2} + \frac{a^2}{b^3}\log\frac{x}{ax+b}.$$

58. $$\int \frac{dx}{x(ax+b)^2} = \frac{1}{b(ax+b)} - \frac{1}{b^2}\log\frac{ax+b}{x}.$$

59. $$\int \frac{dx}{x(ax+b)^3} = \frac{1}{b^3}\left[\frac{1}{2}\left(\frac{ax+2b}{ax+b}\right)^2 + \log\frac{x}{ax+b}\right].$$

60. $$\int \frac{dx}{x^2(ax+b)^2} = -\frac{b+2ax}{b^2x(ax+b)} + \frac{2a}{b^3}\log\frac{ax+b}{x}.$$

61. $\int \sqrt{ax+b}\,dx = \frac{2}{3a}\sqrt{(ax+b)^3}$

62. $\int x\sqrt{ax+b}\,dx = \frac{2(3ax-2b)}{15a^2}\sqrt{(ax+b)^3}$

63. $\int x^2\sqrt{ax+b}\,dx = \frac{2(15a^2x^2-12abx+8b^2)\sqrt{(ax+b)^3}}{105a^3}$

64. $\int x^3\sqrt{ax+b}\,dx$
$= \frac{2(35a^3x^3-30a^2bx^2+24ab^2x-16b^3)\sqrt{(ax+b)^3}}{315a^4}.$

65. $\int x^n\sqrt{ax+b}\,dx = \frac{2}{a^{n+1}}\int u^2(u^2-b)^n du,\ u=\sqrt{ax+b}.$

66. $\int \frac{\sqrt{ax+b}}{x}\,dx = 2\sqrt{ax+b} + b\int \frac{dx}{x\sqrt{ax+b}}.$

67. $\int \frac{dx}{\sqrt{ax+b}} = \frac{2\sqrt{ax+b}}{a}.$

68. $\int \frac{xdx}{\sqrt{ax+b}} = \frac{2(ax-2b)}{3a^2}\sqrt{ax+b}.$

69. $\int \frac{x^2dx}{\sqrt{ax+b}} = \frac{2(3a^2x^2-4abx+8b^2)}{15a^3}\sqrt{ax+b}.$

70. $\int \frac{x^3dx}{\sqrt{ax+b}} = \frac{2(5a^3x^3-6a^2bx^2+8ab^2x-16b^3)}{35a^4}\sqrt{ax+b}.$

71. $\int \frac{x^ndx}{\sqrt{ax+b}} = \frac{2}{a^{n+1}}\int (u^2-b)^n du,\ u=\sqrt{ax+b}.$

72. $\int \frac{dx}{x\sqrt{ax+b}} = \frac{1}{\sqrt{b}}\log\frac{\sqrt{ax+b}-\sqrt{b}}{\sqrt{ax+b}+\sqrt{b}},$ for $b>0.$

73. $\int \frac{dx}{x\sqrt{ax+b}} = \frac{2}{\sqrt{-b}}\tan^{-1}\sqrt{\frac{ax+b}{-b}},\ b<0;\ \frac{-2}{\sqrt{b}}\tanh^{-1}\sqrt{\frac{ax+b}{b}},\ b>0.$

74. $$\int \frac{dx}{x^2\sqrt{ax+b}} = -\frac{\sqrt{ax+b}}{bx} - \frac{a}{2b}\int \frac{dx}{x\sqrt{ax+b}}.$$

75. $$\int \frac{dx}{x^3\sqrt{ax+b}} = -\frac{\sqrt{ax+b}}{2bx^2} + \frac{3a\sqrt{ax+b}}{4b^2x} + \frac{3a^2}{8b^2}\int \frac{dx}{x\sqrt{ax+b}}.$$

76. $$\int \frac{dx}{x^n(ax+b)^m} = -\frac{1}{b^{m+n-1}}\int \frac{(u-a)^{m+n-2}du}{u^m},\ u = \frac{ax+b}{x}.$$

77. $$\int (ax+b)^{\pm\frac{n}{2}}dx = \frac{2(ax+b)^{\frac{2\pm n}{2}}}{a(2\pm n)}.$$

78. $$\int x(ax+b)^{\pm\frac{n}{2}}dx = \frac{2}{a^2}\left[\frac{(ax+b)^{\frac{4\pm n}{2}}}{4\pm n} - \frac{b(ax+b)^{\frac{2\pm n}{2}}}{2\pm n}\right].$$

79. $$\int \frac{dx}{x(ax+b)^{\frac{n}{2}}} = \frac{1}{b}\int \frac{dx}{x(ax+b)^{\frac{n-2}{2}}} - \frac{a}{b}\int \frac{dx}{(ax+b)^{\frac{n}{2}}}.$$

80. $$\int \frac{x^m dx}{\sqrt{ax+b}} = \frac{2x^m\sqrt{ax+b}}{(2m+1)a} - \frac{2mb}{(2m+1)a}\int \frac{x^{m-1}dx}{\sqrt{ax+b}}.$$

81. $$\int \frac{dx}{x^n\sqrt{ax+b}} = \frac{-\sqrt{ax+b}}{(n-1)bx^{n-1}} - \frac{(2n-3)a}{(2n-2)b}\int \frac{dx}{x^{n-1}\sqrt{ax+b}}.$$

82. $$\int \frac{(ax+b)^{\frac{n}{2}}}{x}dx = a\int (ax+b)^{\frac{n-2}{2}}dx + b\int \frac{(ax+b)^{\frac{n-2}{2}}}{x}dx.$$

83. $$\int \frac{dx}{(ax+b)(cx+d)} = \frac{1}{bc-ad}\log\frac{cx+d}{ax+b},\ bc-ad \neq 0.$$

84. $$\int \frac{dx}{(ax+b)^2(cx+d)} = \frac{1}{bc-ad}\left[\frac{1}{ax+b} + \frac{c}{bc-ad}\log\left(\frac{cx+d}{ax+b}\right)\right], bc-ad \neq 0.$$

85. $$\int (ax+b)^n(cx+d)^m\,dx = \frac{1}{(m+n+1)a}\Big[(ax+b)^{n+1}(cx+d)^m - m(bc-ad)\int (ax+b)^n(cx+d)^{m-1}\,dx\Big].$$

86. $$\int \frac{dx}{(ax+b)^n(cx+d)^m} = \frac{1}{(m-1)(bc-ad)}\left[\frac{1}{(ax+b)^{n-1}(cx+d)^{m-1}}\right.$$
$$\left. -a(m+n-2)\int \frac{dx}{(ax+b)^n(cx+d)^{m-1}}\right], \; m>1,\; n>0,\; bc-ad\neq 0.$$

87. $$\int \frac{(ax+b)^n}{(cx+d)^m}\,dx$$
$$= -\frac{1}{(m-1)(bc-ad)}\left[\frac{(ax+b)^{n+1}}{(cx+d)^{m-1}} + (m-n-2)a\int \frac{(ax+b)^n dx}{(cx+d)^{m-1}}\right],$$
$$= \frac{-1}{(m-n-1)c}\left[\frac{(ax+b)^n}{(cx+d)^{m-1}} + n(bc-ad)\int \frac{(ax+b)^{n-1}}{(cx+d)^m}\,dx\right].$$

88. $$\int \frac{xdx}{(ax+b)(cx+d)} = \frac{1}{bc-ad}\left[\frac{b}{a}\log(ax+b)\right.$$
$$\left. -\frac{d}{c}\log(cx+d)\right], \; bc-ad\neq 0.$$

89. $$\int \frac{xdx}{(ax+b)^2(cx+d)} = \frac{1}{bc-ad}\left[-\frac{b}{a(ax+b)}\right.$$
$$\left. -\frac{d}{bc-ad}\log\frac{cx+d}{ax+b}\right], \; bc-ad\neq 0.$$

90. $$\int \frac{cx+d}{\sqrt{ax+b}}\,dx = \frac{2}{3a^2}(3ad-2bc+acx)\sqrt{ax+b}.$$

91. $$\int \frac{\sqrt{ax+b}}{cx+d}\,dx = \frac{2\sqrt{ax+b}}{c}$$
$$-\frac{2}{c}\sqrt{\frac{ad-bc}{c}}\tan^{-1}\sqrt{\frac{c(ax+b)}{ad-bc}}, \; c>0,\; ad>bc.$$

92. $$\int \frac{\sqrt{ax+b}}{cx+d}\,dx = \frac{2\sqrt{ax+b}}{c}$$
$$+\frac{1}{c}\sqrt{\frac{bc-ad}{c}}\log\frac{\sqrt{c(ax+b)}-\sqrt{bc-ad}}{\sqrt{c(ax+b)}+\sqrt{bc-ad}}, \; c>0,\; bc>ad.$$

93. $$\int \frac{dx}{(cx+d)\sqrt{ax+b}} = \frac{2}{\sqrt{c}\sqrt{ad-bc}}\tan^{-1}\sqrt{\frac{c(ax+b)}{ad-bc}},$$
$$c>0,\; ad>bc.$$

94. $$\int \frac{dx}{(cx+d)\sqrt{ax+b}}$$

$$= \frac{1}{\sqrt{c}\sqrt{bc-ad}} \log \frac{\sqrt{c(ax+b)} - \sqrt{bc-ad}}{\sqrt{c(ax+b)} + \sqrt{bc-ad}} \quad c > 0,\ bc > ad.$$

Expressions Containing $ax^2 + c$, $ax^n + c$, $x^2 \pm p^2$, and $p^2 - x^2$.

95. $$\int \frac{dx}{p^2+x^2} = \frac{1}{p} \tan^{-1} \frac{x}{p}, \text{ or } -\frac{1}{p} \operatorname{ctn}^{-1}\left(\frac{x}{p}\right).$$

96. $$\int \frac{dx}{p^2-x^2} = \frac{1}{2p} \log \frac{p+x}{p-x}, \text{ or } \frac{1}{p} \tanh^{-1}\left(\frac{x}{p}\right).$$

97. $$\int \frac{dx}{ax^2+c} = \frac{1}{\sqrt{ac}} \tan^{-1}\left(x\sqrt{\frac{a}{c}}\right), \quad a \text{ and } c > 0.$$

98. $$\int \frac{dx}{ax^2+c} = \frac{1}{2\sqrt{-ac}} \log \frac{x\sqrt{a} - \sqrt{-c}}{x\sqrt{a} + \sqrt{-c}}, \quad a>0,\ c<0.$$

$$= \frac{1}{2\sqrt{-ac}} \log \frac{\sqrt{c} + x\sqrt{-a}}{\sqrt{c} - x\sqrt{-a}}, \quad a < 0,\ c > 0.$$

99. $$\int \frac{dx}{(ax^2+c)^n} = \frac{1}{2(n-1)c} \cdot \frac{x}{(ax^2+c)^{n-1}} + \frac{2n-3}{2(n-1)c} \int \frac{dx}{(ax^2+c)^{n-1}}, \quad n \text{ a positive integer.}$$

100. $$\int x(ax^2+c)^n\,dx = \frac{1}{2a} \frac{(ax^2+c)^{n+1}}{n+1}, \quad n \neq -1.$$

101. $$\int \frac{x}{ax^2+c}\,dx = \frac{1}{2a} \log(ax^2+c).$$

102. $$\int \frac{dx}{x(ax^2+c)} = \frac{1}{2c} \log \frac{ax^2}{ax^2+c}.$$

103. $$\int \frac{dx}{x^2(ax^2+c)} = -\frac{1}{cx} - \frac{a}{c} \int \frac{dx}{ax^2+c}.$$

104. $$\int \frac{x^2\,dx}{ax^2+c} = \frac{x}{a} - \frac{c}{a} \int \frac{dx}{ax^2+c}.$$

105. $\int \frac{x^n dx}{ax^2 + c} = \frac{x^{n-1}}{a(n-1)} - \frac{c}{a}\int \frac{x^{n-2}dx}{ax^2 + c}, \; n \neq 1.$

106. $\int \frac{x^2 dx}{(ax^2 + c)^n} = -\frac{1}{2(n-1)a} \cdot \frac{x}{(ax^2 + c)^{n-1}} + \frac{1}{2(n-1)a}\int \frac{dx}{(ax^2 + c)^{n-1}}.$

107. $\int \frac{dx}{x^2(ax^2 + c)^n} = \frac{1}{c}\int \frac{dx}{x^2(ax^2 + c)^{n-1}} - \frac{a}{c}\int \frac{dx}{(ax^2 + c)^n}.$

108. $\int \sqrt{x^2 \pm p^2}\, dx = \frac{1}{2}\left[x\sqrt{x^2 \pm p^2} \pm p^2 \log\,(x + \sqrt{x^2 \pm p^2})\right].$

109. $\int \sqrt{p^2 - x^2}\, dx = \frac{1}{2}\left[x\sqrt{p^2 - x^2} + p^2 \sin^{-1}\left(\frac{x}{p}\right)\right].$

110. $\int \frac{dx}{\sqrt{x^2 \pm p^2}} = \log\,(x + \sqrt{x^2 \pm p^2}).$

111. $\int \frac{dx}{\sqrt{p^2 - x^2}} = \sin^{-1}\left(\frac{x}{p}\right) \text{ or } -\cos^{-1}\left(\frac{x}{p}\right).$

112. $\int \sqrt{ax^2 + c}\, dx = \frac{x}{2}\sqrt{ax^2 + c} + \frac{c}{2\sqrt{a}} \log\left(x\sqrt{a} + \sqrt{ax^2 + c}\right), \; a > 0.$

113. $\int \sqrt{ax^2 + c}\, dx = \frac{x}{2}\sqrt{ax^2 + c} + \frac{c}{2\sqrt{-a}} \sin^{-1}\left(x\sqrt{\frac{-a}{c}}\right), \; a < 0.$

114. $\int \frac{dx}{\sqrt{ax^2 + c}} = \frac{1}{\sqrt{a}} \log\,(x\sqrt{a} + \sqrt{ax^2 + c}), \; a > 0.$

115. $\int \frac{dx}{\sqrt{ax^2 + c}} = \frac{1}{\sqrt{-a}} \sin^{-1}\left(x\sqrt{\frac{-a}{c}}\right), \; a < 0.$

116. $\int x\sqrt{ax^2 + c} \cdot dx = \frac{1}{3a}\,(ax^2 + c)^{\frac{3}{2}}.$

117. $$\int x^2\sqrt{ax^2+c}\,dx = \frac{x}{4a}\sqrt{(ax^2+c)^3} - \frac{cx}{8a}\sqrt{ax^2+c} - \frac{c^2}{8\sqrt{a^3}}\log\left(x\sqrt{a}+\sqrt{ax^2+c}\right),\ a>0.$$

118. $$\int x^2\sqrt{ax^2+c}\,dx = \frac{x}{4a}\sqrt{(ax^2+c)^3} - \frac{cx}{8a}\sqrt{ax^2+c} - \frac{c^2}{8a\sqrt{-a}}\sin^{-1}\left(x\sqrt{\frac{-a}{c}}\right),\ a<0.$$

119. $$\int \frac{x\,dx}{\sqrt{ax^2+c}} = \frac{1}{a}\sqrt{ax^2+c}\,.$$

120. $$\int \frac{x^2dx}{\sqrt{ax^2+c}} = \frac{x}{a}\sqrt{ax^2+c} - \frac{1}{a}\int\sqrt{ax^2+c}\,dx.$$

121. $$\int \frac{\sqrt{ax^2+c}}{x}\,dx = \sqrt{ax^2+c} + \sqrt{c}\log\frac{\sqrt{ax^2+c}-\sqrt{c}}{x},\ c>0.$$

122. $$\int \frac{\sqrt{ax^2+c}}{x}\,dx = \sqrt{ax^2+c} - \sqrt{-c}\tan^{-1}\frac{\sqrt{ax^2+c}}{\sqrt{-c}},\ c<0.$$

123. $$\int \frac{dx}{x\sqrt{p^2\pm x^2}} = -\frac{1}{p}\log\left(\frac{p+\sqrt{p^2\pm x^2}}{x}\right).$$

124. $$\int \frac{dx}{x\sqrt{x^2-p^2}} = \frac{1}{p}\cos^{-1}\left(\frac{p}{x}\right), \text{ or } -\frac{1}{p}\sin^{-1}\left(\frac{p}{x}\right).$$

125. $$\int \frac{dx}{x\sqrt{ax^2+c}} = \frac{1}{\sqrt{c}}\log\frac{\sqrt{ax^2+c}-\sqrt{c}}{x},\quad c>0.$$

126. $$\int \frac{dx}{x\sqrt{ax^2+c}} = \frac{1}{\sqrt{-c}}\sec^{-1}\left(x\sqrt{-\frac{a}{c}}\right),\quad c<0.$$

127. $$\int \frac{dx}{x^2\sqrt{ax^2+c}} = -\frac{\sqrt{ax^2+c}}{cx}.$$

128. $$\int \frac{x^n dx}{\sqrt{ax^2+c}} = \frac{x^{n-1}\sqrt{ax^2+c}}{na} - \frac{(n-1)c}{na}\int \frac{x^{n-2}dx}{\sqrt{ax^2+c}}, \; n>0.$$

129. $$\int x^n\sqrt{ax^2+c}\,dx = \frac{x^{n-1}(ax^2+c)^{\frac{3}{2}}}{(n+2)a} - \frac{(n-1)c}{(n+2)a}\int x^{n-2}\sqrt{ax^2+c}\cdot dx, \; n>0.$$

130. $$\int \frac{\sqrt{ax^2+c}}{x^n}\,dx = -\frac{(ax^2+c)^{\frac{3}{2}}}{c(n-1)x^{n-1}} - \frac{(n-4)a}{(n-1)c}\int \frac{\sqrt{ax^2+c}}{x^{n-2}}\,dx, \; n>1.$$

131. $$\int \frac{dx}{x^n\sqrt{ax^2+c}} = -\frac{\sqrt{ax^2+c}}{c(n-1)x^{n-1}} - \frac{(n-2)\;a}{(n-1)\;c}\int \frac{dx}{x^{n-2}\sqrt{ax^2+c}}, \; n>1.$$

132. $$\int (ax^2+c)^{\frac{3}{2}}\,dx = \frac{x}{8}(2ax^2+5c)\sqrt{ax^2+c} + \frac{3c^2}{8\sqrt{a}}\log\left(x\sqrt{a}+\sqrt{ax^2+c}\right), \; a>0.$$

133. $$\int (ax^2+c)^{\frac{3}{2}}\,dx = \frac{x}{8}(2ax^2+5c)\sqrt{ax^2+c} + \frac{3c^2}{8\sqrt{-a}}\sin^{-1}\left(x\sqrt{\frac{-a}{c}}\right), \; a<0.$$

134. $$\int \frac{dx}{(ax^2+c)^{\frac{3}{2}}} = \frac{x}{c\sqrt{ax^2+c}}$$

135. $$\int x(ax^2+c)^{\frac{3}{2}}\,dx = \frac{1}{5a}(ax^2+c)^{\frac{5}{2}}.$$

136. $$\int x^2(ax^2+c)^{\frac{3}{2}}\,dx = \frac{x^3}{6}(ax^2+c)^{\frac{3}{2}} + \frac{c}{2}\int x^2\sqrt{ax^2+c}\,dx.$$

137. $$\int x^n(ax^2+c)^{\frac{3}{2}}\,dx = \frac{x^{n+1}(ax^2+c)^{\frac{3}{2}}}{n+4} + \frac{3c}{n+4}\int x^n\sqrt{ax^2+c}\,dx.$$

138. $$\int \frac{xdx}{(ax^2+c)^{\frac{3}{2}}} = -\frac{1}{a\sqrt{ax^2+c}}.$$

139. $$\int \frac{x^2dx}{(ax^2+c)^{\frac{3}{2}}} = -\frac{x}{a\sqrt{ax^2+c}} + \frac{1}{a\sqrt{a}} \log\ (x\sqrt{a} + \sqrt{ax^2+c}),\quad a>0.$$

140. $$\int \frac{x^2dx}{(ax^2+c)^{\frac{3}{2}}} = -\frac{x}{a\sqrt{ax^2+c}} + \frac{1}{a\sqrt{-a}} \sin^{-1}\left(x\sqrt{\frac{-a}{c}}\right),\quad a<0.$$

141. $$\int \frac{x^3dx}{(ax^2+c)^{\frac{3}{2}}} = -\frac{x^2}{a\sqrt{ax^2+c}} + \frac{2}{a^2}\sqrt{ax^2+c}.$$

142. $$\int \frac{dx}{x(ax^n+c)} = \frac{1}{cn} \log \frac{x^n}{ax^n+c}.$$

143. $$\int \frac{dx}{(ax^n+c)^m} = \frac{1}{c}\int \frac{dx}{(ax^n+c)^{m-1}} - \frac{a}{c}\int \frac{x^n dx}{(ax^n+c)^m}.$$

144. $$\int \frac{dx}{x\sqrt{ax^n+c}} = \frac{1}{n\sqrt{c}} \log \frac{\sqrt{ax^n+c}-\sqrt{c}}{\sqrt{ax^n+c}+\sqrt{c}},\quad c>0.$$

145. $$\int \frac{dx}{x\sqrt{ax^n+c}} = \frac{2}{n\sqrt{-c}} \sec^{-1}\sqrt{\frac{-ax^n}{c}},\quad c<0.$$

146. $$\int x^{m-1}(ax^n+c)^p dx$$

$$= \frac{1}{m+np}\left[x^m(ax^n+c)^p + npc\int x^{m-1}(ax^n+c)^{p-1}dx\right]$$

$$= \frac{1}{cn(p+1)}\left[-x^m(ax^n+c)^{p+1} + (m+np+n)\int x^{m-1}(ax^n+c)^{p+1}dx\right].$$

$$= \frac{1}{a(m+np)}\left[x^{m-n}(ax^n+c)^{p+1} - (m-n)c\int x^{m-n-1}(ax^n+c)^p dx\right].$$

$$= \frac{1}{mc}\left[x^m(ax^n+c)^{p+1} - (m+np+n)\int x^{m+n-1}(ax^n+c)^p dx\right].$$

147. $$\int \frac{x^m dx}{(ax^n+c)^p} = \frac{1}{a}\int \frac{x^{m-n}dx}{(ax^n+c)^{p-1}} - \frac{c}{a}\int \frac{x^{m-n}dx}{(ax^n+c)^p}.$$

148. $$\int \frac{dx}{x^m(ax^n+c)^p} = \frac{1}{c}\int \frac{dx}{x^m(ax^n+c)^{p-1}} - \frac{a}{c}\int \frac{dx}{x^{m-n}(ax^n+c)^p}.$$

Expressions Containing $(ax^2 + bx + c)$.

149. $$\int \frac{dx}{ax^2+bx+c} = \frac{1}{\sqrt{b^2-4ac}} \log \frac{2ax+b-\sqrt{b^2-4ac}}{2ax+b+\sqrt{b^2-4ac}}, \quad b^2 > 4ac.$$

150. $$\int \frac{dx}{ax^2+bx+c} = \frac{2}{\sqrt{4ac-b^2}} \tan^{-1}\frac{2ax+b}{\sqrt{4ac-b^2}}, \quad b^2 < 4ac.$$

151. $$\int \frac{dx}{ax^2+bx+c} = -\frac{2}{2ax+b}, \quad b^2 = 4ac.$$

152. $$\int \frac{dx}{(ax^2+bx+c)^{n+1}} = \frac{2ax+b}{n(4ac-b^2)(ax^2+bx+c)^n} + \frac{2(2n-1)a}{n(4ac-b^2)}\int \frac{dx}{(ax^2+bx+c)^n}.$$

153. $$\int \frac{xdx}{ax^2+bx+c} = \frac{1}{2a}\log(ax^2+bx+c) - \frac{b}{2a}\int \frac{dx}{ax^2+bx+c}.$$

154. $$\int \frac{x^2dx}{ax^2+bx+c} = \frac{x}{a} - \frac{b}{2a^2}\log(ax^2+bx+c) + \frac{b^2-2ac}{2a^2}\int \frac{dx}{ax^2+bx+c}.$$

155. $$\int \frac{x^n dx}{ax^2+bx+c} = \frac{x^{n-1}}{(n-1)a} - \frac{c}{a}\int \frac{x^{n-2}dx}{ax^2+bx+c} - \frac{b}{a}\int \frac{x^{n-1}dx}{ax^2+bx+c}.$$

156. $$\int \frac{xdx}{(ax^2+bx+c)^{n+1}} = \frac{-(2c+bx)}{n(4ac-b^2)(ax^2+bx+c)^n} - \frac{b(2n-1)}{n(4ac-b^2)}\int \frac{dx}{(ax^2+bx+c)^n}.$$

157. $$\int \frac{x^m dx}{(ax^2+bx+c)^{n+1}} = -\frac{x^{m-1}}{a(2n-m+1)(ax^2+bx+c)^n} - \frac{n-m+1}{2n-m+1}\cdot\frac{b}{a}\int \frac{x^{m-1}dx}{(ax^2+bx+c)^{n+1}} + \frac{m-1}{2n-m+1}\cdot\frac{c}{a}\int \frac{x^{m-2}dx}{(ax^2+bx+c)^{n+1}}.$$

158. $$\int \frac{dx}{x(ax^2+bx+c)} = \frac{1}{2c}\log\frac{x^2}{ax^2+bx+c} - \frac{b}{2c}\int \frac{dx}{(ax^2+bx+c)}.$$

159. $$\int \frac{dx}{x^2(ax^2+bx+c)} = \frac{b}{2c^2}\log\left(\frac{ax^2+bx+c}{x^2}\right) - \frac{1}{cx} + \left(\frac{b^2}{2c^2} - \frac{a}{c}\right)\int \frac{dx}{(ax^2+bx+c)}.$$

160. $$\int \frac{dx}{x^m(ax^2+bx+c)^{n+1}} = -\frac{1}{(m-1)cx^{m-1}(ax^2+bx+c)^n} - \frac{(n+m-1)}{m-1}\cdot\frac{b}{c}\int \frac{dx}{x^{m-1}(ax^2+bx+c)^{n+1}} - \frac{(2n+m-1)}{m-1}\cdot\frac{a}{c}\int \frac{dx}{x^{m-2}(ax^2+bx+c)^{n+1}}.$$

161. $$\int \frac{dx}{x(ax^2+bx+c)^n} = \frac{1}{2c(n-1)(ax^2+bx+c)^{n-1}} - \frac{b}{2c}\int \frac{dx}{(ax^2+bx+c)^n} + \frac{1}{c}\int \frac{dx}{x(ax^2+bx+c)^{n-1}}.$$

162. $$\int \frac{dx}{\sqrt{ax^2+bx+c}} = \frac{1}{\sqrt{a}}\log(2ax+b+2\sqrt{a}\sqrt{ax^2+bx+c}),\ a>0.$$

163. $$\int \frac{dx}{\sqrt{ax^2+bx+c}} = \frac{1}{\sqrt{-a}}\sin^{-1}\frac{-2ax-b}{\sqrt{b^2-4ac}},\ a<0.$$

164. $$\int \frac{xdx}{\sqrt{ax^2+bx+c}} = \frac{\sqrt{ax^2+bx+c}}{a} - \frac{b}{2a}\int \frac{dx}{\sqrt{ax^2+bx+c}}.$$

165. $$\int \frac{x^n dx}{\sqrt{ax^2+bx+c}} = \frac{x^{n-1}}{an}\sqrt{ax^2+bx+c} - \frac{b(2n-1)}{2an}\int \frac{x^{n-1}dx}{\sqrt{ax^2+bx+c}} - \frac{c(n-1)}{an}\int \frac{x^{n-2}dx}{\sqrt{ax^2+bx+c}}.$$

166. $$\int \sqrt{ax^2+bx+c}\,dx = \frac{2ax+b}{4a}\sqrt{ax^2+bx+c} + \frac{4ac-b^2}{8a}\int \frac{dx}{\sqrt{ax^2+bx+c}}.$$

167. $$\int x\sqrt{ax^2+bx+c}\,dx = \frac{(ax^2+bx+c)^{\frac{3}{2}}}{3a} - \frac{b}{2a}\int \sqrt{ax^2+bx+c}\,dx.$$

168. $$\int x^2\sqrt{ax^2+bx+c}\,dx = \left(x-\frac{5b}{6a}\right)\frac{(ax^2+bx+c)^{\frac{3}{2}}}{4a} + \frac{(5b^2-4ac)}{16a^2}\int\sqrt{ax^2+bx+c}\,dx.$$

169. $$\int\frac{dx}{x\sqrt{ax^2+bx+c}} = -\frac{1}{\sqrt{c}}\log\left(\frac{\sqrt{ax^2+bx+c}+\sqrt{c}}{x}+\frac{b}{2\sqrt{c}}\right), c>0.$$

170. $$\int\frac{dx}{x\sqrt{ax^2+bx+c}} = \frac{1}{\sqrt{-c}}\sin^{-1}\frac{bx+2c}{x\sqrt{b^2-4ac}},\ c<0.$$

171. $$\int\frac{dx}{x\sqrt{ax^2+bx}} = -\frac{2}{bx}\sqrt{ax^2+bx},\ c=0.$$

172. $$\int\frac{dx}{x^n\sqrt{ax^2+bx+c}} = -\frac{\sqrt{ax^2+bx+c}}{c(n-1)x^{n-1}} + \frac{b(3-2n)}{2c(n-1)}\int\frac{dx}{x^{n-1}\sqrt{ax^2+bx+c}} + \frac{a(2-n)}{c(n-1)}\int\frac{dx}{x^{n-2}\sqrt{ax^2+bx+c}}.$$

173. $$\int\frac{dx}{(ax^2+bx+c)^{\frac{3}{2}}} = -\frac{2(2ax+b)}{(b^2-4ac)\sqrt{ax^2+bx+c}},\ b^2\neq 4ac.$$

174. $$\int\frac{dx}{(ax^2+bx+c)^{\frac{3}{2}}} = -\frac{1}{2\sqrt{a^3}(x+b/2a)^2},\ b^2=4ac.$$

Miscellaneous Algebraic Expressions.

175. $$\int\sqrt{2px-x^2}\,dx = \frac{1}{2}\left[(x-p)\sqrt{2px-x^2}+p^2\sin^{-1}[(x-p)/p]\right].$$

176. $$\int\frac{dx}{\sqrt{2px-x^2}} = \cos^{-1}\left(\frac{p-x}{p}\right).$$

177. $$\int\frac{dx}{\sqrt{ax+b}\cdot\sqrt{cx+d}} = \frac{2}{\sqrt{-ac}}\tan^{-1}\sqrt{\frac{-c(ax+b)}{a(cx+d)}}$$ or $$\frac{2}{\sqrt{ac}}\tanh^{-1}\sqrt{\frac{c(ax+b)}{a(cx+d)}}.$$

178. $$\int\sqrt{ax+b}\cdot\sqrt{cx+d}\,dx = \frac{(2acx+bc+ad)\sqrt{ax+b}\cdot\sqrt{cx+d}}{4ac} + \frac{(ad-bc)^2}{8ac}\int\frac{dx}{\sqrt{ax+b}\cdot\sqrt{cx+d}}.$$

179. $\int \sqrt{\frac{cx+d}{ax+b}}\,dx = \frac{\sqrt{ax+b}\cdot\sqrt{cx+d}}{a} + \frac{(ad-bc)}{2a}\int \frac{dx}{\sqrt{ax+b}\cdot\sqrt{cx+d}}.$

180. $\int \sqrt{\frac{x+b}{x+d}}\,dx = \sqrt{x+d}\cdot\sqrt{x+b} + (b-d)\log[\sqrt{x+d}+\sqrt{x+b}].$

181. $\int \sqrt{\frac{1+x}{1-x}}\,dx = \sin^{-1}x - \sqrt{1-x^2}.$

182. $\int \sqrt{\frac{p-x}{q+x}}dx = \sqrt{p-x}\cdot\sqrt{q+x} + (p+q)\sin^{-1}\sqrt{\frac{x+q}{p+q}}.$

183. $\int \sqrt{\frac{p+x}{q-x}}dx = -\sqrt{p+x}\cdot\sqrt{q-x} + (p+q)\sin^{-1}\sqrt{\frac{q-x}{p+q}}.$

184. $\int \frac{dx}{\sqrt{x-p}\cdot\sqrt{q-x}} = 2\sin^{-1}\sqrt{\frac{x-p}{q-p}}.$

Expressions Containing sin *ax.*

185. $\int \sin u\,du = -\cos u$, where u is any function of x.

186. $\int \sin ax\,dx = -\frac{1}{a}\cos ax.$

187. $\int \sin^2 ax\,dx = \frac{x}{2} - \frac{\sin 2ax}{4a}.$

188. $\int \sin^3 ax\,dx = -\frac{1}{a}\cos ax + \frac{1}{3a}\cos^3 ax.$

189. $\int \sin^4 ax\,dx = \frac{3x}{8} - \frac{3\sin 2ax}{16a} - \frac{\sin^3 ax\cos ax}{4a}.$

190. $\int \sin^n ax\,dx = -\frac{\sin^{n-1} ax\cos ax}{na} + \frac{n-1}{n}\int \sin^{n-2} ax\,dx,$ (n pos. integer).

191. $\int \frac{dx}{\sin ax} = \frac{1}{a} \log \tan \frac{ax}{2} = \frac{1}{a} \log (\csc ax - \operatorname{ctn} ax).$

192. $\int \frac{dx}{\sin^2 ax} = \int \csc^2 ax\, dx = -\frac{1}{a} \operatorname{ctn} ax.$

193. $\int \frac{dx}{\sin^n ax} = -\frac{1}{a(n-1)} \frac{\cos ax}{\sin^{n-1} ax} + \frac{n-2}{n-1} \int \frac{dx}{\sin^{n-2} ax},$ n integer > 1.

194. $\int \frac{dx}{1 \pm \sin ax} = \mp \frac{1}{a} \tan \left(\frac{\pi}{4} \mp \frac{ax}{2}\right).$

195. $\int \frac{dx}{b + c \sin ax} = \frac{-2}{a\sqrt{b^2 - c^2}} \tan^{-1}\left[\sqrt{\frac{b-c}{b+c}} \tan\left(\frac{\pi}{4} - \frac{ax}{2}\right)\right], \quad b^2 > c^2.$

196. $\int \frac{dx}{b + c \sin ax} = \frac{-1}{a\sqrt{c^2 - b^2}} \log \frac{c + b \sin ax + \sqrt{c^2 - b^2} \cos ax}{b + c \sin ax}, \quad c^2 > b^2.$

197. $\int \sin ax \sin bx\, dx = \frac{\sin (a-b)x}{2(a-b)} - \frac{\sin (a+b)x}{2(a+b)}, \quad a^2 \neq b^2.$

198. $\int \sqrt{1 + \sin x}\, dx = \pm 2\left(\sin \frac{x}{2} - \cos \frac{x}{2}\right)$; use + sign when $(8k-1)\frac{\pi}{2} < x \leqq (8k+3)\frac{\pi}{2}$, otherwise −, k an integer.

199. $\int \sqrt{1 - \sin x}\, dx = \pm 2\left(\sin \frac{x}{2} + \cos \frac{x}{2}\right)$; use + sign when $(8k-3)\frac{\pi}{2} < x \leqq (8k+1)\frac{\pi}{2}$, otherwise −, k an integer.

Expressions Involving cos *ax.*

200. $\int \cos u\, du = \sin u$, where u is any function of x.

201. $\int \cos ax\, dx = \frac{1}{a} \sin ax.$

202. $\int \cos^2 ax\, dx = \frac{x}{2} + \frac{\sin 2ax}{4a}.$

203. $\int \cos^3 ax\, dx = \frac{1}{a} \sin ax - \frac{1}{3a} \sin^3 ax.$

204. $\int \cos^4 ax\, dx = \frac{3x}{8} + \frac{3 \sin 2ax}{16a} + \frac{\cos^3 ax \sin ax}{4a}.$

205. $\int \cos^n ax\, dx = \frac{\cos^{n-1} ax \sin ax}{na} + \frac{n-1}{n} \int \cos^{n-2} ax\, dx.$ (n pos. integer).

206. $\int \frac{dx}{\cos ax} = \frac{1}{a} \log \tan\left(\frac{ax}{2} + \frac{\pi}{4}\right) = \frac{1}{a} \log (\tan ax + \sec ax).$

207. $\int \frac{dx}{\cos^2 ax} = \frac{1}{a} \tan ax.$

208. $\int \frac{dx}{\cos^n ax} = \frac{1}{a(n-1)} \frac{\sin ax}{\cos^{n-1} ax} + \frac{n-2}{n-1} \int \frac{dx}{\cos^{n-2} ax},$
n integer > 1.

209. $\int \frac{dx}{1 + \cos ax} = \frac{1}{a} \tan \frac{ax}{2}.$ 210. $\int \frac{dx}{1 - \cos ax} = -\frac{1}{a} \operatorname{ctn} \frac{ax}{2}.$

211. $\int \sqrt{1 + \cos x} \cdot dx = \pm\sqrt{2} \int \cos \frac{x}{2}\, dx = \pm 2\sqrt{2} \sin \frac{x}{2}.$
Use + when $(4k-1)\pi < x \leqq (4k+1)\pi$, otherwise $-$, k an integer.

212. $\int \sqrt{1 - \cos x} \cdot dx = \pm\sqrt{2} \int \sin \frac{x}{2}\, dx = \mp 2\sqrt{2} \cos \frac{x}{2}.$
Use top signs when $4k\pi < x \leqq (4k+2)\pi$, otherwise bottom signs.

213. $\int \frac{dx}{b + c \cos ax} = \frac{1}{a\sqrt{b^2 - c^2}} \tan^{-1}\left(\frac{\sqrt{b^2 - c^2} \cdot \sin ax}{c + b \cos ax}\right), \; b^2 > c^2.$

214. $\int \frac{dx}{b + c \cos ax} = \frac{1}{a\sqrt{c^2 - b^2}} \tanh^{-1}\left[\frac{\sqrt{c^2 - b^2} \cdot \sin ax}{c + b \cos ax}\right], c^2 > b^2.$

215. $\int \cos ax \cdot \cos bx \, dx = \frac{\sin (a-b)x}{2(a-b)} + \frac{\sin (a+b)x}{2(a+b)}, a^2 \neq b^2.$

Expressions Containing sin *ax and* cos *ax.*

216. $\int \sin ax \cos bx \, dx = -\tfrac{1}{2}\left[\frac{\cos (a-b)x}{a-b} + \frac{\cos (a+b)x}{a+b}\right], \; a^2 \neq b^2.$

217. $\int \sin^n ax \cos ax \, dx = \frac{1}{a(n+1)} \sin^{n+1} ax, \quad n \neq -1.$

218. $\int \cos^n ax \sin ax \, dx = -\frac{1}{a(n+1)} \cos^{n+1} ax, \quad n \neq -1.$

219. $\int \frac{\sin ax}{\cos ax} dx = -\frac{1}{a} \log \cos ax.$

220. $\int \frac{\cos ax}{\sin ax}\,dx = \frac{1}{a}\log \sin ax.$

221. $\int (b+c\sin ax)^n \cos ax\,dx = \frac{1}{ac(n+1)}(b+c\sin ax)^{n+1}, n\neq -1.$

222. $\int (b+c\cos ax)^n \sin ax\,dx = -\frac{1}{ac(n+1)}(b+c\cos ax)^{n+1}, n\neq -1.$

223. $\int \frac{\cos ax\,dx}{b+c\sin ax} = \frac{1}{ac}\log(b+c\sin ax).$

224. $\int \frac{\sin ax}{b+c\cos ax}\,dx = -\frac{1}{ac}\log(b+c\cos ax).$

225. $\int \frac{dx}{b\sin ax + c\cos ax} = \frac{1}{a\sqrt{b^2+c^2}}\left[\log\tan\tfrac{1}{2}\left(ax+\tan^{-1}\frac{c}{b}\right)\right].$

226. $\int \frac{dx}{b+c\cos ax + d\sin ax} = \frac{-1}{a\sqrt{b^2-c^2-d^2}}\sin^{-1}U,$

$$U \equiv \left[\frac{c^2+d^2+b(c\cos ax + a\sin ax)}{\sqrt{c^2+d^2}\,(b+c\cos ax + d\sin ax)}\right]; \text{ or } = \frac{1}{a\sqrt{c^2+d^2-b^2}}\log V,$$

$$V \equiv \left[\frac{c^2+d^2+b(c\cos ax + d\sin ax) + \sqrt{c^2+d^2-b^2}\,(c\sin ax - d\cos ax)}{\sqrt{c^2+d^2}\,(b+c\cos ax + d\sin ax)}\right],$$

$$b^2 \neq c^2+d^2,\ -\pi < ax < \pi.$$

227. $\int \frac{dx}{b+c\cos ax + d\sin ax}$

$$= \frac{1}{ab}\left[\frac{b-(c+d)\cos ax + (c-d)\sin ax}{b+(c-d)\cos ax + (c+d)\sin ax}\right],\ b^2 = c^2+d^2.$$

228. $$\int \frac{\sin^2 ax\,dx}{b + c\cos^2 ax} = \frac{1}{ac}\sqrt{\frac{b+c}{b}}\tan^{-1}\left(\sqrt{\frac{b}{b+c}}\cdot\tan ax\right) - \frac{x}{c}.$$

229. $$\int \frac{\sin ax\cos ax\,dx}{b\cos^2 ax + c\sin^2 ax} = \frac{1}{2a(c-b)}\log\,(b\cos^2 ax + c\sin^2 ax).$$

230. $$\int \frac{dx}{b^2\cos^2 ax - c^2\sin^2 ax} = \frac{1}{2abc}\log\frac{b\cos ax + c\sin ax}{b\cos ax - c\sin ax}.$$

231. $$\int \frac{dx}{b^2\cos^2 ax + c^2\sin^2 ax} = \frac{1}{abc}\tan^{-1}\left(\frac{c\tan ax}{b}\right).$$

232. $$\int \sin^2 ax\cos^2 ax\,dx = \frac{x}{8} - \frac{\sin 4\,ax}{32\,a}.$$

233. $$\int \frac{dx}{\sin ax\cos ax} = \frac{1}{a}\log\tan ax.$$

234. $$\int \frac{dx}{\sin^2 ax\cos^2 ax} = \frac{1}{a}(\tan ax - \operatorname{ctn} ax).$$

235. $$\int \frac{\sin^2 ax}{\cos ax}dx = \frac{1}{a}\left[-\sin ax + \log\tan\left(\frac{ax}{2} + \frac{\pi}{4}\right)\right].$$

236. $$\int \frac{\cos^2 ax}{\sin ax}dx = \frac{1}{a}\left[\cos ax + \log\tan\frac{ax}{2}\right].$$

237. $$\int \sin^m ax\cos^n ax\,dx = -\frac{\sin^{m-1} ax\cos^{n+1} ax}{a(m+n)} + \frac{m-1}{m+n}\int \sin^{m-2} ax\cos^n ax\,dx,\quad m, n > 0.$$

238. $$\int \sin^m ax\cos^n ax\,dx = \frac{\sin^{m+1} ax\cos^{n-1} ax}{a(m+n)} + \frac{n-1}{m+n}\int \sin^m ax\cos^{n-2} ax\,dx,\quad m, n > 0.$$

239. $$\int \frac{\sin^m ax}{\cos^n ax}dx = \frac{\sin^{m+1} ax}{a(n-1)\cos^{n-1} ax} - \frac{m-n+2}{n-1}\int \frac{\sin^m ax}{\cos^{n-2} ax}dx,\quad m, n > 0,\ n \neq 1.$$

240. $$\int \frac{\cos^n ax}{\sin^m ax}\,dx = \frac{-\cos^{n+1} ax}{a(m-1)\sin^{m-1} ax} + \frac{m-n-2}{(m-1)}\int \frac{\cos^n ax}{\sin^{m-2} ax}\,dx, \quad m, n, > 0, m \neq 1.$$

241. $$\int \frac{dx}{\sin^m ax \cos^n ax} = \frac{1}{a(n-1)}\frac{1}{\sin^{m-1} ax \cos^{n-1} ax} + \frac{m+n-2}{(n-1)}\int \frac{dx}{\sin^m ax \cos^{n-2} ax}.$$

242. $$\int \frac{dx}{\sin^m ax \cos^n ax} = -\frac{1}{a(m-1)}\frac{1}{\sin^{m-1} ax \cos^{n-1} ax} + \frac{m+n-2}{(m-1)}\int \frac{dx}{\sin^{m-2} ax \cos^n ax}.$$

243. $$\int \frac{\sin^{2n} ax}{\cos ax}\,dx = \int \frac{(1-\cos^2 ax)^n}{\cos ax}\,dx.$$ (Expand, divide, and use 205).

244. $$\int \frac{\cos^{2n} ax}{\sin ax}\,dx = \int \frac{(1-\sin^2 ax)^n}{\sin ax}\,dx.$$ (Expand, divide, and use 190).

245. $$\int \frac{\sin^{2n+1} ax}{\cos ax}\,dx = \int \frac{(1-\cos^2 ax)^n}{\cos ax}\sin ax\,dx.$$ (Expand, divide, and use 218).

246. $$\int \frac{\cos^{2n+1} ax}{\sin ax}\,dx = \int \frac{(1-\sin^2 ax)^n}{\sin ax}\cos ax\,dx.$$ (Expand, divide, and use 217).

Expressions Containing tan *ax or* ctn *ax* (tan $ax = 1/\text{ctn}\ ax$).

247. $$\int \tan u\,du = -\log \cos u,$$ or $\log \sec u$, where u is any function of x.

248. $$\int \tan ax\,dx = -\frac{1}{a}\log \cos ax.$$

249. $$\int \tan^2 ax\,dx = \frac{1}{a}\tan ax - x.$$

250. $$\int \tan^3 ax\,dx = \frac{1}{2a}\tan^2 ax + \frac{1}{a}\log \cos ax.$$

251. $\int \tan^n ax\,dx = \frac{1}{a(n-1)} \tan^{n-1} ax - \int \tan^{n-2} ax\,dx,$
n integer >1.

252. $\int \operatorname{ctn} u\,du = \log \sin u$, or $-\log \csc u$, where u is any function of x.

253. $\int \operatorname{ctn}^2 ax\,dx = \int \frac{dx}{\tan^2 ax} = -\frac{1}{a} \operatorname{ctn} ax - x.$

254. $\int \operatorname{ctn}^3 ax\,dx = -\frac{1}{2a} \operatorname{ctn}^2 ax - \frac{1}{a} \log \sin ax.$

255. $\int \operatorname{ctn}^n ax\,dx = \int \frac{dx}{\tan^n ax} = -\frac{1}{a(n-1)} \operatorname{ctn}^{n-1} ax$
$- \int \operatorname{ctn}^{n-2} ax\,dx,\ n$ integer $>1.$

256. $\int \frac{dx}{b + c \tan ax} = \int \frac{\operatorname{ctn} ax\,dx}{b \operatorname{ctn} ax + c}$
$= \frac{1}{b^2 + c^2} \left[bx + \frac{c}{a} \log (b \cos ax + c \sin ax) \right].$

257. $\int \frac{dx}{b + c \operatorname{ctn} ax} = \int \frac{\tan ax\,dx}{b \tan ax + c}$
$= \frac{1}{b^2 + c^2} \left[bx - \frac{c}{a} \log (c \cos ax + b \sin ax) \right].$

258. $\int \frac{dx}{\sqrt{b + c \tan^2 ax}} = \frac{1}{a\sqrt{b - c}} \sin^{-1} \left(\sqrt{\frac{b-c}{b}} \sin ax \right),\ b$ pos., $b^2 > c^2.$

***Expressions Containing* sec $ax = 1/\cos ax$ or csc $ax = 1/\sin ax$.**

259. $\int \sec u\,du = \log (\sec u + \tan u) = \log \tan \left(\frac{u}{2} + \frac{\pi}{4} \right),$
where u is any function of x.

260. $\int \sec ax\,dx = \frac{1}{a} \log \tan \left(\frac{ax}{2} + \frac{\pi}{4} \right).$

261. $\int \sec^2 ax\, dx = \frac{1}{a} \tan ax.$

262. $\int \sec^3 ax\, dx = \frac{1}{2a}\left[\tan ax \sec ax + \log \tan\left(\frac{ax}{2} + \frac{\pi}{4}\right)\right].$

263. $\int \sec^n ax\, dx = \frac{1}{a(n-1)} \frac{\sin ax}{\cos^{n-1} ax} + \frac{n-2}{n-1} \int \sec^{n-2} ax\, dx,$ n integer $> 1.$

264. $\int \csc u\, du = \log(\csc u - \operatorname{ctn} u) = \log \tan \frac{u}{2},$ where u is any function of $x.$

265. $\int \csc ax\, dx = \frac{1}{a} \log \tan \frac{ax}{2}.$

266. $\int \csc^2 ax\, dx = -\frac{1}{a} \operatorname{ctn} ax.$

267. $\int \csc^3 ax\, dx = \frac{1}{2a}\left[-\operatorname{ctn} ax \csc ax + \log \tan \frac{ax}{2}\right].$

268. $\int \csc^n ax\, dx = -\frac{1}{a(n-1)} \frac{\cos ax}{\sin^{n-1} ax} + \frac{n-2}{n-1} \int \csc^{n-2} ax\, dx,$ n integer $> 1.$

***Expressions Containing* tan ax and sec ax or ctn ax and csc ax.**

269. $\int \tan u \sec u\, du = \sec u,$ where u is any function of $x.$

270. $\int \tan ax \sec ax\, dx = \frac{1}{a} \sec ax.$

271. $\int \tan^n ax \sec^2 ax\, dx = \frac{1}{a(n+1)} \tan^{n+1} ax, \quad n \neq -1.$

272. $\int \tan ax \sec^n ax\, dx = \frac{1}{an} \sec^n ax, n \neq 0.$

273. $\int \operatorname{ctn} u \csc u\, du = -\csc u,$ where u is any function of $x.$

274. $\int \operatorname{ctn} ax \csc ax\, dx = -\frac{1}{a} \csc ax.$

275. $\int \operatorname{ctn}^n ax \csc^2 ax\, dx = -\frac{1}{a(n+1)} \operatorname{ctn}^{n+1} ax, \quad n \neq -1.$

276. $\int \operatorname{ctn} ax \csc^n ax\, dx = -\frac{1}{an} \csc^n ax, \; n \neq 0.$

277. $\int \frac{\csc^2 ax\, dx}{\operatorname{ctn} ax} = -\frac{1}{a} \log \operatorname{ctn} ax.$

Expressions Containing Algebraic and Trigonometric Functions.

278. $\int x \sin ax\, dx = \frac{1}{a^2} \sin ax - \frac{1}{a} x \cos ax.$

279. $\int x^2 \sin ax\, dx = \frac{2x}{a^2} \sin ax + \frac{2}{a^3} \cos ax - \frac{x^2}{a} \cos ax.$

280. $\int x^3 \sin ax\, dx = \frac{3x^2}{a^2} \sin ax - \frac{6}{a^4} \sin ax - \frac{x^3}{a} \cos ax + \frac{6x}{a^3} \cos ax.$

281. $\int x \sin^2 ax\, dx = \frac{x^2}{4} - \frac{x \sin 2ax}{4a} - \frac{\cos 2ax}{8a^2}.$

282. $\int x^2 \sin^2 ax\, dx = \frac{x^3}{6} - \left(\frac{x^2}{4a} - \frac{1}{8a^3}\right) \sin 2ax - \frac{x \cos 2ax}{4a^2}.$

283. $\int x^3 \sin^2 ax\, dx = \frac{x^4}{8} - \left(\frac{x^3}{4a} - \frac{3x}{8a^3}\right) \sin 2ax - \left(\frac{3x^2}{8a^2} - \frac{3}{16a^4}\right) \cos 2ax.$

284. $\int x \sin^3 ax\, dx = \frac{x \cos 3ax}{12a} - \frac{\sin 3ax}{36a^2} - \frac{3x \cos ax}{4a} + \frac{3 \sin ax}{4a^2}.$

285. $\int x^n \sin ax\, dx = -\frac{1}{a} x^n \cos ax + \frac{n}{a} \int x^{n-1} \cos ax\, dx, \; n > 0.$

286. $\int \frac{\sin ax\, dx}{x} = ax - \frac{(ax)^3}{3 \cdot 3!} + \frac{(ax)^5}{5 \cdot 5!} - \cdots.$

287. $\int \frac{\sin ax\, dx}{x^m} = \frac{-1}{(m-1)} \frac{\sin ax}{x^{m-1}} + \frac{a}{(m-1)} \int \frac{\cos ax\, dx}{x^{m-1}}.$

288. $\int x \cos ax\, dx = \frac{1}{a^2} \cos ax + \frac{1}{a} x \sin ax.$

289. $\int x^2 \cos ax\, dx = \frac{2x}{a^2} \cos ax - \frac{2}{a^3} \sin ax + \frac{x^2}{a} \sin ax.$

290. $\int x^3 \cos ax\, dx = \frac{(3a^2x^2 - 6) \cos ax}{a^4} + \frac{(a^2x^3 - 6x) \sin ax}{a^3}.$

291. $\int x \cos^2 ax\, dx = \frac{x^2}{4} + \frac{x \sin 2ax}{4a} + \frac{\cos 2ax}{8a^2}.$

292. $\int x^2 \cos^2 ax\, dx = \frac{x^3}{6} + \left(\frac{x^2}{4a} - \frac{1}{8a^3}\right) \sin 2ax + \frac{x \cos 2ax}{4a^2}.$

293. $\int x^3 \cos^2 ax\, dx = \frac{x^4}{8} + \left(\frac{x^3}{4a} - \frac{3x}{8a^3}\right) \sin 2ax + \left(\frac{3x^2}{8a^2} - \frac{3}{16a^4}\right) \cos 2ax.$

294. $\int x \cos^3 ax\, dx = \frac{x \sin 3ax}{12a} + \frac{\cos 3ax}{36a^2} + \frac{3x \sin ax}{4a} + \frac{3 \cos ax}{4a^2}.$

295. $\int x^n \cos ax\, dx = \frac{1}{a} x^n \sin ax - \frac{n}{a} \int x^{n-1} \sin ax\, dx,$ ***n* pos.**

296. $\int \frac{\cos ax\, dx}{x} = \log ax - \frac{(ax)^2}{2 \cdot 2!} + \frac{(ax)^4}{4 \cdot 4!} - \cdots.$

297. $\int \frac{\cos ax}{x^m} dx = -\frac{1}{(m-1)} \cdot \frac{\cos ax}{x^{m-1}} - \frac{a}{(m-1)} \int \frac{\sin ax\, dx}{x^{m-1}}.$

Expressions Containing Exponential and Logarithmic Functions.

298. $\int e^u\, du = e^u$, where u is any function of x.

299. $\int b^u\, du = \frac{b^u}{\log b}$, where u is any function of x.

300. $\int e^{ax}\, dx = \frac{1}{a} e^{ax}, \quad \int b^{ax}\, dx = \frac{b^{ax}}{a \log b}.$

301. $\int xe^{ax}\, dx = \frac{e^{ax}}{a^2} (ax - 1), \int xb^{ax}\, dx = \frac{xb^{ax}}{a \log b} - \frac{b^{ax}}{a^2 (\log b)^2}.$

302. $\int x^2 e^{ax} dx = \frac{e^{ax}}{a^3}(a^2x^2 - 2ax + 2).$

303. $\int x^n e^{ax}\, dx = \frac{1}{a} x^n e^{ax} - \frac{n}{a}\int x^{n-1} e^{ax}\, dx, \quad n \text{ pos.}$

304. $\int x^n e^{ax} dx = \frac{e^{ax}}{a^{n+1}}\Big[(ax)^n - n(ax)^{n-1} + n(n-1)(ax)^{n-2} - \ldots + (-1)^n n!\Big], \; n \text{ pos. integ.}$

305. $\int x^n e^{-ax} dx = -\frac{e^{-ax}}{a^{n+1}}\Big[(ax)^n + n(ax)^{n-1} + n(n-1)(ax)^{n-2} + \ldots + n!\Big], \; n \text{ pos. integ.}$

306. $\int x^n b^{ax}\, dx = \frac{x^n b^{ax}}{a \log b} - \frac{n}{a \log b}\int x^{n-1} b^{ax}\, dx, \quad n \text{ pos.}$

307. $\int \frac{e^{ax}}{x}\, dx = \log x + ax + \frac{(ax)^2}{2 \cdot 2!} + \frac{(ax)^3}{3 \cdot 3!} + \cdots.$

308. $\int \frac{e^{ax}}{x^n}\, dx = \frac{1}{n-1}\Big[-\frac{e^{ax}}{x^{n-1}} + a\int \frac{e^{ax}}{x^{n-1}}\, dx\Big], \; n \text{ integ.} > 1.$

309. $\int \frac{dx}{b + ce^{ax}} = \frac{1}{ab}[ax - \log (b + ce^{ax})].$

310. $\int \frac{e^{ax}\, dx}{b + ce^{ax}} = \frac{1}{ac} \log (b + ce^{ax}).$

311. $\int \frac{dx}{be^{ax} + ce^{-ax}} = \frac{1}{a\sqrt{bc}} \tan^{-1}\left(e^{ax}\sqrt{\frac{b}{c}}\right), \; b \text{ and } c \text{ pos.}$

312. $\int e^{ax} \sin bx\, dx = \frac{e^{ax}}{a^2 + b^2} \quad (a \sin bx - b \cos bx).$

313 $\int e^{ax} \sin bx \sin cx\, dx = \frac{e^{ax}[(b-c) \sin (b-c)x + a \cos (b-c)x]}{2[a^2 + (b-c)^2]} - \frac{e^{ax}[(b+c) \sin (b+c)x + a \cos (b+c)x]}{2[a^2 + (b+c)^2]}.$

314. $$\int e^{ax} \cos bx \, dx = \frac{e^{ax}}{a^2 + b^2} (a \cos bx + b \sin bx).$$

315. $$\int e^{ax} \cos bx \cos cx \, dx = \frac{e^{ax}[(b - c) \sin (b - c)x + a \cos (b - c)x]}{2[a^2 + (b - c)^2]} + \frac{e^{ax}[(b + c) \sin (b + c)x + a \cos (b + c)x]}{2[a^2 + (b + c)^2]}.$$

316. $$\int e^{ax} \sin bx \cos cx \, dx = \frac{e^{ax}[a \sin (b - c)x - (b - c) \cos (b - c)x]}{2[a^2 + (b - c)^2]} + \frac{e^{ax}[a \sin (b + c)x - (b + c) \cos (b + c)x]}{2[a^2 + (b + c)^2]}.$$

317. $$\int e^{ax} \sin bx \sin (bx + c) \, dx = \frac{e^{ax} \cos c}{2a} - \frac{e^{ax} [a \cos (2bx + c) + 2b \sin (2bx + c)]}{2(a^2 + 4b^2)}.$$

318. $$\int e^{ax} \cos bx \cos (bx + c) \, dx = \frac{e^{ax} \cos c}{2a} + \frac{e^{ax} [a \cos (2bx + c) + 2b \sin (2bx + c)]}{2(a^2 + 4b^2)}.$$

319. $$\int e^{ax} \sin bx \cos (bx + c) \, dx = -\frac{e^{ax} \sin c}{2a} + \frac{e^{ax} [a \sin (2bx + c) - 2b \cos (2bx + c)]}{2(a^2 + 4b^2)}.$$

320. $$\int e^{ax} \cos bx \sin (bx + c) \, dx = \frac{e^{ax} \sin c}{2a} + \frac{e^{ax} [a \sin (2bx + c) - 2b \cos (2bx + c)]}{2(a^2 + 4b^2)}.$$

321. $$\int xe^{ax} \sin bx \, dx = \frac{xe^{ax}}{a^2 + b^2} (a \sin bx - b \cos bx) - \frac{e^{ax}}{(a^2 + b^2)^2} [(a^2 - b^2) \sin bx - 2ab \cos bx].$$

322. $$\int xe^{ax}\cos bx\,dx = \frac{xe^{ax}}{a^2+b^2}(a\cos bx + b\sin bx) - \frac{e^{ax}}{(a^2+b^2)^2}[(a^2-b^2)\cos bx + 2ab\sin bx].$$

323. $$\int e^{ax}\cos^n bx\,dx = \frac{e^{ax}\cos^{n-1} bx\,(a\cos bx + nb\sin bx)}{a^2+n^2b^2} + \frac{n(n-1)b^2}{a^2+n^2b^2}\int e^{ax}\cos^{n-2} bx\,dx.$$

324. $$\int e^{ax}\sin^n bx\,dx = \frac{e^{ax}\sin^{n-1} bx\,(a\sin bx - nb\cos bx)}{a^2+n^2b^2} + \frac{n(n-1)b^2}{a^2+n^2b^2}\int e^{ax}\sin^{n-2} bx\,dx.$$

325. $$\int \log ax\,dx = x\log ax - x.$$

326. $$\int x\log ax\,dx = \frac{x^2}{2}\log ax - \frac{x^2}{4}.$$

327. $$\int x^2\log ax\,dx = \frac{x^3}{3}\log ax - \frac{x^3}{9}.$$

328. $$\int (\log ax)^2\,dx = x(\log ax)^2 - 2x\log ax + 2x.$$

329. $$\int (\log ax)^n\,dx = x\,(\log ax)^n - n\int (\log ax)^{n-1}\,dx, \quad n \text{ pos.}$$

330. $$\int x^n\log ax\,dx = x^{n+1}\left[\frac{\log ax}{n+1} - \frac{1}{(n+1)^2}\right], \quad n \neq -1.$$

331. $$\int x^n(\log ax)^m\,dx = \frac{x^{n+1}}{n+1}(\log ax)^m - \frac{m}{n+1}\int x^n(\log ax)^{m-1}dx.$$

332. $$\int \frac{(\log ax)^n}{x}\,dx = \frac{(\log ax)^{n+1}}{n+1}, \quad n \neq -1.$$

333. $$\int \frac{dx}{x\log ax} = \log(\log ax).$$

334. $$\int \frac{dx}{x(\log ax)^n} = -\frac{1}{(n-1)(\log ax)^{n-1}}.$$

335. $$\int \frac{x^n dx}{(\log ax)^m} = \frac{-x^{n+1}}{(m-1)(\log ax)^{m-1}} + \frac{n+1}{m-1}\int \frac{x^n\,dx}{(\log ax)^{m-1}}, \quad m \neq 1.$$

336. $$\int \frac{x^n\,dx}{\log ax} = \frac{1}{a^{n+1}}\int \frac{e^y\,dy}{y}, \quad y = (n+1)\log ax.$$

337. $$\int \frac{x^n\,dx}{\log ax} = \frac{1}{a^{n+1}}\left[\log|\log ax| + (n+1)\log ax + \frac{(n+1)^2(\log ax)^2}{2\cdot 2!} + \frac{(n+1)^3(\log ax)^3}{3\cdot 3!} + \cdots\right].$$

338. $$\int \frac{dx}{\log ax} = \frac{1}{a}\left[\log(\log ax) + \log ax + \frac{(\log ax)^2}{2\cdot 2!} + \frac{(\log ax)^3}{3\cdot 3!} + \cdots\right].$$

339. $$\int \sin(\log ax)\,dx = \frac{x}{2}[\sin(\log ax) - \cos(\log ax)].$$

340. $$\int \cos(\log ax)\,dx = \frac{x}{2}[\sin(\log ax) + \cos(\log ax)].$$

341. $$\int e^{ax}\log bx\,dx = \frac{1}{a}e^{ax}\log bx - \frac{1}{a}\int \frac{e^{ax}}{x}\,dx.$$

Expressions Containing Inverse Trigonometric Functions

342. $$\int \sin^{-1} ax\,dx = x\sin^{-1} ax + \frac{1}{a}\sqrt{1-a^2x^2}.$$

343. $$\int (\sin^{-1} ax)^2\,dx = x(\sin^{-1} ax)^2 - 2x + \frac{2}{a}\sqrt{1-a^2x^2}\sin^{-1} ax.$$

344. $$\int x\sin^{-1} ax\,dx = \frac{x^2}{2}\sin^{-1} ax - \frac{1}{4a^2}\sin^{-1} ax + \frac{x}{4a}\sqrt{1-a^2x^2}.$$

345. $\int x^n \sin^{-1} ax\, dx = \frac{x^{n+1}}{n+1} \sin^{-1} ax - \frac{a}{n+1}\int \frac{x^{n+1}\, dx}{\sqrt{1-a^2x^2}}, n \neq -1.$

346. $\int \frac{\sin^{-1} ax\, dx}{x} = ax + \frac{1}{2\cdot 3\cdot 3}(ax)^3 + \frac{1\cdot 3}{2\cdot 4\cdot 5\cdot 5}(ax)^5 + \frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6\cdot 7\cdot 7}(ax)^7 + \cdots, a^2x^2 < 1.$

347. $\int \frac{\sin^{-1} ax\, dx}{x^2} = -\frac{1}{x}\sin^{-1} ax - a \log \left| \frac{1+\sqrt{1-a^2x^2}}{ax} \right|.$

348. $\int \cos^{-1} ax\, dx = x \cos^{-1} ax - \frac{1}{a}\sqrt{1-a^2x^2}.$

349. $\int (\cos^{-1} ax)^2\, dx = x(\cos^{-1} ax)^2 - 2x - \frac{2}{a}\sqrt{1-a^2x^2}\cos^{-1} ax.$

350. $\int x \cos^{-1} ax\, dx = \frac{x^2}{2}\cos^{-1} ax - \frac{1}{4a^2}\cos^{-1} ax - \frac{x}{4a}\sqrt{1-a^2x^2}.$

351. $\int x^n \cos^{-1} ax\, dx = \frac{x^{n+1}}{n+1}\cos^{-1} ax + \frac{a}{n+1}\int \frac{x^{n+1}\, dx}{\sqrt{1-a^2x^2}}, n \neq -1.$

352. $\int \frac{\cos^{-1} ax\, dx}{x} = \frac{\pi}{2}\log |ax| - ax - \frac{1}{2\cdot 3\cdot 3}(ax)^3 - \frac{1\cdot 3}{2\cdot 4\cdot 5\cdot 5}(ax)^5 - \frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6\cdot 7\cdot 7}(ax)^7 - \cdots, a^2x^2 < 1.$

353. $\int \frac{\cos^{-1} ax\, dx}{x^2} = -\frac{1}{x}\cos^{-1} ax + a \log \left| \frac{1+\sqrt{1-a^2x^2}}{ax} \right|.$

354. $\int \tan^{-1} ax\, dx = x \tan^{-1} ax - \frac{1}{2a}\log (1 + a^2x^2).$

355. $\int x^n \tan^{-1} ax\, dx = \frac{x^{n+1}}{n+1}\tan^{-1} ax - \frac{a}{n+1}\int \frac{x^{n+1}\, dx}{1+a^2x^2}, n \neq -1.$

356. $\displaystyle\int \frac{\tan^{-1} ax\, dx}{x^2} = -\frac{1}{x}\tan^{-1} ax - \frac{a}{2}\log\left(\frac{1+a^2x^2}{a^2x^2}\right).$

357. $\displaystyle\int \operatorname{ctn}^{-1} ax\, dx = x \operatorname{ctn}^{-1} ax + \frac{1}{2a}\log\,(1+a^2x^2).$

358. $\displaystyle\int x^n \operatorname{ctn}^{-1} ax\, dx = \frac{x^{n+1}}{n+1}\operatorname{ctn}^{-1} ax + \frac{a}{n+1}\int \frac{x^{n+1}\, dx}{1+a^2x^2}, \quad n \neq -1.$

359. $\displaystyle\int \frac{\operatorname{ctn}^{-1} ax\, dx}{x^2} = -\frac{1}{x}\operatorname{ctn}^{-1} ax + \frac{a}{2}\log\left(\frac{1+a^2x^2}{a^2x^2}\right).$

360. $\displaystyle\int \sec^{-1} ax\, dx = x \sec^{-1} ax - \frac{1}{a}\log\,(ax + \sqrt{a^2x^2-1}).$

361. $\displaystyle\int x^n \sec^{-1} ax\, dx = \frac{x^{n+1}}{n+1}\sec^{-1} ax \pm \frac{1}{n+1}\int \frac{x^n\, dx}{\sqrt{a^2x^2-1}}, \quad n \neq -1.$

Use + sign when $\frac{\pi}{2} < \sec^{-1} ax < \pi$; − sign when $0 < \sec^{-1} ax < \frac{\pi}{2}$.

362. $\displaystyle\int \csc^{-1} ax\, dx = x \csc^{-1} ax + \frac{1}{a}\log\,(ax + \sqrt{a^2x^2-1}).$

363. $\displaystyle\int x^n \csc^{-1} ax\, dx = \frac{x^{n+1}}{n+1}\csc^{-1} ax \pm \frac{1}{n+1}\int \frac{x^n\, dx}{\sqrt{a^2x^2-1}}, \quad n \neq -1.$

Use + sign when $0 < \csc^{-1} ax < \frac{\pi}{2}$; − sign when $-\frac{\pi}{2} < \csc^{-1} ax < 0$.

Definite Integrals

364. $\int_0^\infty \frac{a\,dx}{a^2+x^2} = \frac{\pi}{2}$, if $a>0$; 0, if $a=0$; $\frac{-\pi}{2}$, if $a<0$.

365. $\int_0^\infty x^{n-1}e^{-x}dx = \int_0^1 \left[\log_e \frac{1}{x}\right]^{n-1} dx = \Gamma(n)$.

$\Gamma(n+1) = n\cdot\Gamma(n)$, if $n>0$. $\quad \Gamma(2) = \Gamma(1) = 1$.

$\Gamma(n+1) = n!$, if n is an integer. $\quad \Gamma(\frac{1}{2}) = \sqrt{\pi}$.

$\Gamma(n) = \Pi(n-1)$. $\quad Z(y) = D_y[\log_e \Gamma(y)]$.

$Z(1) = -0.577216$.

366. $\int_0^\infty e^{-zx}\cdot z^n \cdot x^{n-1}dx = \Gamma(n),\ z>0$.

367. $\int_0^1 x^{m-1}(1-x)^{n-1}dx = \int_0^\infty \frac{x^{m-1}dx}{(1+x)^{m+n}} = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$

368. $\int_0^\infty \frac{x^{n-1}}{1+x}dx = \frac{\pi}{\sin n\pi}$, $0<n<1$.

369. $\int_0^{\frac{\pi}{2}} \sin^n x\,dx = \int_0^{\frac{\pi}{2}} \cos^n x\,dx$

$= \frac{1}{2}\sqrt{\pi}\cdot\frac{\Gamma\left(\frac{n}{2}+\frac{1}{2}\right)}{\Gamma\left(\frac{n}{2}+1\right)}$, if $n>-1$;

$= \frac{1\cdot 3\cdot 5\cdots(n-1)}{2\cdot 4\cdot 6\cdots(n)}\cdot\frac{\pi}{2}$, if n is an even integer;

$= \frac{2\cdot 4\cdot 6\cdots(n-1)}{1\cdot 3\cdot 5\cdot 7\cdots n}$, if n is an odd integer.

370. $\int_0^\infty \frac{\sin^2 x}{x^2}dx = \frac{\pi}{2}$

371. $\int_0^\infty \frac{\sin ax}{x}\,dx = \frac{\pi}{2}$, if $a>0$.

372. $\int_0^\infty \frac{\sin x \cos ax}{x}\,dx = 0$, if $a < -1$, or $a>1$;
$= \frac{\pi}{4}$, if $a = -1$, or $a = 1$;
$= \frac{\pi}{2}$, if $-1 < a < 1$.

373. $\int_0^\pi \sin^2 ax\,dx = \int_0^\pi \cos^2 ax\,dx = \frac{\pi}{2}$.

374. $\int_0^{\pi/a} \sin ax \cdot \cos ax\,dx = \int_0^\pi \sin ax \cdot \cos ax\,dx = 0$.

375. $\int_0^\pi \sin ax \sin bx\,dx = \int_0^\pi \cos ax \cos bx\,dx = 0, \quad a \neq b$.

376. $\int_0^\pi \sin ax \cos bx\,dx = \frac{2a}{a^2-b^2}$, if $a - b$ is odd;
$= 0$, if $a - b$ is even.

377. $\int_0^\infty \frac{\sin ax \sin bx}{x^2}\,dx = \frac{1}{2}\pi a$, if $a < b$.

378. $\int_0^\infty \cos(x^2)\,dx = \int_0^\infty \sin(x^2)\,dx = \frac{1}{2}\sqrt{\frac{\pi}{2}}$.

379. $\int_0^\infty e^{-a^2x^2}\,dx = \frac{\sqrt{\pi}}{2a} = \frac{1}{2a}\,\Gamma\left(\frac{1}{2}\right)$, if $a > 0$.

380. $\int_0^\infty x^n \cdot e^{-ax}\,dx = \frac{\Gamma(n+1)}{a^{n+1}}$,
$= \frac{n!}{a^{n+1}}$, if n is a positive integer, $a > 0$.

381. $\int_0^\infty x^{2n} e^{-ax^2}\,dx = \frac{1 \cdot 3 \cdot 5 \cdots (2n-1)}{2^{n+1}a^n}\sqrt{\frac{\pi}{a}}$.

382. $\int_0^\infty \sqrt{x}\; e^{-ax}\,dx = \frac{1}{2a}\sqrt{\frac{\pi}{a}}$.

383. $\int_0^\infty \frac{e^{-ax}}{\sqrt{x}}\,dx = \sqrt{\frac{\pi}{a}}.$

384. $\int_0^\infty e^{(-x^2-a^2/x^2)}\,dx = \frac{1}{2}e^{-2a}\sqrt{\pi}$, if $a>0$.

385. $\int_0^\infty e^{-ax}\cos bx\,dx = \frac{a}{a^2+b^2}$, if $a>0$.

386. $\int_0^\infty e^{-ax}\sin bx\,dx = \frac{b}{a^2+b^2}$, if $a>0$.

387. $\int_0^\infty \frac{e^{-ax}\sin x}{x}\,dx = \operatorname{ctn}^{-1} a,\ a>0.$

388. $\int_0^\infty e^{-a^2x^2}\cos bx\,dx = \frac{\sqrt{\pi}\cdot e^{-\frac{b^2}{4a^2}}}{2a}$, if $a>0$.

389. $\int_0^1 (\log x)^n\,dx = (-1)^n\cdot n!$, n pos. integ.

390. $\int_0^1 \frac{\log x}{1-x}dx = -\frac{\pi^2}{6}.$

391. $\int_0^1 \frac{\log x}{1+x}\,dx = -\frac{\pi^2}{12}.$

392. $\int_0^1 \frac{\log x}{1-x^2}\,dx = -\frac{\pi^2}{8}.$

393. $\int_0^1 \frac{\log x}{\sqrt{1-x^2}}\,dx = -\frac{\pi}{2}\log 2.$

394. $\int_0^1 \log\left(\frac{1+x}{1-x}\right)\cdot\frac{dx}{x} = \frac{\pi^2}{4}.$

395. $\int_0^\infty \log\left(\frac{e^x+1}{e^x-1}\right)dx = \frac{\pi^2}{4}.$

396. $\int_0^1 \frac{dx}{\sqrt{\log(1/x)}} = \sqrt{\pi}.$

397. $\int_0^1 \log(\log x)\,dx = \int_0^\infty e^{-x}\log x\,dx = \gamma = 0.5772157\cdots.$

398. $\int_0^{\frac{\pi}{2}} \log\sin x\,dx = \int_0^{\frac{\pi}{2}} \log\cos x\,dx = -\frac{\pi}{2}\cdot\log_e 2.$

399. $\int_0^{\pi} x\log\sin x\,dx = -\frac{\pi^2}{2}\cdot\log_e 2.$

400. $\int_0^1 \left(\log\frac{1}{x}\right)^{\frac{1}{2}} dx = \frac{\sqrt{\pi}}{2}.$

401. $\int_0^1 \left(\log\frac{1}{x}\right)^{-\frac{1}{2}} dx = \sqrt{\pi}.$

402. $\int_0^1 x^m \log\left(\frac{1}{x}\right)^n dx = \frac{\Gamma(n+1)}{(m+1)^{n+1}}$, if $m+1>0, \quad n+1>0.$

403. $\int_0^{\pi} \log(a\pm b\cos x)\,dx = \pi\log\left(\frac{a+\sqrt{a^2-b^2}}{2}\right),\ a\geqq b.$

404. $\int_0^{\pi} \frac{\log(1+\sin a\cos x)}{\cos x}\,dx = \pi a.$

405. $\int_0^1 \frac{x^b-x^a}{\log x}\,dx = \log\frac{1+b}{1+a}.$

406. $\int_0^{\pi} \frac{dx}{a+b\cos x} = \frac{\pi}{\sqrt{a^2-b^2}}$, if $a>b>0.$

407. $\int_0^{\frac{\pi}{2}} \frac{dx}{a+b\cos x} = \frac{\cos^{-1}\left(\frac{b}{a}\right)}{\sqrt{a^2-b^2}},\ a>b.$

408. $\int_0^{\infty} \frac{\cos ax\,dx}{1+x^2} = \frac{\pi}{2}\cdot e^{-a}$, if $a>0$; $= \frac{\pi}{2}e^{a}$, if $a<0.$

409. $\int_0^{\infty} \frac{\cos x\,dx}{\sqrt{x}} = \int_0^{\infty} \frac{\sin x\,dx}{\sqrt{x}} = \sqrt{\frac{\pi}{2}}.$

410. $\int_0^\infty \frac{e^{-ax} - e^{-bx}}{x}\,dx = \log\frac{b}{a}.$

411. $\int_0^\infty \frac{\tan^{-1} ax - \tan^{-1} bx}{x}\,dx = \frac{\pi}{2}\log\frac{a}{b}.$

412. $\int_0^\infty \frac{\cos ax - \cos bx}{x}\,dx = \log\frac{b}{a}.$

413. $\int_0^{\frac{\pi}{2}} \frac{dx}{a^2\cos^2 x + b^2\sin^2 x} = \frac{\pi}{2ab}.$

414. $\int_0^{\frac{\pi}{2}} \frac{dx}{(a^2\cos^2 x + b^2\sin^2 x)^2} = \frac{\pi(a^2+b^2)}{4a^3b^3}.$

415. $\int_0^\pi \frac{(a - b\cos x)\,dx}{a^2 - 2ab\cos x + b^2} = 0, \quad \text{if } a^2 < b^2;$

$= \frac{\pi}{a}, \quad \text{if } a^2 > b^2;$

$= \frac{\pi}{2a}, \quad \text{if } a = b.$

416. $\int_0^1 \frac{1+x^2}{1+x^4}\,dx = \frac{\pi}{4}\sqrt{2}.$

417. $\int_0^1 \frac{\log(1+x)}{x}\,dx = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \cdots = \frac{\pi^2}{12}$

418. $\int_{-\infty}^1 \frac{e^{-xu}}{u}\,du = \gamma + \log x - x + \frac{x^2}{2\cdot 2!} - \frac{x^3}{3\cdot 3!} + \frac{x^4}{4\cdot 4!} - \cdots,$

where $\gamma = \lim_{t\to\infty}(1+\frac{1}{2}+\frac{1}{3}+\cdots+\frac{1}{t} - \log t) = 0.5772157\cdots.$

419. $\int_{-\infty}^1 \frac{\cos xu}{u}\,du = \gamma + \log x - \frac{x^2}{2\cdot 2!} + \frac{x^4}{4\cdot 4!} - \frac{x^6}{6\cdot 6!} + \cdots,$

where $\gamma = 0.5772157\cdots.$

420. $\int_0^1 \frac{e^{xu} - e^{-xu}}{u}\,du = 2\left(x + \frac{x^3}{3\cdot 3!} + \frac{x^5}{5\cdot 5!} + \cdots\right).$

421. $\int_0^1 \frac{1 - e^{-xu}}{u}\,du = x - \frac{x^2}{2\cdot 2!} + \frac{x^3}{3\cdot 3!} - \frac{x^4}{4\cdot 4!} + \cdots.$

422. $$\int_0^{\frac{\pi}{2}} \frac{dx}{\sqrt{1-K^2\sin^2 x}} = \frac{\pi}{2}\left[1+\left(\frac{1}{2}\right)^2 K^2+\left(\frac{1\cdot 3}{2\cdot 4}\right)^2 K^4+\left(\frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6}\right)^2 K^6+\cdots\right],$$ if $K^2<1$.

423. $$\int_0^{\frac{\pi}{2}} \sqrt{1-K^2\sin^2 x}\,dx = \frac{\pi}{2}\left[1-\left(\frac{1}{2}\right)^2 K^2 - \left(\frac{1\cdot 3}{2\cdot 4}\right)^2 \frac{K^4}{3} - \left(\frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6}\right)^2 \frac{K^6}{5} - \cdots\right],$$ if $K^2<1$.

424. $$f(x) = \tfrac{1}{2}a_0 + a_1\cos\frac{\pi x}{c} + a_2\cos\frac{2\pi x}{c} + \cdots + b_1\sin\frac{\pi x}{c} + b_2\sin\frac{2\pi x}{c} + \cdots, \quad -c<x<+c,$$

where $$a_m = \frac{1}{c}\int_{-c}^{+c} f(x)\cdot\cos\frac{m\pi x}{c}\cdot dx,$$

$$b_m = \frac{1}{c}\int_{-c}^{+c} f(x)\cdot\sin\frac{m\pi x}{c}\,dx.$$ (Fourier Series)

425. $$\int_0^{\infty} e^{-ax}\cosh bx\,dx = \frac{a}{a^2-b^2},\ a>0,\ a^2\neq b^2.$$

426. $$\int_0^{\infty} e^{-ax}\sinh bx\,dx = \frac{b}{a^2-b^2},\ a>0,\ a^2\neq b^2.$$

427. $$\int_0^{\infty} xe^{-ax}\sin bx\,dx = \frac{2ab}{(a^2+b^2)^2},\ a>0.$$

428. $$\int_0^{\infty} xe^{-ax}\cos bx\,dx = \frac{a^2-b^2}{(a^2+b^2)^2},\ a>0.$$

429. $$\int_0^\infty x^2 e^{-ax} \sin bx \, dx = \frac{2b(3a^2 - b^2)}{(a^2 + b^2)^3}, \quad a > 0.$$

430. $$\int_0^\infty x^2 e^{-ax} \cos bx \, dx = \frac{2a(a^2 - 3b^2)}{(a^2 + b^2)^3}, \quad a > 0.$$

431. $$\int_0^\infty x^3 e^{-ax} \sin bx \, dx = \frac{24ab(a^2 - b^2)}{(a^2 + b^2)^4}, \quad a > 0.$$

432. $$\int_0^\infty x^3 e^{-ax} \cos bx \, dx = \frac{6(a^4 - 6a^2b^2 + b^4)}{(a^2 + b^2)^4}, \quad a > 0.$$

433. $$\int_0^\infty x^n e^{-ax} \sin bx \, dx = \frac{i \cdot n! \, [(a - ib)^{n+1} - (a + ib)^{n+1}]}{2(a^2 + b^2)^{n+1}}, \quad a > 0.$$

434. $$\int_0^\infty x^n e^{-ax} \cos bx \, dx = \frac{n! \, [(a - ib)^{n+1} + (a + ib)^{n+1}]}{2(a^2 + b^2)^{n+1}}, \quad a > 0.$$

VIII. Vector Analysis

149. Definitions. Analytic Representation. A *vector* V is a quantity which is completely specified by a magnitude and a direction. A vector may be represented geometrically by a directed line segment $V = \overrightarrow{OA}$. A *scalar* S is a quantity which is completely specified by a magnitude.

Let i, j, k represent three vectors of unit magnitude along the three mutually perpendicular lines OX, OY, OZ, respectively. Let V be a vector in space, and a, b, c the magnitudes of the projections of V along the three lines OX, OY, OZ, respectively. Then V may be represented by $V = a\,i + b\,j + c\,k$. The magnitude of V is $|V| = +\sqrt{a^2 + b^2 + c^2}$, and the direction cosines of V are such that $\cos\alpha : \cos\beta : \cos\gamma = a : b : c$.

150. Vector Sum V of n vectors. Let $V_1, V_2, \cdots, V_n$ be n vectors given by $V_1 = a_1\,i + b_1\,j + c_1\,k$, etc. Then the *sum* is

$$V = V_1 + V_2 + \cdots + V_n = (a_1 + a_2 + \cdots + a_n)\,i + (b_1 + b_2 + \cdots + b_n)\,j + (c_1 + c_2 + \cdots + c_n)\,k.$$

151. Product of a Scalar S and a Vector V.

$$SV = (Sa)i + (Sb)\,j + (Sc)k.$$

$$(S_1 + S_2)\,V = S_1\,V + S_2\,V. \qquad (V_1 + V_2)\,S = V_1\,S + V_2\,S.$$

152. Scalar Product of Two Vectors: $V_1 \cdot V_2$.

$V_1 \cdot V_2 = |V_1||V_2|\cos\phi$, where ϕ is the angle from V_1 to V_2.

$$V_1 \cdot V_2 = a_1 a_2 + b_1 b_2 + c_1 c_2 = V_2 \cdot V_1. \qquad V_1 \cdot V_1 = |V_1|^2.$$

$$(V_1 + V_2) \cdot V_3 = V_1 \cdot V_3 + V_2 \cdot V_3.$$

$$V_1 \cdot (V_2 + V_3) = V_1 \cdot V_2 + V_1 \cdot V_3.$$

$$i \cdot i = j \cdot j = k \cdot k = 1. \qquad i \cdot j = j \cdot k = k \cdot i = 0.$$

153. Vector Product of Two Vectors: $V_1 \times V_2$.

$V_1 \times V_2 = |V_1|\,|V_2| \sin\phi\ \mathbf{1}$, where ϕ is the angle from V_1 to V_2 and $\mathbf{1}$ is a unit vector perpendicular to the plane of V_1 and V_2 and so directed that a right-handed screw driven in the direction of $\mathbf{1}$ would carry V_1 into V_2.

$$V_1 \times V_2 = -\,V_2 \times V_1 = (b_1 c_2 - b_2 c_1)\,i + (c_1 a_2 - c_2 a_1)\,j + (a_1 b_2 - a_2 b_1)\,\mathbf{k}.$$

$$(V_1 + V_2) \times V_3 = V_1 \times V_3 + V_2 \times V_3.$$

$$V_1 \times (V_2 + V_3) = V_1 \times V_2 + V_1 \times V_3.$$

$$V_1 \times (V_2 \times V_3) = V_2\,(V_1 \cdot V_3) - V_3\,(V_1 \cdot V_2).$$

$$i \times i = j \times j = k \times k = 0,\ i \times j = k,\ j \times k = i,\ k \times i = j.$$

$$V_1 \cdot (V_2 \times V_3) = (V_1 \times V_2) \cdot V_3 = V_2 \cdot (V_3 \times V_1) = [V_1\,V_2\,V_3] = \begin{vmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{vmatrix}.$$

154. Differentiation of Vectors. $V = a\,i + b\,j + c\,k$. If V_1, V_2, $\cdots$ are functions of a scalar variable t, then

$$\frac{d}{dt}(V_1 + V_2 + \cdots) = \frac{dV_1}{dt} + \frac{dV_2}{dt} + \cdots, \text{ where}$$

$$\frac{dV_1}{dt} = \frac{da_1}{dt}\,i + \frac{db_1}{dt}\,j + \frac{dc_1}{dt}\,k, \text{ etc.}$$

$$\frac{d}{dt}(V_1 \cdot V_2) = \frac{dV_1}{dt} \cdot V_2 + V_1 \cdot \frac{dV_2}{dt}.$$

$$\frac{d}{dt}(V_1 \times V_2) = \frac{dV_1}{dt} \times V_2 + V_1 \times \frac{dV_2}{dt}.$$

$$V \cdot \frac{dV}{dt} = |V|\,\frac{d|V|}{dt}. \quad \text{If } |V| \text{ is constant, } \quad V \cdot \frac{dV}{dt} = 0.$$

$$\text{grad } S \equiv \nabla S \equiv \frac{\partial S}{\partial x}\,i + \frac{\partial S}{\partial y}\,j + \frac{\partial S}{\partial z}\,k, \text{ where } S \text{ is a scalar.}$$

$$\text{div } V \equiv \nabla \cdot V \equiv \frac{\partial a}{\partial x} + \frac{\partial b}{\partial y} + \frac{\partial c}{\partial z} \quad \text{(divergence of } S\text{)}.$$

$$\text{curl } V \equiv \text{rot } V \equiv \begin{vmatrix} i & j & k \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ a & b & c \end{vmatrix} \equiv \nabla \times V.$$

$$\text{div grad } S \equiv \nabla^2 S \equiv \frac{\partial^2 S}{\partial x^2} + \frac{\partial^2 S}{\partial y^2} + \frac{\partial^2 S}{\partial z^2}.$$

$$\nabla^2 V \equiv i\,\nabla^2 a + j\,\nabla^2 b + k\,\nabla^2 c.$$

$$\text{curl grad } S = 0. \quad \text{div curl} = 0.$$

$$\text{curl curl } V = \text{grad div } V - \nabla^2 V.$$

155. Green's Theorem. Let F be a vector and V be a volume bounded by a surface S. Then

$$\int_{(V)}\int\int \text{div } F\,dV = \int_{(V)}\int\int \nabla \cdot F\,dV = \int_{(S)}\int F \cdot dS,$$

where the integrations are to be carried out over the volume V and the surface S.

156. Stoke's Theorem. Let F be a vector and $dr = dx\,i + dy\,j + dz\,k$, and S be a surface bounded by a simple closed curve C. Then

$$\int_{(C)} F \cdot dr = \int_{(S)}\int \text{curl } F \cdot d\,S = \int_{(S)}\int \nabla \times F \cdot d\,S.$$

PART TWO—TABLES

Explanation of Tables

Table I. Five-Place Common Logarithms of Numbers from 1 to 10,000.

Definition of Logarithm. The *logarithm* x of the number N to the base b is the exponent of the power to which b must be raised to give N. That is,

$$\log_b N = x \quad \text{or} \quad b^x = N.$$

The number N is positive and b may be any positive number except 1.

Properties of Logarithms.

(*a.*) *The logarithm of a product is equal to the sum of the logarithms of the factors; thus,*

$$\log_b M \cdot N = \log_b M + \log_b N.$$

(*b.*) *The logarithm of a quotient is equal to the logarithm of the numerator minus the logarithm of the denominator; thus,*

$$\log_b \frac{M}{N} = \log_b M - \log_b N.$$

(*c.*) *The logarithm of a power of a number is equal to the logarithm of the base multiplied by the exponent of the power; thus,*

$$\log_b M^p = p \cdot \log_b M.$$

(*d.*) *The logarithm of a root of a number is equal to the logarithm of the number divided by the index of the root; thus,*

$$\log_b \sqrt[q]{M} = \frac{1}{q} \log_b M.$$

Other properties of logarithms:

$\log_b b = 1$ · $\log_b \sqrt[q]{M^p} = \frac{p}{q} \cdot \log_b M.$

$\log_b 1 = 0$ · $\log_b N = \log_a N \cdot \log_b a = \frac{\log_a N}{\log_a b}.$

$\log_b (b^N) = N$ · $b^{\log_b N} = N.$

Systems of Logarithms. There are two common systems of logarithms in use: (1) the *natural* (Napierian or hyperbolic),

system which uses the base $e = 2.71828\cdots$; (2) the *common* (Briggsian) system which uses the base 10.

We shall use the abbreviation* $\log N \equiv \log_{10} N$ in this section.

Unless otherwise stated, tables of logarithms are always tables of common logarithms.

Characteristic of a Common Logarithm of a Number. Every real positive number has a real common logarithm such that if $a < b$, $\log a < \log b$. Neither zero nor any negative number has a real logarithm.

A common logarithm, in general, consists of an integer, which is called the *characteristic*, and a decimal (usually endless) which is called the *mantissa*. The characteristic of any number may be determined from the following rules.

Rule I. *The characteristic of any number greater than* 1 *is one less than the number of digits before the decimal point.*

Rule II.† *The characteristic of a number less than* 1 *is found by subtracting from* 9 *the number of ciphers between the decimal point and the first significant digit, and writing* -10 *after the result.*

Thus the characteristic of log 936 is 2; the characteristic of 9.36 is 0; of log 0.936 is $9-10$; of log 0.00936 is $7-10$.

Mantissa of a Common Logarithm of a Number. An important consequence of the use of base 10 is that the mantissa of a number is independent of the position of the decimal point. Thus 93,600, 93.600, 0.000936, all have the same mantissa. Hence in Tables of Common Logarithms only mantissas are given. This is done in Table I. A five place table gives the values of the mantissa correct to five places of decimals.

To Find the Logarithm of a Given Number N. By means of Rules I and II determine the characteristic. Then use Table I to find mantissa.

To find mantissa when the given number (neglecting decimal point) consists of four, or less, digits (exclusive of ciphers at the beginning or end), look in the column marked N for the first three significant digits and pick the column headed by the fourth digit—the mantissa is the number appearing at the intersection of this row and column. Thus to find the logarithm of 64030, first note (by

* Note, however, that $\log N \equiv \log_e N$ is used in the Table of Integrals.

† Some writers use a dash over the characteristic to indicate a negative value: for example, $\log .004657 = 7.66811-10 = \bar{3}.66811$.

Rule I) that the characteristic is 4. Next in Table I, find 640 in column marked N and opposite it in column 5 is the desired mantissa, .80638. Hence log 64030 = 4.80638. Likewise, log 0.0064030 = 7.80638 − 10; log 0.64030 = 9.80638 −10.

Interpolation. The mantissa of a number of more than four significant figures can be found approximately by assuming that the mantissa varies directly as the number in the small interval not tabulated. Thus if N has five digits (significant), and f is the fifth digit of N, the mantissa of N is

$$m = m_1 + \frac{f}{10}\left(m_2 - m_1\right),$$

where m_1 is the mantissa corresponding to the first four digits of N, m_2 is the next larger mantissa in the table. $(m_2 - m_1)$ is called a *tabular difference.* The proportional part of the difference $m_2 - m_1$ is called the *correction.* These proportional parts are printed without zeros at the right-hand side of each page as an aid to mental multiplications.

For example, find log 64034. Here $f = 4$. From the table we see $m_1 = .80638$, $m_2 = .80645$, whence $m = .80638 + (4/10)\,(.00007)$, log 64034 = 4 + m = 4.80641.

To Find the Number N when its Logarithm is Known. (The number N whose logarithm is k is called the *anti logarithm* of k.)

Case 1. If the mantissa m is found exactly in the Table I, join the figure at the top of the column containing m to the right of the figures in the column marked N and in the same row as m, and place the decimal point according to the characteristic of the logarithm.

Case 2. If the mantissa m is not found exactly in the table, interpolate as follows: find the next smaller mantissa m_1 to m; the first four significant digits of N correspond to the mantissa m_1, and the fifth digit f equals the nearest whole number to

$$f = 10\left(\frac{m - m_1}{m_2 - m_1}\right),$$

where m_2 is the next larger mantissa to m appearing in table. Then locate the decimal point according to the characteristic.

The decimal point may be located by means of the following rules:

Rule III. *If the characteristic of the logarithm is positive (then the mantissa is not followed by −10), begin at the left, count digits one more than the characteristic, and place the decimal point to the right of the last digit counted.*

Rule IV. *If the characteristic is negative (then the mantissa will be preceded by an integer n and followed by* -10*), prefix* $(9-n)$ *ciphers, and place the decimal point to the left of these ciphers.*

Illustrations of the Use of Logarithms.

Example 1. Given $\log x = 2.91089$, find x. The mantissa 91089 appears in the table. Join the figure 5 which appears at the top of the column to the right of the number 814 in the column N, giving the number 8145. By Rule III, the decimal point is placed to the right of 4, thus giving $x = 814.5$.

Example 2. Given $\log x = 2.34917$, find x. The mantissa $m = .34917$ does not appear in the table. The next smaller and next larger mantissas are m_1 and m_2,

$$m_1 = .34908, \quad m = .34917, \quad m_2 = .34928.$$

The first four digits of N, corresponding to m_1, are 2234 and the fifth digit is the nearest whole number (5) to

$$10\left(\frac{m - m_1}{m_2 - m_1}\right) = 10\left(\frac{.00009}{.00020}\right) = 4.5.$$

By Rule III, we locate decimal point, thus giving $x = 223.45$.

Example 3. Find $x = (396.21)\,(.004657)\,(21.21)$.

$\log 396.21 = 2.59792$
$\log .004657 = 7.66811 - 10$
$\log 21.210 = 1.32654$ (add)
$\log x = 11.59257 - 10, \quad x = 39.135.$

Example 4. Find $x = \dfrac{396.21^*}{24.3}$.

$\log 396.21 = 2.59792$
$\log 24.3 = 1.38561$ (subtract)
$\log x = 1.21231, \quad x = 16.305.$

Example 5. Find $x = (3.5273)^4$.

$\log 3.5273 = 0.54745$
4 (multiply)
$\log x = 2.18980, \quad x = 154.81.$

* Some writers use *cologarithms*. The cologarithm of a number N is the negative of the logarithm of N; i. e., colog N = 10.00000 − log N − 10. Adding the cologarithm is equivalent to subtracting the logarithm. Thus in our example, colog 24.3 = (10.00000 − 1.38561) − 10 = 8.61439–10, log 396.21 − log 24.3 = log 396.21 + colog 24.3 = 2.59792 + 8.61439–10 = 11.21231–10 = anti log 16.305.

Example 6. Given $\log x = -2.23653$, to find x. To convert this logarithm to one with a positive mantissa, add algebraically -2.23653 to $10.00000-10$. Thus

$$\begin{array}{r} 10.00000-10 \\ -2.23653 \\ \hline 7.76347-10, \end{array}$$

$\log x = 7.76347-10$, whence $x = 0.0058006$.

Example 7. Find $x = \sqrt[3]{.04657}$.

$\log x = \frac{1}{3} \log (.04657)$,

$= \frac{1}{3}(8.66811-10) = \frac{1}{3}(-1.33189)$,

$\log x = -0.44396 = 9.55604-10$, $x = 0.35978$.

or

$\log x = \frac{1}{3}(8.66811-10) = \frac{1}{3}(28.66811-30)$

$\log x = 9.55604-10$, $x = 0.35978$.

Example 8. Find $x = \dfrac{1}{21.210}$.

$\log x = \log 1 - \log 21.210$

$\log 1 = 10.00000-10$

$\log 21.210 = 1.32654$ (subtract)

$\log x = 8.67346-10$, $x = 0.047148$.

Table II. Seven-place Common Logarithms of Numbers. This table gives seven-place logarithms for numbers of five significant figures from 10000 to 12000.

Table III. Important Constants. This table gives the values and logarithms of a number of important constants.

Table IV. Common Logarithms of Trigonometric Functions. In this table, the logarithmic values of the sine, cosine, tangent, and cotangent of angles at intervals of one minute from 0° to 90° are given. Since $\log \sec A = -\log \cos A$ and $\log \csc A = -\log \sin A$, $\log \sec A$ and $\log \csc A$ are omitted. For angles between 0° and 45°, the number of the degrees and the name of the trigonometric function are read at the top of the page and the number of minutes in the left-hand column. The corresponding information for angles between 45° and 90° is found at the bottom of the page and in the right-hand column.

The arrangement and the principles of interpolation are similar to those given in the explanation for Table I. The -10 portion of the characteristic is not printed in the table but must be written down whenever such a logarithm is used, except in the cases of the tan between 45° and 90°, and the ctn between 0° and 45°.

While the logarithmic values of the trigonometric functions may be interpolated to the nearest second, interpolation for the logarithms of the sine and tangent of small angles from 0° to 3° and for the logarithms of the cosine and cotangent of angles from 87° to 90° is not accurate. Table IVa should be used in these cases.

Table IVa gives

$$S = \log \sin A - \log A' \text{ and } T = \log \tan A - \log A',$$

where A is the given angle and A' is the number of minutes in A, for values of A from 0° to 3°. Then

$$\log \sin A = \log A' + S \text{ and } \log \tan A = \log A' + T.$$

Likewise,

$\log \cos A = \log (90° - A)' + S$ and $\log \operatorname{ctn} A = \log (90° - A)' + T$. for values of A from 87° to 90°, the S and T corresponding to $(90° - A)'$.

For the functions of angles greater than 90°, use the relations given in §57.

Tables of proportional parts are provided in Tables IV which may be used in the interpolation of logarithmic values of the functions between 4° and 86°.

Example 1. Find log sin 21°13′26″.

Turn to the page having 21° at the top. In the row having 13 on the left, find in the column marked "L Sin" at the top log sin 21°13′ = 9.55858 −10. (The −10 portion of the characteristic is omitted in the table.) The tabular difference is 33 and is given in the column marked "*d*". In the table of proportional parts for 33, the correction for 20″ is 11.0 and for 6″ is 3.3. These two corrections must be added to the value of log sin 21°13′. Hence log sin 21°13′26″ = 9.55872 −10.

Example 2. Find log ctn 56°23′37″.

On the page having 56° at the bottom, and in the row having 23 on the right, find in the column marked "L Ctn" at the bottom, log cot 56° 23′ = 9.82270 −10. The tabular difference is 27 and is given in the column marked "*c.d.*" In the table of proportional parts for 27, we obtain 17 as the correction for 37″. Since the logarithmic value of the cotangent decreases as the angle increases from 0° to 90°, this correction for 37″ must be subtracted from log ctn 56°23′. Hence log ctn 56°23′37″ = 9.82253 −10.

Example 3. Find the acute angle A, if log tan A = 9.67341−10. The tabulated value of the logarithm of the tangent just smaller

than 9.67341−10 is 9.67327−10. This corresponds to 25°14′. The difference between 9.67341−10 and 9.67327−10 is 14 and the tabular difference to be used is 33. In the proportional parts table for 33, we find the largest value less than 14 is 11.0, which corresponds to 20″. The difference 14 − 11.0 = 3.0, which corresponds to 5″. Hence, 25″ is the approximate correction and A = 25°14′25″.

Example 4. Find the acute angle A, if log cos A = 9.89317 − 10.

The value of the logarithm of the cosine decreases as the angle increases from 0° to 90°. Hence we must find in the column marked "L Cos" a value just larger than 9.89317 − 10. This value is 9.89324 −10 and corresponds to 38°33′. The difference between 9.89324 −10 and 9.89317 − 10 is 7, and the tabular difference is 10. From the table of proportional parts we see that the largest value just smaller than 7 is 6.7, which corresponds to 40″. The difference 7 − 6.7 = 0.3, which corresponds to 2″. Hence the correction is 42″, approximately. Therefore A = 38°33′42″.

Example 5. Find log sin 0°35′30″.

Convert 35′30″ to minutes. In table IVa, column A, we find for 35.5 minutes, S = 6.46372−10. By Table I, log 35.5 = 1.55023. Hence, log sin 0°35′30″ = log 35.5 + S

= 1.55023 + 6.46372 − 10 = 8.01395 − 10.

Table V. Natural Trigonometric Functions. This table gives the values of the sine, cosine, tangent, and cotangent at intervals of one minute from 0° to 90°. The method of interpolation is similar to that given in the explanation of Table IV.

The following tables are self-explanatory: Table VI. Decimal Equivalents of Common Fractions.—Table VII. Minutes and Seconds to Decimal Parts of a Degree.—Table VIII. Natural Trigonometric Functions for Decimal Fractions to a Degree.—Table IX. Common Logarithms of Functions in Radian Measure.—Table X. Degrees, Minutes, and Seconds to Radians.—Table XI. Natural Trigonometric Functions in Radian Measure.—Table XII. Radians to Degrees, Minutes and Seconds.—Table XIII. Table of Powers and Roots. The square, cube, square root, and cube root of n are given for each integer n from 1 to 999.—Table XIIIa. This table gives 1000 times the reciprocal of n; the circumference and area of a circle of diameter n, for n = 1 to 999.

Table XIV. Natural Logarithms. This table gives the logarithms of N to the Naperian base e ($= 2.71828\ldots$) for equidistant values of N from 0.00 to 10.09 and from 10 to 1109. For values of N greater than 1109, use the formula $\log_e 10N = \log_e N + \log_e 10 = \log_e N + 2.30258509$, or the formula $\log_e N = (\log_e 10)(\log_{10} N) = 2.30258509\ (\log_{10} N)$.

Table XV. Values and Logarithms of Exponential and Hyperbolic Functions. This table gives the values of e^x, e^{-x}, sinh x, cosh x, tanh x, and the common logarithms of e^x, sinh x, and cosh x for values of x equally spaced from 0.00 to 3.00 and for certain values of x from 3.00 to 10.00. The common logarithm of e^{-x} may be found by the relation $\log_{10} e^{-x} = -\log_{10} e^x = \operatorname{colog} x$. To find $\log_{10} \tanh x$, use $\log_{10} \tanh x = \log_{10} \sinh x - \log_{10} \cosh x$. This table may be extended indefinitely by means of Table XVI, since $\log_{10} e^x = M \cdot x$.

Table XVI. Multiples of M and 1/M. The purpose of this table is to facilitate the multiplication of a number N by M and $1/M$. This occurs whenever it is desired to change from common logarithms to natural logarithms, and conversely. Thus

$$\log_{10} x = (\log_e x)(\log_{10} e) = M \cdot \log_e x; \log_e x = \log_{10} x/M.$$

These multiples are also required in

$$\log_{10} e^x = Mx,\ \log_e (10^n \cdot x) = \log_e x + n(1/M),$$

and in the approximate formulae

$$\log_{10} (1 \pm x) = \pm x \cdot M \text{ and } 10^{\pm x} = 1 \pm (1/M)x.$$

The following tables are self-explanatory: Table XVII. Logarithms of Primes.—Table XVIII. Common Logarithms of Gamma Functions.—Table XIX. Compound Interest (See §19).—Table XX. Compound Discount (See §20).—Table XXI. Amount of an Annuity (See §23).—Table XXII. Present Value of an Annuity (See §24).—Table XXIII. Logarithms for Interest Computations.—Table XXIV. American Experience Mortality Table.—Table XXV. Logarithms of Factorial n.—Table XXVa. Binomial Coefficients.—Table XXVb. Probability Functions.—Table XXVc. Factors for Computing Probable Errors.—Table XXVI. Complete Elliptic Integral.—Table XXVII. Four-place Common Logarithms of Trigonometric Functions.—Table XXVIII. Four-place Natural Trigonometric Functions.—Table XXIX. Four-place Common Logarithms of Numbers.—Table XXX. Four-place Common Anti-logarithms of Numbers.

Table I

LOGARITHMS OF NUMBERS

100 — 150

N.	L.	0	1	2	3	4	5	6	7	8	9
100	00	000	043	087	130	173	217	260	303	346	389
101		432	475	518	561	604	647	689	732	775	817
102		860	903	945	988	*030	*072	*115	*157	*199	*242
103	01	284	326	368	410	452	494	536	578	620	662
104		703	745	787	828	870	912	953	995	*036	*078
105	02	119	160	202	243	284	325	366	407	449	490
106		531	572	612	653	694	735	776	816	857	898
107		938	979	*019	*060	*100	*141	*181	*222	*262	*302
108	03	342	383	423	463	503	543	583	623	663	703
109		743	782	822	862	902	941	981	*021	*060	*100
110	04	139	179	218	258	297	336	376	415	454	493
111		532	571	610	650	689	727	766	805	844	883
112		922	961	999	*038	*077	*115	*154	*192	*231	*269
113	05	308	346	385	423	461	500	538	576	614	652
114		690	729	767	805	843	881	918	956	994	*032
115	06	070	108	145	183	221	258	296	333	371	408
116		446	483	521	558	595	633	670	707	744	781
117		819	856	893	930	967	*004	*041	*078	*115	*151
118	07	188	225	262	298	335	372	408	445	482	518
119		555	591	628	664	700	737	773	809	846	882
120		918	954	990	*027	*063	*099	*135	*171	*207	*243
121	08	279	314	350	386	422	458	493	529	565	600
122		636	672	707	743	778	814	849	884	920	955
123		991	*026	*061	*096	*132	*167	*202	*237	*272	*307
124	09	342	377	412	447	482	517	552	587	621	656
125		691	726	760	795	830	864	899	934	968	*003
126	10	037	072	106	140	175	209	243	278	312	346
127		380	415	449	483	517	551	585	619	653	687
128		721	755	789	823	857	890	924	958	992	*025
129	11	059	093	126	160	193	227	261	294	327	361
130		394	428	461	494	528	561	594	628	661	694
131		727	760	793	826	860	893	926	959	992	*024
132	12	057	090	123	156	189	222	254	287	320	352
133		385	418	450	483	516	548	581	613	646	678
134		710	743	775	808	840	872	905	937	969	*001
135	13	033	066	098	130	162	194	226	258	290	322
136		354	386	418	450	481	513	545	577	609	640
137		672	704	735	767	799	830	862	893	925	956
138		988	*019	*051	*082	*114	*145	*176	*208	*239	*270
139	14	301	333	364	395	426	457	489	520	551	582
140		613	644	675	706	737	768	799	829	860	891
141		922	953	983	*014	*045	*076	*106	*137	*168	*198
142	15	229	259	290	320	351	381	412	442	473	503
143		534	564	594	625	655	685	715	746	776	806
144		836	866	897	927	957	987	*017	*047	*077	*107
145	16	137	167	197	227	256	286	316	346	376	406
146		435	465	495	524	554	584	613	643	673	702
147		732	761	791	820	850	879	909	938	967	997
148	17	026	056	085	114	143	173	202	231	260	289
149		319	348	377	406	435	464	493	522	551	580
150		609	638	667	696	725	754	782	811	840	869
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts		
	44	43	42
1	4.4	4.3	4.2
2	8.8	8.6	8.4
3	13.2	12.9	12.6
4	17.6	17.2	16.8
5	22.0	21.5	21.0
6	26.4	25.8	25.2
7	30.8	30.1	29.4
8	35.2	34.4	33.6
9	39.6	38.7	37.8

	41	40	39
1	4.1	4.0	3.9
2	8.2	8.0	7.8
3	12.3	12.0	11.7
4	16.4	16.0	15.6
5	20.5	20.0	19.5
6	24.6	24.0	23.4
7	28.7	28.0	27.3
8	32.8	32.0	31.2
9	36.9	36.0	35.1

	38	37	36
1	3.8	3.7	3.6
2	7.6	7.4	7.2
3	11.4	11.1	10.8
4	15.2	14.8	14.4
5	19.0	18.5	18.0
6	22.8	22.2	21.6
7	26.6	25.9	25.2
8	30.4	29.6	28.8
9	34.2	33.3	32.4

	35	34	33
1	3.5	3.4	3.3
2	7.0	6.8	6.6
3	10.5	10.2	9.9
4	14.0	13.6	13.2
5	17.5	17.0	16.5
6	21.0	20.4	19.8
7	24.5	23.8	23.1
8	28.0	27.2	26.4
9	31.5	30.6	29.7

	32	31	30
1	3.2	3.1	3.0
2	6.4	6.2	6.0
3	9.6	9.3	9.0
4	12.8	12.4	12.0
5	16.0	15.5	15.0
6	19.2	18.6	18.0
7	22.4	21.7	21.0
8	25.6	24.8	24.0
9	28.8	27.9	27.0

Proportional parts

LOGARITHMS OF NUMBERS

150 — 200

N.	L.	0	1	2	3	4	5	6	7	8	9
150	17	609	638	667	696	725	754	782	811	840	869
151		898	926	955	984	*013	*041	*070	*099	*127	*156
152	18	184	213	241	270	298	327	355	384	412	441
153		469	498	526	554	583	611	639	667	696	724
154		752	780	808	837	865	893	921	949	977	*005
155	19	033	061	089	117	145	173	201	229	257	285
156		312	340	368	396	424	451	479	507	535	562
157		590	618	645	673	700	728	756	783	811	838
158		866	893	921	948	976	*003	*030	*058	*085	*112
159	20	140	167	194	222	249	276	303	330	358	385
160		412	439	466	493	520	548	575	602	629	656
161		683	710	737	763	790	817	844	871	898	925
162		952	978	*005	*032	*059	*085	*112	*139	*165	*192
163	21	219	245	272	299	325	352	378	405	431	458
164		484	511	537	564	590	617	643	669	696	722
165		748	775	801	827	854	880	906	932	958	985
166	22	011	037	063	089	115	141	167	194	220	246
167		272	298	324	350	376	401	427	453	479	505
168		531	557	583	608	634	660	686	712	737	763
169		789	814	840	866	891	917	943	968	994	*019
170	23	045	070	096	121	147	172	198	223	249	274
171		300	325	350	376	401	426	452	477	502	528
172		553	578	603	629	654	679	704	729	754	779
173		805	830	855	880	905	930	955	980	*005	*030
174	24	055	080	105	130	155	180	204	229	254	279
175		304	329	353	378	403	428	452	477	502	527
176		551	576	601	625	650	674	699	724	748	773
177		797	822	846	871	895	920	944	969	993	*018
178	25	042	066	091	115	139	164	188	212	237	261
179		285	310	334	358	382	406	431	455	479	503
180		527	551	575	600	624	648	672	696	720	744
181		768	792	816	840	864	888	912	935	959	983
182	26	007	031	055	079	102	126	150	174	198	221
183		245	269	293	316	340	364	387	411	435	458
184		482	505	529	553	576	600	623	647	670	694
185		717	741	764	788	811	834	858	881	905	928
186		951	975	998	*021	*045	*068	*091	*114	*138	*161
187	27	184	207	231	254	277	300	323	346	370	393
188		416	439	462	485	508	531	554	577	600	623
189		646	669	692	715	738	761	784	807	830	852
190		875	898	921	944	967	989	*012	*035	*058	*081
191	28	103	126	149	171	194	217	240	262	285	307
192		330	353	375	398	421	443	466	488	511	533
193		556	578	601	623	646	668	691	713	735	758
194		780	803	825	847	870	892	914	937	959	981
195	29	003	026	048	070	092	115	137	159	181	203
196		226	248	270	292	314	336	358	380	403	425
197		447	469	491	513	535	557	579	601	623	645
198		667	688	710	732	754	776	798	820	842	863
199		885	907	929	951	973	994	*016	*038	*060	*081
200	30	103	125	146	168	190	211	233	255	276	298
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	29	28
1	2.9	2.8
2	5.8	5.6
3	8.7	8.4
4	11.6	11.2
5	14.5	14.0
6	17.4	16.8
7	20.3	19.6
8	23.2	22.4
9	26.1	25.2

	27	26
1	2.7	2.6
2	5.4	5.2
3	8.1	7.8
4	10.8	10.4
5	13.5	13.0
6	16.2	15.6
7	18.9	18.2
8	21.6	20.8
9	24.3	23.4

	25
1	2.5
2	5.0
3	7.5
4	10.0
5	12.5
6	15.0
7	17.5
8	20.0
9	22.5

	24	23
1	2.4	2.3
2	4.8	4.6
3	7.2	6.9
4	9.6	9.2
5	12.0	11.5
6	14.4	13.8
7	16.8	16.1
8	19.2	18.4
9	21.6	20.7

	22	21
1	2.2	2.1
2	4.4	4.2
3	6.6	6.3
4	8.8	8.4
5	11.0	10.5
6	13.2	12.6
7	15.4	14.7
8	17.6	16.8
9	19.8	18.9

Proportional parts

LOGARITHMS OF NUMBERS

200 — 250

N.	L.	0	1	2	3	4	5	6	7	8	9
200	30	103	125	146	168	190	211	233	255	276	298
201		320	341	363	384	406	428	449	471	492	514
202		535	557	578	600	621	643	664	685	707	728
203		750	771	792	814	835	856	878	899	920	942
204		963	984	*006	*027	*048	*069	*091	*112	*133	*154
205	31	175	197	218	239	260	281	302	323	345	366
206		387	408	429	450	471	492	513	534	555	576
207		597	618	639	660	681	702	723	744	765	785
208		806	827	848	869	890	911	931	952	973	994
209	32	015	035	056	077	098	118	139	160	181	201
210		222	243	263	284	305	325	346	366	387	408
211		428	449	469	490	510	531	552	572	593	613
212		634	654	675	695	715	736	756	777	797	818
213		838	858	879	899	919	940	960	980	*001	*021
214	33	041	062	082	102	122	143	163	183	203	224
215		244	264	284	304	325	345	365	385	405	425
216		445	465	486	506	526	546	566	586	606	626
217		646	666	686	706	726	746	766	786	806	826
218		846	866	885	905	925	945	965	985	*005	*025
219	34	044	064	084	104	124	143	163	183	203	223
220		242	262	282	301	321	341	361	380	400	420
221		439	459	479	498	518	537	557	577	596	616
222		635	655	674	694	713	733	753	772	792	811
223		830	850	869	889	908	928	947	967	986	*005
224	35	025	044	064	083	102	122	141	160	180	199
225		218	238	257	276	295	315	334	353	372	392
226		411	430	449	468	488	507	526	545	564	583
227		603	622	641	660	679	698	717	736	755	774
228		793	813	832	851	870	889	908	927	946	965
229		984	*003	*021	*040	*059	*078	*097	*116	*135	*154
230	36	173	192	211	229	248	267	286	305	324	342
231		361	380	399	418	436	455	474	493	511	530
232		549	568	586	605	624	642	661	680	698	717
233		736	754	773	791	810	829	847	866	884	903
234		922	940	959	977	996	*014	*033	*051	*070	*088
235	37	107	125	144	162	181	199	218	236	254	273
236		291	310	328	346	365	383	401	420	438	457
237		475	493	511	530	548	566	585	603	621	639
238		658	676	694	712	731	749	767	785	803	822
239		840	858	876	894	912	931	949	967	985	*003
240	38	021	039	057	075	093	112	130	148	166	184
241		202	220	238	256	274	292	310	328	346	364
242		382	399	417	435	453	471	489	507	525	543
243		561	578	596	614	632	650	668	686	703	721
244		739	757	775	792	810	828	846	863	881	899
245		917	934	952	970	987	*005	*023	*041	*058	*076
246	39	094	111	129	146	164	182	199	217	235	252
247		270	287	305	322	340	358	375	393	410	428
248		445	463	480	498	515	533	550	568	585	602
249		620	637	655	672	690	707	724	742	759	777
250		794	811	829	846	863	881	898	915	933	950
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	22	21
1	2.2	2.1
2	4.4	4.2
3	6.6	6.3
4	8.8	8.4
5	11.0	10.5
6	13.2	12.6
7	15.4	14.7
8	17.6	16.8
9	19.8	18.9

	20
1	2.0
2	4.0
3	6.0
4	8.0
5	10.0
6	12.0
7	14.0
8	16.0
9	18.0

	19
1	1.9
2	3.8
3	5.7
4	7.6
5	9.5
6	11.4
7	13.3
8	15.2
9	17.1

	18
1	1.8
2	3.6
3	5.4
4	7.2
5	9.0
6	10.8
7	12.6
8	14.4
9	16.2

	17
1	1.7
2	3.4
3	5.1
4	6.8
5	8.5
6	10.2
7	11.9
8	13.6
9	15.3

Proportional parts

LOGARITHMS OF NUMBERS

250 — 300

N.	L.	0	1	2	3	4	5	6	7	8	9
250	39	794	811	829	846	863	881	898	915	933	950
251		967	985	*002	*019	*037	*054	*071	*088	*106	*123
252	40	140	157	175	192	209	226	243	261	278	295
253		312	329	346	364	381	398	415	432	449	466
254		483	500	518	535	552	569	586	603	620	637
255		654	671	688	705	722	739	756	773	790	807
256		824	841	858	875	892	909	926	943	960	976
257		993	*010	*027	*044	*061	*078	*095	*111	*128	*145
258	41	162	179	196	212	229	246	263	280	296	313
259		330	347	363	380	397	414	430	447	464	481
260		497	514	531	547	564	581	597	614	631	647
261		664	681	697	714	731	747	764	780	797	814
262		830	847	863	880	896	913	929	946	963	979
263		996	*012	*029	*045	*062	*078	*095	*111	*127	*144
264	42	160	177	193	210	226	243	259	275	292	308
265		325	341	357	374	390	406	423	439	455	472
266		488	504	521	537	553	570	586	602	619	635
267		651	667	684	700	716	732	749	765	781	797
268		813	830	846	862	878	894	911	927	943	959
269		975	991	*008	*024	*040	*056	*072	*088	*104	*120
270	43	136	152	169	185	201	217	233	249	265	281
271		297	313	329	345	361	377	393	409	425	441
272		457	473	489	505	521	537	553	569	584	600
273		616	632	648	664	680	696	712	727	743	759
274		775	791	807	823	838	854	870	886	902	917
275		933	949	965	981	996	*012	*028	*044	*059	*075
276	44	091	107	122	138	154	170	185	201	217	232
277		248	264	279	295	311	326	342	358	373	389
278		404	420	436	451	467	483	498	514	529	545
279		560	576	592	607	623	638	654	669	685	700
280		716	731	747	762	778	793	809	824	840	855
281		871	886	902	917	932	948	963	979	994	*010
282	45	025	040	056	071	086	102	117	133	148	163
283		179	194	209	225	240	255	271	286	301	317
284		332	347	362	378	393	408	423	439	454	469
285		484	500	515	530	545	561	576	591	606	621
286		637	652	667	682	697	712	728	743	758	773
287		788	803	818	834	849	864	879	894	909	924
288		939	954	969	984	*000	*015	*030	*045	*060	*075
289	46	090	105	120	135	150	165	180	195	210	225
290		240	255	270	285	300	315	330	345	359	374
291		389	404	419	434	449	464	479	494	509	523
292		538	553	568	583	598	613	627	642	657	672
293		687	702	716	731	746	761	776	790	805	820
294		835	850	864	879	894	909	923	938	953	967
295		982	997	*012	*026	*041	*056	*070	*085	*100	*114
296	47	129	144	159	173	188	202	217	232	246	261
297		276	290	305	319	334	349	363	378	392	407
298		422	436	451	465	480	494	509	524	538	553
299		567	582	596	611	625	640	654	669	683	698
300		712	727	741	756	770	784	799	813	828	842
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts	
	18
1	1.8
2	3.6
3	5.4
4	7.2
5	9.0
6	10.8
7	12.6
8	14.4
9	16.2
	17
1	1.7
2	3.4
3	5.1
4	6.8
5	8.5
6	10.2
7	11.9
8	13.6
9	15.3
	16
1	1.6
2	3.2
3	4.8
4	6.4
5	8.0
6	9.6
7	11.2
8	12.8
9	14.4
	15
1	1.5
2	3.0
3	4.5
4	6.0
5	7.5
6	9.0
7	10.5
8	12.0
9	13.5
	14
1	1.4
2	2.8
3	4.2
4	5.6
5	7.0
6	8.4
7	9.8
8	11.2
9	12.6
$\log e = 0.43429$	
Proportional parts	

LOGARITHMS OF NUMBERS

300 — 350

N.	L.	0	1	2	3	4	5	6	7	8	9	Proportional parts
300	47	712	727	741	756	770	784	799	813	828	842	
301		857	871	885	900	914	929	943	958	972	986	
302	48	001	015	029	044	058	073	087	101	116	130	
303		144	159	173	187	202	216	230	244	259	273	15
304		287	302	316	330	344	359	373	387	401	416	1 1.5
305		430	444	458	473	487	501	515	530	544	558	2 3.0
306		572	586	601	615	629	643	657	671	686	700	3 4.5
307		714	728	742	756	770	785	799	813	827	841	4 6.0
308		855	869	883	897	911	926	940	954	968	982	5 7.5
309		996	*010	*024	*038	*052	*066	*080	*094	*108	*122	6 9.0
310	49	136	150	164	178	192	206	220	234	248	262	7 10.5
311		276	290	304	318	332	346	360	374	388	402	8 12.0
312		415	429	443	457	471	485	499	513	527	541	9 13.5
313		554	568	582	596	610	624	638	651	665	679	
314		693	707	721	734	748	762	776	790	803	817	
315		831	845	859	872	886	900	914	927	941	955	14
316		969	982	996	*010	*024	*037	*051	*065	*079	*092	1 1.4
317	50	106	120	133	147	161	174	188	202	215	229	2 2.8
318		243	256	270	284	297	311	325	338	352	365	3 4.2
319		379	393	406	420	433	447	461	474	488	501	4 5.6
320		515	529	542	556	569	583	596	610	623	637	5 7.0
321		651	664	678	691	705	718	732	745	759	772	6 8.4
322		786	799	813	826	840	853	866	880	893	907	7 9.8
323		920	934	947	961	974	987	*001	*014	*028	*041	8 11.2
324	51	055	068	081	095	108	121	135	148	162	175	9 12.6
325		188	202	215	228	242	255	268	282	295	308	
326		322	335	348	362	375	388	402	415	428	441	13
327		455	468	481	495	508	521	534	548	561	574	1 1.3
328		587	601	614	627	640	654	667	680	693	706	2 2.6
329		720	733	746	759	772	786	799	812	825	838	3 3.9
330		851	865	878	891	904	917	930	943	957	970	4 5.2
331		983	996	*009	*022	*035	*048	*061	*075	*088	*101	5 6.5
332	52	114	127	140	153	166	179	192	205	218	231	6 7.8
333		244	257	270	284	297	310	323	336	349	362	7 9.1
334		375	388	401	414	427	440	453	466	479	492	8 10.4
335		504	517	530	543	556	569	582	595	608	621	9 11.7
336		634	647	660	673	686	699	711	724	737	750	
337		763	776	789	802	815	827	840	853	866	879	
338		892	905	917	930	943	956	969	982	994	*007	
339	53	020	033	046	058	071	084	097	110	122	135	12
340		148	161	173	186	199	212	224	237	250	263	1 1.2
341		275	288	301	314	326	339	352	364	377	390	2 2.4
342		403	415	428	441	453	466	479	491	504	517	3 3.6
343		529	542	555	567	580	593	605	618	631	643	4 4.8
344		656	668	681	694	706	719	732	744	757	769	5 6.0
345		782	794	807	820	832	845	857	870	882	895	6 7.2
346		908	920	933	945	958	970	983	995	*008	*020	7 8.4
347	54	033	045	058	070	083	095	108	120	133	145	8 9.6
348		158	170	183	195	208	220	233	245	258	270	9 10.8
349		283	295	307	320	332	345	357	370	382	394	
350		407	419	432	444	456	469	481	494	506	518	$\log \pi = 0.49715$
N.	L.	0	1	2	3	4	5	6	7	8	9	Proportional parts

LOGARITHMS OF NUMBERS

350 — 400

N.	L.	0	1	2	3	4	5	6	7	8	9
350	54	407	419	432	444	456	469	481	494	506	518
351		531	543	555	568	580	593	605	617	630	642
352		654	667	679	691	704	716	728	741	753	765
353		777	790	802	814	827	839	851	864	876	888
354		900	913	925	937	949	962	974	986	998	*011
355	55	023	035	047	060	072	084	096	108	121	133
356		145	157	169	182	194	206	218	230	242	255
357		267	279	291	303	315	328	340	352	364	376
358		388	400	413	425	437	449	461	473	485	497
359		509	522	534	546	558	570	582	594	606	618
360		630	642	654	666	678	691	703	715	727	739
361		751	763	775	787	799	811	823	835	847	859
362		871	883	895	907	919	931	943	955	967	979
363		991	*003	*015	*027	*038	*050	*062	*074	*086	*098
364	56	110	122	134	146	158	170	182	194	205	217
365		229	241	253	265	277	289	301	312	324	336
366		348	360	372	384	396	407	419	431	443	455
367		467	478	490	502	514	526	538	549	561	573
368		585	597	608	620	632	644	656	667	679	691
369		703	714	726	738	750	761	773	785	797	808
370		820	832	844	855	867	879	891	902	914	926
371		937	949	961	972	984	996	*008	*019	*031	*043
372	57	054	066	078	089	101	113	124	136	148	159
373		171	183	194	206	217	229	241	252	264	276
374		287	299	310	322	334	345	357	368	380	392
375		403	415	426	438	449	461	473	484	496	507
376		519	530	542	553	565	576	588	600	611	623
377		634	646	657	669	680	692	703	715	726	738
378		749	761	772	784	795	807	818	830	841	852
379		864	875	887	898	910	921	933	944	955	967
380		978	990	*001	*013	*024	*035	*047	*058	*070	*081
381	58	092	104	115	127	138	149	161	172	184	195
382		206	218	229	240	252	263	274	286	297	309
383		320	331	343	354	365	377	388	399	410	422
384		433	444	456	467	478	490	501	512	524	535
385		546	557	569	580	591	602	614	625	636	647
386		659	670	681	692	704	715	726	737	749	760
387		771	782	794	805	816	827	838	850	861	872
388		883	894	906	917	928	939	950	961	973	984
389		995	*006	*017	*028	*040	*051	*062	*073	*084	*095
390	59	106	118	129	140	151	162	173	184	195	207
391		218	229	240	251	262	273	284	295	306	318
392		329	340	351	362	373	384	395	406	417	428
393		439	450	461	472	483	494	506	517	528	539
394		550	561	572	583	594	605	616	627	638	649
395		660	671	682	693	704	715	726	737	748	759
396		770	780	791	802	813	824	835	846	857	868
397		879	890	901	912	923	934	945	956	966	977
398		988	999	*010	*021	*032	*043	*054	*065	*076	*086
399	60	097	108	119	130	141	152	163	173	184	195
400		206	217	228	239	249	260	271	282	293	304
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts									
	13								
1	1.3								
2	2.6								
3	3.9								
4	5.2								
5	6.5								
6	7.8								
7	9.1								
8	10.4								
9	11.7								
	12								
1	1.2								
2	2.4								
3	3.6								
4	4.8								
5	6.0								
6	7.2								
7	8.4								
8	9.6								
9	10.8								
	11								
1	1.1								
2	2.2								
3	3.3								
4	4.4								
5	5.5								
6	6.6								
7	7.7								
8	8.8								
9	9.9								
	10								
1	1.0								
2	2.0								
3	3.0								
4	4.0								
5	5.0								
6	6.0								
7	7.0								
8	8.0								
9	9.0								
N.	L.	0	1	2	3	4	5	6	7	8	9

LOGARITHMS OF NUMBERS

400 — 450

N.	L.	0	1	2	3	4	5	6	7	8	9
400	60	206	217	228	239	249	260	271	282	293	304
401		314	325	336	347	358	369	379	390	401	412
402		423	433	444	455	466	477	487	498	509	520
403		531	541	552	563	574	584	595	606	617	627
404		638	649	660	670	681	692	703	713	724	735
405		746	756	767	778	788	799	810	821	831	842
406		853	863	874	885	895	906	917	927	938	949
407		959	970	981	991	*002	*013	*023	*034	*045	*055
408	61	066	077	087	098	109	119	130	140	151	162
409		172	183	194	204	215	225	236	247	257	268
410		278	289	300	310	321	331	342	352	363	374
411		384	395	405	416	426	437	448	458	469	479
412		490	500	511	521	532	542	553	563	574	584
413		595	606	616	627	637	648	658	669	679	690
414		700	711	721	731	742	752	763	773	784	794
415		805	815	826	836	847	857	868	878	888	899
416		909	920	930	941	951	962	972	982	993	*003
417	62	014	024	034	045	055	066	076	086	097	107
418		118	128	138	149	159	170	180	190	201	211
419		221	232	242	252	263	273	284	294	304	315
420		325	335	346	356	366	377	387	397	408	418
421		428	439	449	459	469	480	490	500	511	521
422		531	542	552	562	572	583	593	603	613	624
423		634	644	655	665	675	685	696	706	716	726
424		737	747	757	767	778	788	798	808	818	829
425		839	849	859	870	880	890	900	910	921	931
426		941	951	961	972	982	992	*002	*012	*022	*033
427	63	043	053	063	073	083	094	104	114	124	134
428		144	155	165	175	185	195	205	215	225	236
429		246	256	266	276	286	296	306	317	327	337
430		347	357	367	377	387	397	407	417	428	438
431		448	458	468	478	488	498	508	518	528	538
432		548	558	568	579	589	599	609	619	629	639
433		649	659	669	679	689	699	709	719	729	739
434		749	759	769	779	789	799	809	819	829	839
435		849	859	869	879	889	899	909	919	929	939
436		949	959	969	979	988	998	*008	*018	*028	*038
437	64	048	058	068	078	088	098	108	118	128	137
438		147	157	167	177	187	197	207	217	227	237
439		246	256	266	276	286	296	306	316	326	335
440		345	355	365	375	385	395	404	414	424	434
441		444	454	464	473	483	493	503	513	523	532
442		542	552	562	572	582	591	601	611	621	631
443		640	650	660	670	680	689	699	709	719	729
444		738	748	758	768	777	787	797	807	816	826
445		836	846	856	865	875	885	895	904	914	924
446		933	943	953	963	972	982	992	*002	*011	*021
447	65	031	040	050	060	070	079	089	099	108	118
448		128	137	147	157	167	176	186	196	205	215
449		225	234	244	254	263	273	283	292	302	312
450		321	331	341	350	360	369	379	389	398	408
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	11
1	1.1
2	2.2
3	3.3
4	4.4
5	5.5
6	6.6
7	7.7
8	8.8
9	9.9

	10
1	1.0
2	2.0
3	3.0
4	4.0
5	5.0
6	6.0
7	7.0
8	8.0
9	9.0

	9
1	0.9
2	1.8
3	2.7
4	3.6
5	4.5
6	5.4
7	6.3
8	7.2
9	8.1

Proportional parts

LOGARITHMS OF NUMBERS

450 — 500

N.	L.	0	1	2	3	4	5	6	7	8	9
450	65	321	331	341	350	360	369	379	389	398	408
451		418	427	437	447	456	466	475	485	495	504
452		514	523	533	543	552	562	571	581	591	600
453		610	619	629	639	648	658	667	677	686	696
454		706	715	725	734	744	753	763	772	782	792
455		801	811	820	830	839	849	858	868	877	887
456		896	906	916	925	935	944	954	963	973	982
457		992	*001	*011	*020	*030	*039	*049	*058	*068	*077
458	66	087	096	106	115	124	134	143	153	162	172
459		181	191	200	210	219	229	238	247	257	266
460		276	285	295	304	314	323	332	342	351	361
461		370	380	389	398	408	417	427	436	445	455
462		464	474	483	492	502	511	521	530	539	549
463		558	567	577	586	596	605	614	624	633	642
464		652	661	671	680	689	699	708	717	727	736
465		745	755	764	773	783	792	801	811	820	829
466		839	848	857	867	876	885	894	904	913	922
467		932	941	950	960	969	978	987	997	*006	*015
468	67	025	034	043	052	062	071	080	089	099	108
469		117	127	136	145	154	164	173	182	191	201
470		210	219	228	237	247	256	265	274	284	293
471		302	311	321	330	339	348	357	367	376	385
472		394	403	413	422	431	440	449	459	468	477
473		486	495	504	514	523	532	541	550	560	569
474		578	587	596	605	614	624	633	642	651	660
475		669	679	688	697	706	715	724	733	742	752
476		761	770	779	788	797	806	815	825	834	843
477		852	861	870	879	888	897	906	916	925	934
478		943	952	961	970	979	988	997	*006	*015	*024
479	68	034	043	052	061	070	079	088	097	106	115
480		124	133	142	151	160	169	178	187	196	205
481		215	224	233	242	251	260	269	278	287	296
482		305	314	323	332	341	350	359	368	377	386
483		395	404	413	422	431	440	449	458	467	476
484		485	494	502	511	520	529	538	547	556	565
485		574	583	592	601	610	619	628	637	646	655
486		664	673	681	690	699	708	717	726	735	744
487		753	762	771	780	789	797	806	815	824	833
488		842	851	860	869	878	886	895	904	913	922
489		931	940	949	958	966	975	984	993	*002	*011
490	69	020	028	037	046	055	064	073	082	090	099
491		108	117	126	135	144	152	161	170	179	188
492		197	205	214	223	232	241	249	258	267	276
493		285	294	302	311	320	329	338	346	355	364
494		373	381	390	399	408	417	425	434	443	452
495		461	469	478	487	496	504	513	522	531	539
496		548	557	566	574	583	592	601	609	618	627
497		636	644	653	662	671	679	688	697	705	714
498		723	732	740	749	758	767	775	784	793	801
499		810	819	827	836	845	854	862	871	880	888
500		897	906	914	923	932	940	949	958	966	975
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts	
	10
1	1.0
2	2.0
3	3.0
4	4.0
5	5.0
6	6.0
7	7.0
8	8.0
9	9.0
	9
1	0.9
2	1.8
3	2.7
4	3.6
5	4.5
6	5.4
7	6.3
8	7.2
9	8.1
	8
1	0.8
2	1.6
3	2.4
4	3.2
5	4.0
6	4.8
7	5.6
8	6.4
9	7.2

Proportional parts

LOGARITHMS OF NUMBERS

500 — 550

N.	L.	0	1	2	3	4	5	6	7	8	9
500	69	897	906	914	923	932	940	949	958	966	975
501		984	992	*001	*010	*018	*027	*036	*044	*053	*062
502	70	070	079	088	096	105	114	122	131	140	148
503		157	165	174	183	191	200	209	217	226	234
504		243	252	260	269	278	286	295	303	312	321
505		329	338	346	355	364	372	381	389	398	406
506		415	424	432	441	449	458	467	475	484	492
507		501	509	518	526	535	544	552	561	569	578
508		586	595	603	612	621	629	638	646	655	663
509		672	680	689	697	706	714	723	731	740	749
510		757	766	774	783	791	800	808	817	825	834
511		842	851	859	868	876	885	893	902	910	919
512		927	935	944	952	961	969	978	986	995	*003
513	71	012	020	029	037	046	054	063	071	079	088
514		096	105	113	122	130	139	147	155	164	172
515		181	189	198	206	214	223	231	240	248	257
516		265	273	282	290	299	307	315	324	332	341
517		349	357	366	374	383	391	399	408	416	425
518		433	441	450	458	466	475	483	492	500	508
519		517	525	533	542	550	559	567	575	584	592
520		600	609	617	625	634	642	650	659	667	675
521		684	692	700	709	717	725	734	742	750	759
522		767	775	784	792	800	809	817	825	834	842
523		850	858	867	875	883	892	900	908	917	925
524		933	941	950	958	966	975	983	991	999	*008
525	72	016	024	032	041	049	057	066	074	082	090
526		099	107	115	123	132	140	148	156	165	173
527		181	189	198	206	214	222	230	239	247	255
528		263	272	280	288	296	304	313	321	329	337
529		346	354	362	370	378	387	395	403	411	419
530		428	436	444	452	460	469	477	485	493	501
531		509	518	526	534	542	550	558	567	575	583
532		591	599	607	616	624	632	640	648	656	665
533		673	681	689	697	705	713	722	730	738	746
534		754	762	770	779	787	795	803	811	819	827
535		835	843	852	860	868	876	884	892	900	908
536		916	925	933	941	949	957	965	973	981	989
537		997	*006	*014	*022	*030	*038	*046	*054	*062	*070
538	73	078	086	094	102	111	119	127	135	143	151
539		159	167	175	183	191	199	207	215	223	231
540		239	247	255	263	272	280	288	296	304	312
541		320	328	336	344	352	360	368	376	384	392
542		400	408	416	424	432	440	448	456	464	472
543		480	488	496	504	512	520	528	536	544	552
544		560	568	576	584	592	600	608	616	624	632
545		640	648	656	664	672	679	687	695	703	711
546		719	727	735	743	751	759	767	775	783	791
547		799	807	815	823	830	838	846	854	862	870
548		878	886	894	902	910	918	926	933	941	949
549		957	965	973	981	989	997	*005	*013	*020	*028
550	74	036	044	052	060	068	076	084	092	099	107
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	9	8	7
1	0.9	0.8	0.7
2	1.8	1.6	1.4
3	2.7	2.4	2.1
4	3.6	3.2	2.8
5	4.5	4.0	3.5
6	5.4	4.8	4.2
7	6.3	5.6	4.9
8	7.2	6.4	5.6
9	8.1	7.2	6.3

Proportional parts

LOGARITHMS OF NUMBERS

550 — 600

N.	L.	0	1	2	3	4	5	6	7	8	9
550	74	036	044	052	060	068	076	084	092	099	107
551		115	123	131	139	147	155	162	170	178	186
552		194	202	210	218	225	233	241	249	257	265
553		273	280	288	296	304	312	320	327	335	343
554		351	359	367	374	382	390	398	406	414	421
555		429	437	445	453	461	468	476	484	492	500
556		507	515	523	531	539	547	554	562	570	578
557		586	593	601	609	617	624	632	640	648	656
558		663	671	679	687	695	702	710	718	726	733
559		741	749	757	764	772	780	788	796	803	811
560		819	827	834	842	850	858	865	873	881	889
561		896	904	912	920	927	935	943	950	958	966
562		974	981	989	997	*005	*012	*020	*028	*035	*043
563	75	051	059	066	074	082	089	097	105	113	120
564		128	136	143	151	159	166	174	182	189	197
565		205	213	220	228	236	243	251	259	266	274
566		282	289	297	305	312	320	328	335	343	351
567		358	366	374	381	389	397	404	412	420	427
568		435	442	450	458	465	473	481	488	496	504
569		511	519	526	534	542	549	557	565	572	580
570		587	595	603	610	618	626	633	641	648	656
571		664	671	679	686	694	702	709	717	724	732
572		740	747	755	762	770	778	785	793	800	808
573		815	823	831	838	846	853	861	868	876	884
574		891	899	906	914	921	929	937	944	952	959
575		967	974	982	989	997	*005	*012	*020	*027	*035
576	76	042	050	057	065	072	080	087	095	103	110
577		118	125	133	140	148	155	163	170	178	185
578		193	200	208	215	223	230	238	245	253	260
579		268	275	283	290	298	305	313	320	328	335
580		343	350	358	365	373	380	388	395	403	410
581		418	425	433	440	448	455	462	470	477	485
582		492	500	507	515	522	530	537	545	552	559
583		567	574	582	589	597	604	612	619	626	634
584		641	649	656	664	671	678	686	693	701	708
585		716	723	730	738	745	753	760	768	775	782
586		790	797	805	812	819	827	834	842	849	856
587		864	871	879	886	893	901	908	916	923	930
588		938	945	953	960	967	975	982	989	997	*004
589	77	012	019	026	034	041	048	056	063	070	078
590		085	093	100	107	115	122	129	137	144	151
591		159	166	173	181	188	195	203	210	217	225
592		232	240	247	254	262	269	276	283	291	298
593		305	313	320	327	335	342	349	357	364	371
594		379	386	393	401	408	415	422	430	437	444
595		452	459	466	474	481	488	495	503	510	517
596		525	532	539	546	554	561	568	576	583	590
597		597	605	612	619	627	634	641	648	656	663
598		670	677	685	692	699	706	714	721	728	735
599		743	750	757	764	772	779	786	793	801	808
600		815	822	830	837	844	851	859	866	873	880
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	8
1	0.8
2	1.6
3	2.4
4	3.2
5	4.0
6	4.8
7	5.6
8	6.4
9	7.2

	7
1	0.7
2	1.4
3	2.1
4	2.8
5	3.5
6	4.2
7	4.9
8	5.6
9	6.3

Proportional parts

LOGARITHMS OF NUMBERS

600 — 650

N.	L.	0	1	2	3	4	5	6	7	8	9
600	77	815	822	830	837	844	851	859	866	873	880
601		887	895	902	909	916	924	931	938	945	952
602		960	967	974	981	988	996	*003	*010	*017	*025
603	78	032	039	046	053	061	068	075	082	089	097
604		104	111	118	125	132	140	147	154	161	168
605		176	183	190	197	204	211	219	226	233	240
606		247	254	262	269	276	283	290	297	305	312
607		319	326	333	340	347	355	362	369	376	383
608		390	398	405	412	419	426	433	440	447	455
609		462	469	476	483	490	497	504	512	519	526
610		533	540	547	554	561	569	576	583	590	597
611		604	611	618	625	633	640	647	654	661	668
612		675	682	689	696	704	711	718	725	732	739
613		746	753	760	767	774	781	789	796	803	810
614		817	824	831	838	845	852	859	866	873	880
615		888	895	902	909	916	923	930	937	944	951
616		958	965	972	979	986	993	*000	*007	*014	*021
617	79	029	036	043	050	057	064	071	078	085	092
618		099	106	113	120	127	134	141	148	155	162
619		169	176	183	190	197	204	211	218	225	232
620		239	246	253	260	267	274	281	288	295	302
621		309	316	323	330	337	344	351	358	365	372
622		379	386	393	400	407	414	421	428	435	442
623		449	456	463	470	477	484	491	498	505	511
624		518	525	532	539	546	553	560	567	574	581
625		588	595	602	609	616	623	630	637	644	650
626		657	664	671	678	685	692	699	706	713	720
627		727	734	741	748	754	761	768	775	782	789
628		796	803	810	817	824	831	837	844	851	858
629		865	872	879	886	893	900	906	913	920	927
630		934	941	948	955	962	969	975	982	989	996
631	80	003	010	017	024	030	037	044	051	058	065
632		072	079	085	092	099	106	113	120	127	134
633		140	147	154	161	168	175	182	188	195	202
634		209	216	223	229	236	243	250	257	264	271
635		277	284	291	298	305	312	318	325	332	339
636		346	353	359	366	373	380	387	393	400	407
637		414	421	428	434	441	448	455	462	468	475
638		482	489	496	502	509	516	523	530	536	543
639		550	557	564	570	577	584	591	598	604	611
640		618	625	632	638	645	652	659	665	672	679
641		686	693	699	706	713	720	726	733	740	747
642		754	760	767	774	781	787	794	801	808	814
643		821	828	835	841	848	855	862	868	875	882
644		889	895	902	909	916	922	929	936	943	949
645		956	963	969	976	983	990	996	*003	*010	*017
646	81	023	030	037	043	050	057	064	070	077	084
647		090	097	104	111	117	124	131	137	144	151
648		158	164	171	178	184	191	198	204	211	218
649		224	231	238	245	251	258	265	271	278	285
650		291	298	305	311	318	325	331	338	345	351

Proportional parts	8
1	0.8
2	1.6
3	2.4
4	3.2
5	4.0
6	4.8
7	5.6
8	6.4
9	7.2

Proportional parts	7
1	0.7
2	1.4
3	2.1
4	2.8
5	3.5
6	4.2
7	4.9
8	5.6
9	6.3

Proportional parts	6
1	0.6
2	1.2
3	1.8
4	2.4
5	3.0
6	3.6
7	4.2
8	4.8
9	5.4

N. L. 0 1 2 3 4 5 6 7 8 9 Proportional parts

LOGARITHMS OF NUMBERS

650 — 700

N.	L.	0	1	2	3	4	5	6	7	8	9
650	81	291	298	305	311	318	325	331	338	345	351
651		358	365	371	378	385	391	398	405	411	418
652		425	431	438	445	451	458	465	471	478	485
653		491	498	505	511	518	525	531	538	544	551
654		558	564	571	578	584	591	598	604	611	617
655		624	631	637	644	651	657	664	671	677	684
656		690	697	704	710	717	723	730	737	743	750
657		757	763	770	776	783	790	796	803	809	816
658		823	829	836	842	849	856	862	869	875	882
659		889	895	902	908	915	921	928	935	941	948
660		954	961	968	974	981	987	994	*000	*007	*014
661	82	020	027	033	040	046	053	060	066	073	079
662		086	092	099	105	112	119	125	132	138	145
663		151	158	164	171	178	184	191	197	204	210
664		217	223	230	236	243	249	256	263	269	276
665		282	289	295	302	308	315	321	328	334	341
666		347	354	360	367	373	380	387	393	400	406
667		413	419	426	432	439	445	452	458	465	471
668		478	484	491	497	504	510	517	523	530	536
669		543	549	556	562	569	575	582	588	595	601
670		607	614	620	627	633	640	646	653	659	666
671		672	679	685	692	698	705	711	718	724	730
672		737	743	750	756	763	769	776	782	789	795
673		802	808	814	821	827	834	840	847	853	860
674		866	872	879	885	892	898	905	911	918	924
675		930	937	943	950	956	963	969	975	982	988
676		995	*001	*008	*014	*020	*027	*033	*040	*046	*052
677	83	059	065	072	078	085	091	097	104	110	117
678		123	129	136	142	149	155	161	168	174	181
679		187	193	200	206	213	219	225	232	238	245
680		251	257	264	270	276	283	289	296	302	308
681		315	321	327	334	340	347	353	359	366	372
682		378	385	391	398	404	410	417	423	429	436
683		442	448	455	461	467	474	480	487	493	499
684		506	512	518	525	531	537	544	550	556	563
685		569	575	582	588	594	601	607	613	620	626
686		632	639	645	651	658	664	670	677	683	689
687		696	702	708	715	721	727	734	740	746	753
688		759	765	771	778	784	790	797	803	809	816
689		822	828	835	841	847	853	860	866	872	879
690		885	891	897	904	910	916	923	929	935	942
691		948	954	960	967	973	979	985	992	998	*004
692	84	011	017	023	029	036	042	048	055	061	067
693		073	080	086	092	098	105	111	117	123	130
694		136	142	148	155	161	167	173	180	186	192
695		198	205	211	217	223	230	236	242	248	255
696		261	267	273	280	286	292	298	305	311	317
697		323	330	336	342	348	354	361	367	373	379
698		386	392	398	404	410	417	423	429	435	442
699		448	454	460	466	473	479	485	491	497	504
700		510	516	522	528	535	541	547	553	559	566
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	7
1	0.7
2	1.4
3	2.1
4	2.8
5	3.5
6	4.2
7	4.9
8	5.6
9	6.3

	6
1	0.6
2	1.2
3	1.8
4	2.4
5	3.0
6	3.6
7	4.2
8	4.8
9	5.4

Proportional parts

LOGARITHMS OF NUMBERS

700 — 750

N.	L.	0	1	2	3	4	5	6	7	8	9
700	84	510	516	522	528	535	541	547	553	559	566
701		572	578	584	590	597	603	609	615	621	628
702		634	640	646	652	658	665	671	677	683	689
703		696	702	708	714	720	726	733	739	745	751
704		757	763	770	776	782	788	794	800	807	813
705		819	825	831	837	844	850	856	862	868	874
706		880	887	893	899	905	911	917	924	930	936
707		942	948	954	960	967	973	979	985	991	997
708	85	003	009	016	022	028	034	040	046	052	058
709		065	071	077	083	089	095	101	107	114	120
710		126	132	138	144	150	156	163	169	175	181
711		187	193	199	205	211	217	224	230	236	242
712		248	254	260	266	272	278	285	291	297	303
713		309	315	321	327	333	339	345	352	358	364
714		370	376	382	388	394	400	406	412	418	425
715		431	437	443	449	455	461	467	473	479	485
716		491	497	503	509	516	522	528	534	540	546
717		552	558	564	570	576	582	588	594	600	606
718		612	618	625	631	637	643	649	655	661	667
719		673	679	685	691	697	703	709	715	721	727
720		733	739	745	751	757	763	769	775	781	788
721		794	800	806	812	818	824	830	836	842	848
722		854	860	866	872	878	884	890	896	902	908
723		914	920	926	932	938	944	950	956	962	968
724		974	980	986	992	998	*004	*010	*016	*022	*028
725	86	034	040	046	052	058	064	070	076	082	088
726		094	100	106	112	118	124	130	136	141	147
727		153	159	165	171	177	183	189	195	201	207
728		213	219	225	231	237	243	249	255	261	267
729		273	279	285	291	297	303	308	314	320	326
730		332	338	344	350	356	362	368	374	380	386
731		392	398	404	410	415	421	427	433	439	445
732		451	457	463	469	475	481	487	493	499	504
733		510	516	522	528	534	540	546	552	558	564
734		570	576	581	587	593	599	605	611	617	623
735		629	635	641	646	652	658	664	670	676	682
736		688	694	700	705	711	717	723	729	735	741
737		747	753	759	764	770	776	782	788	794	800
738		806	812	817	823	829	835	841	847	853	859
739		864	870	876	882	888	894	900	906	911	917
740		923	929	935	941	947	953	958	964	970	976
741		982	988	994	999	*005	*011	*017	*023	*029	*035
742	87	040	046	052	058	064	070	075	081	087	093
743		099	105	111	116	122	128	134	140	146	151
744		157	163	169	175	181	186	192	198	204	210
745		216	221	227	233	239	245	251	256	262	268
746		274	280	286	291	297	303	309	315	320	326
747		332	338	344	349	355	361	367	373	379	384
748		390	396	402	408	413	419	425	431	437	442
749		448	454	460	466	471	477	483	489	495	500
750		506	512	518	523	529	535	541	547	552	558
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	7	6	5
1	0.7	0.6	0.5
2	1.4	1.2	1.0
3	2.1	1.8	1.5
4	2.8	2.4	2.0
5	3.5	3.0	2.5
6	4.2	3.6	3.0
7	4.9	4.2	3.5
8	5.6	4.8	4.0
9	6.3	5.4	4.5

Proportional parts

LOGARITHMS OF NUMBERS

750 — 800

N.	L.	0	1	2	3	4	5	6	7	8	9
750	87	506	512	518	523	529	535	541	547	552	558
751		564	570	576	581	587	593	599	604	610	616
752		622	628	633	639	645	651	656	662	668	674
753		679	685	691	697	703	708	714	720	726	731
754		737	743	749	754	760	766	772	777	783	789
755		795	800	806	812	818	823	829	835	841	846
756		852	858	864	869	875	881	887	892	898	904
757		910	915	921	927	933	938	944	950	955	961
758		967	973	978	984	990	996	*001	*007	*013	*018
759	88	024	030	036	041	047	053	058	064	070	076
760		081	087	093	098	104	110	116	121	127	133
761		138	144	150	156	161	167	173	178	184	190
762		195	201	207	213	218	224	230	235	241	247
763		252	258	264	270	275	281	287	292	298	304
764		309	315	321	326	332	338	343	349	355	360
765		366	372	377	383	389	395	400	406	412	417
766		423	429	434	440	446	451	457	463	468	474
767		480	485	491	497	502	508	513	519	525	530
768		536	542	547	553	559	564	570	576	581	587
769		593	598	604	610	615	621	627	632	638	643
770		649	655	660	666	672	677	683	689	694	700
771		705	711	717	722	728	734	739	745	750	756
772		762	767	773	779	784	790	795	801	807	812
773		818	824	829	835	840	846	852	857	863	868
774		874	880	885	891	897	902	908	913	919	925
775		930	936	941	947	953	958	964	969	975	981
776		986	992	997	*003	*009	*014	*020	*025	*031	*037
777	89	042	048	053	059	064	070	076	081	087	092
778		098	104	109	115	120	126	131	137	143	148
779		154	159	165	170	176	182	187	193	198	204
780		209	215	221	226	232	237	243	248	254	260
781		265	271	276	282	287	293	298	304	310	315
782		321	326	332	337	343	348	354	360	365	371
783		376	382	387	393	398	404	409	415	421	426
784		432	437	443	448	454	459	465	470	476	481
785		487	492	498	504	509	515	520	526	531	537
786		542	548	553	559	564	570	575	581	586	592
787		597	603	609	614	620	625	631	636	642	647
788		653	658	664	669	675	680	686	691	697	702
789		708	713	719	724	730	735	741	746	752	757
790		763	768	774	779	785	790	796	801	807	812
791		818	823	829	834	840	845	851	856	862	867
792		873	878	883	889	894	900	905	911	916	922
793		927	933	938	944	949	955	960	966	971	977
794		982	988	993	998	*004	*009	*015	*020	*026	*031
795	90	037	042	048	053	059	064	069	075	080	086
796		091	097	102	108	113	119	124	129	135	140
797		146	151	157	162	168	173	179	184	189	195
798		200	206	211	217	222	227	233	238	244	249
799		255	260	266	271	276	282	287	293	298	304
800		309	314	320	325	331	336	342	347	352	358

Proportional parts	6
1	0.6
2	1.2
3	1.8
4	2.4
5	3.0
6	3.6
7	4.2
8	4.8
9	5.4

Proportional parts	5
1	0.5
2	1.0
3	1.5
4	2.0
5	2.5
6	3.0
7	3.5
8	4.0
9	4.5

LOGARITHMS OF NUMBERS

800 — 850

N.	L.	0	1	2	3	4	5	6	7	8	9
800	90	309	314	320	325	331	336	342	347	352	358
801		363	369	374	380	385	390	396	401	407	412
802		417	423	428	434	439	445	450	455	461	466
803		472	477	482	488	493	499	504	509	515	520
804		526	531	536	542	547	553	558	563	569	574
805		580	585	590	596	601	607	612	617	623	628
806		634	639	644	650	655	660	666	671	677	682
807		687	693	698	703	709	714	720	725	730	736
808		741	747	752	757	763	768	773	779	784	789
809		795	800	806	811	816	822	827	832	838	843
810		849	854	859	865	870	875	881	886	891	897
811		902	907	913	918	924	929	934	940	945	950
812		956	961	966	972	977	982	988	993	998	*004
813	91	009	014	020	025	030	036	041	046	052	057
814		062	068	073	078	084	089	094	100	105	110
815		116	121	126	132	137	142	148	153	158	164
816		169	174	180	185	190	196	201	206	212	217
817		222	228	233	238	243	249	254	259	265	270
818		275	281	286	291	297	302	307	312	318	323
819		328	334	339	344	350	355	360	365	371	376
820		381	387	392	397	403	408	413	418	424	429
821		434	440	445	450	455	461	466	471	477	482
822		487	492	498	503	508	514	519	524	529	535
823		540	545	551	556	561	566	572	577	582	587
824		593	598	603	609	614	619	624	630	635	640
825		645	651	656	661	666	672	677	682	687	693
826		698	703	709	714	719	724	730	735	740	745
827		751	756	761	766	772	777	782	787	793	798
828		803	808	814	819	824	829	834	840	845	850
829		855	861	866	871	876	882	887	892	897	903
830		908	913	918	924	929	934	939	944	950	955
831		960	965	971	976	981	986	991	997	*002	*007
832	92	012	018	023	028	033	038	044	049	054	059
833		065	070	075	080	085	091	096	101	106	111
834		117	122	127	132	137	143	148	153	158	163
835		169	174	179	184	189	195	200	205	210	215
836		221	226	231	236	241	247	252	257	262	267
837		273	278	283	288	293	298	304	309	314	319
838		324	330	335	340	345	350	355	361	366	371
839		376	381	387	392	397	402	407	412	418	423
840		428	433	438	443	449	454	459	464	469	474
841		480	485	490	495	500	505	511	516	521	526
842		531	536	542	547	552	557	562	567	572	578
843		583	588	593	598	603	609	614	619	624	629
844		634	639	645	650	655	660	665	670	675	681
845		686	691	696	701	706	711	716	722	727	732
846		737	742	747	752	758	763	768	773	778	783
847		788	793	799	804	809	814	819	824	829	834
848		840	845	850	855	860	865	870	875	881	886
849		891	896	901	906	911	916	921	927	932	937
850		942	947	952	957	962	967	973	978	983	988
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	6
1	0.6
2	1.2
3	1.8
4	2.4
5	3.0
6	3.6
7	4.2
8	4.8
9	5.4

	5
1	0.5
2	1.0
3	1.5
4	2.0
5	2.5
6	3.0
7	3.5
8	4.0
9	4.5

Proportional parts

LOGARITHMS OF NUMBERS

850 — 900

N.	L.	0	1	2	3	4	5	6	7	8	9
850	92	942	947	952	957	962	967	973	978	983	988
851		993	998	*003	*008	*013	*018	*024	*029	*034	*039
852	93	044	049	054	059	064	069	075	080	085	090
853		095	100	105	110	115	120	125	131	136	141
854		146	151	156	161	166	171	176	181	186	192
855		197	202	207	212	217	222	227	232	237	242
856		247	252	258	263	268	273	278	283	288	293
857		298	303	308	313	318	323	328	334	339	344
858		349	354	359	364	369	374	379	384	389	394
859		399	404	409	414	420	425	430	435	440	445
860		450	455	460	465	470	475	480	485	490	495
861		500	505	510	515	520	526	531	536	541	546
862		551	556	561	566	571	576	581	586	591	596
863		601	606	611	616	621	626	631	636	641	646
864		651	656	661	666	671	676	682	687	692	697
865		702	707	712	717	722	727	732	737	742	747
866		752	757	762	767	772	777	782	787	792	797
867		802	807	812	817	822	827	832	837	842	847
868		852	857	862	867	872	877	882	887	892	897
869		902	907	912	917	922	927	932	937	942	947
870		952	957	962	967	972	977	982	987	992	997
871	94	002	007	012	017	022	027	032	037	042	047
872		052	057	062	067	072	077	082	086	091	096
873		101	106	111	116	121	126	131	136	141	146
874		151	156	161	166	171	176	181	186	191	196
875		201	206	211	216	221	226	231	236	240	245
876		250	255	260	265	270	275	280	285	290	295
877		300	305	310	315	320	325	330	335	340	345
878		349	354	359	364	369	374	379	384	389	394
879		399	404	409	414	419	424	429	433	438	443
880		448	453	458	463	468	473	478	483	488	493
881		498	503	507	512	517	522	527	532	537	542
882		547	552	557	562	567	571	576	581	586	591
883		596	601	606	611	616	621	626	630	635	640
884		645	650	655	660	665	670	675	680	685	689
885		694	699	704	709	714	719	724	729	734	738
886		743	748	753	758	763	768	773	778	783	787
887		792	797	802	807	812	817	822	827	832	836
888		841	846	851	856	861	866	871	876	880	885
889		890	895	900	905	910	915	919	924	929	934
890		939	944	949	954	959	963	968	973	978	983
891		988	993	998	*002	*007	*012	*017	*022	*027	*032
892	95	036	041	046	051	056	061	066	071	075	080
893		085	090	095	100	105	109	114	119	124	129
894		134	139	143	148	153	158	163	168	173	177
895		182	187	192	197	202	207	211	216	221	226
896		231	236	240	245	250	255	260	265	270	274
897		279	284	289	294	299	303	308	313	318	323
898		328	332	337	342	347	352	357	361	366	371
899		376	381	386	390	395	400	405	410	415	419
900		424	429	434	439	444	448	453	458	463	468
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	6
1	0.6
2	1.2
3	1.8
4	2.4
5	3.0
6	3.6
7	4.2
8	4.8
9	5.4

	5
1	0.5
2	1.0
3	1.5
4	2.0
5	2.5
6	3.0
7	3.5
8	4.0
9	4.5

	4
1	0.4
2	0.8
3	1.2
4	1.6
5	2.0
6	2.4
7	2.8
8	3.2
9	3.6

Proportional parts

LOGARITHMS OF NUMBERS

900 — 950

N.	L.	0	1	2	3	4	5	6	7	8	9
900	95	424	429	434	439	444	448	453	458	463	468
901		472	477	482	487	492	497	501	506	511	516
902		521	525	530	535	540	545	550	554	559	564
903		569	574	578	583	588	593	598	602	607	612
904		617	622	626	631	636	641	646	650	655	660
905		665	670	674	679	684	689	694	698	703	708
906		713	718	722	727	732	737	742	746	751	756
907		761	766	770	775	780	785	789	794	799	804
908		809	813	818	823	828	832	837	842	847	852
909		856	861	866	871	875	880	885	890	895	899
910		904	909	914	918	923	928	933	938	942	947
911		952	957	961	966	971	976	980	985	990	995
912		999	*004	*009	*014	*019	*023	*028	*033	*038	*042
913	96	047	052	057	061	066	071	076	080	085	090
914		095	099	104	109	114	118	123	128	133	137
915		142	147	152	156	161	166	171	175	180	185
916		190	194	199	204	209	213	218	223	227	232
917		237	242	246	251	256	261	265	270	275	280
918		284	289	294	298	303	308	313	317	322	327
919		332	336	341	346	350	355	360	365	369	374
920		379	384	388	393	398	402	407	412	417	421
921		426	431	435	440	445	450	454	459	464	468
922		473	478	483	487	492	497	501	506	511	515
923		520	525	530	534	539	544	548	553	558	562
924		567	572	577	581	586	591	595	600	605	609
925		614	619	624	628	633	638	642	647	652	656
926		661	666	670	675	680	685	689	694	699	703
927		708	713	717	722	727	731	736	741	745	750
928		755	759	764	769	774	778	783	788	792	797
929		802	806	811	816	820	825	830	834	839	844
930		848	853	858	862	867	872	876	881	886	890
931		895	900	904	909	914	918	923	928	932	937
932		942	946	951	956	960	965	970	974	979	984
933		988	993	997	*002	*007	*011	*016	*021	*025	*030
934	97	035	039	044	049	053	058	063	067	072	077
935		081	086	090	095	100	104	109	114	118	123
936		128	132	137	142	146	151	155	160	165	169
937		174	179	183	188	192	197	202	206	211	216
938		220	225	230	234	239	243	248	253	257	262
939		267	271	276	280	285	290	294	299	304	308
940		313	317	322	327	331	336	340	345	350	354
941		359	364	368	373	377	382	387	391	396	400
942		405	410	414	419	424	428	433	437	442	447
943		451	456	460	465	470	474	479	483	488	493
944		497	502	506	511	516	520	525	529	534	539
945		543	548	552	557	562	566	571	575	580	585
946		589	594	598	603	607	612	617	621	626	630
947		635	640	644	649	653	658	663	667	672	676
948		681	685	690	695	699	704	708	713	717	722
949		727	731	736	740	745	749	754	759	763	768
950		772	777	782	786	791	795	800	804	809	813
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	5
1	0.5
2	1.0
3	1.5
4	2.0
5	2.5
6	3.0
7	3.5
8	4.0
9	4.5

	4
1	0.4
2	0.8
3	1.2
4	1.6
5	2.0
6	2.4
7	2.8
8	3.2
9	3.6

Proportional parts

LOGARITHMS OF NUMBERS

950 — 1000

N.	L.	0	1	2	3	4	5	6	7	8	9
950	97	772	777	782	786	791	795	800	804	809	813
951		818	823	827	832	836	841	845	850	855	859
952		864	868	873	877	882	886	891	896	900	905
953		909	914	918	923	928	932	937	941	946	950
954		955	959	964	968	973	978	982	987	991	996
955	98	000	005	009	014	019	023	028	032	037	041
956		046	050	055	059	064	068	073	078	082	087
957		091	096	100	105	109	114	118	123	127	132
958		137	141	146	150	155	159	164	168	173	177
959		182	186	191	195	200	204	209	214	218	223
960		227	232	236	241	245	250	254	259	263	268
961		272	277	281	286	290	295	299	304	308	313
962		318	322	327	331	336	340	345	349	354	358
963		363	367	372	376	381	385	390	394	399	403
964		408	412	417	421	426	430	435	439	444	448
965		453	457	462	466	471	475	480	484	489	493
966		498	502	507	511	516	520	525	529	534	538
967		543	547	552	556	561	565	570	574	579	583
968		588	592	597	601	605	610	614	619	623	628
969		632	637	641	646	650	655	659	664	668	673
970		677	682	686	691	695	700	704	709	713	717
971		722	726	731	735	740	744	749	753	758	762
972		767	771	776	780	784	789	793	798	802	807
973		811	816	820	825	829	834	838	843	847	851
974		856	860	865	869	874	878	883	887	892	896
975		900	905	909	914	918	923	927	932	936	941
976		945	949	954	958	963	967	972	976	981	985
977		989	994	998	*003	*007	*012	*016	*021	*025	*029
978	99	034	038	043	047	052	056	061	065	069	074
979		078	083	087	092	096	100	105	109	114	118
980		123	127	131	136	140	145	149	154	158	162
981		167	171	176	180	185	189	193	198	202	207
982		211	216	220	224	229	233	238	242	247	251
983		255	260	264	269	273	277	282	286	291	295
984		300	304	308	313	317	322	326	330	335	339
985		344	348	352	357	361	366	370	374	379	383
986		388	392	396	401	405	410	414	419	423	427
987		432	436	441	445	449	454	458	463	467	471
988		476	480	484	489	493	498	502	506	511	515
989		520	524	528	533	537	542	546	550	555	559
990		564	568	572	577	581	585	590	594	599	603
991		607	612	616	621	625	629	634	638	642	647
992		651	656	660	664	669	673	677	682	686	691
993		695	699	704	708	712	717	721	726	730	734
994		739	743	747	752	756	760	765	769	774	778
995		782	787	791	795	800	804	808	813	817	822
996		826	830	835	839	843	848	852	856	861	865
997		870	874	878	883	887	891	896	900	904	909
998		913	917	922	926	930	935	939	944	948	952
999		957	961	965	970	974	978	983	987	991	996
1000	00	000	004	009	013	017	022	026	030	035	039
N.	L.	0	1	2	3	4	5	6	7	8	9

Proportional parts

	5
1	0.5
2	1.0
3	1.5
4	2.0
5	2.5
6	3.0
7	3.5
8	4.0
9	4.5

	4
1	0.4
2	0.8
3	1.2
4	1.6
5	2.0
6	2.4
7	2.8
8	3.2
9	3.6

Proportional parts

Table II

LOGARITHMS OF NUMBERS

1000 — 1050

N.	L.	0	1	2	3	4	5	6	7	8	9	d.
1000	000	0000	0434	0869	1303	1737	2171	2605	3039	3473	3907	434
1001		4341	4775	5208	5642	6076	6510	6943	7377	7810	8244	434
1002		8677	9111	9544	9977	*0411	*0844	*1277	*1710	*2143	*2576	433
1003	001	3009	3442	3875	4308	4741	5174	5607	6039	6472	6905	433
1004		7337	7770	8202	8635	9067	9499	9932	*0364	*0796	*1228	432
1005	002	1661	2093	2525	2957	3389	3821	4253	4685	5116	5548	432
1006		5980	6411	6843	7275	7706	8138	8569	9001	9432	9863	431
1007	003	0295	0726	1157	1588	2019	2451	2882	3313	3744	4174	431
1008		4605	5036	5467	5898	6328	6759	7190	7620	8051	8481	431
1009		8912	9342	9772	*0203	*0633	*1063	*1493	*1924	*2354	*2784	430
1010	004	3214	3644	4074	4504	4933	5363	5793	6223	6652	7082	430
1011		7512	7941	8371	8800	9229	9659	*0088	*0517	*0947	*1376	429
1012	005	1805	2234	2663	3092	3521	3950	4379	4808	5237	5666	429
1013		6094	6523	6952	7380	7809	8238	8666	.9094	9523	9951	429
1014	006	0380	0808	1236	1664	2092	2521	2949	3377	3805	4233	428
1015		4660	5088	5516	5944	6372	6799	7227	7655	8082	8510	428
1016		8937	9365	9792	*0219	*0647	*1074	*1501	*1928	*2355	*2782	427
1017	007	3210	3637	4064	4490	4917	5344	5771	6198	6624	7051	427
1018		7478	7904	8331	8757	9184	9610	*0037	*0463	*0889	*1316	426
1019	008	1742	2168	2594	3020	3446	3872	4298	4724	5150	5576	426
1020		6002	6427	6853	7279	7704	8130	8556	8981	9407	9832	426
1021	009	0257	0683	1108	1533	1959	2384	2809	3234	3659	4084	425
1022		4509	4934	5359	5784	6208	6633	7058	7483	7907	8332	425
1023		8756	9181	9605	*0030	*0454	*0878	*1303	*1727	*2151	*2575	424
1024	010	3000	3424	3848	4272	4696	5120	5544	5967	6391	6815	424
1025		7239	7662	8086	8510	8933	9357	9780	*0204	*0627	*1050	424
1026	011	1474	1897	2320	2743	3166	3590	4013	4436	4859	5282	423
1027		5704	6127	6550	6973	7396	7818	8241	8664	9086	9509	423
1028		9931	*0354	*0776	*1198	*1621	*2043	*2465	*2887	*3310	*3732	422
1029	012	4154	4576	4998	5420	5842	6264	6685	7107	7529	7951	422
1030		8372	8794	9215	9637	*0059	*0480	*0901	*1323	*1744	*2165	422
1031	013	2587	3008	3429	3850	4271	4692	5113	5534	5955	6376	421
1032		6797	7218	7639	8059	8480	8901	9321	9742	*0162	*0583	421
1033	014	1003	1424	1844	2264	2685	3105	3525	3945	4365	4785	420
1034		5205	5625	6045	6465	6885	7305	7725	8144	8564	8984	420
1035		9403	9823	*0243	*0662	*1082	*1501	*1920	*2340	*2759	*3178	420
1036	015	3598	4017	4436	4855	5274	5693	6112	6531	6950	7369	419
1037		7788	8206	8625	9044	9462	9881	*0300	*0718	*1137	*1555	419
1038	016	1974	2392	2810	3229	3647	4065	4483	4901	5319	5737	418
1039		6155	6573	6991	7409	7827	8245	8663	9080	9498	9916	418
1040	017	0333	0751	1168	1586	2003	2421	2838	3256	3673	4090	417
1041		4507	4924	5342	5759	6176	6593	7010	7427	7844	8260	417
1042		8677	9094	9511	9927	*0344	*0761	*1177	*1594	*2010	*2427	417
1043	018	2843	3259	3676	4092	4508	4925	5341	5757	6173	6589	416
1044		7005	7421	7837	8253	8669	9084	9500	9916	*0332	*0747	416
1045	019	1163	1578	1994	2410	2825	3240	3656	4071	4486	4902	415
1046		5317	5732	6147	6562	6977	7392	7807	8222	8637	9052	415
1047		9467	9882	*0296	*0711	*1126	*1540	*1955	*2369	*2784	*3198	415
1048	020	3613	4027	4442	4856	5270	5684	6099	6513	6927	7341	414
1049		7755	8169	8583	8997	9411	9824	*0238	*0652	*1066	*1479	414
1050	021	1893	2307	2720	3134	3547	3961	4374	4787	5201	5614	413
N.	L.	0	1	2	3	4	5	6	7	8	9	d.

.000 0000 — .021 5614

LOGARITHMS OF NUMBERS

1050 — 1100

N.	L.	0	1	2	3	4	5	6	7	8	9	d.
1050	021	1893	2307	2720	3134	3547	3961	4374	4787	5201	5614	413
1051		6027	6440	6854	7267	7680	8093	8506	8919	9332	9745	413
1052	022	0157	0570	0983	1396	1808	2221	2634	3046	3459	3871	413
1053		4284	4696	5109	5521	5933	6345	6758	7170	7582	7994	412
1054		8406	8818	9230	9642	*0054	*0466	*0878	*1289	*1701	*2113	412
1055	023	2525	2936	3348	3759	4171	4582	4994	5405	5817	6228	411
1056		6639	7050	7462	7873	8284	8695	9106	9517	9928	*0339	411
1057	024	0750	1161	1572	1982	2393	2804	3214	3625	4036	4446	411
1058		4857	5267	5678	6088	6498	6909	7319	7729	8139	8549	410
1059		8960	9370	9780	*0190	*0600	*1010	*1419	*1829	*2239	*2649	410
1060	025	3059	3468	3878	4288	4697	5107	5516	5926	6335	6744	410
1061		7154	7563	7972	8382	8791	9200	9609	*0018	*0427	*0836	409
1062	026	1245	1654	2063	2472	2881	3289	3698	4107	4515	4924	409
1063		5333	5741	6150	6558	6967	7375	7783	8192	8600	9008	408
1064		9416	9824	*0233	*0641	*1049	*1457	*1865	*2273	*2680	*3088	408
1065	027	3496	3904	4312	4719	5127	5535	5942	6350	6757	7165	408
1066		7572	7979	8387	8794	9201	9609	*0016	*0423	*0830	*1237	407
1067	028	1644	2051	2458	2865	3272	3679	4086	4492	4899	5306	407
1068		5713	6119	6526	6932	7339	7745	8152	8558	8964	9371	406
1069		9777	*0183	*0590	*0996	*1402	*1808	*2214	*2620	*3026	*3432	406
1070	029	3838	4244	4649	5055	5461	5867	6272	6678	7084	7489	406
1071		7895	8300	8706	9111	9516	9922	*0327	*0732	*1138	*1543	405
1072	030	1948	2353	2758	3163	3568	3973	4378	4783	5188	5592	405
1073		5997	6402	6807	7211	7616	8020	8425	8830	9234	9638	405
1074	031	0043	0447	0851	1256	1660	2064	2468	2872	3277	3681	404
1075		4085	4489	4893	5296	5700	6104	6508	6912	7315	7719	404
1076		8123	8526	8930	9333	9737	*0140	*0544	*0947	*1350	*1754	403
1077	032	2157	2560	2963	3367	3770	4173	4576	4979	5382	5785	403
1078		6188	6590	6993	7396	7799	8201	8604	9007	9409	9812	403
1079	033	0214	0617	1019	1422	1824	2226	2629	3031	3433	3835	402
1080		4238	4640	5042	5444	5846	6248	6650	7052	7453	7855	402
1081		8257	8659	9060	9462	9864	*0265	*0667	*1068	*1470	*1871	402
1082	034	2273	2674	3075	3477	3878	4279	4680	5081	5482	5884	401
1083		6285	6686	7087	7487	7888	8289	8690	9091	9491	9892	401
1084	035	0293	0693	1094	1495	1895	2296	2696	3096	3497	3897	400
1085		4297	4698	5098	5498	5898	6298	6698	7098	7498	7898	400
1086		8298	8698	9098	9498	9898	*0297	*0697	*1097	*1496	*1896	400
1087	036	2295	2695	3094	3494	3893	4293	4692	5091	5491	5890	399
1088		6289	6688	7087	7486	7885	8284	8683	9082	9481	9880	399
1089	037	0279	0678	1076	1475	1874	2272	2671	3070	3468	3867	399
1090		4265	4663	5062	5460	5858	6257	6655	7053	7451	7849	398
1091		8248	8646	9044	9442	9839	*0237	*0635	*1033	*1431	*1829	398
1092	038	2226	2624	3022	3419	3817	4214	4612	5009	5407	5804	398
1093		6202	6599	6996	7393	7791	8188	8585	8982	9379	9776	397
1094	039	0173	0570	0967	1364	1761	2158	2554	2951	3348	3745	397
1095		4141	4538	4934	5331	5727	6124	6520	6917	7313	7709	397
1096		8106	8502	8898	9294	9690	*0086	*0482	*0878	*1274	*1670	396
1097	040	2066	2462	2858	3254	3650	4045	4441	4837	5232	5628	396
1098		6023	6419	6814	7210	7605	8001	8396	8791	9187	9582	395
1099		9977	*0372	*0767	*1162	*1557	*1952	*2347	*2742	*3137	*3532	395
1100	041	3927	4322	4716	5111	5506	5900	6295	6690	7084	7479	395
N.	L.	0	1	2	3	4	5	6	7	8	9	d.

LOGARITHMS OF NUMBERS

1100 — 1150

N.	L.	0	1	2	3	4	5	6	7	8	9	d.
1100	041	3927	4322	4716	5111	5506	5900	6295	6690	7084	7479	395
1101		7873	8268	8662	9056	9451	9845	*0239	*0633	*1028	*1422	394
1102	042	1816	2210	2604	2998	3392	3786	4180	4574	4968	5361	394
1103		5755	6149	6543	6936	7330	7723	8117	8510	8904	9297	394
1104		9691	*0084	*0477	*0871	*1264	*1657	*2050	*2444	*2837	*3230	393
1105	043	3623	4016	4409	4802	5195	5587	5980	6373	6766	7159	393
1106		7551	7944	8337	8729	9122	9514	9907	*0299	*0692	*1084	393
1107	044	1476	1869	2261	2653	3045	3437	3829	4222	4614	5006	392
1108		5398	5790	6181	6573	6965	7357	7749	8140	8532	8924	392
1109		9315	9707	*0099	*0490	*0882	*1273	*1664	*2056	*2447	*2839	392
1110	045	3230	3621	4012	4403	4795	5186	5577	5968	6359	6750	391
1111		7141	7531	7922	8313	8704	9095	9485	9876	*0267	*0657	391
1112	046	1048	1438	1829	2219	2610	3000	3391	3781	4171	4561	390
1113		4952	5342	5732	6122	6512	6902	7292	7682	8072	8462	390
1114		8852	9242	9632	*0021	*0411	*0801	*1190	*1580	*1970	*2359	390
1115	047	2749	3138	3528	3917	4306	4696	5085	5474	5864	6253	389
1116		6642	7031	7420	7809	8198	8587	8976	9365	9754	*0143	389
1117	048	0532	0921	1309	1698	2087	2475	2864	3253	3641	4030	389
1118		4418	4806	5195	5583	5972	6360	6748	7136	7525	7913	388
1119		8301	8689	9077	9465	9853	*0241	*0629	*1017	*1405	*1792	388
1120	049	2180	2568	2956	3343	3731	4119	4506	4894	5281	5669	388
1121		6056	6444	6831	7218	7606	7993	8380	8767	9154	9541	387
1122		9929	*0316	*0703	*1090	*1477	*1863	*2250	*2637	*3024	*3411	387
1123	050	3798	4184	4571	4958	5344	5731	6117	6504	6890	7277	387
1124		7663	8049	8436	8822	9208	9595	9981	*0367	*0753	*1139	386
1125	051	1525	1911	2297	2683	3069	3455	3841	4227	4612	4998	386
1126		5384	5770	6155	6541	6926	7312	7697	8083	8468	8854	386
1127		9239	9624	*0010	*0395	*0780	*1166	*1551	*1936	*2321	*2706	385
1128	052	3091	3476	3861	4246	4631	5016	5400	5785	6170	6555	385
1129		6939	7324	7709	8093	8478	8862	9247	9631	*0016	*0400	385
1130	053	0784	1169	1553	1937	2321	2706	3090	3474	3858	4242	384
1131		4626	5010	5394	5778	6162	6546	6929	7313	7697	8081	384
1132		8464	8848	9232	9615	9999	*0382	*0766	*1149	*1532	*1916	384
1133	054	2299	2682	3066	3449	3832	4215	4598	4981	5365	5748	383
1134		6131	6514	6896	7279	7662	8045	8428	8811	9193	9576	383
1135		9959	*0341	*0724	*1106	*1489	*1871	*2254	*2636	*3019	*3401	382
1136	055	3783	4166	4548	4930	5312	5694	6077	6459	6841	7223	382
1137		7605	7987	8369	8750	9132	9514	9896	*0278	*0659	*1041	382
1138	056	1423	1804	2186	2567	2949	3330	3712	4093	4475	4856	381
1139		5237	5619	6000	6381	6762	7143	7524	7905	8287	8668	381
1140		9049	9429	9810	*0191	*0572	*0953	*1334	*1714	*2095	*2476	381
1141	057	2856	3237	3618	3998	4379	4759	5140	5520	5900	6281	381
1142		6661	7041	7422	7802	8182	8562	8942	9322	9702	*0082	380
1143	058	0462	0842	1222	1602	1982	2362	2741	3121	3501	3881	380
1144		4260	4640	5019	5399	5778	6158	6537	6917	7296	7676	380
1145		8055	8434	8813	9193	9572	9951	*0330	*0709	*1088	*1467	379
1146	059	1846	2225	2604	2983	3362	3741	4119	4498	4877	5256	379
1147		5634	6013	6391	6770	7148	7527	7905	8284	8662	9041	379
1148		9419	9797	*0175	*0554	*0932	*1310	*1688	*2066	*2444	*2822	378
1149	060	3200	3578	3956	4334	4712	5090	5468	5845	6223	6601	378
1150		6978	7356	7734	8111	8489	8866	9244	9621	9999	*0376	378
N.	L.	0	1	2	3	4	5	6	7	8	9	d.

LOGARITHMS OF NUMBERS

1150 — 1200

N.	L.	0	1	2	3	4	5	6	7	8	9	d.
1150	060	6978	7356	7734	8111	8489	8866	9244	9621	9999	*0376	378
1151	061	0753	1131	1508	1885	2262	2639	3017	3394	3771	4148	377
1152		4525	4902	5279	5656	6032	6409	6786	7163	7540	7916	377
1153		8293	8670	9046	9423	9799	*0176	*0552	*0929	*1305	*1682	377
1154	062	2058	2434	2811	3187	3563	3939	4316	4692	5068	5444	376
1155		5820	6196	6572	6948	7324	7699	8075	8451	8827	9203	376
1156		9578	9954	*0330	*0705	*1081	*1456	*1832	*2207	*2583	*2958	376
1157	063	3334	3709	4084	4460	4835	5210	5585	5960	6335	6711	375
1158		7086	7461	7836	8211	8585	8960	9335	9710	*0085	*0460	375
1159	064	0834	1209	1584	1958	2333	2708	3082	3457	3831	4205	375
1160		4580	4954	5329	5703	6077	6451	6826	7200	7574	7948	374
1161		8322	8696	9070	9444	9818	*0192	*0566	*0940	*1314	*1688	374
1162	065	2061	2435	2809	3182	3556	3930	4303	4677	5050	5424	374
1163		5797	6171	6544	6917	7291	7664	8037	8410	8784	9157	373
1164		9530	9903	*0276	*0649	*1022	*1395	*1768	*2141	*2514	*2886	373
1165	066	3259	3632	4005	4377	4750	5123	5495	5868	6241	6613	373
1166		6986	7358	7730	8103	8475	8847	9220	9592	9964	*0336	372
1167	067	0709	1081	1453	1825	2197	2569	2941	3313	3685	4057	372
1168		4428	4800	5172	5544	5915	6287	6659	7030	7402	7774	372
1169		8145	8517	8888	9259	9631	*0002	*0374	*0745	*1116	*1487	371
1170	068	1859	2230	2601	2972	3343	3714	4085	4456	4827	5198	371
1171		5569	5940	6311	6681	7052	7423	7794	8164	8535	8906	371
1172		9276	9647	*0017	*0388	*0758	*1129	*1499	*1869	*2240	*2610	370
1173	069	2980	3350	3721	4091	4461	4831	5201	5571	5941	6311	370
1174		6681	7051	7421	7791	8160	8530	8900	9270	9639	*0009	370
1175	070	0379	0748	1118	1487	1857	2226	2596	2965	3335	3704	369
1176		4073	4442	4812	5181	5550	5919	6288	6658	7027	7396	369
1177		7765	8134	8503	8871	9240	9609	9978	*0347	*0715	*1084	369
1178	071	1453	1822	2190	2559	2927	3296	3664	4033	4401	4770	369
1179		5138	5506	5875	6243	6611	6979	7348	7716	8084	8452	368
1180		8820	9188	9556	9924	*0292	*0660	*1028	*1396	*1763	*2131	368
1181	072	2499	2867	3234	3602	3970	4337	4705	5072	5440	5807	368
1182		6175	6542	6910	7277	7644	8011	8379	8746	9113	9480	367
1183		9847	*0215	*0582	*0949	*1316	*1683	*2050	*2416	*2783	*3150	367
1184	073	3517	3884	4251	4617	4984	5351	5717	6084	6450	6817	367
1185		7184	7550	7916	8283	8649	9016	9382	9748	*0114	*0481	366
1186	074	0847	1213	1579	1945	2311	2677	3043	3409	3775	4141	366
1187		4507	4873	5239	5605	5970	6336	6702	7068	7433	7799	366
1188		8164	8530	8895	9261	9626	9992	*0357	*0723	*1088	*1453	365
1189	075	1819	2184	2549	2914	3279	3644	4010	4375	4740	5105	365
1190		5470	5835	6199	6564	6929	7294	7659	8024	8388	8753	365
1191		9118	9482	9847	*0211	*0576	*0940	*1305	*1669	*2034	*2398	364
1192	076	2763	3127	3491	3855	4220	4584	4948	5312	5676	6040	364
1193		6404	6768	7132	7496	7860	8224	8588	8952	9316	9680	364
1194	077	0043	0407	0771	1134	1498	1862	2225	2589	2952	3316	364
1195		3679	4042	4406	4769	5133	5496	5859	6222	6585	6949	363
1196		7312	7675	8038	8401	8764	9127	9490	9853	*0216	*0579	363
1197	078	0942	1304	1667	2030	2393	2755	3118	3480	3843	4206	363
1198		4568	4931	5293	5656	6018	6380	6743	7105	7467	7830	362
1199		8192	8554	8916	9278	9640	*0003	*0365	*0727	*1089	*1451	362
1200	079	1812	2174	2536	2898	3260	3622	3983	4345	4707	5068	362
N.	L.	0	1	2	3	4	5	6	7	8	9	d.

Table III

IMPORTANT CONSTANTS

N	Log N	N	Log N
$\pi = 3.14159265$	0.4971499	$\pi^2 = 9.86960440$	0.9942997
$2\pi = 6.28318531$	0.7981799	$\frac{1}{\pi^2} = 0.10132118$	9.0057003–10
$4\pi = 12.56637061$	1.0992099	$\sqrt{\pi} = 1.77245385$	0.2485749
$\frac{\pi}{2} = 1.57079633$	0.1961199	$\frac{1}{\sqrt{\pi}} = 0.56418958$	9.7514251–10
$\frac{\pi}{3} = 1.04719755$	0.0200286	$\sqrt{\frac{3}{\pi}} = 0.97720502$	9.9899857–10
$\frac{4\pi}{3} = 4.18879020$	0.6220886	$\sqrt{\frac{4}{\pi}} = 1.12837917$	0.0524551
$\frac{\pi}{4} = 0.78539816$	9.8950899–10	$\sqrt[3]{\pi} = 1.46459189$	0.1657166
$\frac{\pi}{6} = 0.52359878$	9.7189986–10	$\frac{1}{\sqrt[3]{\pi}} = 0.68278406$	9.8342834–10
$\frac{1}{\pi} = 0.31830989$	9.5028501–10	$\sqrt[3]{\pi^2} = 2.14502940$	0.3314332
$\frac{1}{2\pi} = 0.15915494$	9.2018201–10	$\sqrt[3]{\frac{3}{4\pi}} = 0.62035049$	9.7926371–10
$\frac{3}{\pi} = 0.95492966$	9.9799714–10	$\sqrt[3]{\frac{\pi}{6}} = 0.80599598$	9.9063329–10
$\frac{4}{\pi} = 1.27323954$	0.1049101		

e = Naperian Base	= 2.71828183	0.43429448
$M = \log_{10} e$	= 0.43429448	9.63778431—10
$1 \div M = \log_e 10$	= 2.30258509	0.36221569
$180 \div \pi$ = degrees in 1 radian	= 57.2957795	1.75812263
$\pi \div 180$ = radians in 1°	= 0.01745329	8.24187737—10
$\pi \div 10800$ = radians in 1′	= 0.0002908882	6.46372612—10
$\pi \div 64\text{E}000$ = radians in 1″	= 0.000004848136811095	4.68557487—10
sin 1″	= 0.000004848136811076	4.68557487—10
tan 1″	= 0.000004848136811152	4.68557487—10
centimeters in 1 ft. (U. S.)	= 30.48006096 (legal)	1.4840158
feet in 1 cm.	= 0.03280833	8.5159842—10
inches in 1 m.	= 39.37 (exact legal value)	1.5951654
pounds in 1 kg.	= 2.204622341	0.3433342
kilograms in 1 lb.	= 0 4535924277	9.6566660—10
cu. in. in 1 (U. S.) gallon	= 231 (exact legal value)	2.3636120
g (average value)	= 32.16 ft./sec./sec.	1.5073
g (legal)	= 980.665 cm./sec.^{2}	2.9915207
weight of 1 cu. ft. of water	= 62.425 lb. (max. density)	1.7953586
weight of 1 cu. ft. of air	= 0.0807 lb. (at 32° F.)	8.907 —10
ft. lb. per sec. in 1 H. P.	= 550 (exact legal value)	2.7403627
kg. m. per sec. in 1 H. P.	= 76.0404	1.8810445
watts in 1 H. P. (legal)	= 745.70	2.8725649

π =	3.14159	26535	89793	23846
e =	2.71828	18284	59045	23536
M =	0.43429	44819	03251	82765
$1 \div M$ =	2.30258	50929	94045	68402
$\log_{10} \pi$ =	0.49714	98726	94133	85435
$\log_{10} M$ =	9.63778	43113	00536	78912

Table IV

COMMON LOGARITHMS OF THE TRIGONOMETRIC FUNCTIONS FROM 0° TO 90°

At Intervals Of One Minute
To Five Decimal Places

Table IVa

AUXILIARY TABLE OF S AND T FOR A IN MINUTES

$S = \log \sin A - \log A'$ and $T = \log \tan A - \log A'$
A' = number of minutes in A, and $(90° - A)'$ = number of minutes in $90° - A$.

A'	S
0 to 13	6.46373 — 10
14 to 42	72 — 10
43 to 58	71 — 10
59 to 71	6.46370 — 10
72 to 81	69 — 10
82 to 91	68 — 10
92 to 99	6.46367 — 10
100 to 107	66 — 10
108 to 115	65 — 10
116 to 121	6.46364 — 10
122 to 128	63 — 10
129 to 134	62 — 10
135 to 140	6.46361 — 10
141 to 146	60 — 10
147 to 151	59 — 10
152 to 157	6.46358 — 10
158 to 162	57 — 10
163 to 167	56 — 10
168 to 171	6.46355 — 10
172 to 176	54 — 10
177 to 181	53 — 10

A'	T
0 to 26	6.46373 — 10
27 to 39	74 — 10
40 to 48	75 — 10
49 to 56	6.46376 — 10
57 to 63	77 — 10
64 to 69	78 — 10
70 to 74	6.46379 — 10
75 to 80	80 — 10
81 to 85	81 — 10
86 to 89	6.46382 — 10
90 to 94	83 — 10
95 to 98	84 — 10
99 to 102	6.46385 — 10
103 to 106	86 — 10
107 to 110	87 — 10
111 to 113	6.46388 — 10
114 to 117	89 — 10
118 to 120	90 — 10
121 to 124	6.46391 — 10
125 to 127	92 — 10
128 to 130	93 — 10

A'	T
131 to 133	6.46394 — 10
134 to 136	95 — 10
137 to 139	96 — 10
140 to 142	6.46397 — 10
143 to 145	98 — 10
146 to 148	99 — 10
149 to 150	6.46400 — 10
151 to 153	01 — 10
154 to 156	02 — 10
157 to 158	6.46403 — 10
159 to 161	04 — 10
162 to 163	05 — 10
164 to 166	6.46406 — 10
167 to 168	07 — 10
169 to 171	08 — 10
172 to 173	6.46409 — 10
174 to 175	10 — 10
176 to 178	11 — 10
179 to 180	6.46412 — 10
181 to 182	13 — 10
183 to 184	14 — 10

For small angles, $\log \sin A = \log A' + S$ and $\log \tan A = \log A' + T$; for angles near 90°, $\log \cos A = \log (90° - A)' + S$ and $\log \operatorname{ctn} A = \log (90° - A)' + T$.

0°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	
0						0.00 000	60
1	6.46 373	30103	6.46 373	30103	3.53 627	0.00 000	59
2	6.76 476	17609	6.76 476	17609	3.23 524	0.00 000	58
3	6.94 085	12494	6.94 085	12494	3.05 915	0.00 000	57
4	7.06 579	9691	7.06 579	9691	2.93 421	0.00 000	56
5	7.16 270	7918	7.16 270	7918	2.83 730	0.00 000	55
6	7.24 188	6694	7.24 188	6694	2.75 812	0.00 000	54
7	7.30 882	5800	7.30 882	5800	2.69 118	0.00 000	53
8	7.36 682	5115	7.36 682	5115	2.63 318	0.00 000	52
9	7.41 797	4576	7.41 797	4576	2.58 203	0.00 000	51
10	7.46 373	4139	7.46 373	4139	2.53 627	0.00 000	50
11	7.50 512	3779	7.50 512	3779	2.49 488	0.00 000	49
12	7.54 291	3476	7.54 291	3476	2.45 709	0.00 000	48
13	7.57 767	3218	7.57 767	3219	2.42 233	0.00 000	47
14	7.60 985	2997	7.60 986	2996	2.39 014	0.00 000	46
15	7.63 982	2802	7.63 982	2803	2.36 018	0.00 000	45
16	7.66 784	2633	7.66 785	2633	2.33 215	0.00 000	44
17	7.69 417	2483	7.69 418	2482	2.30 582	9.99 999	43
18	7.71 900	2348	7.71 900	2348	2.28 100	9.99 999	42
19	7.74 248	2227	7.74 248	2228	2.25 752	9.99 999	41
20	7.76 475	2119	7.76 476	2119	2.23 524	9.99 999	40
21	7.78 594	2021	7.78 595	2020	2.21 405	9.99 999	39
22	7.80 615	1930	7.80 615	1931	2.19 385	9.99 999	38
23	7.82 545	1848	7.82 546	1848	2.17 454	9.99 999	37
24	7.84 393	1773	7.84 394	1773	2.15 606	9.99 999	36
25	7.86 166	1704	7.86 167	1704	2.13 833	9.99 999	35
26	7.87 870	1639	7.87 871	1639	2.12 129	9.99 999	34
27	7.89 509	1579	7.89 510	1579	2.10 490	9.99 999	33
28	7.91 088	1524	7.91 089	1524	2.08 911	9.99 999	32
29	7.92 612	1472	7.92 613	1473	2.07 387	9.99 998	31
30	7.94 084	1424	7.94 086	1424	2.05 914	9.99 998	30
31	7.95 508	1379	7.95 510	1379	2.04 490	9.99 998	29
32	7.96 887	1336	7.96 889	1336	2.03 111	9.99 998	28
33	7.98 223	1297	7.98 225	1297	2.01 775	9.99 998	27
34	7.99 520	1259	7.99 522	1259	2.00 478	9.99 998	26
35	8.00 779	1223	8.00 781	1223	1.99 219	9.99 998	25
36	8.02 002	1190	8.02 004	1190	1.97 996	9.99 998	24
37	8.03 192	1158	8.03 194	1159	1.96 806	9.99 997	23
38	8.04 350	1128	8.04 353	1128	1.95 647	9.99 997	22
39	8.05 478	1100	8.05 481	1100	1.94 519	9.99 997	21
40	8.06 578	1072	8.06 581	1072	1.93 419	9.99 997	20
41	8.07 650	1046	8.07 653	1047	1.92 347	9.99 997	19
42	8.08 696	1022	8.08 700	1022	1.91 300	9.99 997	18
43	8.09 718	999	8.09 722	998	1.90 278	9.99 997	17
44	8.10 717	976	8.10 720	976	1.89 280	9.99 996	16
45	8.11 693	954	8.11 696	955	1.88 304	9.99 996	15
46	8.12 647	934	8.12 651	934	1.87 349	9.99 996	14
47	8.13 581	914	8.13 585	915	1.86 415	9.99 996	13
48	8.14 495	896	8.14 500	895	1.85 500	9.99 996	12
49	8.15 391	877	8.15 395	878	1.84 605	9.99 996	11
50	8.16 268	860	8.16 273	860	1.83 727	9.99 995	10
51	8.17 128	843	8.17 133	843	1.82 867	9.99 995	9
52	8.17 971	827	8.17 976	828	1.82 024	9.99 995	8
53	8.18 798	812	8.18 804	812	1.81 196	9.99 995	7
54	8.19 610	797	8.19 616	797	1.80 384	9.99 995	6
55	8.20 407	782	8.20 413	782	1.79 587	9.99 994	5
56	8.21 189	769	8.21 195	769	1.78 805	9.99 994	4
57	8.21 958	755	8.21 964	756	1.78 036	9.99 994	3
58	8.22 713	743	8.22 720	742	1.77 280	9.99 994	2
59	8.23 456	730	8.23 462	730	1.76 538	9.99 994	1
60	8.24 186		8.24 192		1.75 808	9.99 993	0
′	L Cos	d	L Ctn	c d	L Tan	L Sin	′

For more accurate values of L sin and L tan for interpolated values of angles less than 3° (or L cos or L ctn of angles greater than 87°) use Table IVa, Page 128.

1°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	
0	8.24 186	717	8.24 192	718	1.75 808	9.99 993	60
1	8.24 903	706	8.24 910	706	1.75 090	9.99 993	59
2	8.25 609	695	8.25 616	696	1.74 384	9.99 993	58
3	8.26 304	684	8.26 312	684	1.73 688	9.99 993	57
4	8.26 988	673	8.26 996	673	1.73 004	9.99 992	56
5	8.27 661	663	8.27 669	663	1.72 331	9.99 992	55
6	8.28 324	653	8.28 332	654	1.71 668	9.99 992	54
7	8.28 977	644	8.28 986	643	1.71 014	9.99 992	53
8	8.29 621	634	8.29 629	634	1.70 371	9.99 992	52
9	8.30 255	624	8.30 263	625	1.69 737	9.99 991	51
10	8.30 879	616	8.30 888	617	1.69 112	9.99 991	50
11	8.31 495	608	8.31 505	607	1.68 495	9.99 991	49
12	8.32 103	599	8.32 112	599	1.67 888	9.99 990	48
13	8.32 702	590	8.32 711	591	1.67 289	9.99 990	47
14	8.33 292	583	8.33 302	584	1.66 698	9.99 990	46
15	8.33 875	575	8.33 886	575	1.66 114	9.99 990	45
16	8.34 450	568	8.34 461	568	1.65 539	9.99 989	44
17	8.35 018	560	8.35 029	561	1.64 971	9.99 989	43
18	8.35 578	553	8.35 590	553	1.64 410	9.99 989	42
19	8.36 131	547	8.36 143	546	1.63 857	9.99 989	41
20	8.36 678	539	8.36 689	540	1.63 311	9.99 988	40
21	8.37 217	533	8.37 229	533	1.62 771	9.99 988	39
22	8.37 750	526	8.37 762	527	1.62 238	9.99 988	38
23	8.38 276	520	8.38 289	520	1.61 711	9.99 987	37
24	8.38 796	514	8.38 809	514	1.61 191	9.99 987	36
25	8.39 310	508	8.39 323	509	1.60 677	9.99 987	35
26	8.39 818	502	8.39 832	502	1.60 168	9.99 986	34
27	8.40 320	496	8.40 334	496	1.59 666	9.99 986	33
28	8.40 816	491	8.40 830	491	1.59 170	9.99 986	32
29	8.41 307	485	8.41 321	486	1.58 679	9.99 985	31
30	8.41 792	480	8.41 807	480	1.58 193	9 99 985	30
31	8.42 272	474	8.42 287	475	1.57 713	9.99 985	29
32	8.42 746	470	8.42 762	470	1.57 238	9.99 984	28
33	8.43 216	464	8.43 232	464	1.56 768	9.99 984	27
34	8.43 680	459	8.43 696	460	1.56 304	9.99 984	26
35	8.44 139	455	8.44 156	455	1.55 844	9.99 983	25
36	8.44 594	450	8.44 611	450	1.55 389	9.99 983	24
37	8.45 044	445	8.45 061	446	1.54 939	9.99 983	23
38	8.45 489	441	8.45 507	441	1.54 493	9.99 982	22
39	8.45 930	436	8.45 948	437	1.54 052	9.99 982	21
40	8.46 366	433	8.46 385	432	1.53 615	9.99 982	20
41	8.46 799	427	8.46 817	428	1.53 183	9.99 981	19
42	8.47 226	424	8.47 245	424	1.52 755	9.99 981	18
43	8.47 650	419	8.47 669	420	1.52 331	9.99 981	17
44	8.48 069	416	8.48 089	416	1.51 911	9.99 980	16
45	8.48 485	411	8.48 505	412	1.51 495	9.99 980	15
46	8.48 896	408	8.48 917	408	1.51 083	9.99 979	14
47	8.49 304	404	8.49 325	404	1.50 675	9.99 979	13
48	8.49 708	400	8.49 729	401	1.50 271	9.99 979	12
49	8.50 108	396	8.50 130	397	1.49 870	9.99 978	11
50	8.50 504	393	8.50 527	393	1.49 473	9.99 978	10
51	8.50 897	390	8.50 920	390	1.49 080	9.99 977	9
52	8.51 287	386	8.51 310	386	1.48 690	9.99 977	8
53	8.51 673	382	8.51 696	383	1.48 304	9.99 977	7
54	8.52 055	379	8.52 079	380	1.47 921	9.99 976	6
55	8.52 434	376	8.52 459	376	1.47 541	9.99 976	5
56	8.52 810	373	8.52 835	373	1.47 165	9.99 975	4
57	8.53 183	369	8.53 208	370	1.46 792	9.99 975	3
58	8.53 552	367	8.53 578	367	1.46 422	9.99 974	2
59	8.53 919	363	8.53 945	363	1.46 055	9.99 974	1
60	8.54 282		8.54 308		1.45 692	9.99 974	0
	L Cos	d	L Ctn	c d	L Tan	L Sin	′

For more accurate values of L sin and L tan for interpolated values of angles less than 3° (or L cos or L ctn of angles greater than 87°) use Table IVa, Page 128.

2°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	
0	8.54 282	360	8.54 308	361	1.45 692	9.99 974	60
1	8.54 642	357	8.54 669	358	1.45 331	9.99 973	59
2	8.54 999	355	8.55 027	355	1.44 973	9.99 973	58
3	8.55 354	351	8.55 382	352	1.44 618	9.99 972	57
4	8.55 705	349	8.55 734	349	1.44 266	9.99 972	56
5	8.56 054	346	8.56 083	346	1.43 917	9.99 971	55
6	8.56 400	343	8.56 429	344	1.43 571	9.99 971	54
7	8.56 743	341	8.56 773	341	1.43 227	9.99 970	53
8	8.57 084	337	8.57 114	338	1.42 886	9.99 970	52
9	8.57 421	336	8.57 452	336	1.42 548	9.99 969	51
10	8.57 757	332	8.57 788	333	1.42 212	9.99 969	50
11	8.58 089	330	8.58 121	330	1.41 879	9.99 968	49
12	8.58 419	328	8.58 451	328	1.41 549	9.99 968	48
13	8.58 747	325	8.58 779	326	1.41 221	9.99 967	47
14	8.59 072	323	8.59 105	323	1.40 895	9.99 967	46
15	8.59 395	320	8.59 428	321	1.40 572	9.99 967	45
16	8.59 715	318	8.59 749	319	1.40 251	9.99 966	44
17	8.60 033	316	8.60 068	316	1.39 932	9.99 966	43
18	8.60 349	313	8.60 384	314	1.39 616	9.99 965	42
19	8.60 662	311	8.60 698	311	1.39 302	9.99 964	41
20	8.60 973	309	8.61 009	310	1.38 991	9.99 964	40
21	8.61 282	307	8.61 319	307	1.38 681	9.99 963	39
22	8.61 589	305	8.61 626	305	1.38 374	9.99 963	38
23	8.61 894	302	8.61 931	303	1.38 069	9.99 962	37
24	8.62 196	301	8.62 234	301	1.37 766	9.99 962	36
25	8.62 497	298	8.62 535	299	1.37 465	9.99 961	35
26	8.62 795	296	8.62 834	297	1.37 166	9.99 961	34
27	8.63 091	294	8.63 131	295	1.36 869	9.99 960	33
28	8.63 385	293	8.63 426	292	1.36 574	9.99 960	32
29	8.63 678	290	8.63 718	291	1.36 282	9.99 959	31
30	8.63 968	288	8.64 009	289	1.35 991	9.99 959	30
31	8.64 256	287	8.64 298	287	1.35 702	9.99 958	29
32	8.64 543	284	8.64 585	285	1.35 415	9.99 958	28
33	8.64 827	283	8.64 870	284	1.35 130	9.99 957	27
34	8.65 110	281	8.65 154	281	1.34 846	9.99 956	26
35	8.65 391	279	8.65 435	280	1.34 565	9.99 956	25
36	8.65 670	277	8.65 715	278	1.34 285	9.99 955	24
37	8.65 947	276	8.65 993	276	1.34 007	9.99 955	23
38	8.66 223	274	8.66 269	274	1.33 731	9.99 954	22
39	8.66 497	272	8.66 543	273	1.33 457	9.99 954	21
40	8.66 769	270	8.66 816	271	1.33 184	9.99 953	20
41	8.67 039	269	8.67 087	269	1.32 913	9.99 952	19
42	8.67 308	267	8.67 356	268	1.32 644	9.99 952	18
43	8.67 575	266	8.67 624	266	1.32 376	9.99 951	17
44	8.67 841	263	8.67 890	264	1.32 110	9.99 951	16
45	8.68 104	263	8.68 154	263	1.31 846	9.99 950	15
46	8.68 367	260	8.68 417	261	1.31 583	9.99 949	14
47	8.68 627	259	8.68 678	260	1.31 322	9.99 949	13
48	8.68 886	258	8.68 938	257	1.31 062	9.99 948	12
49	8.69 144	256	8.69 196		1.30 804	9.99 948	11
50	8.69 400	254	8.69 453	255	1.30 547	9.99 947	10
51	8.69 654	253	8.69 708	254	1.30 292	9.99 946	9
52	8.69 907	252	8.69 962	252	1.30 038	9.99 946	8
53	8.70 159	250	8.70 214	251	1.29 786	9.99 945	7
54	8.70 409	249	8.70 465	249	1.29 535	9.99 944	6
55	8.70 658	247	8.70 714	248	1.29 286	9.99 944	5
56	8.70 905	246	8.70 962	246	1.29 038	9.99 943	4
57	8.71 151	244	8.71 208	245	1.28 792	9.99 942	3
58	8.71 395	243	8.71 453	244	1.28 547	9.99 942	2
59	8.71 638	242	8.71 697	243	1.28 303	9.99 941	1
60	8.71 880		8.71 940		1.28 060	9.99 940	0
	L Cos	d	L Ctn	c d	L Tan	L Sin	′

For more accurate values of L sin and L tan for interpolated values of angles less than 3° (or L cos or L ctn of angles greater than 87°) use Table IVa, Page 128.

3°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos		Proportional parts
0	8.71 880	240	8.71 940	241	1.28 060	9.99 940	60	″ 241 239 237 235 234
1	8.72 120	239	8.72 181	239	1.27 819	9.99 940	59	1 4.0 4.0 4.0 3.9 3.9
2	8.72 359	238	8.72 420	239	1.27 580	9.99 939	58	2 8.0 8.0 7.9 7.8 7.8
3	8.72 597	237	8.72 659	237	1.27 341	9.99 938	57	3 12.0 12.0 11.8 11.8 11.7
4	8.72 834	235	8.72 896	236	1.27 104	9.99 938	56	4 16.1 15.9 15.8 15.7 15.6
5	8.73 069	234	8.73 132	234	1.26 868	9.99 937	55	5 20.1 19.9 19.8 19.6 19.5
6	8.73 303	232	8.73 366	234	1.26 634	9.99 936	54	6 24.1 23.9 23.7 23.5 23.4
7	8.73 535	232	8.73 600	232	1.26 400	9.99 936	53	7 28.1 27.9 27.6 27.4 27.3
8	8.73 767	230	8.73 832	231	1.26 168	9.99 935	52	8 32.1 31.9 31.6 31.3 31.2
9	8.73 997	229	8.74 063	229	1.25 937	9.99 934	51	9 36.2 35.8 35.6 35.2 35 1
10	8.74 226	228	8.74 292	229	1.25 708	9.99 934	50	″ 232 229 227 225 223
11	8.74 454	226	8.74 521	227	1.25 479	9.99 933	49	1 3.9 3.8 3.8 3.8 3.7
12	8.74 680	226	8.74 748	226	1.25 252	9.99 932	48	2 7.7 7.6 7.6 7.5 7.4
13	8.74 906	224	8.74 974	225	1.25 026	9.99 932	47	3 11.6 11.4 11.4 11.2 11.2
14	8.75 130	223	8.75 199	224	1.24 801	9.99 931	46	4 15.5 15.3 15.1 15.0 14.9
15	8.75 353	222	8.75 423	222	1.24 577	9.99 930	45	5 19.3 19.1 18.9 18.8 18.6
16	8.75 575	220	8.75 645	222	1.24 355	9.99 929	44	6 23.2 22.9 22.7 22.5 22.3
17	8.75 795	220	8.75 867	220	1.24 133	9.99 929	43	7 27.1 26.7 26.5 26.2 26.0
18	8.76 015	219	8.76 087	219	1.23 913	9.99 928	42	8 30.9 30.5 30.3 30.0 29.7
19	8.76 234	217	8.76 306	219	1.23 694	9.99 927	41	9 34.8 34.4 34.0 33.8 33.4
20	8.76 451	216	8.76 525	217	1.23 475	9.99 926	40	
21	8.76 667	216	8.76 742	216	1.23 258	9.99 926	39	″ 222 220 217 215 213
22	8.76 883	214	8.76 958	215	1.23 042	9.99 925	38	1 3.7 3.7 3.6 3.6 3.6
23	8.77 097	213	8.77 173	214	1.22 827	9.99 924	37	2 7.4 7.3 7.2 7.2 7.1
24	8.77 310	212	8.77 387	213	1.22 613	9.99 923	36	3 11.1 11.0 10.8 10.8 10.6
25	8.77 522	211	8.77 600	211	1.22 400	9.99 923	35	4 14.8 14.7 14.5 14.3 14.2
26	8.77 733	210	8.77 811	211	1.22 189	9.99 922	34	5 18.5 18.3 18.1 17.9 17.8
27	8.77 943	209	8.78 022	210	1.21 978	9.99 921	33	6 22.2 22.0 21.7 21.5 21.3
28	8.78 152	208	8.78 232	209	1.21 768	9.99 920	32	7 25.9 25.7 25.3 25.1 24.8
29	8.78 360	208	8.78 441	208	1.21 559	9.99 920	31	8 29.6 29.3 28.9 28.7 28.4
30	8.78 568	206	8.78 649	206	1.21 351	9.99 919	30	9 33.3 33.0 32.6 32.2 32.0
31	8.78 774	205	8.78 855	206	1.21 145	9.99 918	29	
32	8.78 979	204	8.79 061	205	1.20 939	9.99 917	28	″ 211 208 206 203 201
33	8.79 183	203	8.79 266	204	1.20 734	9.99 917	27	1 3.5 3.5 3.4 3.4 3.4
34	8.79 386	202	8.79 470	203	1.20 530	9.99 916	26	2 7.0 6.9 6.9 6.8 6.7
35	8.79 588	201	8.79 673	202	1.20 327	9.99 915	25	3 10.6 10.4 10.3 10.2 10.0
36	8.79 789	201	8.79 875	201	1.20 125	9.99 914	24	4 14.1 13.9 13.7 13.5 13.4
37	8.79 990	199	8.80 076	201	1.19 924	9.99 913	23	5 17.6 17.3 17.2 16.9 16.8
38	8.80 189	199	8.80 277	199	1.19 723	9.99 913	22	6 21.1 20.8 20.6 20.3 20.1
39	8.80 388	197	8.80 476	198	1.19 524	9.99 912	21	7 24.6 24.3 24.0 23.7 23.4
40	8.80 585	197	8.80 674	198	1.19 326	9.99 911	20	8 28.1 27.7 27.5 27.1 26.8
41	8.80 782	196	8.80 872	196	1.19 128	9.99 910	19	9 31.6 31.2 30.9 30.4 30.2
42	8.80 978	195	8.81 068	196	1.18 932	9.99 909	18	
43	8.81 173	194	8.81 264	196	1.18 736	9.99 909	17	″ 199 197 195 193 192
44	8.81 367	193	8.81 459	195	1.18 541	9.99 908	16	1 3.3 3.3 3.2 3.2 3.2
45	8.81 560	192	8.81 653	194	1.18 347	9.99 907	15	2 6.6 6.6 6.5 6.4 6.4
46	8.81 752	192	8.81 846	193	1.18 154	9.99 906	14	3 10.0 9.8 9.8 9.6 9.6
47	8.81 944	190	8.82 038	192	1.17 962	9.99 905	13	4 13.3 13.1 13.0 12.9 12.8
48	8.82 134	190	8.82 230	192	1.17 770	9.99 904	12	5 16.6 16.4 16.2 16.1 16.0
49	8.82 324	189	8.82 420	190	1.17 580	9.99 904	11	6 19.9 19.7 19.5 19.3 19.2
50	8.82 513	188	8.82 610	190	1.17 390	9.99 903	10	7 23.2 23.0 22.8 22.5 22.4
51	8.82 701	187	8.82 799	189	1.17 201	9.99 902	9	8 26.5 26.3 26.0 25.7 25.6
52	8.82 888	187	8.82 987	188	1.17 013	9.99 901	8	9 29.8 29.6 29.2 29.0 28.8
53	8.83 075	186	8.83 175	188	1.16 825	9.99 900	7	″ 189 187 185 183 181
54	8.83 261	185	8.83 361	186	1.16 639	9.99 899	6	1 3.2 3.1 3.1 3.0 3.0
55	8.83 446	184	8.83 547	186	1.16 453	9.99 898	5	2 6.3 6.2 6.2 6.1 6.0
56	8.83 630	183	8.83 732	185	1.16 268	9.99 898	4	3 9.4 9.4 9.2 9.2 9.0
57	8.83 813	183	8.83 916	184	1.16 084	9.99 897	3	4 12.6 12.5 12.3 12.2 12.1
58	8.83 996	181	8.84 100	182	1.15 900	9.99 896	2	5 15.8 15.6 15.4 15.2 15.1
59	8.84 177	181	8.84 282	182	1.15 718	9.99 895	1	6 18.9 18.7 18.5 18.3 18.1
60	8.84 358		8.84 464		1.15 536	9.99 894	0	7 22.0 21.8 21.6 21.4 21.1
								8 25.2 24.9 24.7 24.4 24.1
								9 28.4 28.0 27.8 27.4 27.2
′	L Cos	d	L Ctn	c d	L Tan	L Sin	′	Proportional parts

4°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L. Sin	d	L Tan	c d	L Ctn	L Cos		Proportional parts				
0	8.84 358	181	8.84 464	182	1.15 536	9.99 894	60	″	182	181	179	178	177
1	8.84 539	179	8.84 646	180	1.15 354	9.99 893	59	1	3.0	3.0	3.0	3.0	3.0
2	8.84 718	179	8.84 826	180	1.15 174	9.99 892	58	2	6.1	6.0	6.0	5.9	5.9
3	8.84 897	178	8.85 006	179	1.14 994	9.99 891	57	3	9.1	9.0	9.0	8.9	8.8
4	8.85 075	177	8.85 185	178	1.14 815	9.99 891	56	4	12.1	12.1	11.9	11.9	11.8
5	8.85 252	177	8.85 363	177	1.14 637	9.99 890	55	5	15.2	15.1	14.9	14.8	14.8
6	8.85 429	176	8.85 540	177	1.14 460	9.99 889	54	6	18.2	18.1	17.9	17.8	17.7
7	8.85 605	175	8.85 717	176	1.14 283	9.99 888	53	7	21.2	21.1	20.9	20.8	20.6
8	8.85 780	175	8.85 893	176	1.14 107	9.99 887	52	8	24.3	24.1	23.9	23.7	23.6
9	8.85 955	173	8.86 069	174	1.13 931	9.99 886	51	9	27.3	27.2	26.8	26.7	26.6
10	8.86 128	173	8.86 243	174	1.13 757	9.99 885	50	″	176	175	174	173	172
11	8.86 301	173	8.86 417	174	1.13 583	9.99 884	49	1	2.9	2.9	2.9	2.9	2.9
12	8.86 474	171	8.86 591	172	1.13 409	9.99 883	48	2	5.9	5.8	5.8	5.8	5.7
13	8.86 645	171	8.86 763	172	1.13 237	9.99 882	47	3	8.8	8.8	8.7	8.6	8.6
14	8.86 816	171	8.86 935	171	1.13 065	9.99 881	46	4	11.7	11.7	11.6	11.5	11.5
15	8.86 987	169	8.87 106	171	1.12 894	9.99 880	45	5	14.7	14.6	14.5	14.4	14.3
16	8.87 156	169	8.87 277	170	1.12 723	9.99 879	44	6	17.6	17.5	17.4	17.3	17.2
17	8.87 325	169	8.87 447	169	1.12 553	9.99 879	43	7	20.5	20.4	20.3	20.2	20.1
18	8.87 494	167	8.87 616	169	1.12 384	9.99 878	42	8	23.5	23.3	23.2	23.1	22.9
19	8.87 661	168	8.87 785	168	1.12 215	9.99 877	41	9	26.4	26.2	26.1	26.0	25.8
20	8.87 829	166	8.87 953	167	1.12 047	9.99 876	40	″	171	170	169	168	167
21	8.87 995	166	8.88 120	167	1.11 880	9.99 875	39	1	2.8	2.8	2.8	2.8	2.8
22	8.88 161	165	8.88 287	166	1.11 713	9.99 874	38	2	5.7	5.7	5.6	5.6	5.6
23	8.88 326	164	8.88 453	165	1.11 547	9.99 873	37	3	8.6	8.5	8.4	8.4	8.4
24	8.88 490	164	8.88 618	165	1.11 382	9.99 872	36	4	11.4	11.3	11.3	11.2	11.1
25	8.88 654	163	8.88 783	165	1.11 217	9.99 871	35	5	14.2	14.2	14.1	14.0	13.9
26	8.88 817	163	8.88 948	163	1.11 052	9.99 870	34	6	17.1	17.0	16.9	16.8	16.7
27	8.88 980	162	8.89 111	163	1.10 889	9.99 869	33	7	20.0	19.8	19.7	19.6	19.5
28	8.89 142	162	8.89 274	163	1.10 726	9.99 868	32	8	22.8	22.7	22.5	22.4	22.3
29	8.89 304	160	8.89 437	161	1.10 563	9.99 867	31	9	25.6	25.5	25.4	25.2	25.0
30	8.89 464	161	8.89 598	162	1.10 402	9.99 866	30	″	166	165	164	163	162
31	8.89 625	159	8.89 760	160	1.10 240	9.99 865	29	1	2.8	2.8	2.7	2.7	2.7
32	8.89 784	159	8.89 920	160	1.10 080	9.99 864	28	2	5.5	5.5	5.5	5.4	5.4
33	8.89 943	159	8.90 080	160	1.09 920	9.99 863	27	3	8.3	8.2	8.2	8.2	8.1
34	8.90 102	158	8.90 240	159	1.09 760	9.99 862	26	4	11.1	11.0	10.9	10.9	10.8
35	8.90 260	157	8.90 399	158	1.09 601	9.99 861	25	5	13.8	13.8	13.7	13.6	13.5
36	8.90 417	157	8.90 557	158	1.09 443	9.99 860	24	6	16.6	16.5	16.4	16.3	16.2
37	8.90 574	156	8.90 715	157	1.09 285	9.99 859	23	7	19.4	19.2	19.1	19.0	18.9
38	8.90 730	155	8.90 872	157	1.09 128	9.99 858	22	8	22.1	22.0	21.9	21.7	21.6
39	8.90 885	155	8.91 029	156	1.08 971	9.99 857	21	9	24.9	24.8	24.6	24.4	24.3
40	8.91 040	155	8.91 185	155	1.08 815	9.99 856	20	″	161	160	159	158	157
41	8.91 195	154	8.91 340	155	1.08 660	9.99 855	19	1	2.7	2.7	2.6	2.6	2.6
42	8.91 349	153	8.91 495	155	1.08 505	9.99 854	18	2	5.4	5.3	5.3	5.3	5.2
43	8.91 502	153	8.91 650	153	1.08 350	9.99 853	17	3	8.0	8.0	8.0	7.9	7.8
44	8.91 655	153	8.91 803	153	1.08 197	9.99 852	16	4	10.7	10.7	10.6	10.5	10.5
45	8.91 807	152	8.91 957	154	1.08 043	9.99 851	15	5	13.4	13.3	13.2	13.2	13.1
46	8.91 959	151	8.92 110	153	1.07 890	9.99 850	14	6	16.1	16.0	15.9	15.8	15.7
47	8.92 110	151	8.92 262	152	1.07 738	9.99 848	13	7	18.8	18.7	18.6	18.4	18.3
48	8.92 261	150	8.92 414	152	1.07 586	9.99 847	12	8	21.5	21.3	21.2	21.1	20.9
49	8.92 411	150	8.92 565	151	1.07 435	9.99 846	11	9	24.2	24.0	23.8	23.7	23.6
50	8.92 561	149	8.92 716	151	1.07 284	9.99 845	10	″	156	155	154	153	152
51	8.92 710	149	8.92 866	150	1.07 134	9.99 844	9	1	2.6	2.6	2.6	2.6	2.5
52	8.92 859	148	8.93 016	150	1.06 984	9.99 843	8	2	5.2	5.2	5.1	5.1	5.1
53	8.93 007	147	8.93 165	149	1.06 835	9.99 842	7	3	7.8	7.8	7.7	7.6	7.6
54	8.93 154	147	8.93 313	148	1.06 687	9.99 841	6	4	10.4	10.3	10.3	10.2	10.1
55	8.93 301	147	8.93 462	149	1.06 538	9.99 840	5	5	13.0	12.9	12.8	12.8	12.7
56	8.93 448	146	8.93 609	147	1.06 391	9.99 839	4	6	15.6	15.5	15.4	15.3	15.2
57	8.93 594	146	8.93 756	147	1.06 244	9.99 838	3	7	18.2	18.1	18.0	17.8	17.7
58	8.93 740	145	8.93 903	147	1.06 097	9.99 837	2	8	20.8	20.7	20.5	20.4	20.3
59	8.93 885	145	8.94 049	146	1.05 951	9.99 836	1	9	23.4	23.2	23.1	23.0	22.8
60	8.94 030		8.94 195		1.05 805	9.99 834	0						
	L Cos	d	L Ctn	c d	L Tan	L Sin	′		Proportional parts				

5°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos		Proportional parts
0	8.94 030	144	8.94 195	145	1.05 805	9.99 834	60	151 149 148 147 146
1	8.94 174	143	8.94 340	145	1.05 660	9.99 833	59	2.5 2.5 2.5 2.4 2.4
2	8.94 317	144	8.94 485	145	1.05 515	9.99 832	58	5.0 5.0 4.9 4.9 4.9
3	8.94 461	142	8.94 630	145	1.05 370	9.99 831	57	7.6 7.4 7.4 7.4 7.3
4	8.94 603	143	8.94 773	143	1.05 227	9.99 830	56	10.1 9.9 9.9 9.8 9.7
5	8.94 746	141	8.94 917	144	1.05 083	9.99 829	55	12.6 12.4 12.3 12.2 12.2
6	8.94 887	142	8.95 060	143	1.04 940	9.99 828	54	15.1 14.9 14.8 14.7 14.6
7	8.95 029	141	8.95 202	142	1.04 798	9.99 827	53	17.6 17.4 17.3 17.2 17.0
8	8.95 170	140	8.95 344	142	1.04 656	9.99 825	52	20.1 19.9 19.7 19.6 19.5
9	8.95 310	140	8.95 486	141	1.04 514	9.99 824	51	22.6 22.4 22.2 22.0 21.9
10	8.95 450	139	8.95 627	140	1.04 373	9.99 823	50	145 144 143 142 141
11	8.95 589	139	8.95 767	141	1.04 233	9.99 822	49	2.4 2.4 2.4 2.4 2.4
12	8.95 728	139	8.95 908	139	1.04 092	9.99 821	48	4.8 4.8 4.8 4.7 4.7
13	8.95 867	138	8.96 047	140	1.03 953	9.99 820	47	7.2 7.2 7.2 7.1 7.0
14	8.96 005	138	8.96 187	138	1.03 813	9.99 819	46	9.7 9.6 9.5 9.5 9.4
15	8.96 143	137	8.96 325	139	1.03 675	9.99 817	45	12.1 12.0 11.9 11.8 11.8
16	8.96 280	137	8.96 464	138	1.03 536	9.99 816	44	14.5 14.4 14.3 14.2 14.1
17	8.96 417	136	8.96 602	138	1.03 398	9.99 815	43	16.9 16.8 16.7 16.6 16.4
18	8.96 553	136	8.96 739	137	1.03 261	9.99 814	42	19.3 19.2 19.1 18.9 18.8
19	8.96 689	136	8.96 877	138	1.03 123	9.99 813	41	21.8 21.6 21.4 21.3 21.2
20	8.96 825	135	8.97 013	136	1.02 987	9.99 812	40	140 139 138 137 136
21	8.96 960	135	8.97 150	137	1.02 850	9.99 810	39	2.3 2.3 2.3 2.3 2.3
22	8.97 095	134	8.97 285	135	1.02 715	9.99 809	38	4.7 4.6 4.6 4.6 4.5
23	8.97 229	134	8.97 421	136	1.02 579	9.99 808	37	7.0 7.0 6.9 6.8 6.8
24	8.97 363	133	8.97 556	135	1.02 444	9.99 807	36	9.3 9.3 9.2 9.1 9.1
25	8.97 496	133	8.97 691	135	1.02 309	9.99 806	35	11.7 11.6 11.5 11.4 11.3
26	8.97 629	133	8.97 825	134	1.02 175	9.99 804	34	14.0 13.9 13.8 13.7 13.6
27	8.97 762	132	8.97 959	134	1.02 041	9.99 803	33	16.3 16.2 16.1 16.0 15.9
28	8.97 894	132	8.98 092	133	1.01 908	9.99 802	32	18.7 18.5 18.4 18.3 18.1
29	8.98 026	131	8.98 225	133	1.01 775	9.99 801	31	21.0 20.8 20.7 20.6 20.4
30	8.98 157	131	8.98 358	132	1.01 642	9.99 800	30	135 134 133 132 131
31	8.98 288	131	8.98 490	132	1.01 510	9.99 798	29	2.2 2.2 2.2 2.2 2.2
32	8.98 419	130	8.98 622	131	1.01 378	9.99 797	28	4.5 4.5 4.4 4.4 4.4
33	8.98 549	130	8.98 753	131	1.01 247	9.99 796	27	6.8 6.7 6.6 6.6 6.6
34	8.98 679	129	8.98 884	131	1.01 116	9.99 795	26	9.0 8.9 8.9 8.8 8.7
35	8.98 808	129	8.99 015	130	1.00 985	9.99 793	25	11.2 11.2 11.1 11.0 10.9
36	8.98 937	129	8.99 145	130	1.00 855	9.99 792	24	13.5 13.4 13.3 13.2 13.1
37	8.99 066	128	8.99 275	130	1.00 725	9.99 791	23	15.8 15.6 15.5 15.4 15.3
38	8.99 194	128	8.99 405	129	1.00 595	9.99 790	22	18.0 17.9 17.7 17.6 17.5
39	8.99 322	128	8.99 534	128	1.00 466	9.99 788	21	20.2 20.1 20.0 19.8 19.6
40	8.99 450	127	8.99 662	129	1.00 338	9.99 787	20	130 129 128 127 126
41	8.99 577	127	8.99 791	128	1.00 209	9.99 786	19	2.2 2.2 2.1 2.1 2.1
42	8.99 704	126	8.99 919	127	1.00 081	9.99 785	18	4.3 4.3 4.3 4.2 4.2
43	8.99 830	126	9.00 046	128	0.99 954	9.99 783	17	6.5 6.4 6.4 6.4 6.3
44	8.99 956	126	9.00 174	127	0.99 826	9.99 782	16	8.7 8.6 8.5 8.5 8.4
45	9.00 082	125	9.00 301	126	0.99 699	9.99 781	15	10.8 10.8 10.7 10.6 10.5
46	9.00 207	125	9.00 427	126	0.99 573	9.99 780	14	13.0 12.9 12.8 12.7 12.6
47	9.00 332	124	9.00 553	126	0.99 447	9.99 778	13	15.2 15.0 14.9 14.8 14.7
48	9.00 456	125	9.00 679	126	0.99 321	9.99 777	12	17.3 17.2 17.1 16.9 16.8
49	9.00 581	123	9.00 805	125	0.99 195	9.99 776	11	19.5 19.4 19.2 19.0 18.9
50	9.00 704	124	9 00 930	125	0.99 070	9.99 775	10	125 124 123 122 121
51	9.00 828	123	9.01 055	124	0.98 945	9 99 773	9	2.1 2.1 2.0 2.0 2.0
52	9.00 951	123	9.01 179	124	0.98 821	9.99 772	8	4.2 4.1 4.1 4.1 4.0
53	9.01 074	122	9.01 303	124	0.98 697	9.99 771	7	6.2 6.2 6.2 6.1 6.0
54	9.01 196	122	9.01 427	123	0.98 573	9.99 769	6	8.3 8.3 8.2 8.1 8.1
55	9.01 318	122	9.01 550	123	0.98 450	9.99 768	5	10.4 10.3 10.2 10.2 10.1
56	9.01 440	121	9.01 673	123	0.98 327	9.99 767	4	12.5 12.4 12.3 12.2 12.1
57	9.01 561	121	9.01 796	122	0.98 204	9.99 765	3	14.6 14.5 14.4 14.2 14.1
58	9.01 682	121	9.01 918	122	0.98 082	9.99 764	2	16.7 16.5 16.4 16.3 16.1
59	9.01 803	120	9.02 040	122	0.97 960	9.99 763	1	18.8 18.6 18.4 18.3 18.2
60	9.01 923		9.02 162		0.97 838	9.99 761	0	
	L Cos	d	L Ctn	c d	L Tan	L Sin	′	Proportional parts

6°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos		Proportional parts			
0	9.01 923	120	9.02 162	121	0.97 838	9.99 761	60	″	121	120	119	118
1	9.02 043	120	9.02 283	121	0.97 717	9.99 760	59	1	2.0	2.0	2.0	2.0
2	9.02 163	120	9.02 404	121	0.97 596	9.99 759	58	2	4.0	4.0	4.0	3.9
3	9.02 283	119	9.02 525	120	0.97 475	9.99 757	57	3	6.0	6.0	6.0	5.9
4	9.02 402	118	9.02 645	121	0.97 355	9.99 756	56	4	8.1	8.0	7.9	7.9
5	9.02 520	119	9.02 766	119	0.97 234	9.99 755	55	5	10.1	10.0	9.9	9.8
6	9.02 639	118	9.02 885	120	0.97 115	9.99 753	54	6	12.1	12.0	11.9	11.8
7	9.02 757	117	9.03 005	119	0.96 995	9.99 752	53	7	14.1	14.0	13.9	13.8
8	9.02 874	118	9.03 124	118	0.96 876	9.99 751	52	8	16.1	16.0	15.9	15.7
9	9.02 992	117	9.03 242	119	0.96 758	9.99 749	51	9	18.2	18.0	17.8	17.7
10	9.03 109	117	9.03 361	118	0.96 639	9.99 748	50	10	20.2	20.0	19.8	19.7
11	9.03 226	116	9.03 479	118	0.96 521	9.99 747	49	20	40.3	40.0	39.7	39.3
12	9.03 342	116	9.03 597	117	0.96 403	9.99 745	48	30	60.5	60.0	59.5	59.0
13	9.03 458	116	9.03 714	118	0.96 286	9.99 744	47	40	80.7	80.0	79.3	78.7
14	9.03 574	116	9.03 832	116	0.96 168	9.99 742	46	50	100.8	100.0	99.2	98.3
15	9.03 690	115	9.03 948	117	0.96 052	9.99 741	45	″	117	116	115	114
16	9.03 805	115	9.04 065	116	0.95 935	9.99 740	44	1	2.0	1.9	1.9	1.9
17	9.03 920	114	9.04 181	116	0.95 819	9.99 738	43	2	3.9	3.9	3.8	3.8
18	9.04 034	115	9.04 297	116	0.95 703	9.99 737	42	3	5.8	5.8	5.8	5.7
19	9.04 149	113	9.04 413	115	0.95 587	9.99 736	41	4	7.8	7.7	7.7	7.6
20	9.04 262	114	9.04 528	115	0.95 472	9.99 734	40	5	9.8	9.7	9.6	9.5
21	9.04 376	114	9.04 643	115	0.95 357	9.99 733	39	6	11.7	11.6	11.5	11.4
22	9.04 490	113	9.04 758	115	0.95 242	9.99 731	38	7	13.6	13.5	13.4	13.3
23	9.04 603	112	9.04 873	114	0.95 127	9.99 730	37	8	15.6	15.5	15.3	15.2
24	9.04 715	113	9.04 987	114	0.95 013	9.99 728	36	9	17.6	17.4	17.2	17.1
25	9.04 828	112	9.05 101	113	0.94 899	9.99 727	35	10	19.5	19.3	19.2	19.0
26	9.04 940	112	9.05 214	114	0.94 786	9.99 726	34	20	39.0	38.7	38.3	38.0
27	9.05 052	112	9.05 328	113	0.94 672	9.99 724	33	30	58.5	58.0	57.5	57.0
28	9.05 164	111	9.05 441	112	0.94 559	9.99 723	32	40	78.0	77.3	76.7	76.0
29	9.05 275	111	9.05 553	113	0.94 447	9.99 721	31	50	97.5	96.7	95.8	95.0
30	9.05 386	111	9.05 666	112	0.94 334	9.99 720	30	″	113	112	111	110
31	9.05 497	110	9.05 778	112	0.94 222	9.99 718	29	1	1.9	1.9	1.8	1.8
32	9.05 607	110	9.05 890	112	0.94 110	9.99 717	28	2	3.8	3.7	3.7	3.7
33	9.05 717	110	9.06 002	111	0.93 998	9.99 716	27	3	5.6	5.6	5.6	5.5
34	9.05 827	110	9.06 113	111	0.93 887	9.99 714	26	4	7.5	7.5	7.4	7.3
35	9.05 937	109	9.06 224	111	0.93 776	9.99 713	25	5	9.4	9.3	9.2	9.2
36	9.06 046	109	9.06 335	110	0.93 665	9.99 711	24	6	11.3	11.2	11.1	11.0
37	9.06 155	109	9.06 445	111	0.93 555	9.99 710	23	7	13.2	13.1	13.0	12.8
38	9.06 264	108	9.06 556	110	0.93 444	9.99 708	22	8	15.1	14.9	14.8	14.7
39	9.06 372	109	9.06 666	109	0.93 334	9.99 707	21	9	17.0	16.8	16.6	16.5
40	9.06 481	108	9.06 775	110	0.93 225	9.99 705	20	10	18.8	18.7	18.5	18.3
41	9.06 589	107	9.06 885	109	0.93 115	9.99 704	19	20	37.7	37.3	37.0	36.7
42	9.06 696	108	9.06 994	109	0.93 006	9.99 702	18	30	56.5	56.0	55.5	55.0
43	9.06 804	107	9.07 103	108	0.92 897	9.99 701	17	40	75.3	74.7	74.0	73.3
44	9.06 911	107	9.07 211	109	0.92 789	9.99 699	16	50	94.2	93.3	92.5	91.7
45	9.07 018	106	9.07 320	108	0.92 680	9.99 698	15					
46	9.07 124	107	9.07 428	108	0.92 572	9.99 696	14	″	109	108	107	106
47	9.07 231	106	9.07 536	107	0.92 464	9.99 695	13	1	1.8	1.8	1.8	1.8
48	9.07 337	105	9.07 643	108	0.92 357	9.99 693	12	2	3.6	3.6	3.6	3.5
49	9.07 442	106	9.07 751	107	0.92 249	9.99 692	11	3	5.4	5.4	5.4	5.3
50	9.07 548	105	9.07 858	106	0.92 142	9.99 690	10	4	7.3	7.2	7.1	7.1
51	9.07 653	105	9.07 964	106	0.92 036	9.99 689	9	5	9.1	9.0	8.9	8.8
52	9.07 758	105	9.08 071	107	0.91 929	9.99 687	8	6	10.9	10.8	10.7	10.6
53	9.07 863	105	9.08 177	106	0.91 823	9.99 686	7	7	12.7	12.6	12.5	12.4
54	9.07 968	104	9.08 283	106	0.91 717	9.99 684	6	8	14.5	14.4	14.3	14.1
55	9.08 072	104	9.08 389	106	0.91 611	9.99 683	5	9	16.4	16.2	16.0	15.9
56	9.08 176	104	9.08 495	105	0.91 505	9.99 681	4	10	18.2	18.0	17.8	17.7
57	9.08 280	103	9.08 600	105	0.91 400	9.99 680	3	20	36.3	36.0	35.7	35.3
58	9.08 383	103	9.08 705	105	0.91 295	9.99 678	2	30	54.5	54.0	53.5	53.0
59	9.08 486	103	9.08 810	104	0.91 190	9.99 677	1	40	72.7	72.0	71.3	70.7
60	9.08 589		9.08 914		0.91 086	9.99 675	0	50	90.8	90.0	89.2	88.3
′	L Cos	d	L Ctn	c d	L Tan	L Sin	′	Proportional parts				

7°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos		Proportional parts				
0	9.08 589	103	9.08 914	105	0.91 086	9.99 675	60	″	105	104	103	102
1	9.08 692	103	9.09 019	104	0.90 981	9.99 674	59	1	1.8	1.7	1.7	1.7
2	9.08 795	102	9.09 123	104	0.90 877	9.99 672	58	2	3.5	3.5	3.4	3.4
3	9.08 897	102	9.09 227	103	0.90 773	9.99 670	57	3	5.2	5.2	5.2	5.1
4	9.08 999	102	9.09 330	104	0.90 670	9.99 669	56	4	7.0	6.9	6.9	6.8
5	9.09 101	101	9.09 434	103	0.90 566	9.99 667	55	5	8.8	8.7	8.6	8.5
6	9.09 202	102	9.09 537	103	0.90 463	9.99 666	54	6	10.5	10.4	10.3	10.2
7	9.09 304	101	9.09 640	102	0.90 360	9.99 664	53	7	12.2	12.1	12.0	11.9
8	9.09 405	101	9.09 742	103	0.90 258	9.99 663	52	8	14.0	13.9	13.7	13.6
9	9.09 506	100	9.09 845	102	0.90 155	9.99 661	51	9	15.8	15.6	15.4	15.3
10	9.09 606	101	9.09 947	102	0.90 053	9.99 659	50	10	17.5	17.3	17.2	17.0
11	9.09 707	100	9.10 049	101	0.89 951	9.99 658	49	20	35.0	34.7	34.3	34.0
12	9.09 807	100	9.10 150	102	0.89 850	9.99 656	48	30	52.5	52.0	51.5	51.0
13	9.09 907	99	9.10 252	101	0.89 748	9.99 655	47	40	70.0	69.3	68.7	68.0
14	9.10 006	100	9.10 353	101	0.89 647	9.99 653	46	50	87.5	86.7	85.8	85.0
15	9.10 106	99	9.10 454	101	0.89 546	9.99 651	45	″	101	100	99	98
16	9.10 205	99	9.10 555	101	0.89 445	9.99 650	44	1	1.7	1.7	1.6	1.6
17	9.10 304	98	9.10 656	100	0.89 344	9.99 648	43	2	3.4	3.3	3.3	3.3
18	9.10 402	99	9.10 756	100	0.89 244	9.99 647	42	3	5.0	5.0	5.0	4.9
19	9.10 501	98	9.10 856	100	0.89 144	9.99 645	41	4	6.7	6.7	6.6	6.5
20	9.10 599	98	9.10 956	100	0.89 044	9.99 643	40	5	8.4	8.3	8.2	8.2
21	9.10 697	98	9.11 056	99	0.88 944	9.99 642	39	6	10.1	10.0	9.9	9.8
22	9.10 795	98	9.11 155	99	0.88 845	9.99 640	38	7	11.8	11.7	11.6	11.4
23	9.10 893	97	9.11 254	99	0.88 746	9.99 638	37	8	13.5	13.3	13.2	13.1
24	9.10 990	97	9.11 353	99	0.88 647	9.99 637	36	9	15.2	15.0	14.8	14.7
25	9.11 087	97	9.11 452	99	0.88 548	9.99 635	35	10	16.8	16.7	16.5	16.3
26	9.11 184	97	9.11 551	98	0.88 449	9.99 633	34	20	33.7	33.3	33.0	32.7
27	9.11 281	96	9.11 649	98	0.88 351	9.99 632	33	30	50.5	50.0	49.5	49.0
28	9.11 377	97	9.11 747	98	0.88 253	9.99 630	32	40	67.3	66.7	66.0	65.3
29	9.11 474	96	9.11 845	98	0.88 155	9.99 629	31	50	84.2	83.3	82.5	81.7
30	9.11 570	96	9.11 943	97	0.88 057	9.99 627	30	″	97	96	95	94
31	9.11 666	95	9.12 040	98	0.87 960	9.99 625	29	1	1.6	1.6	1.6	1.6
32	9.11 761	96	9.12 138	97	0.87 862	9.99 624	28	2	3.2	3.2	3.2	3.1
33	9.11 857	95	9.12 235	97	0.87 765	9.99 622	27	3	4.8	4.8	4.8	4.7
34	9.11 952	95	9.12 332	96	0.87 668	9.99 620	26	4	6.5	6.4	6.3	6.3
35	9.12 047	95	9.12 428	97	0.87 572	9.99 618	25	5	8.1	8.0	7.9	7.8
36	9.12 142	94	9.12 525	96	0.87 475	9.99 617	24	6	9.7	9.6	9.5	9.4
37	9.12 236	95	9.12 621	96	0.87 379	9.99 615	23	7	11.3	11.2	11.1	11.0
38	9.12 331	94	9.12 717	96	0.87 283	9.99 613	22	8	12.9	12.8	12.7	12.5
39	9.12 425	94	9.12 813	96	0.87 187	9.99 612	21	9	14.6	14.4	14.2	14.1
40	9.12 519	93	9.12 909	95	0.87 091	9.99 610	20	10	16.2	16.0	15.8	15.7
41	9.12 612	94	9.13 004	95	0.86 996	9.99 608	19	20	32.3	32.0	31.7	31.3
42	9.12 706	93	9.13 099	95	0.86 901	9.99 607	18	30	48.5	48.0	47.5	47.0
43	9.12 799	93	9.13 194	95	0.86 806	9.99 605	17	40	64.7	64.0	63.3	62.7
44	9.12 892	93	9.13 289	95	0.86 711	9.99 603	16	50	80.8	80.0	79.2	78.3
45	9.12 985	93	9.13 384	94	0.86 616	9.99 601	15					
46	9.13 078	93	9.13 478	95	0.86 522	9.99 600	14	″	93	92	91	90
47	9.13 171	92	9.13 573	94	0.86 427	9.99 598	13	1	1.6	1.5	1.5	1.5
48	9.13 263	92	9.13 667	94	0.86 333	9.99 596	12	2	3.1	3.1	3.0	3.0
49	9.13 355	92	9.13 761	93	0.86 239	9.99 595	11	3	4.6	4.6	4.6	4.5
50	9.13 447	92	9.13 854	94	0.86 146	9.99 593	10	4	6.2	6.1	6.1	6.0
51	9.13 539	91	9.13 948	93	0.86 052	9.99 591	9	5	7.8	7.7	7.6	7.5
52	9.13 630	92	9.14 041	93	0.85 959	9.99 589	8	6	9.3	9.2	9.1	9.0
53	9.13 722	91	9.14 134	93	0.85 866	9.99 588	7	7	10.8	10.7	10.6	10.5
54	9.13 813	91	9.14 227	93	0.85 773	9.99 586	6	8	12.4	12.3	12.1	12.0
55	9.13 904	90	9.14 320	92	0.85 680	9.99 584	5	9	14.0	13.8	13.6	13.5
56	9.13 994	91	9.14 412	92	0.85 588	9.99 582	4	10	15.5	15.3	15.2	15.0
57	9.14 085	90	9.14 504	93	0.85 496	9.99 581	3	20	31.0	30.7	30.3	30.0
58	9.14 175	91	9.14 597	91	0.85 403	9.99 579	2	30	46.5	46.0	45.5	45.0
59	9.14 266	90	9.14 688	92	0.85 312	9.99 577	1	40	62.0	61.3	60.7	60.0
								50	77.5	76.7	75.8	75.0
60	9.14 356		9.14 780		0.85 220	9.99 575	0					
′	L Cos	d	L Ctn	c d	L Tan	L Sin	′	Proportional parts				

8°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos		′
0	9.14 356		9.14 780		0.85 220	9.99 575	60	
1	9.14 445	89	9.14 872	92	0.85 128	9.99 574	59	
2	9.14 535	90	9.14 963	91	0.85 037	9.99 572	58	
3	9.14 624	89	9.15 054	91	0.84 946	9.99 570	57	
4	9.14 714	90	9.15 145	91	0.84 855	9.99 568	56	
		89		91				
5	9.14 803		9.15 236		0.84 764	9.99 566	55	
6	9.14 891	88	9.15 327	91	0.84 673	9.99 565	54	
7	9.14 980	89	9.15 417	90	0.84 583	9.99 563	53	
8	9.15 069	89	9.15 508	91	0.84 492	9.99 561	52	
9	9.15 157	88	9.15 598	90	0.84 402	9.99 559	51	
		88		90				
10	9.15 245		9.15 688		0.84 312	9.99 557	50	
11	9.15 333	88	9.15 777	89	0.84 223	9.99 556	49	
12	9.15 421	88	9.15 867	90	0.84 133	9.99 554	48	
13	9.15 508	87	9.15 956	89	0.84 044	9.99 552	47	
14	9.15 596	88	9.16 046	90	0.83 954	9.99 550	46	
		87		89				
15	9.15 683		9.16 135		0.83 865	9.99 548	45	
16	9.15 770	87	9.16 224	89	0.83 776	9.99 546	44	
17	9.15 857	87	9.16 312	88	0.83 688	9.99 545	43	
18	9.15 944	87	9.16 401	89	0.83 599	9.99 543	42	
19	9.16 030	86	9.16 489	88	0.83 511	9.99 541	41	
		86		88				
20	9.16 116		9.16 577		0.83 423	9.99 539	40	
21	9.16 203	87	9.16 665	88	0.83 335	9.99 537	39	
22	9.16 289	86	9.16 753	88	0.83 247	9.99 535	38	
23	9.16 374	85	9.16 841	88	0.83 159	9.99 533	37	
24	9.16 460	86	9.16 928	87	0.83 072	9.99 532	36	
		85		88				
25	9.16 545		9.17 016		0.82 984	9.99 530	35	
26	9.16 631	86	9.17 103	87	0.82 897	9.99 528	34	
27	9.16 716	85	9.17 190	87	0.82 810	9.99 526	33	
28	9.16 801	85	9.17 277	87	0.82 723	9.99 524	32	
29	9.16 886	85	9.17 363	86	0.82 637	9.99 522	31	
		84		87				
30	9.16 970		9.17 450		0.82 550	9.99 520	30	
31	9.17 055	85	9.17 536	86	0.82 464	9.99 518	29	
32	9.17 139	84	9.17 622	86	0.82 378	9.99 517	28	
33	9.17 223	84	9.17 708	86	0.82 292	9.99 515	27	
34	9.17 307	84	9.17 794	86	0.82 206	9.99 513	26	
		84		86				
35	9.17 391		9.17 880		0.82 120	9.99 511	25	
36	9.17 474	83	9.17 965	85	0.82 035	9.99 509	24	
37	9.17 558	84	9.18 051	86	0.81 949	9.99 507	23	
38	9.17 641	83	9.18 136	85	0.81 864	9.99 505	22	
39	9.17 724	83	9.18 221	85	0.81 779	9.99 503	21	
		83		85				
40	9.17 807		9.18 306		0.81 694	9.99 501	20	
41	9.17 890	83	9.18 391	85	0.81 609	9.99 499	19	
42	9.17 973	83	9.18 475	84	0.81 525	9.99 497	18	
43	9.18 055	82	9.18 560	85	0.81 440	9.99 495	17	
44	9.18 137	82	9.18 644	84	0.81 356	9.99 494	16	
		83		84				
45	9.18 220		9.18 728		0.81 272	9.99 492	15	
46	9.18 302	82	9.18 812	84	0.81 188	9.99 490	14	
47	9.18 383	81	9.18 896	84	0.81 104	9.99 488	13	
48	9.18 465	82	9.18 979	83	0.81 021	9.99 486	12	
49	9.18 547	82	9.19 063	84	0.80 937	9.99 484	11	
		81		83				
50	9.18 628		9.19 146		0.80 854	9.99 482	10	
51	9.18 709	81	9.19 229	83	0.80 771	9.99 480	9	
52	9.18 790	81	9.19 312	83	0.80 688	9.99 478	8	
53	9.18 871	81	9.19 395	83	0.80 605	9.99 476	7	
54	9.18 952	81	9.19 478	83	0.80 522	9.99 474	6	
		81		83				
55	9.19 033		9.19 561		0.80 439	9.99 472	5	
56	9.19 113	80	9.19 643	82	0.80 357	9.99 470	4	
57	9.19 193	80	9.19 725	82	0.80 275	9.99 468	3	
58	9.19 273	80	9.19 807	82	0.80 193	9.99 466	2	
59	9.19 353	80	9.19 889	82	0.80 111	9.99 464	1	
		80		82				
60	9.19 433		9.19 971		0.80 029	9.99 462	0	
′	L Cos	d	L Ctn	c d	L Tan	L Sin		′

Proportional parts			
″	92	91	90
1	1.5	1.5	1.5
2	3.1	3.0	3.0
3	4.6	4.6	4.5
4	6.1	6.1	6.0
5	7.7	7.6	7.5
6	9.2	9.1	9.0
7	10.7	10.6	10.5
8	12.3	12.1	12.0
9	13.8	13.6	13.5
10	15.3	15.2	15.0
20	30.7	30.3	30.0
30	46.0	45.5	45.0
40	61.3	60.7	60.0
50	76.7	75.8	75.0
″	89	88	87
1	1.5	1.5	1.4
2	3.0	2.9	2.9
3	4.4	4.4	4.4
4	5.9	5.9	5.8
5	7.4	7.3	7.2
6	8.9	8.8	8.7
7	10.4	10.3	10.2
8	11.9	11.7	11.6
9	13.4	13.2	13.0
10	14.8	14.7	14.5
20	29.7	29.3	29.0
30	44.5	44.0	43.5
40	59.3	58.7	58.0
50	74.2	73.3	72.5
″	86	85	84
1	1.4	1.4	1.4
2	2.9	2.8	2.8
3	4.3	4.2	4.2
4	5.7	5.7	5.6
5	7.2	7.1	7.0
6	8.6	8.5	8.4
7	10.0	9.9	9.8
8	11.5	11.3	11.2
9	12.9	12.8	12.6
10	14.3	14.2	14.0
20	28.7	28.3	28.0
30	43.0	42.5	42.0
40	57.3	56.7	56.0
50	71.7	70.8	70.0
″	83	82	81
1	1.4	1.4	1.4
2	2.8	2.7	2.7
3	4.2	4.1	4.0
4	5.5	5.5	5.4
5	6.9	6.8	6.8
6	8.3	8.2	8.1
7	9.7	9.6	9.4
8	11.1	10.9	10.8
9	12.4	12.3	12.2
10	13.8	13.7	13.5
20	27.7	27.3	27.0
30	41.5	41.0	40.5
40	55.3	54.7	54.0
50	69.2	68.3	67.5

Proportional parts

9°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos		′
0	9.19 433	80	9.19 971	82	0.80 029	9.99 462	60	
1	9.19 513	79	9.20 053	81	0.79 947	9.99 460	59	
2	9.19 592	80	9.20 134	82	0.79 866	9.99 458	58	
3	9.19 672	79	9.20 216	81	0.79 784	9.99 456	57	
4	9.19 751	79	9.20 297	81	0.79 703	9.99 454	56	
5	9.19 830	79	9.20 378	81	0.79 622	9.99 452	55	
6	9.19 909	79	9.20 459	81	0.79 541	9.99 450	54	
7	9.19 988	79	9.20 540	81	0.79 460	9.99 448	53	
8	9.20 067	78	9.20 621	80	0.79 379	9.99 446	52	
9	9.20 145	78	9.20 701	81	0.79 299	9.99 444	51	
10	9.20 223	79	9.20 782	80	0.79 218	9.99 442	50	
11	9.20 302	78	9.20 862	80	0.79 138	9.99 440	49	
12	9.20 380	78	9.20 942	80	0.79 058	9.99 438	48	
13	9.20 458	77	9.21 022	80	0.78 978	9.99 436	47	
14	9.20 535	78	9.21 102	80	0.78 898	9.99 434	46	
15	9.20 613	78	9.21 182	79	0.78 818	9.99 432	45	
16	9.20 691	77	9.21 261	80	0.78 739	9.99 429	44	
17	9.20 768	77	9.21 341	79	0.78 659	9.99 427	43	
18	9.20 845	77	9.21 420	79	0.78 580	9.99 425	42	
19	9.20 922	77	9.21 499	79	0.78 501	9.99 423	41	
20	9.20 999	77	9.21 578	79	0.78 422	9.99 421	40	
21	9.21 076	77	9.21 657	79	0.78 343	9.99 419	39	
22	9.21 153	76	9.21 736	78	0.78 264	9.99 417	38	
23	9.21 229	77	9.21 814	79	0.78 186	9.99 415	37	
24	9.21 306	76	9.21 893	78	0.78 107	9.99 413	36	
25	9.21 382	76	9.21 971	78	0.78 029	9.99 411	35	
26	9.21 458	76	9.22 049	78	0.77 951	9.99 409	34	
27	9.21 534	76	9.22 127	78	0.77 873	9.99 407	33	
28	9.21 610	75	9.22 205	78	0.77 795	9.99 404	32	
29	9.21 685	76	9.22 283	78	0.77 717	9.99 402	31	
30	9.21 761	75	9.22 361	77	0.77 639	9.99 400	30	
31	9.21 836	76	9.22 438	78	0.77 562	9.99 398	29	
32	9.21 912	75	9.22 516	77	0.77 484	9.99 396	28	
33	9.21 987	75	9.22 593	77	0.77 407	9.99 394	27	
34	9.22 062	75	9.22 670	77	0.77 330	9.99 392	26	
35	9.22 137	74	9.22 747	77	0.77 253	9.99 390	25	
36	9.22 211	75	9.22 824	77	0.77 176	9.99 388	24	
37	9.22 286	75	9.22 901	76	0.77 099	9.99 385	23	
38	9.22 361	74	9.22 977	77	0.77 023	9.99 383	22	
39	9.22 435	74	9.23 054	76	0.76 946	9.99 381	21	
40	9.22 509	74	9.23 130	76	0.76 870	9.99 379	20	
41	9.22 583	74	9.23 206	77	0.76 794	9.99 377	19	
42	9.22 657	74	9.23 283	76	0.76 717	9.99 375	18	
43	9.22 731	74	9.23 359	76	0.76 641	9.99 372	17	
44	9.22 805	73	9.23 435	75	0.76 565	9.99 370	16	
45	9.22 878	74	9.23 510	76	0.76 490	9.99 368	15	
46	9.22 952	73	9.23 586	75	0.76 414	9.99 366	14	
47	9.23 025	73	9.23 661	76	0.76 339	9.99 364	13	
48	9.23 098	73	9.23 737	75	0.76 263	9.99 362	12	
49	9.23 171	73	9.23 812	75	0.76 188	9.99 359	11	
50	9.23 244	73	9.23 887	75	0.76 113	9.99 357	10	
51	9.23 317	73	9.23 962	75	0.76 038	9.99 355	9	
52	9.23 390	72	9.24 037	75	0.75 963	9.99 353	8	
53	9.23 462	73	9.24 112	74	0.75 888	9.99 351	7	
54	9.23 535	72	9.24 186	75	0.75 814	9.99 348	6	
55	9.23 607	72	9.24 261	74	0.75 739	9.99 346	5	
56	9.23 679	73	9.24 335	75	0.75 665	9.99 344	4	
57	9.23 752	71	9.24 410	74	0.75 590	9.99 342	3	
58	9.23 823	72	9.24 484	74	0.75 516	9.99 340	2	
59	9.23 895	72	9.24 558	74	0.75 442	9.99 337	1	
60	9.23 967		9.24 632		0.75 368	9.99 335	0	
	L Cos	d	L Ctn	c d	L Tan	L Sin	′	

Proportional parts

″	80	79	78	77
1	1.3	1.3	1.3	1.3
2	2.7	2.6	2.6	2.6
3	4.0	4.0	3.9	3.8
4	5.3	5.3	5.2	5.1
5	6.7	6.6	6.5	6.4
6	8.0	7.9	7.8	7.7
7	9.3	9.2	9.1	9.0
8	10.7	10.5	10.4	10.3
9	12.0	11.8	11.7	11.6
10	13.3	13.2	13.0	12.8
20	26.7	26.3	26.0	25.7
30	40.0	39.5	39.0	38.5
40	53.3	52.7	52.0	51.3
50	66.7	65.8	65.0	64.2

″	76	75	74	73
1	1.3	1.2	1.2	1.2
2	2.5	2.5	2.5	2.4
3	3.8	3.8	3.7	3.6
4	5.1	5.0	4.9	4.9
5	6.3	6.2	6.2	6.1
6	7.6	7.5	7.4	7.3
7	8.9	8.8	8.6	8.5
8	10.1	10.0	9.9	9.7
9	11.4	11.2	11.1	11.0
10	12.7	12.5	12.3	12.2
20	25.3	25.0	24.7	24.3
30	38.0	37.5	37.0	36.5
40	50.7	50.0	49.3	48.7
50	63.3	62.5	61.7	60.8

″	72	71	3	2
1	1.2	1.2	0.0	0.0
2	2.4	2.4	0.1	0.1
3	3.6	3.6	0.2	0.1
4	4.8	4.7	0.2	0.1
5	6.0	5.9	0.2	0.2
6	7.2	7.1	0.3	0.2
7	8.4	8.3	0.4	0.2
8	9.6	9.5	0.4	0.3
9	10.8	10.6	0.4	0.3
10	12.0	11.8	0.5	0.3
20	24.0	23.7	1.0	0.7
30	36.0	35.5	1.5	1.0
40	48.0	47.3	2.0	1.3
50	60.0	59.2	2.5	1.7

10°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		Proportional parts
0	9.23 967	72	9.24 632	74	0.75 368	9.99 335	2	60	
1	9.24 039	71	9.24 706	73	0.75 294	9.99 333	2	59	
2	9.24 110	71	9.24 779	74	0.75 221	9.99 331	3	58	
3	9.24 181	72	9.24 853	73	0.75 147	9.99 328	2	57	
4	9.24 253	71	9.24 926	74	0.75 074	9.99 326	2	56	
5	9.24 324	71	9.25 000	73	0.75 000	9.99 324	2	55	
6	9.24 395	71	9.25 073	73	0.74 927	9.99 322	3	54	
7	9.24 466	70	9.25 146	73	0.74 854	9.99 319	2	53	
8	9.24 536	71	9.25 219	73	0.74 781	9.99 317	2	52	
9	9.24 607	70	9.25 292	73	0.74 708	9.99 315	2	51	
10	9.24 677	71	9.25 365	72	0.74 635	9.99 313	3	50	
11	9.24 748	70	9.25 437	73	0.74 563	9.99 310	2	49	
12	9.24 818	70	9.25 510	72	0.74 490	9.99 308	2	48	
13	9.24 888	70	9.25 582	73	0.74 418	9.99 306	2	47	
14	9.24 958	70	9.25 655	72	0.74 345	9.99 304	3	46	
15	9.25 028	70	9.25 727	72	0.74 273	9.99 301	2	45	
16	9.25 098	70	9.25 799	72	0.74 201	9.99 299	2	44	
17	9.25 168	69	9.25 871	72	0.74 129	9.99 297	3	43	
18	9.25 237	70	9.25 943	72	0.74 057	9.99 294	2	42	
19	9.25 307	69	9.26 015	71	0.73 985	9.99 292	2	41	
20	9.25 376	69	9.26 086	72	0.73 914	9.99 290	2	40	
21	9.25 445	69	9.26 158	71	0.73 842	9.99 288	3	39	
22	9.25 514	69	9.26 229	72	0.73 771	9.99 285	2	38	
23	9.25 583	69	9.26 301	71	0.73 699	9.99 283	2	37	
24	9.25 652	69	6.26 372	71	0.73 628	9.99 281	3	36	
25	9.25 721	69	9.26 443	71	0.73 557	9.99 278	2	35	
26	9.25 790	68	9.26 514	71	0.73 486	9.99 276	2	34	
27	9.25 858	69	9.26 585	70	0.73 415	9.99 274	3	33	
28	9.25 927	68	9.26 655	71	0.73 345	9.99 271	2	32	
29	9.25 995	68	9.26 726	71	0.73 274	9.99 269	2	31	
30	9.26 063	68	9.26 797	70	0.73 203	9.99 267	3	30	
31	9.26 131	68	9.26 867	70	0.73 133	9.99 264	2	29	
32	9.26 199	68	9.26 937	71	0.73 063	9.99 262	2	28	
33	9.26 267	68	9.27 008	70	0.72 992	9.99 260	3	27	
34	9.26 335	68	9.27 078	70	0.72 922	9.99 257	2	26	
35	9.26 403	67	9.27 148	70	0.72 852	9.99 255	3	25	
36	9.26 470	68	9.27 218	70	0.72 782	9.99 252	2	24	
37	9.26 538	67	9.27 288	69	0.72 712	9.99 250	2	23	
38	9.26 605	67	9.27 357	70	0.72 643	9.99 248	3	22	
39	9.26 672	67	9.27 427	69	0.72 573	9.99 245	2	21	
40	9.26 739	67	9.27 496	70	0.72 504	9.99 243	2	20	
41	9.26 806	67	9.27 566	69	0.72 434	9.99 241	3	19	
42	9.26 873	67	9.27 635	69	0.72 365	9.99 238	2	18	
43	9.26 940	67	9.27 704	69	0.72 296	9.99 236	3	17	
44	9.27 007	66	9.27 773	69	0.72 227	9.99 233	2	16	
45	9.27 073	67	9.27 842	69	0.72 158	9.99 231	2	15	
46	9.27 140	66	9.27 911	69	0.72 089	9.99 229	3	14	
47	9.27 206	67	9.27 980	69	0.72 020	9.99 226	2	13	
48	9.27 273	66	9.28 049	68	0.71 951	9.99 224	3	12	
49	9.27 339	66	9.28 117	69	0.71 883	9.99 221	2	11	
50	9.27 405	66	9.28 186	68	0.71 814	9.99 219	2	10	
51	9.27 471	66	9.28 254	69	0.71 746	9.99 217	3	9	
52	9.27 537	65	9.28 323	68	0.71 677	9.99 214	2	8	
53	9.27 602	66	9.28 391	68	0.71 609	9.99 212	3	7	
54	9.27 668	66	9.28 459	68	0.71 541	9.99 209	2	6	
55	9.27 734	65	9.28 527	68	0.71 473	9.99 207	3	5	
56	9.27 799	65	9.28 595	67	0.71 405	9.99 204	2	4	
57	9.27 864	66	9.28 662	68	0.71 338	9.99 202	2	3	
58	9.27 930	65	9.28 730	68	0.71 270	9.99 200	3	2	
59	9.27 995	65	9.28 798	67	0.71 202	9.99 197	2	1	
60	9.28 060		9.28 865		0.71 135	9.99 195		0	
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′	Proportional parts

Proportional parts			
″	74	73	72
1	1.2	1.2	1.2
2	2.5	2.4	2.4
3	3.7	3.6	3.6
4	4.9	4.9	4.8
5	6.2	6.1	6.0
6	7.4	7.3	7.2
7	8.6	8.5	8.4
8	9.9	9.7	9.6
9	11.1	11.0	10.8
10	12.3	12.2	12.0
20	24.7	24.3	24.0
30	37.0	36.5	36.0
40	49.3	48.7	48.0
50	61.7	60.8	60.0

Proportional parts			
″	71	70	69
1	1.2	1.2	1.2
2	2.4	2.3	2.3
3	3.6	3.5	3.4
4	4.7	4.7	4.6
5	5.9	5.8	5.8
6	7.1	7.0	6.9
7	8.3	8.2	8.0
8	9.5	9.3	9.2
9	10.6	10.5	10.4
10	11.8	11.7	11.5
20	23.7	23.3	23.0
30	35.5	35.0	34.5
40	47.3	46.7	46.0
50	59.2	58.3	57.5

Proportional parts			
″	68	67	66
1	1.1	1.1	1.1
2	2.3	2.2	2.2
3	3.4	3.4	3.3
4	4.5	4.5	4.4
5	5.7	5.6	5.5
6	6.8	6.7	6.6
7	7.9	7.8	7.7
8	9.1	8.9	8.8
9	10.2	10.0	9.9
10	11.3	11.2	11.0
20	22.7	22.3	22.0
30	34.0	33.5	33.0
40	45.3	44.7	44.0
50	56.7	55.8	55.0

11°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	′
0	9.28 060	65	9.28 865	68	0.71 135	9.99 195	3	60
1	9.28 125	65	9.28 933	67	0.71 067	9.99 192	2	59
2	9.28 190	64	9.29 000	67	0.71 000	9.99 190	3	58
3	9.28 254	65	9.29 067	67	0.70 933	9.99 187	2	57
4	9.28 319	65	9.29 134	67	0.70 866	9.99 185	3	56
5	9.28 384	64	9.29 201	67	0.70 799	9.99 182	2	55
6	9.28 448	64	9.29 268	67	0.70 732	9.99 180	3	54
7	9.28 512	65	9.29 335	67	0.70 665	9.99 177	2	53
8	9.28 577	64	9.29 402	66	0.70 598	9.99 175	3	52
9	9.28 641	64	9.29 468	67	0.70 532	9.99 172	2	51
10	9.28 705	64	9.29 535	66	0.70 465	9.99 170	3	50
11	9.28 769	64	9.29 601	67	0.70 399	9.99 167	2	49
12	9.28 833	63	9.29 668	66	0.70 332	9.99 165	3	48
13	9.28 896	64	9.29 734	66	0.70 266	9.99 162	2	47
14	9.28 960	64	9.29 800	66	0.70 200	9.99 160	3	46
15	9.29 024	63	9.29 866	66	0.70 134	9.99 157	2	45
16	9.29 087	63	9.29 932	66	0.70 068	9.99 155	3	44
17	9.29 150	64	9.29 998	66	0.70 002	9.99 152	2	43
18	9.29 214	63	9.30 064	66	0.69 936	9.99 150	3	42
19	9.29 277	63	9.30 130	65	0.69 870	9.99 147	2	41
20	9.29 340	63	9.30 195	66	0.69 805	9.99 145	3	40
21	9.29 403	63	9.30 261	65	0.69 739	9.99 142	2	39
22	9.29 466	63	9.30 326	65	0.69 674	9.99 140	3	38
23	9.29 529	62	9.30 391	66	0.69 609	9.99 137	2	37
24	9.29 591	63	9.30 457	65	0.69 543	9.99 135	3	36
25	9.29 654	62	9.30 522	65	0.69 478	9.99 132	2	35
26	9.29 716	63	9.30 587	65	0.69 413	9.99 130	3	34
27	9.29 779	62	9.30 652	65	0.69 348	9.99 127	3	33
28	9.29 841	62	9.30 717	65	0.69 283	9.99 124	2	32
29	9.29 903	63	9.30 782	64	0.69 218	9.99 122	3	31
30	9.29 966	62	9.30 846	65	0.69 154	9.99 119	2	30
31	9.30 028	62	9.30 911	64	0.69 089	9.99 117	3	29
32	9.30 090	61	9.30 975	65	0.69 025	9.99 114	2	28
33	9.30 151	62	9.31 040	64	0.68 960	9.99 112	3	27
34	9.30 213	62	9.31 104	64	0.68 896	9.99 109	3	26
35	9.30 275	61	9.31 168	65	0.68 832	9.99 106	2	25
36	9.30 336	62	9.31 233	64	0.68 767	9.99 104	3	24
37	9.30 398	61	9.31 297	64	0.68 703	9.99 101	2	23
38	9.30 459	62	9.31 361	64	0.68 639	9.99 099	3	22
39	9.30 521	61	9.31 425	64	0.68 575	9.99 096	3	21
40	9.30 582	61	9.31 489	63	0.68 511	9.99 093	2	20
41	9.30 643	61	9.31 552	64	0.68 448	9.99 091	3	19
42	9.30 704	61	9.31 616	63	0.68 384	9.99 088	2	18
43	9.30 765	61	9.31 679	64	0.68 321	9.99 086	3	17
44	9.30 826	61	9.31 743	63	0.68 257	9.99 083	3	16
45	9.30 887	60	9.31 806	64	0.68 194	9.99 080	2	15
46	9.30 947	61	9.31 870	63	0.68 130	9.99 078	3	14
47	9.31 008	60	9.31 933	63	0.68 067	9.99 075	3	13
48	9.31 068	61	9.31 996	63	0.68 004	9.99 072	2	12
49	9.31 129	60	9.32 059	63	0.67 941	9.99 070	3	11
50	9.31 189	61	9.32 122	63	0.67 878	9.99 067	3	10
51	9.31 250	60	9.32 185	63	0.67 815	9.99 064	2	9
52	9.31 310	60	9.32 248	63	0.67 752	9.99 062	3	8
53	9.31 370	60	9.32 311	62	0.67 689	9.99 059	3	7
54	9.31 430	60	9.32 373	63	0.67 627	9.99 056	2	6
55	9.31 490	59	9.32 436	62	0.67 564	9.99 054	3	5
56	9.31 549	60	9.32 498	63	0.67 502	9.99 051	3	4
57	9.31 609	60	9.32 561	62	0.67 439	9.99 048	3	3
58	9.31 669	59	9.32 623	62	0.67 377	9.99 046	3	2
59	9.31 728	60	9.32 685	62	0.67 315	9.99 043	3	1
60	9.31 788		9.32 747		0.67 253	9.99 040		0
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	65	64	63
1	1.1	1.1	1.0
2	2.2	2.1	2.1
3	3.2	3.2	3.2
4	4.3	4.3	4.2
5	5.4	5.3	5.2
6	6.5	6.4	6.3
7	7.6	7.5	7.4
8	8.7	8.5	8.4
9	9.8	9.6	9.4
10	10.8	10.7	10.5
20	21.7	21.3	21.0
30	32.5	32.0	31.5
40	43.3	42.7	42.0
50	54.2	53.3	52.5

″	62	61	60
1	1.0	1.0	1.0
2	2.1	2.0	2.0
3	3.1	3.0	3.0
4	4.1	4.1	4.0
5	5.2	5.1	5.0
6	6.2	6.1	6.0
7	7.2	7.1	7.0
8	8.3	8.1	8.0
9	9.3	9.2	9.0
10	10.3	10.2	10.0
20	20.7	20.3	20.0
30	31.0	30.5	30.0
40	41.3	40.7	40.0
50	51.7	50.8	50.0

″	59	3	2
1	1.0	0.0	0.0
2	2.0	0.1	0.1
3	3.0	0.2	0.1
4	3.9	0.2	0.1
5	4.9	0.2	0.2
6	5.9	0.3	0.2
7	6.9	0.4	0.2
8	7.9	0.4	0.3
9	8.8	0.4	0.3
10	9.8	0.5	0.3
20	19.7	1.0	0.7
30	29.5	1.5	1.0
40	39.3	2.0	1.3
50	49.2	2.5	1.7

Proportional parts

12°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		Proportional parts
0	9.31 788	59	9.32 747	63	0.67 253	9.99 040	2	60	
1	9.31 847	60	9.32 810	62	0.67 190	9.99 038	3	59	
2	9.31 907	59	9.32 872	61	0.67 128	9.99 035	3	58	
3	9.31 966	59	9.32 933	62	0.67 067	9.99 032	2	57	
4	9.32 025	59	9.32 995	62	0.67 005	9.99 030	3	56	
5	9.32 084	59	9.33 057	62	0.66 943	9.99 027	3	55	
6	9.32 143	59	9.33 119	61	0.66 881	9.99 024	2	54	
7	9.32 202	59	9.33 180	62	0.66 820	9.99 022	3	53	
8	9.32 261	58	9.33 242	61	0.66 758	9.99 019	3	52	
9	9.32 319	59	9.33 303	62	0.66 697	9.99 016	3	51	
10	9.32 378	59	9.33 365	61	0.66 635	9.99 013	2	50	
11	9.32 437	58	9.33 426	61	0.66 574	9.99 011	3	49	
12	9.32 495	58	9.33 487	61	0.66 513	9.99 008	3	48	
13	9.32 553	59	9.33 548	61	0.66 452	9.99 005	3	47	
14	9.32 612	58	9.33 609	61	0.66 391	9.99 002	2	46	
15	9.32 670	58	9.33 670	61	0.66 330	9.99 000	3	45	
16	9.32 728	58	9.33 731	61	0.66 269	9.98 997	3	44	
17	9.32 786	58	9.33 792	61	0.66 208	9.98 994	3	43	
18	9.32 844	58	9.33 853	60	0.66 147	9.98 991	2	42	
19	9.32 902	58	9.33 913	61	0.66 087	9.98 989	3	41	
20	9.32 960	58	9.33 974	60	0.66 026	9.98 986	3	40	
21	9.33 018	57	9.34 034	61	0.65 966	9.98 983	3	39	
22	9.33 075	58	9.34 095	60	0.65 905	9.98 980	2	38	
23	9.33 133	57	9.34 155	60	0 65 845	9.98 978	3	37	
24	9.33 190	58	9.34 215	61	0.65 785	9.98 975	3	36	
25	9.33 248	57	9.34 276	60	0.65 724	9.98 972	3	35	
26	9.33 305	57	9.34 336	60	0.65 664	9.98 969	2	34	
27	9.33 362	58	9.34 396	60	0.65 604	9.98 967	3	33	
28	9.33 420	57	9.34 456	60	0.65 544	9.98 964	3	32	
29	9.33 477	57	9.34 516	60	0.65 484	9.98 961	3	31	
30	9.33 534	57	9.34 576	59	0.65 424	9.98 958	3	30	
31	9.33 591	56	9.34 635	60	0.65 365	9.98 955	2	29	
32	9.33 647	57	9.34 695	60	0.65 305	9.98 953	3	28	
33	9.33 704	57	9.34 755	59	0.65 245	9.98 950	3	27	
34	9.33 761	57	9.34 814	60	0.65 186	9.98 947	3	26	
35	9.33 818	56	9.34 874	59	0.65 126	9.98 944	3	25	
36	9.33 874	57	9.34 933	59	0.65 067	9.98 941	3	24	
37	9.33 931	56	9.34 992	59	0.65 008	9.98 938	2	23	
38	9.33 987	56	9.35 051	60	0.64 949	9.98 936	3	22	
39	9.34 043	57	9.35 111	59	0.64 889	9.98 933	3	21	
40	9.34 100	56	9.35 170	59	0.64 830	9.98 930	3	20	
41	9.34 156	56	9.35 229	59	0.64 771	9.98 927	3	19	
42	9.34 212	56	9.35 288	59	0.64 712	9.98 924	3	18	
43	9.34 268	56	9.35 347	58	0.64 653	9.98 921	2	17	
44	9.34 324	56	9.35 405	59	0.64 595	9.98 919	3	16	
45	9.34 380	56	9.35 464	59	0.64 536	9.98 916	3	15	
46	9.34 436	55	9.35 523	58	0.64 477	9.98 913	3	14	
47	9.34 491	56	9.35 581	59	0.64 419	9.98 910	3	13	
48	9.34 547	55	9.35 640	58	0.64 360	9.98 907	3	12	
49	9.34 602	56	9.35 698	59	0.64 302	9.98 904	3	11	
50	9.34 658	55	9.35 757	58	0.64 243	9.98 901	3	10	
51	9.34 713	56	9.35 815	58	0.64 185	9.98 898	2	9	
52	9.34 769	55	9.35 873	58	0.64 127	9.98 896	3	8	
53	9.34 824	55	9.35 931	58	0.64 069	9.98 893	3	7	
54	9.34 879	55	9.35 989	58	0.64 011	9.98 890	3	6	
55	9.34 934	55	9.36 047	58	0.63 953	9.98 887	3	5	
56	9.34 989	55	9.36 105	58	0.63 895	9.98 884	3	4	
57	9.35 044	55	9.36 163	58	0.63 837	9.98 881	3	3	
58	9.35 099	55	9.36 221	58	0.63 779	9.98 878	3	2	
59	9.35 154	55	9.36 279	57	0.63 721	9.98 875	3	1	
60	9.35 209		9.36 336		0.63 664	9.98 872		0	
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′	Proportional parts

Proportional parts			
″	63	62	61
1	1.0	1.0	1.0
2	2.1	2.1	2.0
3	3.2	3.1	3.0
4	4.2	4.1	4.1
5	5.2	5.2	5.1
6	6.3	6.2	6.1
7	7.4	7.2	7.1
8	8.4	8.3	8.1
9	9.4	9.3	9.2
10	10.5	10.3	10.2
20	21.0	20.7	20.3
30	31.5	31.0	30.5
40	42.0	41.3	40.7
50	52.5	51.7	50.8

Proportional parts			
″	60	59	58
1	1.0	1.0	1.0
2	2.0	2.0	1.9
3	3.0	3.0	2.9
4	4.0	3.9	3.9
5	5.0	4.9	4.8
6	6.0	5.9	5.8
7	7.0	6.9	6.8
8	8.0	7.9	7.7
9	9.0	8.8	8.7
10	10.0	9.8	9.7
20	20.0	19.7	19.3
30	30.0	29.5	29.0
40	40.0	39.3	38.7
50	50.0	49.2	48.3

Proportional parts			
″	57	56	55
1	1.0	0.9	0.9
2	1.9	1.9	1.8
3	2.8	2.8	2.8
4	3.8	3.7	3.7
5	4.8	4.7	4.6
6	5.7	5.6	5.5
7	6.6	6.5	6.4
8	7.6	7.5	7.3
9	8.6	8.4	8.2
10	9.5	9.3	9.2
20	19.0	18.7	18.3
30	28.5	28.0	27.5
40	38.0	37.3	36.7
50	47.5	46.7	45.8

13°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		′
0	9.35 209		9.36 336		0.63 664	9.98 872		60	
1	9.35 263	54	9.36 394	58	0.63 606	9.98 869	3	59	
2	9.35 318	55	9.36 452	58	0.63 548	9.98 867	2	58	
3	9.35 373	55	9.36 509	57	0.63 491	9.98 864	3	57	
4	9.35 427	54	9.36 566	57	0.63 434	9.98 861	3	56	
		54		58			3		
5	9.35 481		9.36 624		0.63 376	9.98 858		55	
6	9.35 536	55	9.36 681	57	0.63 319	9.98 855	3	54	
7	9.35 590	54	9.36 738	57	0.63 262	9.98 852	3	53	
8	9.35 644	54	9.36 795	57	0.63 205	9.98 849	3	52	
9	9.35 698	54	9.36 852	57	0.63 148	9.98 846	3	51	
		54		57			3		
10	9.35 752		9.36 909		0.63 091	9.98 843		50	
11	9.35 806	54	9.36 966	57	0.63 034	9.98 840	3	49	
12	9.35 860	54	9.37 023	57	0.62 977	9.98 837	3	48	
13	9.35 914	54	9.37 080	57	0.62 920	9.98 834	3	47	
14	9.35 968	54	9.37 137	57	0.62 863	9.98 831	3	46	
		54		56			3		
15	9.36 022		9.37 193		0.62 807	9.98 828		45	
16	9.36 075	53	9.37 250	57	0.62 750	9.98 825	3	44	
17	9.36 129	54	9.37 306	56	0.62 694	9.98 822	3	43	
18	9.36 182	53	9.37 363	57	0.62 637	9.98 819	3	42	
19	9.36 236	54	9.37 419	56	0.62 581	9.98 816	3	41	
		53		57			3		
20	9.36 289		9.37 476		0.62 524	9.98 813		40	
21	9.36 342	53	9.37 532	56	0.62 468	9.98 810	3	39	
22	9.36 395	53	9.37 588	56	0.62 412	9.98 807	3	38	
23	9.36 449	54	9.37 644	56	0.62 356	9.98 804	3	37	
24	9.36 502	53	9.37 700	56	0.62 300	9.98 801	3	36	
		53		56			3		
25	9.36 555		9.37 756		0.62 244	9.98 798		35	
26	9.36 608	53	9.37 812	56	0.62 188	9.98 795	3	34	
27	9.36 660	52	9.37 868	56	0.62 132	9.98 792	3	33	
28	9.36 713	53	9.37 924	56	0.62 076	9.98 789	3	32	
29	9.36 766	53	9.37 980	56	0.62 020	9.98 786	3	31	
		53		55			3		
30	9.36 819		9.38 035		0.61 965	9.98 783		30	
31	9.36 871	52	9.38 091	56	0.61 909	9.98 780	3	29	
32	9.36 924	53	9.38 147	56	0.61 853	9.98 777	3	28	
33	9.36 976	52	9.38 202	55	0.61 798	9.98 774	3	27	
34	9.37 028	52	9.38 257	55	0.61 743	9.98 771	3	26	
		53		56			3		
35	9.37 081		9.38 313		0.61 687	9.98 768		25	
36	9.37 133	52	9.38 368	55	0.61 632	9.98 765	3	24	
37	9.37 185	52	9.38 423	55	0.61 577	9.98 762	3	23	
38	9.37 237	52	9.38 479	56	0.61 521	9.98 759	3	22	
39	9.37 289	52	9.38 534	55	0.61 466	9.98 756	3	21	
		52		55			3		
40	9.37 341		9.38 589		0.61 411	9.98 753		20	
41	9.37 393	52	9.38 644	55	0.61 356	9.98 750	3	19	
42	9.37 445	52	9.38 699	55	0.61 301	9.98 746	4	18	
43	9.37 497	52	9.38 754	55	0.61 246	9.98 743	3	17	
44	9.37 549	52	9.38 808	54	0.61 192	9.98 740	3	16	
		51		55			3		
45	9.37 600		9.38 863		0.61 137	9.98 737		15	
46	9.37 652	52	9.38 918	55	0.61 082	9.98 734	3	14	
47	9.37 703	51	9.38 972	54	0.61 028	9.98 731	3	13	
48	9.37 755	52	9.39 027	55	0.60 973	9.98 728	3	12	
49	9.37 806	51	9.39 082	55	0.60 918	9.98 725	3	11	
		52		54			3		
50	9.37 858		9.39 136		0.60 864	9.98 722		10	
51	9.37 909	51	9.39 190	54	0.60 810	9.98 719	3	9	
52	9.37 960	51	9.39 245	55	0.60 755	9.98 715	4	8	
53	9.38 011	51	9.39 299	54	0.60 701	9.98 712	3	7	
54	9.38 062	51	9.39 353	54	0.60 647	9.98 709	3	6	
				54			3		
55	9.38 113		9.39 407		0.60 593	9.98 706		5	
56	9.38 164	51	9.39 461	54	0.60 539	9.98 703	3	4	
57	9.38 215	51	9.39 515	54	0.60 485	9.98 700	3	3	
58	9.38 266	51	9.39 569	54	0.60 431	9.98 697	3	2	
59	9.38 317	51	9.39 623	54	0.60 377	9.98 694	3	1	
		51		54			4		
60	9.38 368		9.39 677		0.60 323	9.98 690		0	
	L Cos	d	L Ctn	c d	L Tan	L Sin	d		′

Proportional parts

″	57	56	55
1	1.0	0.9	0.9
2	1.9	1.9	1.8
3	2.8	2.8	2.8
4	3.8	3.7	3.7
5	4.8	4.7	4.6
6	5.7	5.6	5.5
7	6.6	6.5	6.4
8	7.6	7.5	7.3
9	8.6	8.4	8.2
10	9.5	9.3	9.2
20	19.0	18.7	18.3
30	28.5	28.0	27.5
40	38.0	37.3	36.7
50	47.5	46.7	45.8

″	54	53	52
1	0.9	0.9	0.9
2	1.8	1.8	1.7
3	2.7	2.6	2.6
4	3.6	3.5	3.5
5	4.5	4.4	4.3
6	5.4	5.3	5.2
7	6.3	6.2	6.1
8	7.2	7.1	6.9
9	8.1	8.0	7.8
10	9.0	8.8	8.7
20	18.0	17.7	17.3
30	27.0	26.5	26.0
40	36.0	35.3	34.7
50	45.0	44.2	43.3

″	51	4	3	2
1	0.8	0.1	0.0	0.0
2	1.7	0.1	0.1	0.1
3	2.6	0.2	0.2	0.1
4	3.4	0.3	0.2	0.1
5	4.2	0.3	0.2	0.2
6	5.1	0.4	0.3	0.2
7	6.0	0.5	0.4	0.2
8	6.8	0.5	0.4	0.3
9	7.6	0.6	0.4	0.3
10	8.5	0.7	0.5	0.3
20	17.0	1.3	1.0	0.7
30	25.5	2.0	1.5	1.0
40	34.0	2.7	2.0	1.3
50	42.5	3.3	2.5	1.7

Proportional parts

14°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		Proportional parts
0	9.38 366	50	9.39 677	54	0.60 323	9.98 690	3	60	
1	9.38 418	51	9.39 731	54	0.60 269	9.98 687	3	59	
2	9.38 469	50	9.39 785	53	0.60 215	9.98 684	3	58	
3	9.38 519	51	9.39 838	54	0.60 162	9.98 681	3	57	
4	9.38 570	50	9.39 892	53	0.60 108	9.98 678	3	56	
5	9.38 620	50	9.39 945	54	0.60 055	9.98 675	4	55	
6	9.38 670	51	9.39 999	53	0.60 001	9.98 671	3	54	
7	9.38 721	50	9.40 052	54	0.59 948	9.98 668	3	53	
8	9.38 771	50	9.40 106	53	0.59 894	9.98 665	3	52	
9	9.38 821	50	9.40 159	53	0.59 841	9.98 662	3	51	
10	9.38 871	50	9.40 212	54	0.59 788	9.98 659	3	50	
11	9.38 921	50	9.40 266	53	0.59 734	9.98 656	4	49	
12	9.38 971	50	9.40 319	53	0.59 681	9.98 652	3	48	
13	9.39 021	50	9.40 372	53	0.59 628	9.98 649	3	47	
14	9.39 071	50	9.40 425	53	0.59 575	9.98 646	3	46	
15	9.39 121	49	9.40 478	53	0.59 522	9.98 643	3	45	
16	9.39 170	50	9.40 531	53	0.59 469	9.98 640	4	44	
17	9.39 220	50	9.40 584	52	0.59 416	9.98 636	3	43	
18	9.39 270	49	9.40 636	53	0.59 364	9.98 633	3	42	
19	9.39 319	50	9.40 689	53	0.59 311	9.98 630	3	41	
20	9.39 369	49	9.40 742	53	0.59 258	9.98 627	4	40	
21	9.39 418	49	9.40 795	52	0.59 205	9.98 623	3	39	
22	9.39 467	50	9.40 847	53	0.59 153	9.98 620	3	38	
23	9.39 517	49	9.40 900	52	0.59 100	9.98 617	3	37	
24	9.39 566	49	9.40 952	53	0.59 048	9.98 614	4	36	
25	9.39 615	49	9.41 005	52	0.58 995	9.98 610	3	35	
26	9.39 664	49	9.41 057	52	0.58 943	9.98 607	3	34	
27	9.39 713	49	9.41 109	52	0.58 891	9.98 604	3	33	
28	9.39 762	49	9.41 161	53	0.58 839	9.98 601	4	32	
29	9.39 811	49	9.41 214	52	0.58 786	9.98 597	3	31	
30	9.39 860	49	9.41 266	52	0.58 734	9.98 594	3	30	
31	9.39 909	49	9.41 318	52	0.58 682	9.98 591	3	29	
32	9.39 958	48	9.41 370	52	0.58 630	9.98 588	4	28	
33	9.40 006	49	9.41 422	52	0.58 578	9.98 584	3	27	
34	9.40 055	48	9.41 474	52	0.58 526	9.98 581	3	26	
35	9.40 103	49	9.41 526	52	0.58 474	9.98 578	4	25	
36	9.40 152	48	9.41 578	51	0.58 422	9.98 574	3	24	
37	9.40 200	49	9.41 629	52	0.58 371	9.98 571	3	23	
38	9.40 249	48	9.41 681	52	0.58 319	9.98 568	3	22	
39	9.40 297	49	9.41 733	51	0.58 267	9.98 565	4	21	
40	9.40 346	48	9.41 784	52	0.58 216	9.98 561	3	20	
41	9.40 394	48	9.41 836	51	0.58 164	9.98 558	3	19	
42	9.40 442	48	9.41 887	52	0.58 113	9.98 555	4	18	
43	9.40 490	48	9.41 939	51	0.58 061	9.98 551	3	17	
44	9.40 538	48	9.41 990	51	0.58 010	9.98 548	3	16	
45	9.40 586	48	9.42 041	52	0.57 959	9.98 545	4	15	
46	9.40 634	48	9.42 093	51	0.57 907	9.98 541	3	14	
47	9.40 682	48	9.42 144	51	0.57 856	9.98 538	3	13	
48	9.40 730	48	9.42 195	51	0.57 805	9.98 535	4	12	
49	9.40 778	47	9.42 246	51	0.57 754	9.98 531	3	11	
50	9.40 825	48	9.42 297	51	0.57 703	9.98 528	3	10	
51	9.40 873	48	9.42 348	51	0.57 652	9.98 525	4	9	
52	9.40 921	47	9.42 399	51	0.57 601	9.98 521	3	8	
53	9.40 968	48	9.42 450	51	0.57 550	9.98 518	3	7	
54	9.41 016	47	9.42 501	51	0.57 499	9.98 515	4	6	
55	9.41 063	48	9.42 552	51	0.57 448	9.98 511	3	5	
56	9.41 111	47	9.42 603	50	0.57 397	9.98 508	3	4	
57	9.41 158	47	9.42 653	51	0.57 347	9.98 505	4	3	
58	9.41 205	47	9.42 704	51	0.57 296	9.98 501	3	2	
59	9.41 252	48	9.42 755	50	0.57 245	9.98 498	4	1	
60	9.41 300		9.42 805		0.57 195	9.98 494		0	
—	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′	Proportional parts

″	54	53	52
1	0.9	0.9	0.9
2	1.8	1.8	1.7
3	2.7	2.6	2.6
4	3.6	3.5	3.5
5	4.5	4.4	4.3
6	5.4	5.3	5.2
7	6.3	6.2	6.1
8	7.2	7.1	6.9
9	8.1	8.0	7.8
10	9.0	8.8	8.7
20	18.0	17.7	17.3
30	27.0	26.5	26.0
40	36.0	35.3	34.7
50	45.0	44.2	43.3

″	51	50	49
1	0.8	0.8	0.8
2	1.7	1.7	1.6
3	2.6	2.5	2.4
4	3.4	3.3	3.3
5	4.2	4.2	4.1
6	5.1	5.0	4.9
7	6.0	5.8	5.7
8	6.8	6.7	6.5
9	7.6	7.5	7.4
10	8.5	8.3	8.2
20	17.0	16.7	16.3
30	25.5	25.0	24.5
40	34.0	33.3	32.7
50	42.5	41.7	40.8

″	48	47	4	3
1	0.8	0.8	0.1	0.0
2	1.6	1.6	0.1	0.1
3	2.4	2.4	0.2	0.2
4	3.2	3.1	0.3	0.2
5	4.0	3.9	0.3	0.2
6	4.8	4.7	0.4	0.3
7	5.6	5.5	0.5	0.4
8	6.4	6.3	0.5	0.4
9	7.2	7.0	0.6	0.4
10	8.0	7.8	0.7	0.5
20	16.0	15.7	1.3	1.0
30	24.0	23.5	2.0	1.5
40	32.0	31.3	2.7	2.0
50	40.0	39.2	3.3	2.5

15°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		′
0	9.41 300	47	9.42 805	51	0.57 195	9.98 494	3	60	0
1	9.41 347	47	9.42 856	50	0.57 144	9.98 491	3	59	1
2	9.41 394	47	9.42 906	51	0.57 094	9.98 488	4	58	2
3	9.41 441	47	9.42 957	50	0.57 043	9.98 484	3	57	3
4	9.41 488	47	9.43 007	50	0.56 993	9.98 481	4	56	4
5	9.41 535	47	9.43 057	51	0.56 943	9.98 477	3	55	5
6	9.41 582	46	9.43 108	50	0.56 892	9.98 474	3	54	6
7	9.41 628	47	9.43 158	50	0.56 842	9.98 471	4	53	7
8	9.41 675	47	9.43 208	50	0.56 792	9.98 467	3	52	8
9	9.41 722	46	9.43 258	50	0.56 742	9.98 464	4	51	9
10	9.41 768	47	9.43 308	50	0.56 692	9.98 460	3	50	10
11	9.41 815	46	9.43 358	50	0.56 642	9.98 457	4	49	11
12	9.41 861	47	9.43 408	50	0.56 592	9.98 453	3	48	12
13	9.41 908	46	9.43 458	50	0.56 542	9.98 450	3	47	13
14	9.41 954	47	9.43 508	50	0.56 492	9.98 447	4	46	14
15	9.42 001	46	9.43 558	49	0.56 442	9.98 443	3	45	15
16	9.42 047	46	9.43 607	50	0.56 393	9.98 440	4	44	16
17	9.42 093	47	9.43 657	50	0.56 343	9.98 436	3	43	17
18	9.42 140	46	9.43 707	49	0.56 293	9.98 433	4	42	18
19	9.42 186	46	9.43 756	50	0.56 244	9.98 429	3	41	19
20	9.42 232	46	9.43 806	49	0.56 194	9.98 426	4	40	20
21	9.42 278	46	9.43 855	50	0.56 145	9.98 422	3	39	21
22	9.42 324	46	9.43 905	49	0.56 095	9.98 419	4	38	22
23	9.42 370	46	9.43 954	50	0.56 046	9.98 415	3	37	23
24	9.42 416	45	9.44 004	49	0.55 996	9.98 412	3	36	24
25	9.42 461	46	9.44 053	49	0.55 947	9.98 409	4	35	25
26	9.42 507	46	9.44 102	49	0.55 898	9.98 405	3	34	26
27	9.42 553	46	9.44 151	50	0.55 849	9.98 402	4	33	27
28	9.42 599	45	9.44 201	49	0.55 799	9.98 398	3	32	28
29	9.42 644	46	9.44 250	49	0.55 750	9.98 395	4	31	29
30	9.42 690	45	9.44 299	49	0.55 701	9.98 391	3	30	30
31	9.42 735	46	9.44 348	49	0.55 652	9.98 388	4	29	31
32	9.42 781	45	9.44 397	49	0.55 603	9.98 384	3	28	32
33	9.42 826	46	9.44 446	49	0.55 554	9.98 381	4	27	33
34	9.42 872	45	9.44 495	49	0.55 505	9.98 377	4	26	34
35	9.42 917	45	9.44 544	48	0.55 456	9.98 373	3	25	35
36	9.42 962	46	9.44 592	49	0.55 408	9.98 370	4	24	36
37	9.43 008	45	9.44 641	49	0.55 359	9.98 366	3	23	37
38	9.43 053	45	9.44 690	48	0.55 310	9.98 363	4	22	38
39	9.43 098	45	9.44 738	49	0.55 262	9.98 359	3	21	39
40	9.43 143	45	9.44 787	49	0.55 213	9.98 356	4	20	40
41	9.43 188	45	9.44 836	48	0.55 164	9.98 352	3	19	41
42	9.43 233	45	9.44 884	49	0.55 116	9.98 349	4	18	42
43	9.43 278	45	9.44 933	48	0.55 067	9.98 345	3	17	43
44	9.43 323	44	9.44 981	48	0.55 019	9.98 342	4	16	44
45	9.43 367	45	9.45 029	49	0.54 971	9.98 338	4	15	45
46	9.43 412	45	9.45 078	48	0.54 922	9.98 334	3	14	46
47	9.43 457	45	9.45 126	48	0.54 874	9.98 331	4	13	47
48	9.43 502	44	9.45 174	48	0.54 826	9.98 327	3	12	48
49	9.43 546	45	9.45 222	49	0.54 778	9.98 324	4	11	49
50	9.43 591	44	9.45 271	48	0.54 729	9.98 320	3	10	50
51	9.43 635	45	9.45 319	48	0 54 681	9.98 317	4	9	51
52	9.43 680	44	9.45 367	48	0.54 633	9.98 313	4	8	52
53	9.43 724	45	9.45 415	48	0.54 585	9.98 309	3	7	53
54	9.43 769	44	9.45 463	48	0.54 537	9.98 306	4	6	54
55	9.43 813	44	9.45 511	48	0.54 489	9.98 302	3	5	55
56	9.43 857	44	9.45 559	47	0.54 441	9.98 299	4	4	56
57	9.43 901	45	9.45 606	48	0.54 394	9.98 295	4	3	57
58	9.43 946	44	9.45 654	48	0.54 346	9.98 291	3	2	58
59	9.43 990	44	9.45 702	48	0.54 298	9.98 288	4	1	59
60	9.44 034		9.45 750		0.54 250	9.98 284		0	60
′	L Cos	d	L Ctn	c d	L Tan	L Sin	d		′

Proportional parts

″	51	50	49
1	0.8	0.8	0.8
2	1.7	1.7	1.6
3	2.6	2.5	2.4
4	3.4	3.3	3.3
5	4.2	4.2	4.1
6	5.1	5.0	4.9
7	6.0	5.8	5.7
8	6.8	6.7	6.5
9	7.6	7.5	7.4
10	8.5	8.3	8.2
20	17.0	16.7	16.3
30	25.5	25.0	24.5
40	34.0	33.3	32.7
50	42.5	41.7	40.8

″	48	47	46
1	0.8	0.8	0.8
2	1.6	1.6	1.5
3	2.4	2.4	2.3
4	3.2	3.1	3.1
5	4.0	3.9	3.8
6	4.8	4.7	4.6
7	5.6	5.5	5.4
8	6.4	6.3	6.1
9	7.2	7.0	6.9
10	8.0	7.8	7.7
20	16.0	15.7	15.3
30	24.0	23.5	23.0
40	32.0	31.3	30.7
50	40.0	39.2	38.3

″	45	44	4	3
1	0.8	0.7	0.1	0.0
2	1.5	1.5	0.1	0.1
3	2.2	2.2	0.2	0.2
4	3.0	2.9	0.3	0.2
5	3.8	3.7	0.3	0.2
6	4.5	4.4	0.4	0.3
7	5.2	5.1	0.5	0.4
8	6.0	5.9	0.5	0.4
9	6.8	6.6	0.6	0.4
10	7.5	7.3	0.7	0.5
20	15.0	14.7	1.3	1.0
30	22.5	22.0	2.0	1.5
40	30.0	29.3	2.7	2.0
50	37.5	36.7	3.3	2.5

16°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.44 034	44	9.45 750	47	0.54 250	9.98 284	3	60
1	9.44 078	44	9.45 797	48	0.54 203	9.98 281	4	59
2	9.44 122	44	9.45 845	47	0.54 155	9.98 277	4	58
3	9.44 166	44	9.45 892	48	0.54 108	9.98 273	3	57
4	9.44 210	43	9.45 940	47	0.54 060	9.98 270	4	56
5	9.44 253	44	9.45 987	48	0.54 013	9.98 266	4	55
6	9.44 297	44	9.46 035	47	0.53 965	9.98 262	3	54
7	9.44 341	44	9.46 082	48	0.53 918	9.98 259	4	53
8	9.44 385	43	9.46 130	47	0.53 870	9.98 255	4	52
9	9.44 428	44	9.46 177	47	0.53 823	9.98 251	3	51
10	9.44 472	44	9.46 224	47	0.53 776	9.98 248	4	50
11	9.44 516	43	9.46 271	48	0.53 729	9.98 244	4	49
12	9.44 559	43	9.46 319	47	0.53 681	9.98 240	4	48
13	9.44 602	44	9.46 366	47	0.53 634	9.98 237	3	47
14	9.44 646	43	9.46 413	47	0.53 587	9.98 233	4	46
15	9.44 689	44	9.46 460	47	0.53 540	9.98 229	4	45
16	9.44 733	43	9.46 507	47	0.53 493	9.98 226	3	44
17	9.44 776	43	9.46 554	47	0.53 446	9.98 222	4	43
18	9.44 819	43	9.46 601	47	0.53 399	9.98 218	4	42
19	9.44 862	43	9.46 648	46	0.53 352	9.98 215	3	41
20	9.44 905	43	9.46 694	47	0.53 306	9.98 211	4	40
21	9.44 948	44	9.46 741	47	0.53 259	9.98 207	4	39
22	9.44 992	43	9.46 788	47	0.53 212	9.98 204	3	38
23	9.45 035	42	9.46 835	46	0.53 165	9.98 200	4	37
24	9.45 077	43	9.46 881	47	0.53 119	9.98 196	4	36
25	9.45 120	43	9.46 928	47	0.53 072	9.98 192	4	35
26	9.45 163	43	9.46 975	46	0.53 025	9.98 189	3	34
27	9.45 206	43	9.47 021	47	0.52 979	9.98 185	4	33
28	9.45 249	43	9.47 068	46	0.52 932	9.98 181	4	32
29	9.45 292	42	9.47 114	46	0.52 886	9.98 177	4	31
30	9.45 334	43	9.47 160	47	0.52 840	9.98 174	3	30
31	9.45 377	42	9.47 207	46	0.52 793	9.98 170	4	29
32	9.45 419	43	9.47 253	46	0.52 747	9.98 166	4	28
33	9.45 462	42	9.47 299	46	0.52 701	9.98 162	4	27
34	9.45 504	43	9.47 346	47	0.52 654	9.98 159	3	26
35	9.45 547	42	9.47 392	46	0.52 608	9.98 155	4	25
36	9.45 589	43	9.47 438	46	0.52 562	9.98 151	4	24
37	9.45 632	42	9.47 484	46	0.52 516	9.98 147	4	23
38	9.45 674	42	9.47 530	46	0.52 470	9.98 144	3	22
39	9.45 716	42	9.47 576	46	0.52 424	9.98 140	4	21
40	9.45 758	43	9.47 622	46	0.52 378	9.98 136	4	20
41	9.45 801	42	9.47 668	46	0.52 332	9.98 132	4	19
42	9.45 843	42	9.47 714	46	0.52 286	9.98 129	3	18
43	9.45 885	42	9.47 760	46	0.52 240	9.98 125	4	17
44	9.45 927	42	9.47 806	46	0.52 194	9.98 121	4	16
45	9.45 969	42	9.47 852	46	0.52 148	9.98 117	4	15
46	9.46 011	42	9.47 897	45	0.52 103	9.98 113	4	14
47	9.46 053	42	9.47 943	46	0.52 057	9.98 110	3	13
48	9.46 095	41	9.47 989	46	0.52 011	9.98 106	4	12
49	9.46 136	42	9.48 035	46	0.51 965	9.98 102	4	11
50	9.46 178	42	9.48 080	45	0.51 920	9.98 098	4	10
51	9.46 220	42	9.48 126	46	0.51 874	9.98 094	4	9
52	9.46 262	41	9.48 171	45	0.51 829	9.98 090	4	8
53	9.46 303	42	9.48 217	46	0.51 783	9.98 087	3	7
54	9.46 345	41	9.48 262	45	0.51 738	9.98 083	4	6
55	9.46 386	42	9.48 307	45	0.51 693	9.98 079	4	5
56	9.46 428	41	9.48 353	46	0.51 647	9.98 075	4	4
57	9.46 469	42	9.48 398	45	0.51 602	9.98 071	4	3
58	9.46 511	41	9.48 443	45	0.51 557	9.98 067	4	2
59	9.46 552	42	9.48 489	46	0.51 511	9.98 063	3	1
60	9.46 594		9.48 534	45	0.51 466	9.98 060		0
—	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	48	47	46
1	0.8	0.8	0.8
2	1.6	1.6	1.5
3	2.4	2.4	2.3
4	3.2	3.1	3.1
5	4.0	3.9	3.8
6	4.8	4.7	4.6
7	5.6	5.5	5.4
8	6.4	6.3	6.1
9	7.2	7.0	6.9
10	8.0	7.8	7.7
20	16.0	15.7	15.3
30	24.0	23.5	23.0
40	32.0	31.3	30.7
50	40.0	39.2	38.3

″	45	44	43
1	0.8	0.7	0.7
2	1.5	1.5	1.4
3	2.2	2.2	2.2
4	3.0	2.9	2.9
5	3.8	3.7	3.6
6	4.5	4.4	4.3
7	5.2	5.1	5.0
8	6.0	5.9	5.7
9	6.8	6.6	6.4
10	7.5	7.3	7.2
20	15.0	14.7	14.3
30	22.5	22.0	21.5
40	30.0	29.3	28.7
50	37.5	36.7	35.8

″	42	41	4	3
1	0.7	0.7	0.1	0.0
2	1.4	1.4	0.1	0.1
3	2.1	2.0	0.2	0.2
4	2.8	2.7	0.3	0.2
5	3.5	3.4	0.3	0.2
6	4.2	4.1	0.4	0.3
7	4.9	4.8	0.5	0.4
8	5.6	5.5	0.5	0.4
9	6.3	6.2	0.6	0.4
10	7.0	6.8	0.7	0.5
20	14.0	13.7	1.3	1.0
30	21.0	20.5	2.0	1.5
40	28.0	27.3	2.7	2.0
50	35.0	34.2	3.3	2.5

Proportional parts

17°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.46 594	41	9.48 534	45	0.51 466	9.98 060	4	60
1	9.46 635	41	9.48 579	45	0.51 421	9.98 056	4	59
2	9.46 676	41	9.48 624	45	0.51 376	9.98 052	4	58
3	9.46 717	41	9.48 669	45	0.51 331	9.98 048	4	57
4	9.46 758	42	9.48 714	45	0.51 286	9.98 044	4	56
5	9.46 800	41	9.48 759	45	0.51 241	9.98 040	4	55
6	9.46 841	41	9.48 804	45	0.51 196	9.98 036	4	54
7	9.46 882	41	9.48 849	45	0.51 151	9.98 032	3	53
8	9.46 923	41	9.48 894	45	0.51 106	9.98 029	4	52
9	9.46 964	41	9.48 939	45	0.51 061	9.98 025	4	51
10	9.47 005	40	9.48 984	45	0.51 016	9.98 021	4	50
11	9.47 045	41	9.49 029	44	0.50 971	9.98 017	4	49
12	9.47 086	41	9.49 073	45	0.50 927	9.98 013	4	48
13	9.47 127	41	9.49 118	45	0.50 882	9.98 009	4	47
14	9.47 168	41	9.49 163	44	0.50 837	9.98 005	4	46
15	9.47 209	40	9.49 207	45	0.50 793	9.98 001	4	45
16	9.47 249	41	9.49 252	44	0.50 748	9.97 997	4	44
17	9.47 290	40	9.49 296	45	0.50 704	9.97 993	4	43
18	9.47 330	41	9.49 341	44	0.50 659	9.97 989	3	42
19	9.47 371	40	9.49 385	45	0.50 615	9.97 986	4	41
20	9.47 411	41	9.49 430	44	0.50 570	9.97 982	4	40
21	9.47 452	40	9.49 474	45	0.50 526	9.97 978	4	39
22	9.47 492	41	9.49 519	44	0.50 481	9.97 974	4	38
23	9.47 533	40	9.49 563	44	0.50 437	9.97 970	4	37
24	9.47 573	40	9.49 607	44	0.50 393	9.97 966	4	36
25	9.47 613	41	9.49 652	44	0.50 348	9.97 962	4	35
26	9.47 654	40	9.49 696	44	0.50 304	9.97 958	4	34
27	9.47 694	40	9.49 740	44	0.50 260	9.97 954	4	33
28	9.47 734	40	9.49 784	44	0.50 216	9.97 950	4	32
29	9.47 774	40	9.49 828	44	0.50 172	9.97 946	4	31
30	9.47 814	40	9.49 872	44	0.50 128	9.97 942	4	30
31	9.47 854	40	9.49 916	44	0.50 084	9.97 938	4	29
32	9.47 894	40	9.49 960	44	0.50 040	9.97 934	4	28
33	9.47 934	40	9.50 004	44	0.49 996	9.97 930	4	27
34	9.47 974	40	9.50 048	44	0.49 952	9.97 926	4	26
35	9.48 014	40	9.50 092	44	0.49 908	9.97 922	4	25
36	9.48 054	40	9.50 136	44	0.49 864	9.97 918	4	24
37	9.48 094	39	9.50 180	43	0.49 820	9.97 914	4	23
38	9.48 133	40	9.50 223	44	0.49 777	9.97 910	4	22
39	9.48 173	40	9.50 267	44	0.49 733	9.97 906	4	21
40	9.48 213	39	9.50 311	44	0.49 689	9.97 902	4	20
41	9.48 252	40	9.50 355	43	0.49 645	9.97 898	4	19
42	9.48 292	40	9.50 398	44	0.49 602	9.97 894	4	18
43	9.48 332	39	9.50 442	43	0.49 558	9.97 890	4	17
44	9.48 371	40	9.50 485	44	0.49 515	9.97 886	4	16
45	9.48 411	39	9.50 529	43	0.49 471	9.97 882	4	15
46	9.48 450	40	9.50 572	44	0.49 428	9.97 878	4	14
47	9.48 490	39	9.50 616	43	0.49 384	9.97 874	4	13
48	9.48 529	39	9.50 659	44	0.49 341	9.97 870	4	12
49	9.48 568	39	9.50 703	43	0.49 297	9.97 866	5	11
50	9.48 607	40	9.50 746	43	0.49 254	9.97 861	4	10
51	9.48 647	39	9.50 789	44	0.49 211	9.97 857	4	9
52	9.48 686	39	9.50 833	43	0.49 167	9.97 853	4	8
53	9.48 725	39	9.50 876	43	0.49 124	9.97 849	4	7
54	9.48 764	39	9.50 919	43	0.49 081	9.97 845	4	6
55	9.48 803	39	9.50 962	43	0.49 038	9.97 841	4	5
56	9.48 842	39	9.51 005	43	0.48 995	9.97 837	4	4
57	9.48 881	39	9.51 048	44	0.48 952	9.97 833	4	3
58	9.48 920	39	9.51 092	43	0.48 908	9.97 829	4	2
59	9.48 959	39	9.51 135	43	0.48 865	9.97 825	4	1
60	9.48 998		9.51 178		0.48 822	9.97 821		0
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	45	44	43
1	0.8	0.7	0.7
2	1.5	1.5	1.4
3	2.2	2.2	2.2
4	3.0	2.9	2.9
5	3.8	3.7	3.6
6	4.5	4.4	4.3
7	5.2	5.1	5.0
8	6.0	5.9	5.7
9	6.8	6.6	6.4
10	7.5	7.3	7.2
20	15.0	14.7	14.3
30	22.5	22.0	21.5
40	30.0	29.3	28.7
50	37.5	36.7	35.8

″	42	41	40
1	0.7	0.7	0.7
2	1.4	1.4	1.3
3	2.1	2.0	2.0
4	2.8	2.7	2.7
5	3.5	3.4	3.3
6	4.2	4.1	4.0
7	4.9	4.8	4.7
8	5.6	5.5	5.3
9	6.3	6.2	6.0
10	7.0	6.8	6.7
20	14.0	13.7	13.3
30	21.0	20.5	20.0
40	28.0	27.3	26.7
50	35.0	34.2	33.3

″	39	5	4	3
1	0.6	0.1	0.1	0.0
2	1.3	0.2	0.1	0.1
3	2.0	0.2	0.2	0.2
4	2.6	0.3	0.3	0.2
5	3.2	0.4	0.3	0.2
6	3.9	0.5	0.4	0.3
7	4.6	0.6	0.5	0.4
8	5.2	0.7	0.5	0.4
9	5.8	0.8	0.6	0.4
10	6.5	0.8	0.7	0.5
20	13.0	1.7	1.3	1.0
30	19.5	2.5	2.0	1.5
40	26.0	3.3	2.7	2.0
50	32.5	4.2	3.3	2.5

Proportional parts

18°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		′
0	9.48 998	39	9.51 178	43	0.48 822	9.97 821	4	60	
1	9.49 037	39	9.51 221	43	0.48 779	9.97 817	5	59	
2	9.49 076	39	9.51 264	42	0.48 736	9.97 812	4	58	
3	9.49 115	38	9.51 306	43	0.48 694	9.97 808	4	57	
4	9.49 153	39	9.51 349	43	0.48 651	9.97 804	4	56	
5	9.49 192	39	9.51 392	43	0.48 608	9.97 800	4	55	
6	9.49 231	38	9.51 435	43	0.48 565	9.97 796	4	54	
7	9.49 269	39	9.51 478	42	0.48 522	9.97 792	4	53	
8	9.49 308	39	9.51 520	43	0.48 480	9.97 788	4	52	
9	9.49 347	38	9.51 563	43	0.48 437	9.97 784	5	51	
10	9.49 385	39	9.51 606	42	0.48 394	9.97 779	4	50	
11	9.49 424	38	9.51 648	43	0.48 352	9.97 775	4	49	
12	9.49 462	38	9.51 691	43	0.48 309	9.97 771	4	48	
13	9.49 500	39	9.51 734	42	0.48 266	9.97 767	4	47	
14	9.49 539	38	9.51 776	43	0.48 224	9.97 763	4	46	
15	9.49 577	38	9.51 819	42	0.48 181	9.97 759	5	45	
16	9.49 615	39	9.51 861	42	0.48 139	9.97 754	4	44	
17	9.49 654	38	9.51 903	43	0.48 097	9.97 750	4	43	
18	9.49 692	38	9.51 946	42	0.48 054	9.97 746	4	42	
19	9.49 730	38	9.51 988	43	0.48 012	9.97 742	4	41	
20	9.49 768	38	9.52 031	42	0.47 969	9.97 738	4	40	
21	9.49 806	38	9.52 073	42	0.47 927	9.97 734	5	39	
22	9.49 844	38	9.52 115	42	0.47 885	9.97 729	4	38	
23	9.49 882	38	9.52 157	43	0.47 843	9.97 725	4	37	
24	9.49 920	38	9.52 200	42	0.47 800	9.97 721	4	36	
25	9.49 958	38	9.52 242	42	0.47 758	9.97 717	4	35	
26	9.49 996	38	9.52 284	42	0.47 716	9.97 713	5	34	
27	9.50 034	38	9.52 326	42	0.47 674	9.97 708	4	33	
28	9.50 072	38	9.52 368	42	0.47 632	9.97 704	4	32	
29	9.50 110	38	9.52 410	42	0.47 590	9.97 700	4	31	
30	9.50 148	37	9.52 452	42	0.47 548	9.97 696	5	30	
31	9.50 185	38	9.52 494	42	0.47 506	9.97 691	4	29	
32	9.50 223	38	9.52 536	42	0.47 464	9.97 687	4	28	
33	9.50 261	37	9.52 578	42	0.47 422	9.97 683	4	27	
34	9.50 298	38	9.52 620	41	0.47 380	9.97 679	5	26	
35	9.50 336	38	9.52 661	42	0.47 339	9.97 674	4	25	
36	9.50 374	37	9.52 703	42	0.47 297	9.97 670	4	24	
37	9.50 411	38	9.52 745	42	0.47 255	9.97 666	4	23	
38	9.50 449	37	9.52 787	42	0.47 213	9.97 662	5	22	
39	9.50 486	37	9.52 829	41	0.47 171	9.97 657	4	21	
40	9.50 523	38	9.52 870	42	0.47 130	9.97 653	4	20	
41	9.50 561	37	9.52 912	41	0.47 088	9.97 649	4	19	
42	9.50 598	37	9.52 953	42	0.47 047	9.97 645	5	18	
43	9.50 635	38	9.52 995	42	0.47 005	9.97 640	4	17	
44	9.50 673	37	9.53 037	41	0.46 963	9.97 636	4	16	
45	9.50 710	37	9.53 078	42	0.46 922	9.97 632	4	15	
46	9.50 747	37	9.53 120	41	0.46 880	9.97 628	5	14	
47	9.50 784	37	9.53 161	41	0.46 839	9.97 623	4	13	
48	9.50 821	37	9.53 202	42	0.46 798	9.97 619	4	12	
49	9.50 858	38	9.53 244	41	0.46 756	9.97 615	5	11	
50	9.50 896	37	9.53 285	42	0.46 715	9.97 610	4	10	
51	9.50 933	37	9.53 327	41	0.46 673	9.97 606	4	9	
52	9.50 970	37	9.53 368	41	0.46 632	9.97 602	5	8	
53	9.51 007	36	9.53 409	41	0.46 591	9.97 597	4	7	
54	9.51 043	37	9.53 450	42	0.46 550	9.97 593	4	6	
55	9.51 080	37	9.53 492	41	0.46 508	9.97 589	5	5	
56	9.51 117	37	9.53 533	41	0.46 467	9.97 584	4	4	
57	9.51 154	37	9.53 574	41	0.46 426	9.97 580	4	3	
58	9.51 191	36	9.53 615	41	0.46 385	9.97 576	5	2	
59	9.51 227	37	9.53 656	41	0.46 344	9.97 571	4	1	
60	9.51 264		9.53 697		0.46 303	9.97 567		0	
′	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′	

Proportional parts

″	43	42	41
1	0.7	0.7	0.7
2	1.4	1.4	1.4
3	2.2	2.1	2.0
4	2.9	2.8	2.7
5	3.6	3.5	3.4
6	4.3	4.2	4.1
7	5.0	4.9	4.8
8	5.7	5.6	5.5
9	6.4	6.3	6.2
10	7.2	7.0	6.8
20	14.3	14.0	13.7
30	21.5	21.0	20.5
40	28.7	28.0	27.3
50	35.8	35.0	34.2

″	39	38	37
1	0.6	0.6	0.6
2	1.3	1.3	1.2
3	2.0	1.9	1.8
4	2.6	2.5	2.5
5	3.2	3.2	3.1
6	3.9	3.8	3.7
7	4.6	4.4	4.3
8	5.2	5.1	4.9
9	5.8	5.7	5.6
10	6.5	6.3	6.2
20	13.0	12.7	12.3
30	19.5	19.0	18.5
40	26.0	25.3	24.7
50	32.5	31.7	30.8

″	36	5	4
1	0.6	0.1	0.1
2	1.2	0.2	0.1
3	1.8	0.2	0.2
4	2.4	0.3	0.3
5	3.0	0.4	0.3
6	3.6	0.5	0.4
7	4.2	0.6	0.5
8	4.8	0.7	0.5
9	5.4	0.8	0.6
10	6.0	0.8	0.7
20	12.0	1.7	1.3
30	18.0	2.5	2.0
40	24.0	3.3	2.7
50	30.0	4.2	3.3

19°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		′
0	9.51 264	37	9.53 697	41	0.46 303	9.97 567	4	60	
1	9.51 301	37	9.53 738	41	0.46 262	9.97 563	5	59	
2	9.51 338	36	9.53 779	41	0.46 221	9.97 558	4	58	
3	9.51 374	37	9.53 820	41	0.46 180	9.97 554	4	57	
4	9.51 411	36	9.53 861	41	0.46 139	9.97 550	5	56	
5	9.51 447	37	9.53 902	41	0.46 098	9.97 545	4	55	
6	9.51 484	36	9.53 943	41	0.46 057	9.97 541	5	54	
7	9.51 520	37	9.53 984	41	0.46 016	9.97 536	4	53	
8	9.51 557	36	9.54 025	40	0.45 975	9.97 532	4	52	
9	9.51 593	36	9.54 065	41	0.45 935	9.97 528	5	51	
10	9.51 629	37	9.54 106	41	0.45 894	9.97 523	4	50	
11	9.51 666	36	9.54 147	40	0.45 853	9.97 519	4	49	
12	9.51 702	36	9.54 187	41	0.45 813	9.97 515	5	48	
13	9.51 738	36	9.54 228	41	0.45 772	9.97 510	4	47	
14	9.51 774	37	9.54 269	40	0.45 731	9.97 506	5	46	
15	9.51 811	36	9.54 309	41	0.45 691	9.97 501	4	45	
16	9.51 847	36	9.54 350	40	0.45 650	9.97 497	5	44	
17	9.51 883	36	9.54 390	41	0.45 610	9.97 492	4	43	
18	9.51 919	36	9.54 431	40	0.45 569	9.97 488	4	42	
19	9.51 955	36	9.54 471	41	0.45 529	9.97 484	5	41	
20	9.51 991	36	9.54 512	40	0.45 488	9.97 479	4	40	
21	9.52 027	36	9.54 552	41	0.45 448	9.97 475	5	39	
22	9.52 063	36	9.54 593	40	0.45 407	9.97 470	4	38	
23	9.52 099	36	9.54 633	40	0.45 367	9.97 466	5	37	
24	9.52 135	36	9.54 673	41	0.45 327	9.97 461	4	36	
25	9.52 171	36	9.54 714	40	0.45 286	9.97 457	4	35	
26	9.52 207	35	9.54 754	40	0.45 246	9.97 453	5	34	
27	9.52 242	36	9.54 794	41	0.45 206	9.97 448	4	33	
28	9.52 278	36	9.54 835	40	0.45 165	9.97 444	5	32	
29	9.52 314	36	9.54 875	40	0.45 125	9.97 439	4	31	
30	9.52 350	35	9.54 915	40	0.45 085	9.97 435	5	30	
31	9.52 385	36	9.54 955	40	0.45 045	9.97 430	4	29	
32	9.52 421	35	9.54 995	40	0.45 005	9.97 426	5	28	
33	9.52 456	36	9.55 035	40	0.44 965	9.97 421	4	27	
34	9.52 492	35	9.55 075	40	0.44 925	9.97 417	5	26	
35	9.52 527	36	9.55 115	40	0.44 885	9.97 412	4	25	
36	9.52 563	35	9.55 155	40	0.44 845	9.97 408	5	24	
37	9.52 598	36	9.55 195	40	0.44 805	9.97 403	4	23	
38	9.52 634	35	9.55 235	40	0.44 765	9.97 399	5	22	
39	9.52 669	36	9.55 275	40	0.44 725	9.97 394	4	21	
40	9.52 705	35	9.55 315	40	0.44 685	9.97 390	5	20	
41	9.52 740	35	9.55 355	40	0.44 645	9.97 385	4	19	
42	9.52 775	36	9.55 395	40	0.44 605	9.97 381	5	18	
43	9.52 811	35	9.55 434	39	0.44 566	9.97 376	4	17	
44	9.52 846	35	9.55 474	40	0.44 526	9.97 372	5	16	
45	9.52 881	35	9.55 514	40	0.44 486	9.97 367	4	15	
46	9.52 916	35	9.55 554	39	0.44 446	9.97 363	5	14	
47	9.52 951	35	9.55 593	40	0.44 407	9.97 358	5	13	
48	9.52 986	35	9.55 633	40	0.44 367	9.97 353	4	12	
49	9.53 021	35	9.55 673	39	0.44 327	9.97 349	5	11	
50	9.53 056	36	9.55 712	40	0.44 288	9.97 344	4	10	
51	9.53 092	34	9.55 752	39	0.44 248	9.97 340	5	9	
52	9.53 126	35	9.55 791	40	0.44 209	9.97 335	4	8	
53	9.53 161	35	9.55 831	39	0.44 169	9.97 331	5	7	
54	9.53 196	35	9.55 870	40	0.44 130	9.97 326	4	6	
55	9.53 231	35	9.55 910	39	0.44 090	9.97 322	5	5	
56	9.53 266	35	9.55 949	40	0.44 051	9.97 317	5	4	
57	9.53 301	35	9.55 989	39	0.44 011	9.97 312	4	3	
58	9.53 336	34	9.56 028	39	0.43 972	9.97 308	5	2	
59	9.53 370	35	9.56 067	40	0.43 933	9.97 303	4	1	
60	9.53 405		9.56 107		0.43 893	9.97 299		0	
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′	

Proportional parts

″	41	40	39
1	0.7	0.7	0.6
2	1.4	1.3	1.3
3	2.0	2.0	2.0
4	2.7	2.7	2.6
5	3.4	3.3	3.2
6	4.1	4.0	3.9
7	4.8	4.7	4.6
8	5.5	5.3	5.2
9	6.2	6.0	5.8
10	6.8	6.7	6.5
20	13.7	13.3	13.0
30	20.5	20.0	19.5
40	27.3	26.7	26.0
50	34.2	33.3	32.5

″	37	36	35
1	0.6	0.6	0.6
2	1.2	1.2	1.2
3	1.8	1.8	1.8
4	2.5	2.4	2.3
5	3.1	3.0	2.9
6	3.7	3.6	3.5
7	4.3	4.2	4.1
8	4.9	4.8	4.7
9	5.6	5.4	5.2
10	6.2	6.0	5.8
20	12.3	12.0	11.7
30	18.5	18.0	17.5
40	24.7	24.0	23.3
50	30.8	30.0	29.2

″	34	5	4
1	0.6	0.1	0.1
2	1.1	0.2	0.1
3	1.7	0.2	0.2
4	2.3	0.3	0.3
5	2.8	0.4	0.3
6	3.4	0.5	0.4
7	4.0	0.6	0.5
8	4.5	0.7	0.5
9	5.1	0.8	0.6
10	5.7	0.8	0.7
20	11.3	1.7	1.3
30	17.0	2.5	2.0
40	22.7	3.3	2.7
50	28.3	4.2	3.3

Proportional parts

20°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	′
0	9.53 405	35	9.56 107	39	0.43 893	9.97 299	5	60
1	9.53 440	35	9.56 146	39	0.43 854	9.97 294	5	59
2	9.53 475	34	9.56 185	39	0.43 815	9.97 289	4	58
3	9.53 509	35	9.56 224	40	0.43 776	9.97 285	5	57
4	9.53 544	34	9.56 264	39	0.43 736	9.97 280	4	56
5	9.53 578	35	9.56 303	39	0.43 697	9.97 276	5	55
6	9.53 613	34	9.56 342	39	0.43 658	9.97 271	5	54
7	9.53 647	35	9.56 381	39	0.43 619	9.97 266	4	53
8	9.53 682	34	9.56 420	39	0.43 580	9.97 262	5	52
9	9.53 716	35	9.56 459	39	0.43 541	9.97 257	5	51
10	9.53 751	34	9.56 498	39	0.43 502	9.97 252	4	50
11	9.53 785	34	9.56 537	39	0.43 463	9.97 248	5	49
12	9.53 819	35	9.56 576	39	0.43 424	9.97 243	5	48
13	9.53 854	34	9.56 615	39	0.43 385	9.97 238	4	47
14	9.53 888	34	9.56 654	39	0.43 346	9.97 234	5	46
15	9.53 922	35	9.56 693	39	0.43 307	9.97 229	5	45
16	9.53 957	34	9.56 732	39	0.43 268	9.97 224	4	44
17	9.53 991	34	9.56 771	39	0.43 229	9.97 220	5	43
18	9.54 025	34	9.56 810	39	0.43 190	9.97 215	5	42
19	9.54 059	34	9.56 849	38	0.43 151	9.97 210	4	41
20	9.54 093	34	9.56 887	39	0.43 113	9.97 206	5	40
21	9.54 127	34	9.56 926	39	0.43 074	9.97 201	5	39
22	9.54 161	34	9.56 965	39	0.43 035	9.97 196	5	38
23	9.54 195	34	9.57 004	39	0.42 996	9.97 192	4	37
24	9.54 229	34	9.57 042	38	0.42 958	9.97 187	5	36
25	9.54 263	34	9.57 081	39	0.42 919	9.97 182	5	35
26	9.54 297	34	9.57 120	39	0.42 880	9.97 178	4	34
27	9.54 331	34	9.57 158	38	0.42 842	9.97 173	5	33
28	9.54 365	34	9.57 197	39	0.42 803	9.97 168	5	32
29	9.54 399	34	9.57 235	38	0.42 765	9.97 163	5	31
30	9.54 433	33	9.57 274	39	0.42 726	9.97 159	4	30
31	9.54 466	34	9.57 312	38	0.42 688	9.97 154	5	29
32	9.54 500	34	9.57 351	39	0.42 649	9.97 149	5	28
33	9.54 534	34	9.57 389	38	0.42 611	9.97 145	4	27
34	9.54 567	33	9.57 428	39	0.42 572	9.97 140	5	26
35	9.54 601	34	9.57 466	38	0.42 534	9.97 135	5	25
36	9.54 635	33	9.57 504	38	0.42 496	9.97 130	5	24
37	9.54 668	34	9.57 543	39	0.42 457	9.97 126	4	23
38	9.54 702	33	9.57 581	38	0.42 419	9.97 121	5	22
39	9.54 735	34	9.57 619	38	0.42 381	9.97 116	5	21
40	9.54 769	33	9.57 658	39	0.42 342	9.97 111	5	20
41	9.54 802	34	9.57 696	38	0.42 304	9.97 107	4	19
42	9.54 836	33	9.57 734	38	0.42 266	9.97 102	5	18
43	9.54 869	34	9.57 772	38	0.42 228	9.97 097	5	17
44	9.54 903	33	9.57 810	39	0.42 190	9.97 092	5	16
45	9.54 936	33	9.57 849	38	0.42 151	9.97 087	4	15
46	9.54 969	34	9.57 887	38	0.42 113	9.97 083	5	14
47	9.55 003	33	9.57 925	38	0.42 075	9.97 078	5	13
48	9.55 036	33	9.57 963	38	0.42 037	9.97 073	5	12
49	9.55 069	33	9.58 001	38	0.41 999	9.97 068	5	11
50	9.55 102	34	9.58 039	38	0.41 961	9.97 063	4	10
51	9.55 136	33	9.58 077	38	0.41 923	9.97 059	5	9
52	9.55 169	33	9.58 115	38	0.41 885	9.97 054	5	8
53	9.55 202	33	9.58 153	38	0.41 847	9.97 049	5	7
54	9.55 235	33	9.58 191	38	0.41 809	9.97 044	5	6
55	9.55 268	33	9.58 229	38	0.41 771	9.97 039	4	5
56	9.55 301	33	9.58 267	37	0.41 733	9.97 035	5	4
57	9.55 334	33	9.58 304	38	0.41 696	9.97 030	5	3
58	9.55 367	33	9.58 342	38	0.41 658	9.97 025	5	2
59	9.55 400	33	9.58 380	38	0.41 620	9.97 020	5	1
60	9.55 433		9.58 418		0.41 582	9.97 015		0
′	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	40	39	38
1	0.7	0.6	0.6
2	1.3	1.3	1.3
3	2.0	2.0	1.9
4	2.7	2.6	2.5
5	3.3	3.2	3.2
6	4.0	3.9	3.8
7	4.7	4.6	4.4
8	5.3	5.2	5.1
9	6.0	5.8	5.7
10	6.7	6.5	6.3
20	13.3	13.0	12.7
30	20.0	19.5	19.0
40	26.7	26.0	25.3
50	33.3	32.5	31.7

″	37	35	34
1	0.6	0.6	0.6
2	1.2	1.2	1.1
3	1.8	1.8	1.7
4	2.5	2.3	2.3
5	3.1	2.9	2.8
6	3.7	3.5	3.4
7	4.3	4.1	4.0
8	4.9	4.7	4.5
9	5.6	5.2	5.1
10	6.2	5.8	5.7
20	12.3	11.7	11.3
30	18.5	17.5	17.0
40	24.7	23.3	22.7
50	30.8	29.2	28.3

″	33	5	4
1	0.6	0.1	0.1
2	1.1	0.2	0.1
3	1.6	0.2	0.2
4	2.2	0.3	0.3
5	2.8	0.4	0.3
6	3.3	0.5	0.4
7	3.8	0.6	0.5
8	4.4	0.7	0.5
9	5.0	0.8	0.6
10	5.5	0.8	0.7
20	11.0	1.7	1.3
30	16.5	2.5	2.0
40	22.0	3.3	2.7
50	27.5	4.2	3.3

Proportional parts

21°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.55 433	33	9.58 418	37	0.41 582	9.97 015	5	60
1	9.55 466	33	9.58 455	38	0.41 545	9.97 010	5	59
2	9.55 499	33	9.58 493	38	0.41 507	9.97 005	4	58
3	9.55 532	32	9.58 531	38	0.41 469	9.97 001	5	57
4	9.55 564	33	9.58 569	37	0.41 431	9.96 996	5	56
5	9.55 597	33	9.58 606	38	0.41 394	9.96 991	5	55
6	9.55 630	33	9.58 644	37	0.41 356	9.96 986	5	54
7	9.55 663	32	9.58 681	38	0.41 319	9.96 981	5	53
8	9.55 695	33	9.58 719	38	0.41 281	9.96 976	5	52
9	9.55 728	33	9.58 757	37	0.41 243	9.96 971	5	51
10	9.55 761	32	9.58 794	38	0.41 206	9.96 966	4	50
11	9.55 793	33	9.58 832	37	0.41 168	9.96 962	5	49
12	9.55 826	32	9.58 869	38	0.41 131	9.96 957	5	48
13	9.55 858	33	9.58 907	37	0.41 093	9.96 952	5	47
14	9.55 891	32	9.58 944	37	0.41 056	9.96 947	5	46
15	9.55 923	33	9.58 981	38	0.41 019	9.96 942	5	45
16	9.55 956	32	9.59 019	37	0.40 981	9.96 937	5	44
17	9.55 988	33	9.59 056	38	0.40 944	9.96 932	5	43
18	9.56 021	32	9.59 094	37	0.40 906	9.96 927	5	42
19	9.56 053	32	9.59 131	37	0.40 869	9.96 922	5	41
20	9.56 085	33	9.59 168	37	0.40 832	9.96 917	5	40
21	9.56 118	32	9.59 205	38	0.40 795	9.96 912	5	39
22	9.56 150	32	9.59 243	37	0.40 757	9.96 907	5	38
23	9.56 182	33	9.59 280	37	0.40 720	9.96 903	4	37
24	9.56 215	32	9.59 317	37	0.40 683	9.96 898	5	36
25	9.56 247	32	9.59 354	37	0.40 646	9.96 893	5	35
26	9.56 279	32	9.59 391	38	0.40 609	9.96 888	5	34
27	9.56 311	32	9.59 429	37	0.40 571	9.96 883	5	33
28	9.56 343	32	9.59 466	37	0.40 534	9.96 878	5	32
29	9.56 375	33	9.59 503	37	0.40 497	9.96 873	5	31
30	9.56 408	32	9.59 540	37	0.40 460	9.96 868	5	30
31	9.56 440	32	9.59 577	37	0.40 423	9.96 863	5	29
32	9.56 472	32	9.59 614	37	0.40 386	9.96 858	5	28
33	9.56 504	32	9.59 651	37	0.40 349	9.96 853	5	27
34	9.56 536	32	9.59 688	37	0.40 312	9.96 848	5	26
35	9.56 568	31	9.59 725	37	0.40 275	9.96 843	5	25
36	9.56 599	32	9.59 762	37	0.40 238	9.96 838	5	24
37	9.56 631	32	9.59 799	36	0.40 201	9.96 833	5	23
38	9.56 663	32	9.59 835	37	0.40 165	9.96 828	5	22
39	9.56 695	32	9.59 872	37	0.40 128	9.96 823	5	21
40	9.56 727	32	9.59 909	37	0.40 091	9.96 818	5	20
41	9.56 759	31	9.59 946	37	0.40 054	9.96 813	5	19
42	9.56 790	32	9.59 983	36	0.40 017	9.96 808	5	18
43	9.56 822	32	9.60 019	37	0.39 981	9.96 803	5	17
44	9.56 854	32	9.60 056	37	0.39 944	9.96 798	5	16
45	9.56 886	31	9.60 093	37	0.39 907	9.96 793	5	15
46	9.56 917	32	9.60 130	36	0.39 870	9.96 788	5	14
47	9.56 949	31	9.60 166	37	0.39 834	9.96 783	5	13
48	9.56 980	32	9.60 203	37	0.39 797	9.96 778	5	12
49	9.57 012	32	9.60 240	36	0.39 760	9.96 772	6	11
50	9.57 044	31	9.60 276	37	0.39 724	9.96 767	5	10
51	9.57 075	32	9.60 313	36	0.39 687	9.96 762	5	9
52	9.57 107	31	9.60 349	37	0.39 651	9.96 757	5	8
53	9.57 138	31	9.60 386	37	0.39 614	9.96 752	5	7
54	9.57 169	32	9.60 422	36	0.39 578	9.96 747	5	6
55	9.57 201	31	9.60 459	36	0.39 541	9.96 742	5	5
56	9.57 232	32	9.60 495	37	0.39 505	9.96 737	5	4
57	9.57 264	31	9.60 532	36	0.39 468	9.96 732	5	3
58	9.57 295	31	9.60 568	37	0.39 432	9.96 727	5	2
59	9.57 326	32	9.60 605	36	0.39 395	9.96 722	5	1
60	9.57 358		9.60 641		0.39 359	9.96 717		0
′	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	38	37	36
1	0.6	0.6	0.6
2	1.3	1.2	1.2
3	1.9	1.8	1.8
4	2.5	2.5	2.4
5	3.2	3.1	3.0
6	3.8	3.7	3.6
7	4.4	4.3	4.2
8	5.1	4.9	4.8
9	5.7	5.6	5.4
10	6.3	6.2	6.0
20	12.7	12.3	12.0
30	19.0	18.5	18.0
40	25.3	24.7	24.0
50	31.7	30.8	30.0

″	33	32	31
1	0.6	0.5	0.5
2	1.1	1.1	1.0
3	1.6	1.6	1.6
4	2.2	2.1	2.1
5	2.8	2.7	2.6
6	3.3	3.2	3.1
7	3.8	3.7	3.6
8	4.4	4.3	4.1
9	5.0	4.8	4.6
10	5.5	5.3	5.2
20	11.0	10.7	10.3
30	16.5	16.0	15.5
40	22.0	21.3	20.7
50	27.5	26.7	25.8

″	6	5	4
1	0.1	0.1	0.1
2	0.2	0.2	0.1
3	0.3	0.2	0.2
4	0.4	0.3	0.3
5	0.5	0.4	0.3
6	0.6	0.5	0.4
7	0.7	0.6	0.5
8	0.8	0.7	0.5
9	0.9	0.8	0.6
10	1.0	0.8	0.7
20	2.0	1.7	1.3
30	3.0	2.5	2.0
40	4.0	3.3	2.7
50	5.0	4.2	3.3

Proportional parts

22°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		Proportional parts
0	9.57 358	31	9.60 641	36	0.39 359	9.96 717	6	60	
1	9.57 389	31	9.60 677	37	0.39 323	9.96 711	5	59	
2	9.57 420	31	9.60 714	36	0.39 286	9.96 706	5	58	
3	9.57 451	31	9.60 750	36	0.39 250	9.96 701	5	57	
4	9.57 482	32	9.60 786	37	0.39 214	9.96 696	5	56	
5	9.57 514	31	9.60 823	36	0.39 177	9.96 691	5	55	
6	9.57 545	31	9.60 859	36	0.39 141	9.96 686	5	54	
7	9.57 576	31	9.60 895	36	0.39 105	9.96 681	5	53	
8	9.57 607	31	9.60 931	36	0.39 069	9.96 676	6	52	
9	9.57 638	31	9.60 967	37	0.39 033	9.96 670	5	51	
10	9.57 669	31	9.61 004	36	0.38 996	9.96 665	5	50	
11	9.57 700	31	9.61 040	36	0.38 960	9.96 660	5	49	
12	9.57 731	31	9.61 076	36	0.38 924	9.96 655	5	48	
13	9.57 762	31	9.61 112	36	0.38 888	9.96 650	5	47	
14	9.57 793	31	9.61 148	36	0.38 852	9.96 645	5	46	
15	9.57 824	31	9.61 184	36	0.38 816	9.96 640	6	45	
16	9.57 855	30	9.61 220	36	0.38 780	9.96 634	5	44	
17	9.57 885	31	9.61 256	36	0.38 744	9.96 629	5	43	
18	9.57 916	31	9.61 292	36	0.38 708	9.96 624	5	42	
19	9.57 947	31	9.61 328	36	0.38 672	9.96 619	5	41	
20	9.57 978	30	9.61 364	36	0.38 636	9.96 614	6	40	
21	9.58 008	31	9.61 400	36	0.38 600	9.96 608	5	39	
22	9.58 039	31	9.61 436	36	0.38 564	9.96 603	5	38	
23	9.58 070	31	9.61 472	36	0.38 528	9.96 598	5	37	
24	9.58 101	30	9.61 508	36	0.38 492	9.96 593	5	36	
25	9.58 131	31	9.61 544	35	0.38 456	9.96 588	6	35	
26	9.58 162	30	9.61 579	36	0.38 421	9.96 582	5	34	
27	9.58 192	31	9.61 615	36	0.38 385	9.96 577	5	33	
28	9.58 223	30	9.61 651	36	0.38 349	9.96 572	5	32	
29	9.58 253	31	9.61 687	35	0.38 313	9.96 567	5	31	
30	9.58 284	30	9.61 722	36	0.38 278	9.96 562	6	30	
31	9.58 314	31	9.61 758	36	0.38 242	9.96 556	5	29	
32	9.58 345	30	9.61 794	36	0.38 206	9.96 551	5	28	
33	9.58 375	31	9.61 830	35	0.38 170	9.96 546	5	27	
34	9.58 406	30	9.61 865	36	0.38 135	9.96 541	6	26	
35	9.58 436	31	9.61 901	35	0.38 099	9.96 535	5	25	
36	9.58 467	30	9.61 936	36	0.38 064	9.96 530	5	24	
37	9.58 497	30	9.61 972	36	0.38 028	9.96 525	5	23	
38	9.58 527	30	9.62 008	35	0.37 992	9.96 520	6	22	
39	9.58 557	31	9.62 043	36	0.37 957	9.96 514	5	21	
40	9.58 588	30	9.62 079	35	0.37 921	9.96 509	5	20	
41	9.58 618	30	9.62 114	36	0.37 886	9.96 504	6	19	
42	9.58 648	30	9.62 150	35	0.37 850	9.96 498	5	18	
43	9.58 678	31	9.62 185	36	0.37 815	9.96 493	5	17	
44	9.58 709	30	9.62 221	35	0.37 779	9.96 488	5	16	
45	9.58 739	30	9.62 256	36	0.37 744	9.96 483	6	15	
46	9.58 769	30	9.62 292	35	0.37 708	9.96 477	5	14	
47	9.58 799	30	9.62 327	35	0.37 673	9.96 472	5	13	
48	9.58 829	30	9.62 362	36	0.37 638	9.96 467	6	12	
49	9.58 859	30	9.62 398	35	0.37 602	9.96 461	5	11	
50	9.58 889	30	9.62 433	35	0.37 567	9.96 456	5	10	
51	9.58 919	30	9.62 468	36	0.37 532	9.96 451	6	9	
52	9.58 949	30	9.62 504	35	0.37 496	9.96 445	5	8	
53	9.58 979	30	9.62 539	35	0.37 461	9.96 440	5	7	
54	9.59 009	30	9.62 574	35	0.37 426	9.96 435	6	6	
55	9.59 039	30	9.62 609	36	0.37 391	9.96 429	5	5	
56	9.59 069	29	9.62 645	35	0.37 355	9.96 424	5	4	
57	9.59 098	30	9.62 680	35	0.37 320	9.96 419	6	3	
58	9.59 128	30	9.62 715	35	0.37 285	9.96 413	5	2	
59	9.59 158	30	9.62 750	35	0.37 250	9.96 408	5	1	
60	9.59 188		9.62 785		0.37 215	9.96 403		0	
′	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′	Proportional parts

Proportional parts			
″	37	36	35
1	0.6	0.6	0.6
2	1.2	1.2	1.2
3	1.8	1.8	1.8
4	2.5	2.4	2.3
5	3.1	3.0	2.9
6	3.7	3.6	3.5
7	4.3	4.2	4.1
8	4.9	4.8	4.7
9	5.6	5.4	5.2
10	6.2	6.0	5.8
20	12.3	12.0	11.7
30	18.5	18.0	17.5
40	24.7	24.0	23.3
50	30.8	30.0	29.2

Proportional parts			
″	32	31	30
1	0.5	0.5	0.5
2	1.1	1.0	1.0
3	1.6	1.6	1.5
4	2.1	2.1	2.0
5	2.7	2.6	2.5
6	3.2	3.1	3.0
7	3.7	3.6	3.5
8	4.3	4.1	4.0
9	4.8	4.6	4.5
10	5.3	5.2	5.0
20	10.7	10.3	10.0
30	16.0	15.5	15.0
40	21.3	20.7	20.0
50	26.7	25.8	25.0

Proportional parts			
″	29	6	5
1	0.5	0.1	0.1
2	1.0	0.2	0.2
3	1.4	0.3	0.2
4	1.9	0.4	0.3
5	2.4	0.5	0.4
6	2.9	0.6	0.5
7	3.4	0.7	0.6
8	3.9	0.8	0.7
9	4.4	0.9	0.8
10	4.8	1.0	0.8
20	9.7	2.0	1.7
30	14.5	3.0	2.5
40	19.3	4.0	3.3
50	24.2	5.0	4.2

23°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		′
0	9.59 188	30	9.62 785	35	0.37 215	9.96 403	6	60	
1	9.59 218	29	9.62 820	35	0.37 180	9.96 397	5	59	
2	9.59 247	30	9.62 855	35	0.37 145	9.96 392	5	58	
3	9.59 277	30	9.62 890	36	0.37 110	9.96 387	6	57	
4	9.59 307	29	9.62 926	35	0.37 074	9.96 381	5	56	
5	9.59 336	30	9.62 961	35	0.37 039	9.96 376	6	55	
6	9.59 366	30	9.62 996	35	0.37 004	9.96 370	5	54	
7	9.59 396	29	9.63 031	35	0.36 969	9.96 365	5	53	
8	9.59 425	30	9.63 066	35	0.36 934	9.96 360	6	52	
9	9.59 455	29	9.63 101	34	0.36 899	9.96 354	5	51	
10	9.59 484	30	9.63 135	35	0.36 865	9.96 349	6	50	
11	9.59 514	29	9.63 170	35	0.36 830	9.96 343	5	49	
12	9.59 543	30	9.63 205	35	0.36 795	9.96 338	5	48	
13	9.59 573	29	9.63 240	35	0.36 760	9.96 333	6	47	
14	9.59 602	30	9.63 275	35	0.36 725	9.96 327	5	46	
15	9.59 632	29	9.63 310	35	0.36 690	9.96 322	6	45	
16	9.59 661	29	9.63 345	34	0.36 655	9.96 316	5	44	
17	9.59 690	30	9.63 379	35	0.36 621	9.96 311	6	43	
18	9.59 720	29	9.63 414	35	0.36 586	9.96 305	5	42	
19	9.59 749	29	9.63 449	35	0.36 551	9.96 300	6	41	
20	9.59 778	30	9.63 484	35	0.36 516	9.96 294	5	40	
21	9.59 808	29	9.63 519	34	0.36 481	9.96 289	5	39	
22	9.59 837	29	9.63 553	35	0.36 447	9.96 284	6	38	
23	9.59 866	29	9.63 588	35	0.36 412	9.96 278	5	37	
24	9.59 895	29	9.63 623	34	0.36 377	9.96 273	6	36	
25	9.59 924	30	9.63 657	35	0.36 343	9.96 267	5	35	
26	9.59 954	29	9.63 692	34	0.36 308	9.96 262	6	34	
27	9.59 983	29	9.63 726	35	0.36 274	9.96 256	5	33	
28	9.60 012	29	9.63 761	35	0.36 239	9.96 251	6	32	
29	9.60 041	29	9.63 796	34	0.36 204	9.96 245	5	31	
30	9.60 070	29	9.63 830	35	0.36 170	9.96 240	6	30	
31	9.60 099	29	9.63 865	34	0.36 135	9.96 234	5	29	
32	9.60 128	29	9.63 899	35	0.36 101	9.96 229	6	28	
33	9.60 157	29	9.63 934	34	0.36 066	9.96 223	5	27	
34	9.60 186	29	9.63 968	35	0.36 032	9.96 218	6	26	
35	9.60 215	29	9.64 003	34	0.35 997	9.96 212	5	25	
36	9.60 244	29	9.64 037	35	0.35 963	9.96 207	6	24	
37	9.60 273	29	9.64 072	34	0.35 928	9.96 201	5	23	
38	9.60 302	29	9.64 106	34	0.35 894	9.96 196	6	22	
39	9.60 331	28	9.64 140	35	0.35 860	9.96 190	5	21	
40	9.60 359	29	9.64 175	34	0.35 825	9.96 185	6	20	
41	9.60 388	29	9.64 209	34	0.35 791	9.96 179	5	19	
42	9.60 417	29	9.64 243	35	0.35 757	9.96 174	6	18	
43	9.60 446	28	9.64 278	34	0.35 722	9.96 168	6	17	
44	9.60 474	29	9.64 312	34	0.35 688	9.96 162	5	16	
45	9.60 503	29	9.64 346	35	0.35 654	9.96 157	6	15	
46	9.60 532	29	9.64 381	34	0.35 619	9.96 151	5	14	
47	9.60 561	28	9.64 415	34	0.35 585	9.96 146	6	13	
48	9.60 589	29	9.64 449	34	0.35 551	9.96 140	5	12	
49	9.60 618	28	9.64 483	34	0.35 517	9.96 135	6	11	
50	9.60 646	29	9.64 517	35	0.35 483	9.96 129	6	10	
51	9.60 675	29	9.64 552	34	0.35 448	9.96 123	5	9	
52	9.60 704	28	9.64 586	34	0.35 414	9.96 118	6	8	
53	9.60 732	29	9.64 620	34	0.35 380	9.96 112	5	7	
54	9.60 761	28	9.64 654	34	0.35 346	9.96 107	6	6	
55	9.60 789	29	9.64 688	34	0.35 312	9.96 101	6	5	
56	9.60 818	28	9.64 722	34	0.35 278	9.96 095	5	4	
57	9.60 846	29	9.64 756	34	0.35 244	9.96 090	6	3	
58	9.60 875	28	9.64 790	34	0.35 210	9.96 084	5	2	
59	9.60 903	28	9.64 824	34	0.35 176	9.96 079	6	1	
60	9.60 931		9.64 858		0.35 142	9.96 073		0	
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′	

Proportional parts

″	36	35	34
1	0.6	0.6	0.6
2	1.2	1.2	1.1
3	1.8	1.8	1.7
4	2.4	2.3	2.3
5	3.0	2.9	2.8
6	3.6	3.5	3.4
7	4.2	4.1	4.0
8	4.8	4.7	4.5
9	5.4	5.2	5.1
10	6.0	5.8	5.7
20	12.0	11.7	11.3
30	18.0	17.5	17.0
40	24.0	23.3	22.7
50	30.0	29.2	28.3

″	30	29	28
1	0.5	0.5	0.5
2	1.0	1.0	0.9
3	1.5	1.4	1.4
4	2.0	1.9	1.9
5	2.5	2.4	2.3
6	3.0	2.9	2.8
7	3.5	3.4	3.3
8	4.0	3.9	3.7
9	4.5	4.4	4.2
10	5.0	4.8	4.7
20	10.0	9.7	9.3
30	15.0	14.5	14.0
40	20.0	19.3	18.7
50	25.0	24.2	23.3

″	6	5
1	0.1	0.1
2	0.2	0.2
3	0.3	0.2
4	0.4	0.3
5	0.5	0.4
6	0.6	0.5
7	0.7	0.6
8	0.8	0.7
9	0.9	0.8
10	1.0	0.8
20	2.0	1.7
30	3.0	2.5
40	4.0	3.3
50	5.0	4.2

Proportional parts

24°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.60 931	29	9.64 858	34	0.35 142	9.96 073	6	60
1	9.60 960	28	9.64 892	34	0.35 108	9.96 067	5	59
2	9.60 988	28	9.64 926	34	0.35 074	9.96 062	6	58
3	9.61 016	29	9.64 960	34	0.35 040	9.96 056	6	57
4	9.61 045	28	9.64 994	34	0.35 006	9.96 050	5	56
5	9.61 073	28	9.65 028	34	0.34 972	9.96 045	6	55
6	9.61 101	28	9.65 062	34	0.34 938	9.96 039	5	54
7	9.61 129	29	9.65 096	34	0.34 904	9.96 034	6	53
8	9.61 158	28	9.65 130	34	0.34 870	9.96 028	6	52
9	9.61 186	28	9.65 164	33	0.34 836	9.96 022	5	51
10	9.61 214	28	9.65 197	34	0.34 803	9.96 017	6	50
11	9.61 242	28	9.65 231	34	0.34 769	9.96 011	6	49
12	9.61 270	28	9.65 265	34	0.34 735	9.96 005	5	48
13	9.61 298	28	9.65 299	34	0.34 701	9.96 000	6	47
14	9.61 326	28	9.65 333	33	0.34 667	9.95 994	6	46
15	9.61 354	28	9.65 366	34	0.34 634	9.95 988	6	45
16	9.61 382	29	9.65 400	34	0.34 600	9.95 982	5	44
17	9.61 411	27	9.65 434	34	0.34 566	9.95 977	6	43
18	9.61 438	28	9.65 467	33	0.34 533	9.95 971	6	42
19	9.61 466	28	9.65 501	34	0.34 499	9.95 965	5	41
20	9.61 494	28	9.65 535	33	0.34 465	9.95 960	6	40
21	9.61 522	28	9.65 568	34	0.34 432	9.95 954	6	39
22	9.61 550	28	9.65 602	34	0.34 398	9.95 948	6	38
23	9.61 578	28	9.65 636	34	0.34 364	9.95 942	6	37
24	9.61 606	28	9.65 669	33	0.34 331	9.95 937	5	36
25	9.61 634	28	9.65 703	33	0.34 297	9.95 931	6	35
26	9.61 662	27	9.65 736	34	0.34 264	9.95 925	5	34
27	9.61 689	28	9.65 770	33	0.34 230	9.95 920	6	33
28	9.61 717	28	9.65 803	34	0.34 197	9.95 914	6	32
29	9.61 745	28	9.65 837	33	0.34 163	9.95 908	6	31
30	9.61 773	27	9.65 870	34	0.34 130	9.95 902	5	30
31	9.61 800	28	9.65 904	33	0.34 096	9.95 897	6	29
32	9.61 828	28	9.65 937	34	0.34 063	9.95 891	6	28
33	9.61 856	27	9.65 971	33	0.34 029	9.95 885	6	27
34	9.61 883	28	9.66 004	34	0.33 996	9.95 879	6	26
35	9.61 911	28	9.66 038	33	0.33 962	9.95 873	5	25
36	9.61 939	27	9.66 071	33	0.33 929	9.95 868	6	24
37	9.61 966	28	9.66 104	34	0.33 896	9.95 862	6	23
38	9.61 994	27	9.66 138	33	0.33 862	9.95 856	6	22
39	9.62 021	28	9.66 171	33	0.33 829	9.95 850	6	21
40	9.62 049	27	9.66 204	34	0.33 796	9.95 844	5	20
41	9.62 076	28	9.66 238	33	0.33 762	9.95 839	6	19
42	9.62 104	27	9.66 271	33	0.33 729	9.95 833	6	18
43	9.62 131	28	9.66 304	33	0.33 696	9.95 827	6	17
44	9.62 159	27	9.66 337	34	0.33 663	9.95 821	6	16
45	9.62 186	28	9.66 371	33	0.33 629	9.95 815	5	15
46	9.62 214	27	9.66 404	33	0.33 596	9.95 810	6	14
47	9.62 241	27	9.66 437	33	0.33 563	9.95 804	6	13
48	9.62 268	28	9.66 470	33	0.33 530	9.95 798	6	12
49	9.62 296	27	9.66 503	34	0.33 497	9.95 792	6	11
50	9.62 323	27	9.66 537	33	0.33 463	9.95 786	6	10
51	9.62 350	27	9.66 570	33	0.33 430	9.95 780	5	9
52	9.62 377	28	9.66 603	33	0.33 397	9.95 775	6	8
53	9.62 405	27	9.66 636	33	0.33 364	9.95 769	6	7
54	9.62 432	27	9.66 669	33	0.33 331	9.95 763	6	6
55	9.62 459	27	9.66 702	33	0.33 298	9.95 757	6	5
56	9.62 486	27	9.66 735	33	0.33 265	9.95 751	6	4
57	9.62 513	28	9.66 768	33	0.33 232	9.95 745	6	3
58	9.62 541	27	9.66 801	33	0.33 199	9.95 739	6	2
59	9.62 568	27	9.66 834	33	0.33 166	9.95 733	5	1
60	9.62 595		9.66 867		0.33 133	9.95 728		0
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	34	33
1	0.6	0.6
2	1.1	1.1
3	1.7	1.6
4	2.3	2.2
5	2.8	2.8
6	3.4	3.3
7	4.0	3.8
8	4.5	4.4
9	5.1	5.0
10	5.7	5.5
20	11.3	11.0
30	17.0	16.5
40	22.7	22.0
50	28.3	27.5

″	29	28	27
1	0.5	0.5	0.4
2	1.0	0.9	0.9
3	1.4	1.4	1.4
4	1.9	1.9	1.8
5	2.4	2.3	2.2
6	2.9	2.8	2.7
7	3.4	3.3	3.2
8	3.9	3.7	3.6
9	4.4	4.2	4.0
10	4.8	4.7	4.5
20	9.7	9.3	9.0
30	14.5	14.0	13.5
40	19.3	18.7	18.0
50	24.2	23.3	22.5

″	6	5
1	0.1	0.1
2	0.2	0.2
3	0.3	0.2
4	0.4	0.3
5	0.5	0.4
6	0.6	0.5
7	0.7	0.6
8	0.8	0.7
9	0.9	0.8
10	1.0	0.8
20	2.0	1.7
30	3.0	2.5
40	4.0	3.3
50	5.0	4.2

Proportional parts

25°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		′
0	9.62 595	27	9.66 867	33	0.33 133	9.95 728	6	60	0
1	9.62 622	27	9.66 900	33	0.33 100	9.95 722	6	59	1
2	9.62 649	27	9.66 933	33	0.33 067	9.95 716	6	58	2
3	9.62 676	27	9.66 966	33	0.33 034	9.95 710	6	57	3
4	9.62 703	27	9.66 999	33	0.33 001	9.95 704	6	56	4
5	9.62 730	27	9.67 032	33	0.32 968	9.95 698	6	55	5
6	9.62 757	27	9.67 065	33	0.32 935	9.95 692	6	54	6
7	9.62 784	27	9.67 098	33	0.32 902	9.95 686	6	53	7
8	9.62 811	27	9.67 131	32	0.32 869	9.95 680	6	52	8
9	9.62 838	27	9.67 163	33	0.32 837	9.95 674	6	51	9
10	9.62 865	27	9.67 196	33	0.32 804	9.95 668	5	50	10
11	9.62 892	26	9.67 229	33	0.32 771	9.95 663	6	49	11
12	9.62 918	27	9.67 262	33	0.32 738	9.95 657	6	48	12
13	9.62 945	27	9.67 295	32	0.32 705	9.95 651	6	47	13
14	9.62 972	27	9.67 327	33	0.32 673	9.95 645	6	46	14
15	9.62 999	27	9.67 360	33	0.32 640	9.95 639	6	45	15
16	9.63 026	26	9.67 393	33	0.32 607	9.95 633	6	44	16
17	9.63 052	27	9.67 426	32	0.32 574	9.95 627	6	43	17
18	9.63 079	27	9.67 458	33	0.32 542	9.95 621	6	42	18
19	9.63 106	27	9.67 491	33	0.32 509	9.95 615	6	41	19
20	9.63 133	26	9.67 524	32	0.32 476	9.95 609	6	40	20
21	9.63 159	27	9.67 556	33	0.32 444	9.95 603	6	39	21
22	9.63 186	27	9.67 589	33	0.32 411	9.95 597	6	38	22
23	9.63 213	26	9.67 622	32	0.32 378	9.95 591	6	37	23
24	9.63 239	27	9.67 654	33	0.32 346	9.95 585	6	36	24
25	9.63 266	26	9.67 687	32	0.32 313	9.95 579	6	35	25
26	9.63 292	27	9.67 719	33	0.32 281	9.95 573	6	34	26
27	9.63 319	26	9.67 752	33	0.32 248	9.95 567	6	33	27
28	9.63 345	27	9.67 785	32	0.32 215	9.95 561	6	32	28
29	9.63 372	26	9.67 817	33	0.32 183	9.95 555	6	31	29
30	9.63 398	27	9.67 850	32	0.32 150	9.95 549	6	30	30
31	9.63 425	26	9.67 882	33	0.32 118	9.95 543	6	29	31
32	9.63 451	27	9.67 915	32	0.32 085	9.95 537	6	28	32
33	9.63 478	26	9.67 947	33	0.32 053	9.95 531	6	27	33
34	9.63 504	27	9.67 980	32	0.32 020	9.95 525	6	26	34
35	9.63 531	26	9.68 012	32	0.31 988	9.95 519	6	25	35
36	9.63 557	26	9.68 044	33	0.31 956	9.95 513	6	24	36
37	9.63 583	27	9.68 077	32	0.31 923	9.95 507	7	23	37
38	9.63 610	26	9.68 109	33	0.31 891	9.95 500	6	22	38
39	9.63 636	26	9.68 142	32	0.31 858	9.95 494	6	21	39
40	9.63 662	27	9.68 174	32	0.31 826	9.95 488	6	20	40
41	9.63 689	26	9.68 206	33	0.31 794	9.95 482	6	19	41
42	9.63 715	26	9.68 239	33	0.31 761	9.95 476	6	18	42
43	9.63 741	26	9.68 271	32	0.31 729	9.95 470	6	17	43
44	9.63 767	27	9.68 303	33	0.31 697	9.95 464	6	16	44
45	9.63 794	26	9.68 336	32	0.31 664	9.95 458	6	15	45
46	9.63 820	26	9.68 368	32	0.31 632	9.95 452	6	14	46
47	9.63 846	26	9.68 400	32	0.31 600	9.95 446	6	13	47
48	9.63 872	26	9.68 432	33	0.31 568	9.95 440	6	12	48
49	9.63 898	26	9.68 465	32	0.31 535	9.95 434	7	11	49
50	9.63 924	26	9.68 497	32	0.31 503	9.95 427	6	10	50
51	9.63 950	26	9.68 529	32	0.31 471	9.95 421	6	9	51
52	9.63 976	26	9.68 561	32	0.31 439	9.95 415	6	8	52
53	9.64 002	26	9.68 593	33	0.31 407	9.95 409	6	7	53
54	9.64 028	26	9.68 626	32	0.31 374	9.95 403	6	6	54
55	9.64 054	26	9.68 658	32	0.31 342	9.95 397	6	5	55
56	9.64 080	26	9.68 690	32	0.31 310	9.95 391	7	4	56
57	9.64 106	26	9.68 722	32	0.31 278	9.95 384	6	3	57
58	9.64 132	26	9.68 754	32	0.31 246	9.95 378	6	2	58
59	9.64 158	26	9.68 786	32	0.31 214	9.95 372	6	1	59
60	9.64 184		9.68 818		0.31 182	9.95 366		0	60
	L Cos	d	L Ctn	c d	L Tan	L Sin	d		′

Proportional parts

″	33	32
1	0.6	0.5
2	1.1	1.1
3	1.6	1.6
4	2.2	2.1
5	2.8	2.7
6	3.3	3.2
7	3.8	3.7
8	4.4	4.3
9	5.0	4.8
10	5.5	5.3
20	11.0	10.7
30	16.5	16.0
40	22.0	21.3
50	27.5	26.7

″	27	26
1	0.4	0.4
2	0.9	0.9
3	1.4	1.3
4	1.8	1.7
5	2.2	2.2
6	2.7	2.6
7	3.2	3.0
8	3.6	3.5
9	4.0	3.9
10	4.5	4.3
20	9.0	8.7
30	13.5	13.0
40	18.0	17.3
50	22.5	21.7

″	7	6	5
1	0.1	0.1	0.1
2	0.2	0.2	0.2
3	0.4	0.3	0.2
4	0.5	0.4	0.3
5	0.6	0.5	0.4
6	0.7	0.6	0.5
7	0.8	0.7	0.6
8	0.9	0.8	0.7
9	1.0	0.9	0.8
10	1.2	1.0	0.8
20	2.3	2.0	1.7
30	3.5	3.0	2.5
40	4.7	4.0	3.3
50	5.8	5.0	4.2

Proportional parts

26°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.64 184	26	9.68 818	32	0.31 182	9.95 366	6	60
1	9.64 210	26	9.68 850	32	0.31 150	9.95 360	6	59
2	9.64 236	26	9.68 882	32	0.31 118	9.95 354	6	58
3	9.64 262	26	9.68 914	32	0.31 086	9.95 348	7	57
4	9.64 288	25	9.68 946	32	0.31 054	9.95 341	6	56
5	9.64 313	26	9.68 978	32	0.31 022	9.95 335	6	55
6	9.64 339	26	9.69 010	32	0.30 990	9.95 329	6	54
7	9.64 365	26	9.69 042	32	0.30 958	9.95 323	6	53
8	9.64 391	26	9.69 074	32	0.30 926	9.95 317	7	52
9	9.64 417	25	9.69 106	32	0.30 894	9.95 310	6	51
10	9.64 442	26	9.69 138	32	0.30 862	9.95 304	6	50
11	9.64 468	26	9.69 170	32	0.30 830	9.95 298	6	49
12	9.64 494	25	9.69 202	32	0.30 798	9.95 292	6	48
13	9.64 519	26	9.69 234	32	0.30 766	9.95 286	7	47
14	9.64 545	26	9.69 266	32	0.30 734	9.95 279	6	46
15	9.64 571	25	9.69 298	31	0.30 702	9.95 273	6	45
16	9.64 596	26	9.69 329	32	0.30 671	9.95 267	6	44
17	9.64 622	25	9.69 361	32	0.30 639	9.95 261	7	43
18	9.64 647	26	9.69 393	32	0.30 607	9.95 254	6	42
19	9.64 673	25	9.69 425	32	0.30 575	9.95 248	6	41
20	9.64 698	26	9.69 457	31	0.30 543	9.95 242	6	40
21	9.64 724	25	9.69 488	32	0.30 512	9.95 236	7	39
22	9.64 749	26	9.69 520	32	0.30 480	9.95 229	6	38
23	9.64 775	25	9.69 552	32	0.30 448	9.95 223	6	37
24	9.64 800	26	9.69 584	31	0.30 416	9.95 217	6	36
25	9.64 826	25	9.69 615	32	0.30 385	9.95 211	7	35
26	9.64 851	26	9.69 647	32	0.30 353	9.95 204	6	34
27	9.64 877	25	9.69 679	31	0.30 321	9.95 198	6	33
28	9.64 902	25	9.69 710	32	0.30 290	9.95 192	7	32
29	9.64 927	26	9.69 742	32	0.30 258	9.95 185	6	31
30	9.64 953	25	9.69 774	31	0.30 226	9.95 179	6	30
31	9.64 978	26	9.69 805	32	0.30 195	9.95 173	6	29
32	9.65 003	25	9.69 837	31	0.30 163	9.95 167	7	28
33	9.65 029	25	9.69 868	32	0.30 132	9.95 160	6	27
34	9.65 054	25	9.69 900	32	0.30 100	9.95 154	6	26
35	9.65 079	25	9.69 932	31	0.30 068	9.95 148	7	25
36	9.65 104	26	9.69 963	32	0.30 037	9.95 141	6	24
37	9.65 130	25	9.69 995	31	0.30 005	9.95 135	6	23
38	9.65 155	25	9.70 026	32	0.29 974	9.95 129	7	22
39	9.65 180	25	9.70 058	31	0.29 942	9.95 122	6	21
40	9.65 205	25	9.70 089	32	0.29 911	9.95 116	6	20
41	9.65 230	25	9.70 121	31	0.29 879	9.95 110	7	19
42	9.65 255	26	9.70 152	32	0.29 848	9.95 103	6	18
43	9.65 281	25	9.70 184	31	0.29 816	9.95 097	7	17
44	9.65 306	25	9.70 215	32	0.29 785	9.95 090	6	16
45	9.65 331	25	9.70 247	31	0.29 753	9.95 084	6	15
46	9.65 356	25	9.70 278	31	0.29 722	9.95 078	7	14
47	9.65 381	25	9.70 309	32	0.29 691	9.95 071	6	13
48	9.65 406	25	9.70 341	31	0.29 659	9.95 065	6	12
49	9.65 431	25	9.70 372	32	0.29 628	9.95 059	7	11
50	9.65 456	25	9.70 404	31	0.29 596	9.95 052	6	10
51	9.65 481	25	9.70 435	31	0.29 565	9.95 046	7	9
52	9.65 506	25	9.70 466	32	0.29 534	9.95 039	6	8
53	9.65 531	25	9.70 498	31	0.29 502	9.95 033	6	7
54	9.65 556	24	9.70 529	31	0.29 471	9.95 027	7	6
55	9.65 580	25	9.70 560	32	0.29 440	9.95 020	6	5
56	9.65 605	25	9.70 592	31	0.29 408	9.95 014	7	4
57	9.65 630	25	9.70 623	31	0.29 377	9.95 007	6	3
58	9.65 655	25	9.70 654	31	0.29 346	9.95 001	6	2
59	9.65 680	25	9.70 685	32	0.29 315	9.94 995	7	1
60	9.65 705		9.70 717		0.29 283	9.94 988		0
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	32	31
1	0.5	0.5
2	1.1	1.0
3	1.6	1.6
4	2.1	2.1
5	2.7	2.6
6	3.2	3.1
7	3.7	3.6
8	4.3	4.1
9	4.8	4.6
10	5.3	5.2
20	10.7	10.3
30	16.0	15.5
40	21.3	20.7
50	26.7	25.8

″	26	25	24
1	0.4	0.4	0.4
2	0.9	0.8	0.8
3	1.3	1.2	1.2
4	1.7	1.7	1.6
5	2.2	2.1	2.0
6	2.6	2.5	2.4
7	3.0	2.9	2.8
8	3.5	3.3	3.2
9	3.9	3.8	3.6
10	4.3	4.2	4.0
20	8.7	8.3	8.0
30	13.0	12.5	12.0
40	17.3	16.7	16.0
50	21.7	20.8	20.0

″	7	6
1	0.1	0.1
2	0.2	0.2
3	0.4	0.3
4	0.5	0.4
5	0.6	0.5
6	0.7	0.6
7	0.8	0.7
8	0.9	0.8
9	1.0	0.9
10	1.2	1.0
20	2.3	2.0
30	3.5	3.0
40	4.7	4.0
50	5.8	5.0

Proportional parts

27°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.65 705	24	9.70 717	31	0.29 283	9.94 988	6	60
1	9.65 729	25	9.70 748	31	0.29 252	9.94 982	7	59
2	9.65 754	25	9.70 779	31	0.29 221	9.94 975	6	58
3	9.65 779	25	9.70 810	31	0.29 190	9.94 969	7	57
4	9.65 804	24	9.70 841	32	0.29 159	9.94 962	6	56
5	9.65 828	25	9.70 873	31	0.29 127	9.94 956	7	55
6	9.65 853	25	9.70 904	31	0.29 096	9.94 949	6	54
7	9.65 878	24	9.70 935	31	0.29 065	9.94 943	7	53
8	9.65 902	25	9.70 966	31	0.29 034	9.94 936	6	52
9	9.65 927	25	9.70 997	31	0.29 003	9.94 930	7	51
10	9.65 952	24	9.71 028	31	0.28 972	9.94 923	6	50
11	9.65 976	25	9.71 059	31	0.28 941	9.94 917	6	49
12	9.66 001	24	9.71 090	31	0.28 910	9.94 911	7	48
13	9.66 025	25	9.71 121	32	0.28 879	9.94 904	6	47
14	9.66 050	25	9.71 153	31	0.28 847	9.94 898	7	46
15	9.66 075	24	9.71 184	31	0.28 816	9.94 891	6	45
16	9.66 099	25	9.71 215	31	0.28 785	9.94 885	7	44
17	9.66 124	24	9.71 246	31	0.28 754	9.94 878	7	43
18	9.66 148	25	9.71 277	31	0.28 723	9.94 871	6	42
19	9.66 173	24	9.71 308	31	0.28 692	9.94 865	7	41
20	9.66 197	24	9.71 339	31	0.28 661	9.94 858	6	40
21	9.66 221	24	9.71 370	31	0.28 630	9.94 852	7	39
22	9.66 246	25	9.71 401	30	0.28 599	9.94 845	6	38
23	9.66 270	24	9.71 431	31	0.28 569	9.94 839	7	37
24	9.66 295	25	9.71 462	31	0.28 538	9.94 832	6	36
25	9.66 319	24	9.71 493	31	0.28 507	9.94 826	7	35
26	9.66 343	25	9.71 524	31	0.28 476	9.94 819	6	34
27	9.66 368	24	9.71 555	31	0.28 445	9.94 813	7	33
28	9.66 392	24	9.71 586	31	0.28 414	9.94 806	7	32
29	9.66 416	25	9.71 617	31	0.28 383	9.94 799	6	31
30	9.66 441	24	9.71 648	31	0.28 352	9.94 793	7	30
31	9.66 465	24	9.71 679	30	0.28 321	9.94 786	6	29
32	9.66 489	24	9.71 709	31	0.28 291	9.94 780	7	28
33	9.66 513	24	9.71 740	31	0.28 260	9.94 773	6	27
34	9.66 537	25	9.71 771	31	0.28 229	9.94 767	7	26
35	9.66 562	24	9.71 802	31	0.28 198	9.94 760	7	25
36	9.66 586	24	9.71 833	30	0.28 167	9.94 753	6	24
37	9.66 610	24	9.71 863	31	0.28 137	9.94 747	7	23
38	9.66 634	24	9.71 894	31	0.28 106	9.94 740	6	22
39	9.66 658	24	9.71 925	30	0.28 075	9.94 734	7	21
40	9.66 682	24	9.71 955	31	0.28 045	9.94 727	7	20
41	9.66 706	25	9.71 986	31	0.28 014	9.94 720	6	19
42	9.66 731	24	9.72 017	31	0.27 983	9.94 714	7	18
43	9.66 755	24	9.72 048	30	0.27 952	9.94 707	7	17
44	9.66 779	24	9.72 078	31	0.27 922	9.94 700	6	16
45	9.66 803	24	9.72 109	31	0.27 891	9.94 694	7	15
46	9.66 827	24	9.72 140	30	0.27 860	9.94 687	7	14
47	9.66 851	24	9.72 170	31	0.27 830	9.94 680	6	13
48	9.66 875	24	9.72 201	30	0.27 799	9.94 674	7	12
49	9.66 899	23	9.72 231	31	0.27 769	9.94 667	7	11
50	9.66 922	24	9.72 262	31	0.27 738	9.94 660	6	10
51	9.66 946	24	9.72 293	30	0.27 707	9.94 654	7	9
52	9.66 970	24	9.72 323	31	0.27 677	9.94 647	7	8
53	9.66 994	24	9.72 354	30	0.27 646	9.94 640	6	7
54	9.67 018	24	9.72 384	31	0.27 616	9.94 634	7	6
55	9.67 042	24	9.72 415	30	0.27 585	9.94 627	7	5
56	9.67 066	24	9.72 445	31	0.27 555	9.94 620	6	4
57	9.67 090	23	9.72 476	30	0.27 524	9.94 614	7	3
58	9.67 113	24	9.72 506	31	0.27 494	9.94 607	7	2
59	9.67 137	24	9.72 537	30	0.27 463	9.94 600	7	1
60	9.67 161		9.72 567		0.27 433	9.94 593		0
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	32	31	30
1	0.5	0.5	0.5
2	1.1	1.0	1.0
3	1.6	1.6	1.5
4	2.1	2.1	2.0
5	2.7	2.6	2.5
6	3.2	3.1	3.0
7	3.7	3.6	3.5
8	4.3	4.1	4.0
9	4.8	4.6	4.5
10	5.3	5.2	5.0
20	10.7	10.3	10.0
30	16.0	15.5	15.0
40	21.3	20.7	20.0
50	26.7	25.8	25.0

″	25	24	23
1	0.4	0.4	0.4
2	0.8	0.8	0.8
3	1.2	1.2	1.2
4	1.7	1.6	1.5
5	2.1	2.0	1.9
6	2.5	2.4	2.3
7	2.9	2.8	2.7
8	3.3	3.2	3.1
9	3.8	3.6	3.4
10	4.2	4.0	3.8
20	8.3	8.0	7.7
30	12.5	12.0	11.5
40	16.7	16.0	15.3
50	20.8	20.0	19.2

″	7	6
1	0.1	0.1
2	0.2	0.2
3	0.4	0.3
4	0.5	0.4
5	0.6	0.5
6	0.7	0.6
7	0.8	0.7
8	0.9	0.8
9	1.0	0.9
10	1.2	1.0
20	2.3	2.0
30	3.5	3.0
40	4.7	4.0
50	5.8	5.0

Proportional parts

28°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.67 161	24	9.72 567	31	0.27 433	9.94 593	6	60
1	9.67 185	23	9.72 598	30	0.27 402	9.94 587	7	59
2	9.67 208	24	9.72 628	31	0.27 372	9.94 580	7	58
3	9.67 232	24	9.72 659	30	0.27 341	9.94 573	6	57
4	9.67 256	24	9.72 689	31	0.27 311	9.94 567	7	56
5	9.67 280	23	9.72 720	30	0.27 280	9.94 560	7	55
6	9.67 303	24	9.72 750	30	0.27 250	9.94 553	7	54
7	9.67 327	23	9.72 780	31	0.27 220	9.94 546	6	53
8	9.67 350	24	9.72 811	30	0.27 189	9.94 540	7	52
9	9.67 374	24	9.72 841	31	0.27 159	9.94 533	7	51
10	9.67 398	23	9.72 872	30	0.27 128	9.94 526	7	50
11	9.67 421	24	9.72 902	30	0.27 098	9.94 519	6	49
12	9.67 445	23	9.72 932	31	0.27 068	9.94 513	7	48
13	9.67 468	24	9.72 963	30	0.27 037	9.94 506	7	47
14	9.67 492	23	9.72 993	30	0.27 007	9.94 499	7	46
15	9.67 515	24	9.73 023	31	0.26 977	9.94 492	7	45
16	9.67 539	23	9.73 054	30	0.26 946	9.94 485	6	44
17	9.67 562	24	9.73 084	30	0.26 916	9.94 479	7	43
18	9.67 586	23	9.73 114	30	0.26 886	9.94 472	7	42
19	9.67 609	24	9.73 144	31	0.26 856	9.94 465	7	41
20	9.67 633	23	9.73 175	30	0.26 825	9.94 458	7	40
21	9.67 656	24	9.73 205	30	0.26 795	9.94 451	6	39
22	9.67 680	23	9.73 235	30	0.26 765	9.94 445	7	38
23	9.67 703	23	9.73 265	30	0.26 735	9.94 438	7	37
24	9.67 726	24	9.73 295	31	0.26 705	9.94 431	7	36
25	9.67 750	23	9.73 326	30	0.26 674	9.94 424	7	35
26	9.67 773	23	9.73 356	30	0.26 644	9.94 417	7	34
27	9.67 796	24	9.73 386	30	0.26 614	9.94 410	6	33
28	9.67 820	23	9.73 416	30	0.26 584	9.94 404	7	32
29	9.67 843	23	9.73 446	30	0.26 554	9.94 397	7	31
30	9.67 866	24	9.73 476	31	0.26 524	9.94 390	7	30
31	9.67 890	23	9.73 507	30	0.26 493	9.94 383	7	29
32	9.67 913	23	9.73 537	30	0.26 463	9.94 376	7	28
33	9.67 936	23	9.73 567	30	0.26 433	9.94 369	7	27
34	9.67 959	23	9.73 597	30	0.26 403	9.94 362	7	26
35	9.67 982	24	9.73 627	30	0.26 373	9.94 355	6	25
36	9.68 006	23	9.73 657	30	0.26 343	9.94 349	7	24
37	9.68 029	23	9.73 687	30	0.26 313	9.94 342	7	23
38	9.68 052	23	9.73 717	30	0.26 283	9.94 335	7	22
39	9.68 075	23	9.73 747	30	0.26 253	9.94 328	7	21
40	9.68 098	23	9.73 777	30	0.26 223	9.94 321	7	20
41	9.68 121	23	9.73 807	30	0.26 193	9.94 314	7	19
42	9.68 144	23	9.73 837	30	0.26 163	9.94 307	7	18
43	9.68 167	23	9.73 867	30	0.26 133	9.94 300	7	17
44	9.68 190	23	9.73 897	30	0.26 103	9.94 293	7	16
45	9.68 213	24	9.73 927	30	0.26 073	9.94 286	7	15
46	9.68 237	23	9.73 957	30	0.26 043	9.94 279	6	14
47	9.68 260	23	9.73 987	30	0.26 013	9.94 273	7	13
48	9.68 283	22	9.74 017	30	0.25 983	9.94 266	7	12
49	9.68 305	23	9.74 047	30	0.25 953	9.94 259	7	11
50	9.68 328	23	9.74 077	30	0.25 923	9.94 252	7	10
51	9 68 351	23	9.74 107	30	0.25 893	9.94 245	7	9
52	9.68 374	23	9.74 137	29	0.25 863	9.94 238	7	8
53	9.68 397	23	9.74 166	30	0.25 834	9.94 231	7	7
54	9.68 420	23	9.74 196	30	0.25 804	9.94 224	7	6
55	9.68 443	23	9.74 226	30	0.25 774	9.94 217	7	5
56	9.68 466	23	9.74 256	30	0.25 744	9.94 210	7	4
57	9.68 489	23	9.74 286	30	0.25 714	9.94 203	7	3
58	9.68 512	22	9.74 316	29	0.25 684	9.94 196	7	2
59	9.68 534	23	9.74 345	30	0.25 655	9.94 189	7	1
60	9.68 557		9.74 375		0.25 625	9.94 182		0
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	31	30	29
1	0.5	0.5	0.5
2	1.0	1.0	1.0
3	1.6	1.5	1.4
4	2.1	2.0	1.9
5	2.6	2.5	2.4
6	3.1	3.0	2.9
7	3.6	3.5	3.4
8	4.1	4.0	3.9
9	4.6	4.5	4.4
10	5.2	5.0	4.8
20	10.3	10.0	9.7
30	15.5	15.0	14.5
40	20.7	20.0	19.3
50	25.8	25.0	24.2

″	24	23	22
1	0.4	0.4	0.4
2	0.8	0.8	0.7
3	1.2	1.2	1.1
4	1.6	1.5	1.5
5	2.0	1.9	1.8
6	2.4	2.3	2.2
7	2.8	2.7	2.6
8	3.2	3.1	2.9
9	3.6	3.4	3.3
10	4.0	3.8	3.7
20	8.0	7.7	7.3
30	12.0	11.5	11.0
40	16.0	15.3	14.7
50	20.0	19.2	18.3

″	7	6
1	0.1	0.1
2	0.2	0.2
3	0.4	0.3
4	0.5	0.4
5	0.6	0.5
6	0.7	0.6
7	0.8	0.7
8	0.9	0.8
9	1.0	0.9
10	1.2	1.0
20	2.3	2.0
30	3.5	3.0
40	4.7	4.0
50	5.8	5.0

Proportional parts

29°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.68 557	23	9.74 375	30	0.25 625	9.94 182	7	60
1	9.68 580	23	9.74 405	30	0.25 595	9.94 175	7	59
2	9.68 603	22	9.74 435	30	0.25 565	9.94 168	7	58
3	9.68 625	23	9.74 465	29	0.25 535	9.94 161	7	57
4	9.68 648	23	9.74 494	30	0.25 506	9.94 154	7	56
5	9.68 671	23	9.74 524	30	0.25 476	9.94 147	7	55
6	9.68 694	22	9.74 554	29	0.25 446	9.94 140	7	54
7	9.68 716	23	9.74 583	30	0.25 417	9.94 133	7	53
8	9.68 739	23	9.74 613	30	0.25 387	9.94 126	7	52
9	9.68 762	22	9.74 643	30	0.25 357	9.94 119	7	51
10	9.68 784	23	9.74 673	29	0.25 327	9.94 112	7	50
11	9.68 807	22	9.74 702	30	0.25 298	9.94 105	7	49
12	9.68 829	23	9.74 732	30	0.25 268	9.94 098	8	48
13	9.68 852	23	9.74 762	29	0.25 238	9.94 090	7	47
14	9.68 875	22	9.74 791	30	0.25 209	9.94 083	7	46
15	9.68 897	23	9.74 821	30	0.25 179	9.94 076	7	45
16	9.68 920	22	9.74 851	29	0.25 149	9.94 069	7	44
17	9.68 942	23	9.74 880	30	0.25 120	9.94 062	7	43
18	9.68 965	22	9.74 910	29	0.25 090	9.94 055	7	42
19	9.68 987	23	9.74 939	30	0.25 061	9.94 048	7	41
20	9.69 010	22	9.74 969	29	0.25 031	9.94 041	7	40
21	9.69 032	23	9.74 998	30	0.25 002	9.94 034	7	39
22	9.69 055	22	9.75 028	30	0.24 972	9.94 027	7	38
23	9.69 077	23	9.75 058	29	0.24 942	9.94 020	8	37
24	9.69 100	22	9.75 087	30	0.24 913	9.94 012	7	36
25	9.69 122	22	9.75 117	29	0.24 883	9.94 005	7	35
26	9.69 144	23	9.75 146	30	0.24 854	9.93 998	7	34
27	9.69 167	22	9.75 176	29	0.24 824	9.93 991	7	33
28	9.69 189	23	9.75 205	30	0.24 795	9.93 984	7	32
29	9.69 212	22	9.75 235	29	0.24 765	9.93 977	7	31
30	9.69 234	22	9.75 264	30	0.24 736	9.93 970	7	30
31	9.69 256	23	9.75 294	29	0.24 706	9.93 963	8	29
32	9.69 279	22	9.75 323	30	0.24 677	9.93 955	7	28
33	9.69 301	22	9.75 353	29	0.24 647	9.93 948	7	27
34	9.69 323	22	9.75 382	29	0.24 618	9.93 941	7	26
35	9.69 345	23	9.75 411	30	0.24 589	9.93 934	7	25
36	9.69 368	22	9.75 441	29	0.24 559	9.93 927	7	24
37	9.69 390	22	9.75 470	30	0.24 530	9.93 920	8	23
38	9.69 412	22	9.75 500	29	0.24 500	9.93 912	7	22
39	9.69 434	22	9.75 529	29	0.24 471	9.93 905	7	21
40	9.69 456	23	9.75 558	30	0.24 442	9.93 898	7	20
41	9.69 479	22	9.75 588	29	0.24 412	9.93 891	7	19
42	9.69 501	22	9.75 617	29	0.24 383	9.93 884	8	18
43	9.69 523	22	9.75 647	30	0.24 353	9.93 876	7	17
44	9.69 545	22	9.75 676	29	0.24 324	9.93 869	7	16
45	9.69 567	22	9.75 705	30	0.24 295	9.93 862	7	15
46	9.69 589	22	9.75 735	29	0.24 265	9.93 855	8	14
47	9.69 611	22	9.75 764	29	0.24 236	9.93 847	7	13
48	9.69 633	22	9.75 793	29	0.24 207	9.93 840	7	12
49	9.69 655	22	9.75 822	30	0.24 178	9.93 833	7	11
50	9.69 677	22	9.75 852	29	0.24 148	9.93 826	7	10
51	9.69 699	22	9.75 881	29	0.24 119	9.93 819	8	9
52	9.69 721	22	9.75 910	29	0.24 090	9.93 811	7	8
53	9.69 743	22	9.75 939	30	0.24 061	9.93 804	7	7
54	9.69 765	22	9.75 969	29	0.24 031	9.93 797	8	6
55	9.69 787	22	9.75 998	29	0.24 002	9.93 789	7	5
56	9.69 809	22	9.76 027	29	0.23 973	9.93 782	7	4
57	9.69 831	22	9.76 056	30	0.23 944	9.93 775	7	3
58	9.69 853	22	9.76 086	29	0.23 914	9.93 768	8	2
59	9.69 875	22	9.76 115	29	0.23 885	9.93 760	7	1
60	9.69 897		9.76 144		0.23 856	9.93 753		0
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	30	29	23
1	0.5	0.5	0.4
2	1.0	1.0	0.8
3	1.5	1.4	1.2
4	2.0	1.9	1.5
5	2.5	2.4	1.9
6	3.0	2.9	2.3
7	3.5	3.4	2.7
8	4.0	3.9	3.1
9	4.5	4.4	3.4
10	5.0	4.8	3.8
20	10.0	9.7	7.7
30	15.0	14.5	11.5
40	20.0	19.3	15.3
50	25.0	24.2	19.2

″	22	8	7
1	0.4	0.1	0.1
2	0.7	0.3	0.2
3	1.1	0.4	0.4
4	1.5	0.5	0.5
5	1.8	0.7	0.6
6	2.2	0.8	0.7
7	2.6	0.9	0.8
8	2.9	1.1	0.9
9	3.3	1.2	1.0
10	3.7	1.3	1.2
20	7.3	2.7	2.3
30	11.0	4.0	3.5
40	14.7	5.3	4.7
50	18.3	6.7	5.8

Proportional parts

30°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.69 897	22	9.76 144	29	0.23 856	9.93 753	7	60
1	9.69 919	22	9.76 173	29	0.23 827	9.93 746	8	59
2	9.69 941	22	9.76 202	29	0.23 798	9.93 738	7	58
3	9.69 963	21	9.76 231	30	0.23 769	9.93 731	7	57
4	9.69 984	22	9.76 261	29	0.23 739	9.93 724	7	56
5	9.70 006	22	9.76 290	29	0.23 710	9.93 717	8	55
6	9.70 028	22	9.76 319	29	0.23 681	9.93 709	7	54
7	9.70 050	22	9.76 348	29	0.23 652	9.93 702	7	53
8	9.70 072	21	9.76 377	29	0.23 623	9.93 695	8	52
9	9.70 093	22	9.76 406	29	0.23 594	9.93 687	7	51
10	9.70 115	22	9.76 435	29	0.23 565	9.93 680	7	50
11	9.70 137	22	9.76 464	29	0.23 536	9.93 673	8	49
12	9.70 159	21	9.76 493	29	0.23 507	9.93 665	7	48
13	9.70 180	22	9.76 522	29	0.23 478	9.93 658	8	47
14	9.70 202	22	9.76 551	29	0.23 449	9.93 650	7	46
15	9.70 224	21	9.76 580	29	0.23 420	9.93 643	7	45
16	9.70 245	22	9.76 609	30	0.23 391	9.93 636	8	44
17	9.70 267	21	9.76 639	29	0.23 361	9.93 628	7	43
18	9.70 288	22	9.76 668	29	0.23 332	9.93 621	7	42
19	9.70 310	22	9.76 697	28	0.23 303	9.93 614	8	41
20	9.70 332	21	9.76 725	29	0.23 275	9.93 606	7	40
21	9.70 353	22	9.76 754	29	0.23 246	9.93 599	8	39
22	9.70 375	21	9.76 783	29	0.23 217	9.93 591	7	38
23	9.70 396	22	9.76 812	29	0.23 188	9.93 584	7	37
24	9.70 418	21	9.76 841	29	0.23 159	9.93 577	8	36
25	9.70 439	22	9.76 870	29	0.23 130	9.93 569	7	35
26	9.70 461	21	9.76 899	29	0.23 101	9.93 562	8	34
27	9.70 482	22	9.76 928	29	0.23 072	9.93 554	7	33
28	9.70 504	21	9.76 957	29	0.23 043	9.93 547	8	32
29	9.70 525	22	9.76 986	29	0.23 014	9.93 539	7	31
30	9.70 547	21	9.77 015	29	0.22 985	9.93 532	7	30
31	9.70 568	22	9.77 044	29	0.22 956	9.93 525	8	29
32	9.70 590	21	9.77 073	29	0.22 927	9.93 517	7	28
33	9.70 611	22	9.77 101	28	0.22 899	9.93 510	8	27
34	9.70 633	21	9.77 130	29	0.22 870	9.93 502	7	26
35	9.70 654	21	9.77 159	29	0.22 841	9.93 495	8	25
36	9.70 675	22	9.77 188	29	0.22 812	9.93 487	7	24
37	9.70 697	21	9.77 217	29	0.22 783	9.93 480	8	23
38	9.70 718	21	9.77 246	28	0.22 754	9.93 472	7	22
39	9.70 739	22	9.77 274	29	0.22 726	9.93 465	8	21
40	9.70 761	21	9.77 303	29	0.22 697	9.93 457	7	20
41	9.70 782	21	9.77 332	29	0.22 668	9.93 450	8	19
42	9.70 803	21	9.77 361	29	0.22 639	9.93 442	7	18
43	9.70 824	22	9.77 390	28	0.22 610	9.93 435	8	17
44	9.70 846	21	9.77 418	29	0.22 582	9.93 427	7	16
45	9.70 867	21	9.77 447	29	0.22 553	9.93 420	8	15
46	9.70 888	21	9.77 476	29	0.22 524	9.93 412	7	14
47	9.70 909	22	9.77 505	29	0.22 495	9.93 405	8	13
48	9.70 931	21	9.77 533	28	0.22 467	9.93 397	7	12
49	9.70 952	21	9.77 562	29	0.22 438	9.93 390	8	11
50	9.70 973	21	9.77 591	28	0.22 409	9.93 382	7	10
51	9.70 994	21	9.77 619	28	0.22 381	9.93 375	8	9
52	9.71 015	21	9.77 648	29	0.22 352	9.93 367	7	8
53	9.71 036	22	9.77 677	29	0.22 323	9.93 360	8	7
54	9.71 058	21	9.77 706	28	0.22 294	9.93 352	8	6
55	9.71 079	21	9.77 734	29	0.22 266	9.93 344	7	5
56	9.71 100	21	9.77 763	28	0.22 237	9.93 337	8	4
57	9.71 121	21	9.77 791	29	0.22 209	9.93 329	7	3
58	9.71 142	21	9.77 820	29	0.22 180	9.93 322	8	2
59	9.71 163	21	9.77 849	28	0.22 151	9.93 314	7	1
60	9.71 184		9.77 877		0.22 123	9.93 307		0
′	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	30	29	28
1	0.5	0.5	0.5
2	1.0	1.0	0.9
3	1.5	1.4	1.4
4	2.0	1.9	1.9
5	2.5	2.4	2.3
6	3.0	2.9	2.8
7	3.5	3.4	3.3
8	4.0	3.9	3.7
9	4.5	4.4	4.2
10	5.0	4.8	4.7
20	10.0	9.7	9.3
30	15.0	14.5	14.0
40	20.0	19.3	18.7
50	25.0	24.2	23.3

″	22	21
1	0.4	0.4
2	0.7	0.7
3	1.1	1.0
4	1.5	1.4
5	1.8	1.8
6	2.2	2.1
7	2.6	2.4
8	2.9	2.8
9	3.3	3.2
10	3.7	3.5
20	7.3	7.0
30	11.0	10.5
40	14.7	14.0
50	18.3	17.5

″	8	7
1	0.1	0.1
2	0.3	0.2
3	0.4	0.4
4	0.5	0.5
5	0.7	0.6
6	0.8	0.7
7	0.9	0.8
8	1.1	0.9
9	1.2	1.0
10	1.3	1.2
20	2.7	2.3
30	4.0	3.5
40	5.3	4.7
50	6.7	5.8

Proportional parts

31°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	′
0	9.71 184		9.77 877		0.22 123	9.93 307		60
1	9.71 205	21	9.77 906	29	0.22 094	9.93 299	8	59
2	9.71 226	21	9.77 935	29	0.22 065	9.93 291	8	58
3	9.71 247	21	9.77 963	28	0.22 037	9.93 284	7	57
4	9.71 268	21	9.77 992	29	0.22 008	9.93 276	8	56
		21		28			7	
5	9.71 289		9.78 020		0.21 980	9.93 269		55
6	9.71 310	21	9.78 049	29	0.21 951	9.93 261	8	54
7	9.71 331	21	9.78 077	28	0.21 923	9.93 253	8	53
8	9.71 352	21	9.78 106	29	0.21 894	9.93 246	7	52
9	9.71 373	21	9.78 135	29	0.21 865	9.93 238	8	51
		20		28			8	
10	9.71 393		9.78 163		0.21 837	9.93 230		50
11	9.71 414	21	9.78 192	29	0.21 808	9.93 223	7	49
12	9.71 435	21	9.78 220	28	0.21 780	9.93 215	8	48
13	9.71 456	21	9.78 249	29	0.21 751	9.93 207	8	47
14	9.71 477	21	9.78 277	28	0.21 723	9.93 200	7	46
		21		29			8	
15	9.71 498		9.78 306		0.21 694	9.93 192		45
16	9.71 519	21	9.78 334	28	0.21 666	9.93 184	8	44
17	9.71 539	20	9.78 363	29	0.21 637	9.93 177	7	43
18	9.71 560	21	9.78 391	28	0.21 609	9.93 169	8	42
19	9.71 581	21	9.78 419	28	0.21 581	9.93 161	8	41
		21		29			7	
20	9.71 602		9.78 448		0.21 552	9.93 154		40
21	9.71 622	20	9.78 476	28	0.21 524	9.93 146	8	39
22	9.71 643	21	9.78 505	29	0.21 495	9.93 138	8	38
23	9.71 664	21	9.78 533	28	0.21 467	9.93 131	7	37
24	9.71 685	21	9.78 562	29	0.21 438	9.93 123	8	36
		20		28			8	
25	9.71 705		9.78 590		0.21 410	9.93 115		35
26	9.71 726	21	9.78 618	28	0.21 382	9.93 108	7	34
27	9.71 747	21	9.78 647	29	0.21 353	9.93 100	8	33
28	9.71 767	20	9.78 675	28	0.21 325	9.93 092	8	32
29	9.71 788	21	9.78 704	29	0.21 296	9.93 084	8	31
		21		28			7	
30	9.71 809		9.78 732		0.21 268	9.93 077		30
31	9.71 829	20	9.78 760	28	0.21 240	9.93 069	8	29
32	9.71 850	21	9.78 789	29	0.21 211	9.93 061	8	28
33	9.71 870	20	9.78 817	28	0.21 183	9.93 053	8	27
34	9.71 891	21	9.78 845	28	0.21 155	9.93 046	7	26
		20		29			8	
35	9.71 911		9.78 874		0.21 126	9.93 038		25
36	9.71 932	21	9.78 902	28	0.21 098	9.93 030	8	24
37	9.71 952	20	9.78 930	28	0.21 070	9.93 022	8	23
38	9.71 973	21	9.78 959	29	0.21 041	9.93 014	8	22
39	9.71 994	21	9.78 987	28	0.21 013	9.93 007	7	21
		20		28			8	
40	9.72 014		9.79 015		0.20 985	9.92 999		20
41	9.72 034	20	9.79 043	28	0.20 957	9.92 991	8	19
42	9.72 055	21	9.79 072	29	0.20 928	9.92 983	8	18
43	9.72 075	20	9.79 100	28	0.20 900	9.92 976	7	17
44	9.72 096	21	9.79 128	28	0.20 872	9.92 968	8	16
		20		28			8	
45	9.72 116		9.79 156		0.20 844	9.92 960		15
46	9.72 137	21	9.79 185	29	0.20 815	9.92 952	8	14
47	9.72 157	20	9.79 213	28	0.20 787	9.92 944	8	13
48	9.72 177	20	9.79 241	28	0.20 759	9.92 936	8	12
49	9.72 198	21	9.79 269	28	0.20 731	9.92 929	7	11
		20		28			8	
50	9.72 218		9.79 297		0.20 703	9.92 921		10
51	9.72 238	20	9.79 326	29	0.20 674	9.92 913	8	9
52	9.72 259	21	9.79 354	28	0.20 646	9.92 905	8	8
53	9.72 279	20	9.79 382	28	0.20 618	9.92 897	8	7
54	9.72 299	20	9.79 410	28	0.20 590	9.92 889	8	6
		21		28			8	
55	9.72 320		9.79 438		0.20 562	9.92 881		5
56	9.72 340	20	9.79 466	28	0.20 534	9.92 874	7	4
57	9.72 360	20	9.79 495	29	0.20 505	9.92 866	8	3
58	9.72 381	21	9.79 523	28	0.20 477	9.92 858	8	2
59	9.72 401	20	9.79 551	28	0.20 449	9.92 850	8	1
		20		28			8	
60	9.72 421		9.79 579		0.20 421	9.92 842		0
′	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts		
″	29	28
1	0.5	0.5
2	1.0	0.9
3	1.4	1.4
4	1.9	1.9
5	2.4	2.3
6	2.9	2.8
7	3.4	3.3
8	3.9	3.7
9	4.4	4.2
10	4.8	4.7
20	9.7	9.3
30	14.5	14.0
40	19.3	18.7
50	24.2	23.3

Proportional parts		
″	21	20
1	0.4	0.3
2	0.7	0.7
3	1.0	1.0
4	1.4	1.3
5	1.8	1.7
6	2.1	2.0
7	2.4	2.3
8	2.8	2.7
9	3.2	3.0
10	3.5	3.3
20	7.0	6.7
30	10.5	10.0
40	14.0	13.3
50	17.5	16.7

Proportional parts		
″	8	7
1	0.1	0.1
2	0.3	0.2
3	0.4	0.4
4	0.5	0.5
5	0.7	0.6
6	0.8	0.7
7	0.9	0.8
8	1.1	0.9
9	1.2	1.0
10	1.3	1.2
20	2.7	2.3
30	4.0	3.5
40	5.3	4.7
50	6.7	5.8

32°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.72 421	20	9.79 579	28	0.20 421	9.92 842	8	60
1	9.72 441	20	9.79 607	28	0.20 393	9.92 834	8	59
2	9.72 461	21	9.79 635	28	0.20 365	9.92 826	8	58
3	9.72 482	20	9.79 663	28	0.20 337	9.92 818	8	57
4	9.72 502	20	9.79 691	28	0.20 309	9.92 810	8	56
5	9.72 522	20	9.79 719	28	0.20 281	9.92 803	8	55
6	9.72 542	20	9.79 747	29	0.20 253	9.92 795	8	54
7	9.72 562	20	9.79 776	28	0.20 224	9.92 787	8	53
8	9.72 582	20	9.79 804	28	0.20 196	9.92 779	8	52
9	9.72 602	20	9.79 832	28	0.20 168	9.92 771	8	51
10	9.72 622	21	9.79 860	28	0.20 140	9.92 763	8	50
11	9.72 643	20	9.79 888	28	0.20 112	9.92 755	8	49
12	9.72 663	20	9.79 916	28	0.20 084	9.92 747	8	48
13	9.72 683	20	9.79 944	28	0.20 056	9.92 739	8	47
14	9.72 703	20	9.79 972	28	0.20 028	9.92 731	8	46
15	9.72 723	20	9.80 000	28	0.20 000	9.92 723	8	45
16	9.72 743	20	9.80 028	28	0.19 972	9.92 715	8	44
17	9.72 763	20	9.80 056	28	0.19 944	9.92 707	8	43
18	9.72 783	20	9.80 084	28	0.19 916	9.92 699	8	42
19	9.72 803	20	9.80 112	28	0.19 888	9.92 691	8	41
20	9.72 823	20	9.80 140	28	0.19 860	9.92 683	8	40
21	9.72 843	20	9.80 168	27	0.19 832	9.92 675	8	39
22	9.72 863	20	9.80 195	28	0.19 805	9.92 667	8	38
23	9.72 883	19	9.80 223	28	0.19 777	9.92 659	8	37
24	9.72 902	20	9.80 251	28	0.19 749	9.92 651	8	36
25	9.72 922	20	9.80 279	28	0.19 721	9.92 643	8	35
26	9.72 942	20	9.80 307	28	0.19 693	9.92 635	8	34
27	9.72 962	20	9.80 335	28	0.19 665	9.92 627	8	33
28	9.72 982	20	9.80 363	28	0.19 637	9.92 619	8	32
29	9.73 002	20	9.80 391	28	0.19 609	9.92 611	8	31
30	9.73 022	19	9.80 419	28	0.19 581	9.92 603	8	30
31	9.73 041	20	9.80 447	27	0.19 553	9.92 595	8	29
32	9.73 061	20	9.80 474	28	0.19 526	9.92 587	8	28
33	9.73 081	20	9.80 502	28	0.19 498	9.92 579	8	27
34	9.73 101	20	9.80 530	28	0.19 470	9.92 571	8	26
35	9.73 121	19	9.80 558	28	0.19 442	9.92 563	8	25
36	9.73 140	20	9.80 586	28	0.19 414	9.92 555	9	24
37	9.73 160	20	9.80 614	28	0.19 386	9.92 546	8	23
38	9.73 180	20	9.80 642	27	0.19 358	9.92 538	8	22
39	9.73 200	19	9.80 669	28	0.19 331	9.92 530	8	21
40	9.73 219	20	9.80 697	28	0.19 303	9.92 522	8	20
41	9.73 239	20	9.80 725	28	0.19 275	9.92 514	8	19
42	9.73 259	19	9.80 753	28	0.19 247	9.92 506	8	18
43	9.73 278	20	9.80 781	27	0.19 219	9.92 498	8	17
44	9.73 298	20	9.80 808	28	0.19 192	9.92 490	8	16
45	9.73 318	19	9.80 836	28	0.19 164	9.92 482	9	15
46	9.73 337	20	9.80 864	28	0.19 136	9.92 473	8	14
47	9.73 357	20	9.80 892	27	0.19 108	9.92 465	8	13
48	9.73 377	19	9.80 919	28	0.19 081	9.92 457	8	12
49	9.73 396	20	9.80 947	28	0.19 053	9.92 449	8	11
50	9.73 416	19	9.80 975	28	0.19 025	9.92 441	8	10
51	9.73 435	20	9.81 003	27	0.18 997	9.92 433	8	9
52	9.73 455	19	9.81 030	28	0.18 970	9.92 425	9	8
53	9.73 474	20	9.81 058	28	0.18 942	9.92 416	8	7
54	9.73 494	19	9.81 086	27	0.18 914	9.92 408	8	6
55	9.73 513	20	9.81 113	28	0.18 887	9.92 400	8	5
56	9.73 533	19	9.81 141	28	0.18 859	9.92 392	8	4
57	9.73 552	20	9.81 169	27	0.18 831	9.92 384	8	3
58	9.73 572	19	9.81 196	28	0.18 804	9.92 376	9	2
59	9.73 591	20	9.81 224	28	0.18 776	9.92 367	8	1
60	9.73 611		9.81 252		0.18 748	9.92 359		0
′	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	29	28	27
1	0.5	0.5	0.4
2	1.0	0.9	0.9
3	1.4	1.4	1.4
4	1.9	1.9	1.8
5	2.4	2.3	2.2
6	2.9	2.8	2.7
7	3.4	3.3	3.2
8	3.9	3.7	3.6
9	4.4	4.2	4.0
10	4.8	4.7	4.5
20	9.7	9.3	9.0
30	14.5	14.0	13.5
40	19.3	18.7	18.0
50	24.2	23.3	22.5

″	21	20	19
1	0.4	0.3	0.3
2	0.7	0.7	0.6
3	1.0	1.0	1.0
4	1.4	1.3	1.3
5	1.8	1.7	1.6
6	2.1	2.0	1.9
7	2.4	2.3	2.2
8	2.8	2.7	2.5
9	3.2	3.0	2.8
10	3.5	3.3	3.2
20	7.0	6.7	6.3
30	10.5	10.0	9.5
40	14.0	13.3	12.7
50	17.5	16.7	15.8

″	9	8	7
1	0.2	0.1	0.1
2	0.3	0.3	0.2
3	0.4	0.4	0.4
4	0.6	0.5	0.5
5	0.8	0.7	0.6
6	0.9	0.8	0.7
7	1.0	0.9	0.8
8	1.2	1.1	0.9
9	1.4	1.2	1.0
10	1.5	1.3	1.2
20	3.0	2.7	2.3
30	4.5	4.0	3.5
40	6.0	5.3	4.7
50	7.5	6.7	5.8

Proportional parts

33°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	′
0	9.73 611	19	9.81 252	27	0.18 748	9.92 359	8	60
1	9.73 630	20	9.81 279	28	0.18 721	9.92 351	8	59
2	9.73 650	19	9.81 307	28	0.18 693	9.92 343	8	58
3	9.73 669	20	9.81 335	27	0.18 665	9.92 335	9	57
4	9.73 689	19	9.81 362	28	0.18 638	9.92 326	8	56
5	9.73 708	19	9.81 390	28	0.18 610	9.92 318	8	55
6	9.73 727	20	9.81 418	27	0.18 582	9.92 310	8	54
7	9.73 747	19	9.81 445	28	0.18 555	9.92 302	9	53
8	9.73 766	19	9.81 473	27	0.18 527	9.92 293	8	52
9	9.73 785	20	9.81 500	28	0.18 500	9.92 285	8	51
10	9.73 805	19	9.81 528	28	0.18 472	9.92 277	8	50
11	9.73 824	19	9.81 556	27	0.18 444	9.92 269	9	49
12	9.73 843	20	9.81 583	28	0.18 417	9.92 260	8	48
13	9.73 863	19	9.81 611	27	0.18 389	9.92 252	8	47
14	9.73 882	19	9.81 638	28	0.18 362	9.92 244	9	46
15	9.73 901	20	9.81 666	27	0.18 334	9.92 235	8	45
16	9.73 921	19	9.81 693	28	0.18 307	9.92 227	8	44
17	9.73 940	19	9.81 721	27	0.18 279	9.92 219	8	43
18	9.73 959	19	9.81 748	28	0.18 252	9.92 211	9	42
19	9.73 978	19	9.81 776	27	0.18 224	9.92 202	8	41
20	9.73 997	20	9.81 803	28	0.18 197	9.92 194	8	40
21	9.74 017	19	9.81 831	27	0.18 169	9.92 186	9	39
22	9.74 036	19	9.81 858	28	0.18 142	9.92 177	8	38
23	9.74 055	19	9.81 886	27	0.18 114	9.92 169	8	37
24	9.74 074	19	9.81 913	28	0.18 087	9.92 161	9	36
25	9.74 093	20	9.81 941	27	0.18 059	9.92 152	8	35
26	9.74 113	19	9.81 968	28	0.18 032	9.92 144	8	34
27	9.74 132	19	9.81 996	27	0.18 004	9.92 136	9	33
28	9.74 151	19	9.82 023	28	0.17 977	9.92 127	8	32
29	9.74 170	19	9.82 051	27	0.17 949	9.92 119	8	31
30	9.74 189	19	9.82 078	28	0.17 922	9.92 111	9	30
31	9.74 208	19	9.82 106	27	0.17 894	9.92 102	8	29
32	9.74 227	19	9.82 133	28	0.17 867	9.92 094	8	28
33	9.74 246	19	9.82 161	27	0.17 839	9.92 086	9	27
34	9.74 265	19	9.82 188	27	0.17 812	9.92 077	8	26
35	9.74 284	19	9.82 215	28	0.17 785	9.92 069	9	25
36	9.74 303	19	9.82 243	27	0.17 757	9.92 060	8	24
37	9.74 322	19	9.82 270	28	0.17 730	9.92 052	8	23
38	9.74 341	19	9.82 298	27	0.17 702	9.92 044	9	22
39	9.74 360	19	9.82 325	27	0.17 675	9.92 035	8	21
40	9.74 379	19	9.82 352	28	0.17 648	9.92 027	9	20
41	9.74 398	19	9.82 380	27	0.17 620	9.92 018	8	19
42	9.74 417	19	9.82 407	27	0.17 593	9.92 010	8	18
43	9.74 436	19	9.82 435	28	0.17 565	9.92 002	8	17
44	9.74 455	19	9.82 462	27	0.17 538	9.91 993	9	16
45	9.74 474	19	9.82 489	28	0.17 511	9.91 985	9	15
46	9.74 493	19	9.82 517	27	0.17 483	9.91 976	8	14
47	9.74 512	19	9.82 544	27	0.17 456	9.91 968	9	13
48	9.74 531	18	9.82 571	28	0.17 429	9.91 959	8	12
49	9.74 549	19	9.82 599	27	0.17 401	9.91 951	9	11
50	9.74 568	19	9.82 626	27	0.17 374	9.91 942	8	10
51	9.74 587	19	9.82 653	28	0.17 347	9.91 934	9	9
52	9.74 606	19	9.82 681	27	0.17 319	9.91 925	8	8
53	9.74 625	19	9.82 708	27	0.17 292	9.91 917	9	7
54	9.74 644	18	9.82 735	27	0.17 265	9.91 908	8	6
55	9.74 662	19	9.82 762	28	0.17 238	9.91 900	9	5
56	9.74 681	19	9.82 790	27	0.17 210	9.91 891	8	4
57	9.74 700	19	9.82 817	27	0.17 183	9.91 883	9	3
58	9.74 719	18	9.82 844	27	0.17 156	9.91 874	8	2
59	9.74 737	19	9.82 871	28	0.17 129	9.91 866	9	1
60	9.74 756		9.82 899		0.17 101	9.91 857		0
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	28	27
1	0.5	0.4
2	0.9	0.9
3	1.4	1.4
4	1.9	1.8
5	2.3	2.2
6	2.8	2.7
7	3.3	3.2
8	3.7	3.6
9	4.2	4.0
10	4.7	4.5
20	9.3	9.0
30	14.0	13.5
40	18.7	18.0
50	23.3	22.5

″	20	19	18
1	0.3	0.3	0.3
2	0.7	0.6	0.6
3	1.0	1.0	0.9
4	1.3	1.3	1.2
5	1.7	1.6	1.5
6	2.0	1.9	1.8
7	2.3	2.2	2.1
8	2.7	2.5	2.4
9	3.0	2.8	2.7
10	3.3	3.2	3.0
20	6.7	6.3	6.0
30	10.0	9.5	9.0
40	13.3	12.7	12.0
50	16.7	15.8	15.0

″	9	8
1	0.2	0.1
2	0.3	0.3
3	0.4	0.4
4	0.6	0.5
5	0.8	0.7
6	0.9	0.8
7	1.0	0.9
8	1.2	1.1
9	1.4	1.2
10	1.5	1.3
20	3.0	2.7
30	4.5	4.0
40	6.0	5.3
50	7.5	6.7

Proportional parts

34°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.74 756	19	9.82 899	27	0.17 101	9.91 857	8	60
1	9.74 775	19	9.82 926	27	0.17 074	9.91 849	9	59
2	9.74 794	18	9.82 953	27	0.17 047	9.91 840	8	58
3	9.74 812	19	9.82 980	28	0.17 020	9.91 832	9	57
4	9.74 831	19	9.83 008	27	0.16 992	9.91 823	8	56
5	9.74 850	18	9.83 035	27	0.16 965	9.91 815	9	55
6	9.74 868	19	9.83 062	27	0.16 938	9.91 806	8	54
7	9.74 887	19	9.83 089	28	0.16 911	9.91 798	9	53
8	9.74 906	18	9.83 117	27	0.16 883	9.91 789	8	52
9	9.74 924	19	9.83 144	27	0.16 856	9.91 781	9	51
10	9.74 943	18	9.83 171	27	0.16 829	9.91 772	9	50
11	9.74 961	19	9.83 198	27	0.16 802	9.91 763	8	49
12	9.74 980	19	9.83 225	27	0.16 775	9.91 755	9	48
13	9.74 999	18	9.83 252	28	0.16 748	9.91 746	8	47
14	9.75 017	19	9.83 280	27	0.16 720	9.91 738	9	46
15	9.75 036	18	9.83 307	27	0.16 693	9.91 729	9	45
16	9.75 054	19	9.83 334	27	0.16 666	9.91 720	8	44
17	9.75 073	18	9.83 361	27	0.16 639	9.91 712	9	43
18	9.75 091	19	9.83 388	27	0.16 612	9.91 703	8	42
19	9.75 110	18	9.83 415	27	0.16 585	9.91 695	9	41
20	9.75 128	19	9.83 442	28	0.16 558	9.91 686	9	40
21	9.75 147	18	9.83 470	27	0.16 530	9.91 677	8	39
22	9.75 165	19	9.83 497	27	0.16 503	9.91 669	9	38
23	9.75 184	18	9.83 524	27	0.16 476	9.91 660	9	37
24	9.75 202	19	9.83 551	27	0.16 449	9.91 651	8	36
25	9.75 221	18	9.83 578	27	0.16 422	9.91 643	9	35
26	9.75 239	19	9.83 605	27	0.16 395	9.91 634	9	34
27	9.75 258	18	9.83 632	27	0.16 368	9.91 625	8	33
28	9.75 276	18	9.83 659	27	0.16 341	9.91 617	9	32
29	9.75 294	19	9.83 686	27	0.16 314	9.91 608	9	31
30	9.75 313	18	9.83 713	27	0.16 287	9.91 599	9	30
31	9.75 331	19	9.83 740	28	0.16 260	9.91 591	8	29
32	9.75 350	18	9.83 768	27	0.16 232	9.91 582	9	28
33	9.75 368	18	9.83 795	27	0.16 205	9.91 573	9	27
34	9.75 386	19	9.83 822	27	0.16 178	9.91 565	8	26
35	9.75 405	18	9.83 849	27	0.16 151	9.91 556	9	25
36	9.75 423	18	9.83 876	27	0.16 124	9.91 547	9	24
37	9.75 441	18	9.83 903	27	0.16 097	9.91 538	8	23
38	9.75 459	19	9.83 930	27	0.16 070	9.91 530	9	22
39	9.75 478	18	9.83 957	27	0.16 043	9.91 521	9	21
40	9.75 496	18	9.83 984	27	0.16 016	9.91 512	8	20
41	9.75 514	19	9.84 011	27	0.15 989	9.91 504	9	19
42	9.75 533	18	9.84 038	27	0.15 962	9.91 495	9	18
43	9.75 551	18	9.84 065	27	0.15 935	9.91 486	9	17
44	9.75 569	18	9.84 092	27	0.15 908	9.91 477	9	16
45	9.75 587	18	9.84 119	27	0.15 881	9.91 469	8	15
46	9.75 605	19	9.84 146	27	0.15 854	9.91 460	9	14
47	9.75 624	18	9.84 173	27	0.15 827	9.91 451	9	13
48	9.75 642	18	9.84 200	27	0.15 800	9.91 442	9	12
49	9.75 660	18	9.84 227	27	0.15 773	9.91 433	9	11
50	9.75 678	18	9.84 254	26	0.15 746	9.91 425	8	10
51	9.75 696	18	9.84 280	27	0.15 720	9.91 416	9	9
52	9.75 714	19	9.84 307	27	0.15 693	9.91 407	9	8
53	9.75 733	18	9.84 334	27	0.15 666	9.91 398	9	7
54	9.75 751	18	9.84 361	27	0.15 639	9.91 389	9	6
55	9.75 769	18	9.84 388	27	0.15 612	9.91 381	9	5
56	9.75 787	18	9.84 415	27	0.15 585	9.91 372	9	4
57	9.75 805	18	9.84 442	27	0.15 558	9.91 363	9	3
58	9.75 823	18	9.84 469	27	0.15 531	9.91 354	9	2
59	9.75 841	18	9.84 496	27	0.15 504	9.91 345	9	1
60	9.75 859		9.84 523		0.15 477	9.91 336		0
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	28	27	26
1	0.5	0.4	0.4
2	0.9	0.9	0.9
3	1.4	1.4	1.3
4	1.9	1.8	1.7
5	2.3	2.2	2.2
6	2.8	2.7	2.6
7	3.3	3.2	3.0
8	3.7	3.6	3.5
9	4.2	4.0	3.9
10	4.7	4.5	4.3
20	9.3	9.0	8.7
30	14.0	13.5	13.0
40	18.7	18.0	17.3
50	23.3	22.5	21.7

″	19	18
1	0.3	0.3
2	0.6	0.6
3	1.0	0.9
4	1.3	1.2
5	1.6	1.5
6	1.9	1.8
7	2.2	2.1
8	2.5	2.4
9	2.8	2.7
10	3.2	3.0
20	6.3	6.0
30	9.5	9.0
40	12.7	12.0
50	15.8	15.0

″	9	8
1	0.2	0.1
2	0.3	0.3
3	0.4	0.4
4	0.6	0.5
5	0.8	0.7
6	0.9	0.8
7	1.0	0.9
8	1.2	1.1
9	1.4	1.2
10	1.5	1.3
20	3.0	2.7
30	4.5	4.0
40	6.0	5.3
50	7.5	6.7

Proportional parts

35°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.75 859	18	9.84 523	27	0.15 477	9.91 336	8	60
1	9.75 877	18	9.84 550	26	0.15 450	9.91 328	9	59
2	9.75 895	18	9.84 576	27	0.15 424	9.91 319	9	58
3	9.75 913	18	9.84 603	27	0.15 397	9.91 310	9	57
4	9.75 931	18	9.84 630	27	0.15 370	9.91 301	9	56
5	9.75 949	18	9.84 657	27	0.15 343	9.91 292	9	55
6	9.75 967	18	9.84 684	27	0.15 316	9.91 283	9	54
7	9.75 985	18	9.84 711	27	0.15 289	9.91 274	8	53
8	9.76 003	18	9.84 738	26	0.15 262	9.91 266	9	52
9	9.76 021	18	9.84 764	27	0.15 236	9.91 257	9	51
10	9.76 039	18	9.84 791	27	0.15 209	9.91 248	9	50
11	9.76 057	18	9.84 818	27	0.15 182	9.91 239	9	49
12	9.76 075	18	9.84 845	27	0.15 155	9.91 230	9	48
13	9.76 093	18	9.84 872	27	0.15 128	9.91 221	9	47
14	9.76 111	18	9.84 899	26	0.15 101	9.91 212	9	46
15	9.76 129	17	9.84 925	27	0.15 075	9.91 203	9	45
16	9.76 146	18	9.84 952	27	0.15 048	9.91 194	9	44
17	9.76 164	18	9.84 979	27	0.15 021	9.91 185	9	43
18	9.76 182	18	9.85 006	27	0.14 994	9.91 176	9	42
19	9.76 200	18	9.85 033	26	0.14 967	9.91 167	9	41
20	9.76 218	18	9.85 059	27	0.14 941	9.91 158	9	40
21	9.76 236	17	9.85 086	27	0.14 914	9.91 149	8	39
22	9.76 253	18	9.85 113	27	0.14 887	9.91 141	9	38
23	9.76 271	18	9.85 140	26	0.14 860	9.91 132	9	37
24	9.76 289	18	9.85 166	27	0.14 834	9.91 123	9	36
25	9.76 307	17	9.85 193	27	0.14 807	9.91 114	9	35
26	9.76 324	18	9.85 220	27	0.14 780	9.91 105	9	34
27	9.76 342	18	9.85 247	26	0.14 753	9.91 096	9	33
28	9.76 360	18	9.85 273	27	0.14 727	9.91 087	9	32
29	9.76 378	17	9.85 300	27	0.14 700	9.91 078	9	31
30	9.76 395	18	9.85 327	27	0.14 673	9.91 069	9	30
31	9.76 413	18	9.85 354	26	0.14 646	9.91 060	9	29
32	9.76 431	17	9.85 380	27	0.14 620	9.91 051	9	28
33	9.76 448	18	9.85 407	27	0.14 593	9.91 042	9	27
34	9.76 466	18	9.85 434	26	0.14 566	9.91 033	10	26
35	9.76 484	17	9.85 460	27	0.14 540	9.91 023	9	25
36	9.76 501	18	9.85 487	27	0.14 513	9.91 014	9	24
37	9.76 519	18	9.85 514	26	0.14 486	9.91 005	9	23
38	9.76 537	17	9.85 540	27	0.14 460	9.90 996	9	22
39	9.76 554	18	9.85 567	27	0.14 433	9.90 987	9	21
40	9.76 572	18	9.85 594	26	0.14 406	9.90 978	9	20
41	9.76 590	17	9.85 620	27	0.14 380	9.90 969	9	19
42	9.76 607	18	9.85 647	27	0.14 353	9.90 960	9	18
43	9.76 625	17	9.85 674	27	0.14 326	9.90 951	9	17
44	9.76 642	18	9.85 700	26	0.14 300	9.90 942	9	16
45	9.76 660	17	9.85 727	27	0.14 273	9.90 933	9	15
46	9.76 677	18	9.85 754	27	0.14 246	9.90 924	9	14
47	9.76 695	17	9.85 780	26	0.14 220	9.90 915	9	13
48	9.76 712	18	9.85 807	27	0.14 193	9.90 906	10	12
49	9.76 730	17	9.85 834	27	0.14 166	9.90 896	9	11
50	9.76 747	18	9.85 860	27	0.14 140	9.90 887	9	10
51	9.76 765	17	9.85 887	26	0.14 113	9.90 878	9	9
52	9.76 782	18	9.85 913	27	0.14 087	9.90 869	9	8
53	9.76 800	17	9.85 940	27	0.14 060	9.90 860	9	7
54	9.76 817	18	9.85 967	27	0.14 033	9.90 851	9	6
55	9.76 835	17	9.85 993	27	0.14 007	9.90 842	10	5
56	9.76 852	18	9.86 020	26	0.13 980	9.90 832	9	4
57	9.76 870	17	9.86 046	27	0.13 954	9.90 823	9	3
58	9.76 887	17	9.86 073	27	0.13 927	9.90 814	9	2
59	9.76 904	18	9.86 100	26	0.13 900	9.90 805	9	1
60	9.76 922		9.86 126		0.13 874	9.90 796		0
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	27	26	18
1	0.4	0.4	0.3
2	0.9	0.9	0.6
3	1.4	1.3	0.9
4	1.8	1.7	1.2
5	2.2	2.2	1.5
6	2.7	2.6	1.8
7	3.2	3.0	2.1
8	3.6	3.5	2.4
9	4.0	3.9	2.7
10	4.5	4.3	3.0
20	9.0	8.7	6.0
30	13.5	13.0	9.0
40	18.0	17.3	12.0
50	22.5	21.7	15.0

″	17	10
1	0.3	0.2
2	0.6	0.3
3	0.8	0.5
4	1.1	0.7
5	1.4	0.8
6	1.7	1.0
7	2.0	1.2
8	2.3	1.3
9	2.6	1.5
10	2.8	1.7
20	5.7	3.3
30	8.5	5.0
40	11.3	6.7
50	14.2	8.3

″	9	8
1	0.2	0.1
2	0.3	0.3
3	0.4	0.4
4	0.6	0.5
5	0.8	0.7
6	0.9	0.8
7	1.0	0.9
8	1.2	1.1
9	1.4	1.2
10	1.5	1.3
20	3.0	2.7
30	4.5	4.0
40	6.0	5.3
50	7.5	6.7

Proportional parts

36°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.76 922	17	9.86 126	27	0.13 874	9.90 796	9	60
1	9.76 939	18	9.86 153	26	0.13 847	9.90 787	10	59
2	9.76 957	17	9.86 179	27	0.13 821	9.90 777	9	58
3	9.76 974	17	9.86 206	26	0.13 794	9.90 768	9	57
4	9.76 991	18	9.86 232	27	0.13 768	9.90 759	9	56
5	9.77 009	17	9.86 259	26	0.13 741	9.90 750	9	55
6	9.77 026	17	9.86 285	27	0.13 715	9.90 741	10	54
7	9.77 043	18	9.86 312	26	0.13 688	9.90 731	9	53
8	9.77 061	17	9.86 338	27	0.13 662	9.90 722	9	52
9	9.77 078	17	9.86 365	27	0.13 635	9.90 713	9	51
10	9.77 095	17	9.86 392	26	0.13 608	9.90 704	10	50
11	9.77 112	18	9.86 418	27	0.13 582	9.90 694	9	49
12	9.77 130	17	9.86 445	26	0.13 555	9.90 685	9	48
13	9.77 147	17	9.86 471	27	0.13 529	9.90 676	9	47
14	9.77 164	17	9.86 498	26	0.13 502	9.90 667	10	46
15	9.77 181	18	9.86 524	27	0.13 476	9.90 657	9	45
16	9.77 199	17	9.86 551	26	0.13 449	9.90 648	9	44
17	9.77 216	17	9.86 577	26	0.13 423	9.90 639	9	43
18	9.77 233	17	9.86 603	27	0.13 397	9.90 630	10	42
19	9.77 250	18	9.86 630	26	0.13 370	9.90 620	9	41
20	9.77 268	17	9.86 656	27	0.13 344	9.90 611	9	40
21	9.77 285	17	9.86 683	26	0.13 317	9.90 602	10	39
22	9.77 302	17	9.86 709	27	0.13 291	9.90 592	9	38
23	9.77 319	17	9.86 736	26	0.13 264	9.90 583	9	37
24	9.77 336	17	9.86 762	26	0.13 238	9.90 574	9	36
25	9.77 353	17	9.86 789	26	0.13 211	9.90 565	10	35
26	9.77 370	17	9.86 815	27	0.13 185	9.90 555	9	34
27	9.77 387	18	9.86 842	26	0.13 158	9.90 546	9	33
28	9.77 405	17	9.86 868	26	0.13 132	9.90 537	10	32
29	9.77 422	17	9.86 894	27	0.13 106	9.90 527	9	31
30	9.77 439	17	9.86 921	26	0.13 079	9.90 518	9	30
31	9.77 456	17	9.86 947	27	0.13 053	9.90 509	9	29
32	9.77 473	17	9.86 974	26	0.13 026	9.90 499	10	28
33	9.77 490	17	9.87 000	27	0.13 000	9.90 490	9	27
34	9.77 507	17	9.87 027	26	0.12 973	9.90 480	10	26
35	9.77 524	17	9.87 053	26	0.12 947	9.90 471	9	25
36	9.77 541	17	9.87 079	27	0.12 921	9.90 462	10	24
37	9.77 558	17	9.87 106	26	0.12 894	9.90 452	9	23
38	9.77 575	17	9.87 132	26	0.12 868	9.90 443	9	22
39	9.77 592	17	9.87 158	27	0.12 842	9.90 434	10	21
40	9.77 609	17	9.87 185	26	0.12 815	9.90 424	9	20
41	9.77 626	17	9.87 211	27	0.12 789	9.90 415	10	19
42	9.77 643	17	9.87 238	26	0.12 762	9.90 405	9	18
43	9.77 660	17	9.87 264	26	0.12 736	9.90 396	10	17
44	9.77 677	17	9.87 290	27	0.12 710	9.90 386	9	16
45	9.77 694	17	9.87 317	26	0.12 683	9.90 377	9	15
46	9.77 711	17	9.87 343	26	0.12 657	9.90 368	10	14
47	9.77 728	16	9.87 369	27	0.12 631	9.90 358	9	13
48	9.77 744	17	9.87 396	26	0.12 604	9.90 349	10	12
49	9.77 761	17	9.87 422	26	0.12 578	9.90 339	9	11
50	9.77 778	17	9.87 448	27	0.12 552	9.90 330	10	10
51	9.77 795	17	9.87 475	26	0.12 525	9.90 320	9	9
52	9.77 812	17	9.87 501	26	0.12 499	9.90 311	10	8
53	9.77 829	17	9.87 527	27	0.12 473	9.90 301	9	7
54	9.77 846	16	9.87 554	26	0.12 446	9.90 292	10	6
55	9.77 862	17	9.87 580	26	0.12 420	9.90 282	9	5
56	9.77 879	17	9.87 606	27	0.12 394	9.90 273	10	4
57	9.77 896	17	9.87 633	26	0.12 367	9.90 263	9	3
58	9.77 913	17	9.87 659	26	0.12 341	9.90 254	10	2
59	9.77 930	16	9.87 685	26	0.12 315	9.90 244	9	1
60	9.77 946		9.87 711		0.12 289	9.90 235		0
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	27	26
1	0.4	0.4
2	0.9	0.9
3	1.4	1.3
4	1.8	1.7
5	2.2	2.2
6	2.7	2.6
7	3.2	3.0
8	3.6	3.5
9	4.0	3.9
10	4.5	4.3
20	9.0	8.7
30	13.5	13.0
40	18.0	17.3
50	22.5	21.7

″	18	17	16
1	0.3	0.3	0.3
2	0.6	0.6	0.5
3	0.9	0.8	0.8
4	1.2	1.1	1.1
5	1.5	1.4	1.3
6	1.8	1.7	1.6
7	2.1	2.0	1.9
8	2.4	2.3	2.1
9	2.7	2.6	2.4
10	3.0	2.8	2.7
20	6.0	5.7	5.3
30	9.0	8.5	8.0
40	12.0	11.3	10.7
50	15.0	14.2	13.3

″	10	9
1	0.2	0.2
2	0.3	0.3
3	0.5	0.4
4	0.7	0.6
5	0.8	0.8
6	1.0	0.9
7	1.2	1.0
8	1.3	1.2
9	1.5	1.4
10	1.7	1.5
20	3.3	3.0
30	5.0	4.5
40	6.7	6.0
50	8.3	7.5

Proportional parts

37°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.77 946	17	9.87 711	27	0.12 289	9.90 235	10	60
1	9.77 963	17	9.87 738	26	0.12 262	9.90 225	9	59
2	9.77 980	17	9.87 764	26	0.12 236	9.90 216	10	58
3	9.77 997	16	9.87 790	27	0.12 210	9.90 206	9	57
4	9.78 013	17	9.87 817	26	0.12 183	9.90 197	10	56
5	9.78 030	17	9.87 843	26	0.12 157	9.90 187	9	55
6	9.78 047	16	9.87 869	26	0.12 131	9.90 178	10	54
7	9.78 063	17	9.87 895	27	0.12 105	9.90 168	9	53
8	9.78 080	17	9.87 922	26	0.12 078	9.90 159	10	52
9	9.78 097	16	9.87 948	26	0.12 052	9.90 149	10	51
10	9.78 113	17	9.87 974	26	0.12 026	9.90 139	9	50
11	9.78 130	17	9.88 000	27	0.12 000	9.90 130	10	49
12	9.78 147	16	9.88 027	26	0.11 973	9.90 120	9	48
13	9.78 163	17	9.88 053	26	0.11 947	9.90 111	10	47
14	9.78 180	17	9.88 079	26	0.11 921	9.90 101	10	46
15	9.78 197	16	9.88 105	26	0.11 895	9.90 091	9	45
16	9.78 213	17	9.88 131	27	0.11 869	9.90 082	10	44
17	9.78 230	16	9.88 158	26	0.11 842	9.90 072	9	43
18	9.78 246	17	9.88 184	26	0.11 816	9.90 063	10	42
19	9.78 263	17	9.88 210	26	0.11 790	9.90 053	10	41
20	9.78 280	16	9.88 236	26	0.11 764	9.90 043	9	40
21	9.78 296	17	9.88 262	27	0.11 738	9.90 034	10	39
22	9.78 313	16	9.88 289	26	0.11 711	9.90 024	10	38
23	9.78 329	17	9.88 315	26	0.11 685	9.90 014	9	37
24	9.78 346	16	9.88 341	26	0.11 659	9.90 005	10	36
25	9.78 362	17	9.88 367	26	0.11 633	9.89 995	10	35
26	9.78 379	16	9.88 393	27	0.11 607	9.89 985	9	34
27	9.78 395	17	9.88 420	26	0.11 580	9.89 976	10	33
28	9.78 412	16	9.88 446	26	0.11 554	9.89 966	10	32
29	9.78 428	17	9.88 472	26	0.11 528	9.89 956	9	31
30	9.78 445	16	9.88 498	26	0.11 502	9.89 947	10	30
31	9.78 461	17	9.88 524	26	0.11 476	9.89 937	10	29
32	9.78 478	16	9.88 550	27	0.11 450	9.89 927	9	28
33	9.78 494	16	9.88 577	26	0.11 423	9.89 918	10	27
34	9.78 510	17	9.88 603	26	0.11 397	9.89 908	10	26
35	9.78 527	16	9.88 629	26	0.11 371	9.89 898	10	25
36	9.78 543	17	9.88 655	26	0.11 345	9.89 888	9	24
37	9.78 560	16	9.88 681	26	0.11 319	9.89 879	10	23
38	9.78 576	16	9.88 707	26	0.11 293	9.89 869	10	22
39	9.78 592	17	9.88 733	26	0.11 267	9.89 859	10	21
40	9.78 609	16	9.88 759	27	0.11 241	9.89 849	9	20
41	9.78 625	17	9.88 786	26	0.11 214	9.89 840	10	19
42	9.78 642	16	9.88 812	26	0.11 188	9.89 830	10	18
43	9.78 658	16	9.88 838	26	0.11 162	9.89 820	10	17
44	9.78 674	17	9.88 864	26	0.11 136	9.89 810	9	16
45	9.78 691	16	9.88 890	26	0.11 110	9.89 801	10	15
46	9.78 707	16	9.88 916	26	0.11 084	9.89 791	10	14
47	9.78 723	16	9.88 942	26	0.11 058	9.89 781	10	13
48	9.78 739	17	9.88 968	26	0.11 032	9.89 771	10	12
49	9.78 756	16	9.88 994	26	0.11 006	9.89 761	9	11
50	9.78 772	16	9.89 020	26	0.10 980	9.89 752	10	10
51	9.78 788	17	9.89 046	27	0.10 954	9.89 742	10	9
52	9.78 805	16	9.89 073	26	0.10 927	9.89 732	10	8
53	9.78 821	16	9.89 099	26	0.10 901	9.89 722	10	7
54	9.78 837	16	9.89 125	26	0.10 875	9.89 712	10	6
55	9.78 853	16	9.89 151	26	0.10 849	9.89 702	9	5
56	9.78 869	17	9.89 177	26	0.10 823	9.89 693	10	4
57	9.78 886	16	9.89 203	26	0.10 797	9.89 683	10	3
58	9.78 902	16	9.89 229	26	0.10 771	9.89 673	10	2
59	9.78 918	16	9.89 255	26	0.10 745	9.89 663	10	1
60	9.78 934		9.89 281		0.10 719	9.89 653		0
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	27	26
1	0.4	0.4
2	0.9	0.9
3	1.4	1.3
4	1.8	1.7
5	2.2	2.2
6	2.7	2.6
7	3.2	3.0
8	3.6	3.5
9	4.0	3.9
10	4.5	4.3
20	9.0	8.7
30	13.5	13.0
40	18.0	17.3
50	22.5	21.7

″	17	16
1	0.3	0.3
2	0.6	0.5
3	0.8	0.8
4	1.1	1.1
5	1.4	1.3
6	1.7	1.6
7	2.0	1.9
8	2.3	2.1
9	2.6	2.4
10	2.8	2.7
20	5.7	5.3
30	8.5	8.0
40	11.3	10.7
50	14.2	13.3

″	10	9
1	0.2	0.2
2	0.3	0.3
3	0.5	0.4
4	0.7	0.6
5	0.8	0.8
6	1.0	0.9
7	1.2	1.0
8	1.3	1.2
9	1.5	1.4
10	1.7	1.5
20	3.3	3.0
30	5.0	4.5
40	6.7	6.0
50	8.3	7.5

Proportional parts

38°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		
0	9.78 934	16	9.89 281	26	0.10 719	9.89 653	10	60	
1	9.78 950	17	9.89 307	26	0.10 693	9.89 643	10	59	
2	9.78 967	16	9.89 333	26	0.10 667	9.89 633	9	58	
3	9.78 983	16	9.89 359	26	0.10 641	9.89 624	10	57	
4	9.78 999	16	9.89 385	26	0.10 615	9.89 614	10	56	
5	9.79 015	16	9.89 411	26	0.10 589	9.89 604	10	55	
6	9.79 031	16	9.89 437	26	0.10 563	9.89 594	10	54	
7	9.79 047	16	9.89 463	26	0.10 537	9.89 584	10	53	
8	9.79 063	16	9.89 489	26	0.10 511	9.89 574	10	52	
9	9.79 079	16	9.89 515	26	0.10 485	9.89 564	10	51	
10	9.79 095	16	9.89 541	26	0.10 459	9.89 554	10	50	
11	9.79 111	17	9.89 567	26	0.10 433	9.89 544	10	49	
12	9.79 128	16	9.89 593	26	0.10 407	9.89 534	10	48	
13	9.79 144	16	9.89 619	26	0.10 381	9.89 524	10	47	
14	9.79 160	16	9.89 645	26	0.10 355	9.89 514	10	46	
15	9.79 176	16	9.89 671	26	0.10 329	9.89 504	9	45	
16	9.79 192	16	9.89 697	26	0.10 303	9.89 495	10	44	
17	9.79 208	16	9.89 723	26	0.10 277	9.89 485	10	43	
18	9.79 224	16	9.89 749	26	0.10 251	9.89 475	10	42	
19	9.79 240	16	9.89 775	26	0.10 225	9.89 465	10	41	
20	9.79 256	16	9.89 801	26	0.10 199	9.89 455	10	40	
21	9.79 272	16	9.89 827	26	0.10 173	9.89 445	10	39	
22	9.79 288	16	9.89 853	26	0.10 147	9.89 435	10	38	
23	9.79 304	16	9.89 879	26	0.10 121	9.89 425	10	37	
24	9.79 319	15	9.89 905	26	0.10 095	9.89 415	10	36	
25	9.79 335	16	9.89 931	26	0.10 069	9.89 405	10	35	
26	9.79 351	16	9.89 957	26	0.10 043	9.89 395	10	34	
27	9.79 367	16	9.89 983	26	0.10 017	9.89 385	10	33	
28	9.79 383	16	9.90 009	26	0.09 991	9.89 375	10	32	
29	9.79 399	16	9.90 035	26	0.09 965	9.89 364	11	31	
30	9.79 415	16	9.90 061	25	0.09 939	9.89 354	10	30	
31	9.79 431	16	9.90 086	26	0.09 914	9.89 344	10	29	
32	9.79 447	16	9.90 112	26	0.09 888	9.89 334	10	28	
33	9.79 463	16	9.90 138	26	0.09 862	9.89 324	10	27	
34	9.79 478	15	9.90 164	26	0.09 836	9.89 314	10	26	
35	9.79 494	16	9.90 190	26	0.09 810	9.89 304	10	25	
36	9.79 510	16	9.90 216	26	0.09 784	9.89 294	10	24	
37	9.79 526	16	9.90 242	26	0.09 758	9.89 284	10	23	
38	9.79 542	16	9.90 268	26	0.09 732	9.89 274	10	22	
39	9.79 558	15	9.90 294	26	0.09 706	9.89 264	10	21	
40	9.79 573	16	9.90 320	26	0.09 680	9.89 254	10	20	
41	9.79 589	16	9.90 346	25	0.09 654	9.89 244	11	19	
42	9.79 605	16	9.90 371	26	0.09 629	9.89 233	10	18	
43	9.79 621	16	9.90 397	26	0.09 603	9.89 223	10	17	
44	9.79 636	15	9.90 423	26	0.09 577	9.89 213	10	16	
45	9.79 652	16	9.90 449	26	0.09 551	9.89 203	10	15	
46	9.79 668	16	9.90 475	26	0.09 525	9.89 193	10	14	
47	9.79 684	16	9.90 501	26	0.09 499	9.89 183	10	13	
48	9.79 699	15	9.90 527	26	0.09 473	9.89 173	11	12	
49	9.79 715	16	9.90 553	25	0.09 447	9.89 162	10	11	
50	9.79 731	15	9.90 578	26	0.09 422	9.89 152	10	10	
51	9.79 746	16	9.90 604	26	0.09 396	9.89 142	10	9	
52	9.79 762	16	9.90 630	26	0.09 370	9.89 132	10	8	
53	9.79 778	16	9.90 656	26	0.09 344	9.89 122	10	7	
54	9.79 793	15	9.90 682	26	0.09 318	9.89 112	11	6	
55	9.79 809	16	9.90 708	26	0.09 292	9.89 101	10	5	
56	9.79 825	15	9.90 734	25	0.09 266	9.89 091	10	4	
57	9.79 840	16	9.90 759	26	0.09 241	9.89 081	10	3	
58	9.79 856	16	9.90 785	26	0.09 215	9.89 071	11	2	
59	9.79 872	15	9.90 811	26	0.09 189	9.89 060	10	1	
60	9.79 887		9.90 837		0.09 163	9.89 050		0	
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′	

Proportional parts

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17 3	16.7
50	21.7	20.8

″	17	16	15
1	0.3	0.3	0.2
2	0.6	0.5	0.5
3	0.8	0.8	0.8
4	1.1	1.1	1.0
5	1.4	1.3	1.2
6	1.7	1.6	1.5
7	2.0	1.9	1.8
8	2.3	2.1	2.0
9	2.6	2.4	2.2
10	2.8	2.7	2.5
20	5.7	5.3	5.0
30	8.5	8.0	7.5
40	11.3	10.7	10.0
50	14.2	13.3	12.5

″	11	10	9
1	0.2	0.2	0.2
2	0.4	0.3	0.3
3	0.6	0.5	0.4
4	0.7	0.7	0.6
5	0.9	0.8	0.8
6	1.1	1.0	0.9
7	1.3	1.2	1.0
8	1.5	1.3	1.2
9	1.6	1.5	1.4
10	1.8	1.7	1.5
20	3.7	3.3	3.0
30	5.5	5.0	4.5
40	7.3	6.7	6.0
50	9.2	8.3	7.5

Proportional parts

39°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		′
0	9.79 887	16	9.90 837	26	0.09 163	9.89 050	10	60	
1	9.79 903	15	9.90 863	26	0.09 137	9.89 040	10	59	
2	9.79 918	16	9.90 889	25	0.09 111	9.89 030	10	58	
3	9.79 934	16	9.90 914	26	0.09 086	9.89 020	11	57	
4	9.79 950	15	9.90 940	26	0.09 060	9.89 009	10	56	
5	9.79 965	16	9.90 966	26	0.09 034	9.88 999	10	55	
6	9.79 981	15	9.90 992	26	0.09 008	9.88 989	11	54	
7	9.79 996	16	9.91 018	25	0.08 982	9.88 978	10	53	
8	9.80 012	15	9.91 043	26	0.08 957	9.88 968	10	52	
9	9.80 027	16	9.91 069	26	0.08 931	9.88 958	10	51	
10	9.80 043	15	9.91 095	26	0.08 905	9.88 948	11	50	
11	9.80 058	16	9.91 121	26	0.08 879	9.88 937	10	49	
12	9.80 074	15	9.91 147	25	0.08 853	9.88 927	10	48	
13	9.80 089	16	9.91 172	26	0.08 828	9.88 917	11	47	
14	9.80 105	15	9.91 198	26	0.08 802	9.88 906	10	46	
15	9.80 120	16	9.91 224	26	0.08 776	9.88 896	10	45	
16	9.80 136	15	9.91 250	26	0.08 750	9.88 886	11	44	
17	9.80 151	15	9.91 276	25	0.08 724	9.88 875	10	43	
18	9.80 166	16	9.91 301	26	0.08 699	9.88 865	10	42	
19	9.80 182	15	9.91 327	26	0.08 673	9.88 855	11	41	
20	9.80 197	16	9.91 353	26	0.08 647	9.88 844	10	40	
21	9.80 213	15	9.91 379	25	0.08 621	9.88 834	10	39	
22	9.80 228	16	9.91 404	26	0.08 596	9.88 824	11	38	
23	9.80 244	15	9.91 430	26	0.08 570	9.88 813	10	37	
24	9.80 259	15	9.91 456	26	0.08 544	9.88 803	10	36	
25	9.80 274	16	9.91 482	25	0.08 518	9.88 793	11	35	
26	9.80 290	15	9.91 507	26	0.08 493	9.88 782	10	34	
27	9.80 305	15	9.91 533	26	0.08 467	9.88 772	11	33	
28	9.80 320	16	9.91 559	26	0.08 441	9.88 761	10	32	
29	9.80 336	15	9.91 585	25	0.08 415	9.88 751	10	31	
30	9.80 351	15	9.91 610	26	0.08 390	9.88 741	11	30	
31	9.80 366	16	9.91 636	26	0.08 364	9.88 730	10	29	
32	9.80 382	15	9.91 662	26	0.08 338	9.88 720	11	28	
33	9.80 397	15	9.91 688	25	0.08 312	9.88 709	10	27	
34	9.80 412	16	9.91 713	26	0.08 287	9.88 699	11	26	
35	9.80 428	15	9.91 739	26	0.08 261	9.88 688	10	25	
36	9.80 443	15	9.91 765	26	0.08 235	9.88 678	10	24	
37	9.80 458	15	9.91 791	26	0.08 209	9.88 668	11	23	
38	9.80 473	16	9.91 816	25	0.08 184	9.88 657	10	22	
39	9.80 489	15	9.91 842	26	0.08 158	9.88 647	11	21	
40	9.80 504	15	9.91 868	26	0.08 132	9.88 636	10	20	
41	9.80 519	15	9.91 893	25	0.08 107	9.88 626	10	19	
42	9.80 534	16	9.91 919	26	0.08 081	9.88 615	11	18	
43	9.80 550	15	9.91 945	26	0.08 055	9.88 605	10	17	
44	9.80 565	15	9.91 971	26	0.08 029	9.88 594	11	16	
45	9.80 580	15	9.91 996	25	0.08 004	9.88 584	10	15	
46	9.80 595	15	9.92 022	26	0.07 978	9.88 573	11	14	
47	9.80 610	15	9.92 048	26	0.07 952	9.88 563	10	13	
48	9.80 625	15	9.92 073	25	0.07 927	9.88 552	11	12	
49	9.80 641	16	9.92 099	26	0.07 901	9.88 542	10	11	
50	9.80 656	15	9.92 125	26	0.07 875	9.88 531	11	10	
51	9.80 671	15	9.92 150	25	0.07 850	9.88 521	10	9	
52	9.80 686	15	9.92 176	26	0.07 824	9.88 510	11	8	
53	9.80 701	15	9.92 202	26	0.07 798	9.88 499	11	7	
54	9.80 716	15	9.92 227	25	0.07 773	9.88 489	10	6	
55	9.80 731	15	9.92 253	26	0.07 747	9.88 478	11	5	
56	9.80 746	16	9.92 279	26	0.07 721	9.88 468	10	4	
57	9.80 762	15	9.92 304	25	0.07 696	9.88 457	11	3	
58	9.80 777	15	9.92 330	26	0.07 670	9.88 447	10	2	
59	9.80 792	15	9.92 356	26	0.07 644	9.88 436	11	1	
60	9.80 807		9.92 381	25	0.07 619	9.88 425	11	0	
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′	

Proportional parts

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	16	15
1	0.3	0.2
2	0.5	0.5
3	0.8	0.8
4	1.1	1.0
5	1.3	1.2
6	1.6	1.5
7	1.9	1.8
8	2.1	2.0
9	2.4	2.2
10	2.7	2.5
20	5.3	5.0
30	8.0	7.5
40	10.7	10.0
50	13.3	12.5

″	11	10
1	0.2	0.2
2	0.4	0.3
3	0.6	0.5
4	0.7	0.7
5	0.9	0.8
6	1.1	1.0
7	1.3	1.2
8	1.5	1.3
9	1.6	1.5
10	1.8	1.7
20	3.7	3.3
30	5.5	5.0
40	7.3	6.7
50	9.2	8.3

Proportional parts

40°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		Proportional parts
0	9.80 807	15	9.92 381	26	0.07 619	9.88 425	10	60	
1	9.80 822	15	9.92 407	26	0.07 593	9.88 415	11	59	
2	9.80 837	15	9.92 433	25	0.07 567	9.88 404	10	58	
3	9.80 852	15	9.92 458	26	0.07 542	9.88 394	11	57	
4	9.80 867	15	9.92 484	26	0.07 516	9.88 383	11	56	
5	9.80 882	15	9.92 510	25	0.07 490	9.88 372	10	55	
6	9.80 897	15	9.92 535	26	0.07 465	9.88 362	11	54	
7	9.80 912	15	9.92 561	26	0.07 439	9.88 351	11	53	
8	9.80 927	15	9.92 587	25	0.07 413	9.88 340	10	52	
9	9.80 942	15	9.92 612	26	0.07 388	9.88 330	11	51	
10	9.80 957	15	9.92 638	25	0.07 362	9.88 319	11	50	
11	9.80 972	15	9.92 663	26	0.07 337	9.88 308	10	49	
12	9.80 987	15	9.92 689	26	0.07 311	9.88 298	11	48	
13	9.81 002	15	9.92 715	25	0.07 285	9.88 287	11	47	
14	9.81 017	15	9.92 740	26	0.07 260	9.88 276	10	46	
15	9.81 032	15	9.92 766	26	0.07 234	9.88 266	11	45	
16	9.81 047	14	9.92 792	25	0.07 208	9.88 255	11	44	
17	9.81 061	15	9.92 817	26	0.07 183	9.88 244	10	43	
18	9.81 076	15	9.92 843	25	0.07 157	9.88 234	11	42	
19	9.81 091	15	9.92 868	26	0.07 132	9.88 223	11	41	
20	9.81 106	15	9.92 894	26	0.07 106	9.88 212	11	40	
21	9.81 121	15	9.92 920	25	0.07 080	9.88 201	10	39	
22	9.81 136	15	9.92 945	26	0.07 055	9.88 191	11	38	
23	9.81 151	15	9.92 971	25	0.07 029	9.88 180	11	37	
24	9.81 166	14	9.92 996	26	0.07 004	9.88 169	11	36	
25	9.81 180	15	9.93 022	26	0.06 978	9.88 158	10	35	
26	9.81 195	15	9.93 048	25	0.06 952	9.88 148	11	34	
27	9.81 210	15	9.93 073	26	0.06 927	9.88 137	11	33	
28	9.81 225	15	9.93 099	25	0.06 901	9.88 126	11	32	
29	9.81 240	14	9.93 124	26	0.06 876	9.88 115	10	31	
30	9.81 254	15	9.93 150	25	0.06 850	9.88 105	11	30	
31	9.81 269	15	9.93 175	26	0.06 825	9.88 094	11	29	
32	9.81 284	15	9.93 201	26	0.06 799	9.88 083	11	28	
33	9.81 299	15	9.93 227	25	0.06 773	9.88 072	11	27	
34	9.81 314	14	9.93 252	26	0.06 748	9.88 061	10	26	
35	9.81 328	15	9.93 278	25	0.06 722	9.88 051	11	25	
36	9.81 343	15	9.93 303	26	0.06 697	9.88 040	11	24	
37	9.81 358	14	9.93 329	25	0.06 671	9.88 029	11	23	
38	9.81 372	15	9.93 354	26	0.06 646	9.88 018	11	22	
39	9.81 387	15	9.93 380	26	0.06 620	9.88 007	11	21	
40	9.81 402	15	9.93 406	25	0.06 594	9.87 996	11	20	
41	9.81 417	14	9.93 431	26	0.06 569	9.87 985	10	19	
42	9.81 431	15	9.93 457	25	0.06 543	9.87 975	11	18	
43	9.81 446	15	9.93 482	26	0.06 518	9.87 964	11	17	
44	9.81 461	14	9.93 508	25	0.06 492	9.87 953	11	16	
45	9.81 475	15	9.93 533	26	0.06 467	9.87 942	11	15	
46	9.81 490	15	9.93 559	25	0.06 441	9.87 931	11	14	
47	9.81 505	14	9.93 584	26	0.06 416	9.87 920	11	13	
48	9.81 519	15	9.93 610	26	0.06 390	9.87 909	11	12	
49	9.81 534	15	9.93 636	25	0.06 364	9.87 898	11	11	
50	9.81 549	14	9.93 661	26	0.06 339	9.87 887	10	10	
51	9.81 563	15	9.93 687	25	0.06 313	9.87 877	11	9	
52	9.81 578	14	9.93 712	26	0.06 288	9.87 866	11	8	
53	9.81 592	15	9.93 738	26	0.06 262	9.87 855	11	7	
54	9.81 607	15	9.93 763	25	0.06 237	9.87 844	11	6	
55	9.81 622	14	9.93 789	25	0.06 211	9.87 833	11	5	
56	9.81 636	15	9.93 814	26	0.06 186	9.87 822	11	4	
57	9.81 651	14	9.93 840	25	0.06 160	9.87 811	11	3	
58	9.81 665	15	9.93 865	26	0.06 135	9.87 800	11	2	
59	9.81 680	14	9.93 891	25	0.06 109	9.87 789	11	1	
60	9.81 694		9.93 916		0.06 084	9.87 778		0	
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′	Proportional parts

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	15	14
1	0.2	0.2
2	0.5	0.5
3	0.8	0.7
4	1.0	0.9
5	1.2	1.2
6	1.5	1.4
7	1.8	1.6
8	2.0	1.9
9	2.2	2.1
10	2.5	2.3
20	5.0	4.7
30	7.5	7.0
40	10.0	9.3
50	12.5	11.7

″	11	10
1	0.2	0.2
2	0.4	0.3
3	0.5	0.5
4	0.7	0.7
5	0.9	0.8
6	1.1	1.0
7	1.3	1.2
8	1.5	1.3
9	1.6	1.5
10	1.8	1.7
20	3.7	3.3
30	5.5	5.0
40	7.3	6.7
50	9.2	8.3

41°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		′
0	9.81 694	15	9.93 916	26	0.06 084	9.87 778	11	60	0
1	9.81 709	14	9.93 942	25	0.06 058	9.87 767	11	59	1
2	9.81 723	15	9.93 967	26	0.06 033	9.87 756	11	58	2
3	9.81 738	14	9.93 993	25	0.06 007	9.87 745	11	57	3
4	9.81 752	15	9.94 018	26	0.05 982	9.87 734	11	56	4
5	9.81 767	14	9.94 044	25	0.05 956	9.87 723	11	55	5
6	9.81 781	15	9.94 069	26	0.05 931	9.87 712	11	54	6
7	9.81 796	14	9.94 095	25	0.05 905	9.87 701	11	53	7
8	9.81 810	15	9.94 120	26	0.05 880	9.87 690	11	52	8
9	9.81 825	14	9.94 146	25	0.05 854	9.87 679	11	51	9
10	9.81 839	15	9.94 171	26	0.05 829	9.87 668	11	50	10
11	9.81 854	14	9.94 197	25	0.05 803	9.87 657	11	49	11
12	9.81 868	14	9.94 222	26	0.05 778	9.87 646	11	48	12
13	9.81 882	15	9.94 248	25	0.05 752	9.87 635	11	47	13
14	9.81 897	14	9.94 273	26	0.05 727	9.87 624	11	46	14
15	9.81 911	15	9.94 299	25	0.05 701	9.87 613	12	45	15
16	9.81 926	14	9.94 324	26	0.05 676	9.87 601	11	44	16
17	9.81 940	15	9.94 350	25	0.05 650	9.87 590	11	43	17
18	9.81 955	14	9.94 375	26	0.05 625	9.87 579	11	42	18
19	9.81 969	14	9.94 401	25	0.05 599	9.87 568	11	41	19
20	9.81 983	15	9.94 426	26	0.05 574	9.87 557	11	40	20
21	9.81 998	14	9.94 452	25	0.05 548	9.87 546	11	39	21
22	9.82 012	14	9.94 477	26	0.05 523	9.87 535	11	38	22
23	9.82 026	15	9.94 503	25	0.05 497	9.87 524	11	37	23
24	9.82 041	14	9.94 528	26	0.05 472	9.87 513	12	36	24
25	9.82 055	14	9.94 554	25	0.05 446	9.87 501	11	35	25
26	9.82 069	15	9.94 579	25	0.05 421	9.87 490	11	34	26
27	9.82 084	14	9.94 604	26	0.05 396	9.87 479	11	33	27
28	9.82 098	14	9.94 630	25	0.05 370	9.87 468	11	32	28
29	9.82 112	14	9.94 655	26	0.05 345	9.87 457	11	31	29
30	9.82 126	15	9.94 681	25	0.05 319	9.87 446	12	30	30
31	9.82 141	14	9.94 706	26	0.05 294	9.87 434	11	29	31
32	9.82 155	14	9.94 732	25	0.05 268	9.87 423	11	28	32
33	9.82 169	15	9.94 757	26	0.05 243	9.87 412	11	27	33
34	9.82 184	14	9.94 783	25	0.05 217	9.87 401	11	26	34
35	9.82 198	14	9.94 808	26	0.05 192	9.87 390	12	25	35
36	9.82 212	14	9.94 834	25	0.05 166	9.87 378	11	24	36
37	9.82 226	14	9.94 859	25	0.05 141	9.87 367	11	23	37
38	9.82 240	15	9.94 884	26	0.05 116	9.87 356	11	22	38
39	9.82 255	14	9.94 910	25	0.05 090	9.87 345	11	21	39
40	9.82 269	14	9.94 935	26	0.05 065	9.87 334	12	20	40
41	9.82 283	14	9.94 961	25	0.05 039	9.87 322	11	19	41
42	9.82 297	14	9.94 986	25	0.05 014	9.87 311	11	18	42
43	9.82 311	15	9.95 012	26	0.04 988	9.87 300	11	17	43
44	9.82 326	14	9.95 037	25	0.04 963	9.87 288	12	16	44
45	9.82 340	14	9.95 062	25	0.04 938	9.87 277	11	15	45
46	9.82 354	14	9.95 088	25	0.04 912	9.87 266	11	14	46
47	9.82 368	14	9.95 113	26	0.04 887	9.87 255	12	13	47
48	9.82 382	14	9.95 139	25	0.04 861	9.87 243	11	12	48
49	9.82 396	14	9.95 164	26	0.04 836	9.87 232	11	11	49
50	9.82 410	14	9.95 190	25	0.04 810	9.87 221	12	10	50
51	9.82 424	15	9.95 215	25	0.04 785	9.87 209	11	9	51
52	9.82 439	14	9.95 240	26	0.04 760	9.87 198	11	8	52
53	9.82 453	14	9.95 266	25	0.04 734	9.87 187	12	7	53
54	9.82 467	14	9.95 291	26	0.04 709	9.87 175	11	6	54
55	9.82 481	14	9.95 317	25	0.04 683	9.87 164	11	5	55
56	9.82 495	14	9.95 342	26	0.04 658	9.87 153	12	4	56
57	9.82 509	14	9.95 368	25	0.04 632	9.87 141	11	3	57
58	9.82 523	14	9.95 393	25	0.04 607	9.87 130	11	2	58
59	9.82 537	14	9.95 418	26	0.04 582	9.87 119	12	1	59
60	9.82 551		9.95 444		0.04 556	9.87 107		0	60
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′	

Proportional parts

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	15	14
1	0.2	0.2
2	0.5	0.5
3	0.8	0.7
4	1.0	0.9
5	1.2	1.2
6	1.5	1.4
7	1.8	1.6
8	2.0	1.9
9	2.2	2.1
10	2.5	2.3
20	5.0	4.7
30	7.5	7.0
40	10.0	9.3
50	12.5	11.7

″	12	11
1	0.2	0.2
2	0.4	0.4
3	0.6	0.6
4	0.8	0.7
5	1.0	0.9
6	1.2	1.1
7	1.4	1.3
8	1.6	1.5
9	1.8	1.6
10	2.0	1.8
20	4.0	3.7
30	6.0	5.5
40	8.0	7.3
50	10.0	9.2

Proportional parts

42°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		′
0	9.82 551	14	9.95 444	25	0.04 556	9.87 107	11	60	0
1	9.82 565	14	9.95 469	26	0.04 531	9.87 096	11	59	1
2	9.82 579	14	9.95 495	25	0.04 505	9.87 085	12	58	2
3	9.82 593	14	9.95 520	25	0.04 480	9.87 073	11	57	3
4	9.82 607	14	9.95 545	26	0.04 455	9.87 062	12	56	4
5	9.82 621	14	9.95 571	25	0.04 429	9.87 050	11	55	5
6	9.82 635	14	9.95 596	26	0.04 404	9.87 039	11	54	6
7	9.82 649	14	9.95 622	25	0.04 378	9.87 028	12	53	7
8	9.82 663	14	9.95 647	25	0.04 353	9.87 016	11	52	8
9	9.82 677	14	9.95 672	26	0.04 328	9.87 005	12	51	9
10	9.82 691	14	9.95 698	25	0.04 302	9.86 993	11	50	10
11	9.82 705	14	9.95 723	25	0.04 277	9.86 982	12	49	11
12	9.82 719	14	9.95 748	26	0.04 252	9.86 970	11	48	12
13	9.82 733	14	9.95 774	25	0.04 226	9.86 959	12	47	13
14	9.82 747	14	9.95 799	26	0.04 201	9.86 947	11	46	14
15	9.82 761	14	9.95 825	25	0.04 175	9.86 936	12	45	15
16	9.82 775	13	9.95 850	25	0.04 150	9.86 924	11	44	16
17	9.82 788	14	9.95 875	26	0.04 125	9.86 913	11	43	17
18	9.82 802	14	9.95 901	25	0.04 099	9.86 902	12	42	18
19	9.82 816	14	9.95 926	26	0.04 074	9.86 890	11	41	19
20	9.82 830	14	9.95 952	25	0.04 048	9.86 879	12	40	20
21	9.82 844	14	9.95 977	25	0.04 023	9.86 867	12	39	21
22	9.82 858	14	9.96 002	26	0.03 998	9.86 855	11	38	22
23	9.82 872	13	9.96 028	25	0.03 972	9.86 844	12	37	23
24	9.82 885	14	9.96 053	25	0.03 947	9.86 832	11	36	24
25	9.82 899	14	9.96 078	26	0.03 922	9.86 821	12	35	25
26	9.82 913	14	9.96 104	25	0.03 896	9.86 809	11	34	26
27	9.82 927	14	9.96 129	26	0.03 871	9.86 798	12	33	27
28	9.82 941	14	9.96 155	25	0.03 845	9.86 786	11	32	28
29	9.82 955	13	9.96 180	25	0.03 820	3.86 775	12	31	29
30	9.82 968	14	9.96 205	26	0.03 795	9.86 763	11	30	30
31	9.82 982	14	9.96 231	25	0.03 769	9.86 752	12	29	31
32	9.82 996	14	9.96 256	25	0.03 744	9.86 740	12	28	32
33	9.83 010	14	9.96 281	26	0.03 719	9.86 728	11	27	33
34	9.83 023	13	9.96 307	25	0.03 693	9.86 717	12	26	34
35	9.83 037	14	9.96 332	25	0.03 668	9.86 705	11	25	35
36	9.83 051	14	9.96 357	26	0.03 643	9.86 694	12	24	36
37	9.83 065	14	9.96 383	25	0.03 617	9.86 682	12	23	37
38	9.83 078	13	9.96 408	25	0.03 592	9.86 670	11	22	38
39	9.83 092	14	9.96 433	26	0.03 567	9.86 659	12	21	39
40	9.83 106	14	9.96 459	25	0.03 541	9.86 647	12	20	40
41	9.83 120	14	9.96 484	25	0.03 516	9.86 635	12	19	41
42	9.83 133	13	9.96 510	26	0.03 490	9.86 624	11	18	42
43	9.83 147	14	9.96 535	25	0.03 465	9.86 612	12	17	43
44	9.83 161	14	9.96 560	25	0.03 440	9.86 600	12	16	44
45	9.83 174	13	9.96 586	26	0.03 414	9.86 589	11	15	45
46	9.83 188	14	9.96 611	25	0.03 389	9.86 577	12	14	46
47	9.83 202	14	9.96 636	25	0.03 364	9.86 565	12	13	47
48	9.83 215	13	9.96 662	26	0.03 338	9.86 554	11	12	48
49	9.83 229	14	9.96 687	25	0.03 313	9.86 542	12	11	49
50	9.83 242	13	9.96 712	25	0.03 288	9.86 530	12	10	50
51	9.83 256	14	9.96 738	26	0.03 262	9.86 518	11	9	51
52	9.83 270	14	9.96 763	25	0.03 237	9.86 507	12	8	52
53	9.83 283	13	9.96 788	25	0.03 212	9.86 495	12	7	53
54	9.83 297	14	9.96 814	26	0.03 186	9.86 483	12	6	54
55	9.83 310	13	9.96 839	25	0.03 161	9.86 472	11	5	55
56	9.83 324	14	9.96 864	25	0.03 136	9.86 460	12	4	56
57	9.83 338	14	9.96 890	26	0.03 110	9.86 448	12	3	57
58	9.83 351	13	9.96 915	25	0.03 085	9.86 436	12	2	58
59	9.83 365	14	9.96 940	25	0.03 060	9.86 425	11	1	59
60	9.83 378	13	9.96 966	26	0.03 034	9.86 413	12	0	60
′	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′	

Proportional parts

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	14	13
1	0.2	0.2
2	0.5	0.4
3	0.7	0.6
4	0.9	0.9
5	1.2	1.1
6	1.4	1.3
7	1.6	1.5
8	1.9	1.7
9	2.1	2.0
10	2.3	2.2
20	4.7	4.3
30	7.0	6.5
40	9.3	8.7
50	11.7	10.8

″	12	11
1	0.2	0.2
2	0.4	0.4
3	0.6	0.6
4	0.8	0.7
5	1.0	0.9
6	1.2	1.1
7	1.4	1.3
8	1.6	1.5
9	1.8	1.6
10	2.0	1.8
20	4.0	3.7
30	6.0	5.5
40	8.0	7.3
50	10.0	9.2

Proportional parts

43°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d		′
0	9.83 378	14	9.96 966	25	0.03 034	9.86 413	12	60	0
1	9.83 392	13	9.96 991	25	0.03 009	9.86 401	12	59	1
2	9.83 405	14	9.97 016	26	0.02 984	9.86 389	12	58	2
3	9.83 419	13	9.97 042	25	0.02 958	9.86 377	11	57	3
4	9.83 432	14	9.97 067	25	0.02 933	9.86 366	12	56	4
5	9.83 446	13	9.97 092	26	0.02 908	9.86 354	12	55	5
6	9.83 459	14	9.97 118	25	0.02 882	9.86 342	12	54	6
7	9.83 473	13	9.97 143	25	0.02 857	9.86 330	12	53	7
8	9.83 486	14	9.97 168	25	0.02 832	9.86 318	12	52	8
9	9.83 500	13	9.97 193	26	0.02 807	9.86 306	11	51	9
10	9.83 513	14	9.97 219	25	0.02 781	9.86 295	12	50	10
11	9.83 527	13	9.97 244	25	0.02 756	9.86 283	12	49	11
12	9.83 540	14	9.97 269	26	0.02 731	9.86 271	12	48	12
13	9.83 554	13	9.97 295	25	0.02 705	9.86 259	12	47	13
14	9.83 567	14	9.97 320	25	0.02 680	9.86 247	12	46	14
15	9.83 581	13	9.97 345	26	0.02 655	9.86 235	12	45	15
16	9.83 594	14	9.97 371	25	0.02 629	9.86 223	12	44	16
17	9.83 608	13	9.97 396	25	0.02 604	9.86 211	11	43	17
18	9.83 621	13	9.97 421	26	0.02 579	9.86 200	12	42	18
19	9.83 634	14	9.97 447	25	0.02 553	9.86 188	12	41	19
20	9.83 648	13	9.97 472	25	0.02 528	9.86 176	12	40	20
21	9.83 661	13	9.97 497	26	0.02 503	9.86 164	12	39	21
22	9.83 674	14	9.97 523	25	0.02 477	9.86 152	12	38	22
23	9.83 688	13	9.97 548	25	0.02 452	9.86 140	12	37	23
24	9.83 701	14	9.97 573	25	0.02 427	9.86 128	12	36	24
25	9.83 715	13	9.97 598	26	0.02 402	9.86 116	12	35	25
26	9.83 728	13	9.97 624	25	0.02 376	9.86 104	12	34	26
27	9.83 741	14	9.97 649	25	0.02 351	9.86 092	12	33	27
28	9.83 755	13	9.97 674	26	0.02 326	9.86 080	12	32	28
29	9.83 768	13	9.97 700	25	0.02 300	9.86 068	12	31	29
30	9.83 781	14	9.97 725	25	0.02 275	9.86 056	12	30	30
31	9.83 795	13	9.97 750	26	0.02 250	9.86 044	12	29	31
32	9.83 808	13	9.97 776	25	0.02 224	9.86 032	12	28	32
33	9.83 821	13	9.97 801	25	0.02 199	9.86 020	12	27	33
34	9.83 834	14	9.97 826	25	0.02 174	9.86 008	12	26	34
35	9.83 848	13	9.97 851	26	0.02 149	9.85 996	12	25	35
36	9.83 861	13	9.97 877	25	0.02 123	9.85 984	12	24	36
37	9.83 874	13	9.97 902	25	0.02 098	9.85 972	12	23	37
38	9.83 887	14	9.97 927	26	0.02 073	9.85 960	12	22	38
39	9.83 901	13	9.97 953	25	0.02 047	9.85 948	12	21	39
40	9.83 914	13	9.97 978	25	0.02 022	9.85 936	12	20	40
41	9.83 927	13	9.98 003	26	0.01 997	9.85 924	12	19	41
42	9.83 940	14	9.98 029	25	0.01 971	9.85 912	12	18	42
43	9.83 954	13	9.98 054	25	0.01 946	9.85 900	12	17	43
44	9.83 967	13	9.98 079	25	0.01 921	9.85 888	12	16	44
45	9.83 980	13	9.98 104	26	0.01 896	9.85 876	12	15	45
46	9.83 993	13	9.98 130	25	0.01 870	9.85 864	13	14	46
47	9.84 006	14	9.98 155	25	0.01 845	9.85 851	12	13	47
48	9.84 020	13	9.98 180	26	0.01 820	9.85 839	12	12	48
49	9.84 033	13	9.98 206	25	0.01 794	9.85 827	12	11	49
50	9.84 046	13	9.98 231	25	0.01 769	9.85 815	12	10	50
51	9.84 059	13	9.98 256	25	0.01 744	9.85 803	12	9	51
52	9.84 072	13	9.98 281	26	0.01 719	9.85 791	12	8	52
53	9.84 085	13	9.98 307	25	0.01 693	9.85 779	13	7	53
54	9.84 098	14	9.98 332	25	0.01 668	9.85 766	12	6	54
55	9.84 112	13	9.98 357	26	0.01 643	9.85 754	12	5	55
56	9.84 125	13	9.98 383	25	0.01 617	9.85 742	12	4	56
57	9.84 138	13	9.98 408	25	0.01 592	9.85 730	12	3	57
58	9.84 151	13	9.98 433	25	0.01 567	9.85 718	12	2	58
59	9.84 164	13	9.98 458	26	0.01 542	9.85 706	13	1	59
60	9.84 177		9.98 484		0.01 516	9.85 693		0	60
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′	

Proportional parts		
″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.6	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

Proportional parts		
″	14	13
1	0.2	0.2
2	0.5	0.4
3	0.7	0.6
4	0.9	0.9
5	1.2	1.1
6	1.4	1.3
7	1.6	1.5
8	1.9	1.7
9	2.1	2.0
10	2.3	2.2
20	4.7	4.3
30	7.0	6.5
40	9.3	8.7
50	11.7	10.8

Proportional parts		
″	12	11
1	0.2	0.2
2	0.4	0.4
3	0.6	0.6
4	0.8	0.7
5	1.0	0.9
6	1.2	1.1
7	1.4	1.3
8	1.6	1.5
9	1.8	1.6
10	2.0	1.8
20	4.0	3.7
30	6.0	5.5
40	8.0	7.3
50	10.0	9.2

44°—LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

′	L Sin	d	L Tan	c d	L Ctn	L Cos	d	
0	9.84 177	13	9.98 484	25	0.01 516	9.85 693	12	60
1	9.84 190	13	9.98 509	25	0.01 491	9.85 681	12	59
2	9.84 203	13	9.98 534	26	0.01 466	9.85 669	12	58
3	9.84 216	13	9.98 560	25	0.01 440	9.85 657	12	57
4	9.84 229	13	9.98 585	25	0.01 415	9.85 645	13	56
5	9.84 242	13	9.98 610	25	0.01 390	9.85 632	12	55
6	9.84 255	14	9.98 635	26	0.01 365	9.85 620	12	54
7	9.84 269	13	9.98 661	25	0.01 339	9.85 608	12	53
8	9.84 282	13	9.98 686	25	0.01 314	9.85 596	13	52
9	9.84 295	13	9.98 711	26	0.01 289	9.85 583	12	51
10	9.84 308	13	9.98 737	25	0.01 263	9.85 571	12	50
11	9.84 321	13	9.98 762	25	0.01 238	9.85 559	12	49
12	9.84 334	13	9.98 787	25	0.01 213	9.85 547	13	48
13	9.84 347	13	9.98 812	26	0.01 188	9.85 534	12	47
14	9.84 360	13	9.98 838	25	0.01 162	9.85 522	12	46
15	9.84 373	12	9.98 863	25	0.01 137	9.85 510	13	45
16	9.84 385	13	9.98 888	25	0.01 112	9.85 497	12	44
17	9.84 398	13	9.98 913	26	0.01 087	9.85 485	12	43
18	9.84 411	13	9.98 939	25	0.01 061	9.85 473	13	42
19	9.84 424	13	9.98 964	25	0.01 036	9.85 460	12	41
20	9.84 437	13	9.98 989	26	0.01 011	9.85 448	12	40
21	9.84 450	13	9.99 015	25	0.00 985	9.85 436	13	39
22	9.84 463	13	9.99 040	25	0.00 960	9.85 423	12	38
23	9.84 476	13	9.99 065	25	0.00 935	9.85 411	12	37
24	9.84 489	13	9.99 090	26	0.00 910	9.85 399	13	36
25	9.84 502	13	9.99 116	25	0.00 884	9.85 386	12	35
26	9.84 515	13	9.99 141	25	0.00 859	9.85 374	13	34
27	9.84 528	12	9.99 166	25	0.00 834	9.85 361	12	33
28	9.84 540	13	9.99 191	26	0.00 809	9.85 349	12	32
29	9.84 553	13	9.99 217	25	0.00 783	9.85 337	13	31
30	9.84 566	13	9.99 242	25	0.00 758	9.85 324	12	30
31	9.84 579	13	9.99 267	26	0.00 733	9.85 312	13	29
32	9.84 592	13	9.99 293	25	0.00 707	9.85 299	12	28
33	9.84 605	13	9.99 318	25	0.00 682	9.85 287	13	27
34	9.84 618	12	9.99 343	25	0.00 657	9.85 274	12	26
35	9.84 630	13	9.99 368	26	0.00 632	9.85 262	12	25
36	9.84 643	13	9.99 394	25	0.00 606	9.85 250	13	24
37	9.84 656	13	9.99 419	25	0.00 581	9.85 237	12	23
38	9.84 669	13	9.99 444	25	0.00 556	9.85 225	13	22
39	9.84 682	12	9.99 469	26	0.00 531	9.85 212	12	21
40	9.84 694	13	9.99 495	25	0.00 505	9.85 200	13	20
41	9.84 707	13	9.99 520	25	0.00 480	9.85 187	12	19
42	9.84 720	13	9.99 545	25	0.00 455	9.85 175	13	18
43	9.84 733	12	9.99 570	26	0.00 430	9.85 162	12	17
44	9.84 745	13	9.99 596	25	0.00 404	9.85 150	13	16
45	9.84 758	13	9.99 621	25	0.00 379	9.85 137	12	15
46	9.84 771	13	9.99 646	26	0.00 354	9.85 125	13	14
47	9.84 784	12	9.99 672	25	0.00 328	9.85 112	12	13
48	9.84 796	13	9.99 697	25	0.00 303	9.85 100	13	12
49	9.84 809	13	9.99 722	25	0.00 278	9.85 087	13	11
50	9.84 822	13	9.99 747	26	0.00 253	9.85 074	12	10
51	9.84 835	12	9.99 773	25	0.00 227	9.85 062	13	9
52	9.84 847	13	9.99 798	25	0.00 202	9.85 049	12	8
53	9.84 860	13	9.99 823	25	0.00 177	9.85 037	13	7
54	9.84 873	12	9.99 848	26	0.00 152	9.85 024	12	6
55	9.84 885	13	9.99 874	25	0.00 126	9.85 012	13	5
56	9.84 898	13	9.99 899	25	0.00 101	9.84 999	13	4
57	9.84 911	12	9.99 924	25	0.00 076	9.84 986	12	3
58	9.84 923	13	9.99 949	26	0.00 051	9.84 974	13	2
59	9.84 936	13	9.99 975	25	0.00 025	9.84 961	12	1
60	9.84 949		0.00 000		0.00 000	9.84 949		0
	L Cos	d	L Ctn	c d	L Tan	L Sin	d	′

Proportional parts

″	26	25
1	0.4	0.4
2	0.9	0.8
3	1.3	1.2
4	1.7	1.7
5	2.2	2.1
6	2.5	2.5
7	3.0	2.9
8	3.5	3.3
9	3.9	3.8
10	4.3	4.2
20	8.7	8.3
30	13.0	12.5
40	17.3	16.7
50	21.7	20.8

″	14	13	12
1	0.2	0.2	0.2
2	0.5	0.4	0.4
3	0.7	0.6	0.6
4	0.9	0.9	0.8
5	1.2	1.1	1.0
6	1.4	1.3	1.2
7	1.6	1.5	1.4
8	1.9	1.7	1.6
9	2.1	2.0	1.8
10	2.3	2.2	2.0
20	4.7	4.3	4.0
30	7.0	6.5	6.0
40	9.3	8.7	8.0
50	11.7	10.8	10.0

Proportional parts

Table V

NATURAL TRIGONOMETRIC FUNCTIONS

0°				179°	1°				178°
′	Sin	Tan	Ctn	Cos	′	Sin	Tan	Ctn	Cos	′
0	.00000	.00000	———	1.0000	60	.01745	.01746	57.290	.99985	60
1	.00029	.00029	3437.7	1.0000	59	.01774	.01775	56.351	.99984	59
2	.00058	.00058	1718.9	1.0000	58	.01803	.01804	55.442	.99984	58
3	.00087	.00087	1145.9	1.0000	57	.01832	.01833	54.561	.99983	57
4	.00116	.00116	859.44	1.0000	56	.01862	.01862	53.709	.99983	56
5	.00145	.00145	687.55	1.0000	55	.01891	.01891	52.882	.99982	55
6	.00175	.00175	572.96	1.0000	54	.01920	.01920	52.081	.99982	54
7	.00204	.00204	491.11	1.0000	53	.01949	.01949	51.303	.99981	53
8	.00233	.00233	429.72	1.0000	52	.01978	.01978	50.549	.99980	52
9	.00262	.00262	381.97	1.0000	51	.02007	.02007	49.816	.99980	51
10	.00291	.00291	343.77	1.0000	50	.02036	.02036	49.104	.99979	50
11	.00320	.00320	312.52	.99999	49	.02065	.02066	48.412	.99979	49
12	.00349	.00349	286.48	.99999	48	.02094	.02095	47.740	.99978	48
13	.00378	.00378	264.44	.99999	47	.02123	.02124	47.085	.99977	47
14	.00407	.00407	245.55	.99999	46	.02152	.02153	46.449	.99977	46
15	.00436	.00436	229.18	.99999	45	.02181	.02182	45.829	.99976	45
16	.00465	.00465	214.86	.99999	44	.02211	.02211	45.226	.99976	44
17	.00495	.00495	202.22	.99999	43	.02240	.02240	44.639	.99975	43
18	.00524	.00524	190.98	.99999	42	.02269	.02269	44.066	.99974	42
19	.00553	.00553	180.93	.99998	41	.02298	.02298	43.508	.99974	41
20	.00582	.00582	171.89	.99998	40	.02327	.02328	42.964	.99973	40
21	.00611	.00611	163.70	.99998	39	.02356	.02357	42.433	.99972	39
22	.00640	.00640	156.26	.99998	38	.02385	.02386	41.916	.99972	38
23	.00669	.00669	149.47	.99998	37	.02414	.02415	41.411	.99971	37
24	.00698	.00698	143.24	.99998	36	.02443	.02444	40.917	.99970	36
25	.00727	.00727	137.51	.99997	35	.02472	.02473	40.436	.99969	35
26	.00756	.00756	132.22	.99997	34	.02501	.02502	39.965	.99969	34
27	.00785	.00785	127.32	.99997	33	.02530	.02531	39.506	.99968	33
28	.00814	.00815	122.77	.99997	32	.02560	.02560	39.057	.99967	32
29	.00844	.00844	118.54	.99996	31	.02589	.02589	38.618	.99966	31
30	.00873	.00873	114.59	.99996	30	.02618	.02619	38.188	.99966	30
31	.00902	.00902	110.89	.99996	29	.02647	.02648	37.769	.99965	29
32	.00931	.00931	107.43	.99996	28	.02676	.02677	37.358	.99964	28
33	.00960	.00960	104.17	.99995	27	.02705	.02706	36.956	.99963	27
34	.00989	.00989	101.11	.99995	26	.02734	.02735	36.563	.99963	26
35	.01018	.01018	98.218	.99995	25	.02763	.02764	36.178	.99962	25
36	.01047	.01047	95.489	.99995	24	.02792	.02793	35.801	.99961	24
37	.01076	.01076	92.908	.99994	23	.02821	.02822	35.431	.99960	23
38	.01105	.01105	90.463	.99994	22	.02850	.02851	35.070	.99959	22
39	.01134	.01135	88.144	.99994	21	.02879	.02881	34.715	.99959	21
40	.01164	.01164	85.940	.99993	20	.02908	.02910	34.368	.99958	20
41	.01193	.01193	83.844	.99993	19	.02938	.02939	34.027	.99957	19
42	.01222	.01222	81.847	.99993	18	.02967	.02968	33.694	.99956	18
43	.01251	.01251	79.943	.99992	17	.02996	.02997	33.366	.99955	17
44	.01280	.01280	78.126	.99992	16	.03025	.03026	33.045	.99954	16
45	.01309	.01309	76.390	.99991	15	.03054	.03055	32.730	.99953	15
46	.01338	.01338	74.729	.99991	14	.03083	.03084	32.421	.99952	14
47	.01367	.01367	73.139	.99991	13	.03112	.03114	32.118	.99952	13
48	.01396	.01396	71.615	.99990	12	.03141	.03143	31.821	.99951	12
49	.01425	.01425	70.153	.99990	11	.03170	.03172	31.528	.99950	11
50	.01454	.01455	68.750	.99989	10	.03199	.03201	31.242	.99949	10
51	.01483	.01484	67.402	.99989	9	.03228	.03230	30.960	.99948	9
52	.01513	.01513	66.105	.99989	8	.03257	.03259	30.683	.99947	8
53	.01542	.01542	64.858	.99988	7	.03286	.03288	30.412	.99946	7
54	.01571	.01571	63.657	.99988	6	.03316	.03317	30.145	.99945	6
55	.01600	.01600	62.499	.99987	5	.03345	.03346	29.882	.99944	5
56	.01629	.01629	61.383	.99987	4	.03374	.03376	29.624	.99943	4
57	.01658	.01658	60.306	.99986	3	.03403	.03405	29.371	.99942	3
58	.01687	.01687	59.266	.99986	2	.03432	.03434	29.122	.99941	2
59	.01716	.01716	58.261	.99985	1	.03461	.03463	28.877	.99940	1
60	.01745	.01746	57.290	.99985	0	.03490	.03492	28.636	.99939	0
	Cos	Ctn	Tan	Sin	′	Cos	Ctn	Tan	Sin	′
90°				89°	91°				88°	

2° **177°**

′	Sin	Tan	Ctn	Cos	
0	.03490	.03492	28.636	.99939	60
1	.03519	.03521	28.399	.99938	59
2	.03548	.03550	28.166	.99937	58
3	.03577	.03579	27.937	.99936	57
4	.03606	.03609	27.712	.99935	56
5	.03635	.03638	27.490	.99934	55
6	.03664	.03667	27.271	.99933	54
7	.03693	.03696	27.057	.99932	53
8	.03723	.03725	26.845	.99931	52
9	.03752	.03754	26.637	.99930	51
10	.03781	.03783	26.432	.99929	50
11	.03810	.03812	26.230	.99927	49
12	.03839	.03842	26.031	.99926	48
13	.03868	.03871	25.835	.99925	47
14	.03897	.03900	25.642	.99924	46
15	.03926	.03929	25.452	.99923	45
16	.03955	.03958	25.264	.99922	44
17	.03984	.03987	25.080	.99921	43
18	.04013	.04016	24.898	.99919	42
19	.04042	.04046	24 719	.99918	41
20	.04071	.04075	24.542	.99917	40
21	.04100	.04104	24.368	.99916	39
22	.04129	.04133	24.196	.99915	38
23	.04159	.04162	24.026	.99913	37
24	.04188	.04191	23.859	.99912	36
25	.04217	.04220	23.695	.99911	35
26	.04246	.04250	23.532	.99910	34
27	.04275	.04279	23.372	.99909	33
28	.04304	.04308	23.214	.99907	32
29	.04333	.04337	23.058	.99906	31
30	.04362	.04366	22.904	.99905	30
31	.04391	.04395	22.752	.99904	29
32	.04420	.04424	22.602	.99902	28
33	.04449	.04454	22.454	.99901	27
34	.04478	.04483	22.308	.99900	26
35	.04507	.04512	22.164	.99898	25
36	.04536	.04541	22.022	.99897	24
37	.04565	.04570	21.881	.99896	23
38	.04594	.04599	21.743	.99894	22
39	.04623	.04628	21.606	.99893	21
40	.04653	.04658	21.470	.99892	20
41	.04682	.04687	21.337	.99890	19
42	.04711	.04716	21.205	.99889	18
43	.04740	.04745	21.075	.99888	17
44	.04769	.04774	20.946	.99886	16
45	.04798	.04803	20.819	.99885	15
46	.04827	.04833	20.693	.99883	14
47	.04856	.04862	20.569	.99882	13
48	.04885	.04891	20.446	.99881	12
49	.04914	.04920	20.325	.99879	11
50	.04943	.04949	20.206	.99878	10
51	.04972	.04978	20.087	.99876	9
52	.05001	.05007	19.970	.99875	8
53	.05030	.05037	19.855	.99873	7
54	.05059	.05066	19.740	.99872	6
55	.05088	.05095	19.627	.99870	5
56	.05117	.05124	19.516	.99869	4
57	.05146	.05153	19.405	.99867	3
58	.05175	.05182	19.296	.99866	2
59	.05205	.05212	19.188	.99864	1
60	.05234	.05241	19.081	.99863	0
	Cos	Ctn	Tan	Sin	′

92° **87°**

3° **176°**

′	Sin	Tan	Ctn	Cos	
0	.05234	.05241	19.081	.99863	60
1	.05263	.05270	18.976	.99861	59
2	.05292	.05299	18.871	.99860	58
3	.05321	.05328	18.768	.99858	57
4	.05350	.05357	18.666	.99857	56
5	.05379	.05387	18.564	.99855	55
6	.05408	.05416	18.464	.99854	54
7	.05437	.05445	18.366	.99852	53
8	.05466	.05474	18.268	.99851	52
9	.05495	.05503	18.171	.99849	51
10	.05524	.05533	18.075	.99847	50
11	.05553	.05562	17.980	.99846	49
12	.05582	.05591	17.886	.99844	48
13	.05611	.05620	17.793	.99842	47
14	.05640	.05649	17.702	.99841	46
15	.05669	.05678	17.611	.99839	45
16	.05698	.05708	17.521	.99838	44
17	.05727	.05737	17.431	.99836	43
18	.05756	.05766	17.343	.99834	42
19	.05785	.05795	17.256	.99833	41
20	.05814	.05824	17.169	.99831	40
21	.05844	.05854	17.084	.99829	39
22	.05873	.05883	16.999	.99827	38
23	.05902	.05912	16.915	.99826	37
24	.05931	.05941	16.832	.99824	36
25	.05960	.05970	16.750	.99822	35
26	.05989	.05999	16.668	.99821	34
27	.06018	.06029	16.587	.99819	33
28	.06047	.06058	16.507	.99817	32
29	.06076	.06087	16.428	.99815	31
30	.06105	.06116	16.350	.99813	30
31	.06134	.06145	16.272	.99812	29
32	.06163	.06175	16.195	.99810	28
33	.06192	.06204	16.119	.99808	27
34	.06221	.06233	16.043	.99806	26
35	.06250	.06262	15.969	.99804	25
36	.06279	.06291	15.895	.99803	24
37	.06308	.06321	15.821	.99801	23
38	.06337	.06350	15.748	.99799	22
39	.06366	.06379	15.676	.99797	21
40	.06395	.06408	15.605	.99795	20
41	.06424	.06438	15.534	.99793	19
42	.06453	.06467	15.464	.99792	18
43	.06482	.06496	15.394	.99790	17
44	.06511	.06525	15.325	.99788	16
45	.06540	.06554	15.257	.99786	15
46	.06569	.06584	15.189	.99784	14
47	.06598	.06613	15.122	.99782	13
48	.06627	.06642	15.056	.99780	12
49	.06656	.06671	14.990	.99778	11
50	.06685	.06700	14.924	.99776	10
51	.06714	.06730	14.860	.99774	9
52	.06743	.06759	14.795	.99772	8
53	.06773	.06788	14.732	.99770	7
54	.06802	.06817	14.669	.99768	6
55	.06831	.06847	14.606	.99766	5
56	.06860	.06876	14.544	.99764	4
57	.06889	.06905	14.482	.99762	3
58	.06918	.06934	14.421	.99760	2
59	.06947	.06963	14.361	.99758	1
60	.06976	.06993	14.301	.99756	0
	Cos	Ctn	Tan	Sin	′

93° **86°**

4°				175°
′	Sin	Tan	Ctn	Cos
0	.06976	.06993	14.301	.99756
1	.07005	.07022	14.241	.99754
2	.07034	.07051	14.182	.99752
3	.07063	.07080	14.124	.99750
4	.07092	.07110	14.065	.99748
5	.07121	.07139	14.008	.99746
6	.07150	.07168	13.951	.99744
7	.07179	.07197	13.894	.99742
8	.07208	.07227	13.838	.99740
9	.07237	.07256	13.782	.99738
10	.07266	.07285	13.727	.99736
11	.07295	.07314	13.672	.99734
12	.07324	.07344	13.617	.99731
13	.07353	.07373	13.563	.99729
14	.07382	.07402	13.510	.99727
15	.07411	.07431	13.457	.99725
16	.07440	.07461	13.404	.99723
17	.07469	.07490	13.352	.99721
18	.07498	.07519	13.300	.99719
19	.07527	.07548	13.248	.99716
20	.07556	.07578	13.197	.99714
21	.07585	.07607	13.146	.99712
22	.07614	.07636	13.096	.99710
23	.07643	.07665	13.046	.99708
24	.07672	.07695	12.996	.99705
25	.07701	.07724	12.947	.99703
26	.07730	.07753	12.898	.99701
27	.07759	.07782	12.850	.99699
28	.07788	.07812	12.801	.99696
29	.07817	.07841	12.754	.99694
30	.07846	.07870	12.706	.99692
31	.07875	.07899	12.659	.99689
32	.07904	.07929	12.612	.99687
33	.07933	.07958	12.566	.99685
34	.07962	.07987	12.520	.99683
35	.07991	.08017	12.474	.99680
36	.08020	.08046	12.429	.99678
37	.08049	.08075	12.384	.99676
38	.08078	.08104	12.339	.99673
39	.08107	.08134	12.295	.99671
40	.08136	.08163	12.251	.99668
41	.08165	.08192	12.207	.99666
42	.08194	.08221	12.163	.99664
43	.08223	.08251	12.120	.99661
44	.08252	.08280	12.077	.99659
45	.08281	.08309	12.035	.99657
46	.08310	.08339	11.992	.99654
47	.08339	.08368	11.950	.99652
48	.08368	.08397	11.909	.99649
49	.08397	.08427	11.867	.99647
50	.08426	.08456	11.826	.99644
51	.08455	.08485	11.785	.99642
52	.08484	.08514	11.745	.99639
53	.08513	.08544	11.705	.99637
54	.08542	.08573	11.664	.99635
55	.08571	.08602	11.625	.99632
56	.08600	.08632	11.585	.99630
57	.08629	.08661	11.546	.99627
58	.08658	.08690	11.507	.99625
59	.08687	.08720	11.468	.99622
60	.08716	.08749	11.430	.99619
	Cos	Ctn	Tan	Sin
94°				85°

5°				174°
′	Sin	Tan	Ctn	Cos
0	.08716	.08749	11.430	.99619
1	.08745	.08778	11.392	.99617
2	.08774	.08807	11.354	.99614
3	.08803	.08837	11.316	.99612
4	.08831	.08866	11.279	.99609
5	.08860	.08895	11.242	.99607
6	.08889	.08925	11.205	.99604
7	.08918	.08954	11.168	.99602
8	.08947	.08983	11.132	.99599
9	.08976	.09013	11.095	.99596
10	.09005	.09042	11.059	.99594
11	.09034	.09071	11.024	.99591
12	.09063	.09101	10.988	.99588
13	.09092	.09130	10.953	.99586
14	.09121	.09159	10.918	.99583
15	.09150	.09189	10.883	.99580
16	.09179	.09218	10.848	.99578
17	.09208	.09247	10.814	.99575
18	.09237	.09277	10.780	.99572
19	.09266	.09306	10.746	.99570
20	.09295	.09335	10.712	.99567
21	.09324	.09365	10.678	.99564
22	.09353	.09394	10.645	.99562
23	.09382	.09423	10.612	.99559
24	.09411	.09453	10.579	.99556
25	.09440	.09482	10.546	.99553
26	.09469	.09511	10.514	.99551
27	.09498	.09541	10.481	.99548
28	.09527	.09570	10.449	.99545
29	.09556	.09600	10.417	.99542
30	.09585	.09629	10.385	.99540
31	.09614	.09658	10.354	.99537
32	.09642	.09688	10.322	.99534
33	.09671	.09717	10.291	.99531
34	.09700	.09746	10.260	.99528
35	.09729	.09776	10.229	.99526
36	.09758	.09805	10.199	.99523
37	.09787	.09834	10.168	.99520
38	.09816	.09864	10.138	.99517
39	.09845	.09893	10.108	.99514
40	.09874	.09923	10.078	.99511
41	.09903	.09952	10.048	.99508
42	.09932	.09981	10.019	.99506
43	.09961	.10011	9.9893	.99503
44	.09990	.10040	9.9601	.99500
45	.10019	.10069	9.9310	.99497
46	.10048	.10099	9.9021	.99494
47	.10077	.10128	9.8734	.99491
48	.10106	.10158	9.8448	.99488
49	.10135	.10187	9.8164	.99485
50	.10164	.10216	9.7882	.99482
51	.10192	.10246	9.7601	.99479
52	.10221	.10275	9.7322	.99476
53	.10250	.10305	9.7044	.99473
54	.10279	.10334	9.6768	.99470
55	.10308	.10363	9.6493	.99467
56	.10337	.10393	9.6220	.99464
57	.10366	.10422	9.5949	.99461
58	.10395	.10452	9.5679	.99458
59	.10424	.10481	9.5411	.99455
60	.10453	.10510	9.5144	.99452
	Cos	Ctn	Tan	Sin
95°				84°

6° (173°)

′	Sin	Tan	Ctn	Cos	
0	.10453	.10510	9.5144	.99452	60
1	.10482	.10540	9.4878	.99449	59
2	.10511	.10569	9.4614	.99446	58
3	.10540	.10599	9.4352	.99443	57
4	.10569	.10628	9.4090	.99440	56
5	.10597	.10657	9.3831	.99437	55
6	.10626	.10687	9.3572	.99434	54
7	.10655	.10716	9.3315	.99431	53
8	.10684	.10746	9.3060	.99428	52
9	.10713	.10775	9.2806	.99424	51
10	.10742	.10805	9.2553	.99421	50
11	.10771	.10834	9.2302	.99418	49
12	.10800	.10863	9.2052	.99415	48
13	.10829	.10893	9.1803	.99412	47
14	.10858	.10922	9.1555	.99409	46
15	.10887	.10952	9.1309	.99406	45
16	.10916	.10981	9.1065	.99402	44
17	.10945	.11011	9.0821	.99399	43
18	.10973	.11040	9.0579	.99396	42
19	.11002	.11070	9.0338	.99393	41
20	.11031	.11099	9.0098	.99390	40
21	.11060	.11128	8.9860	.99386	39
22	.11089	.11158	8.9623	.99383	38
23	.11118	.11187	8.9387	.99380	37
24	.11147	.11217	8.9152	.99377	36
25	.11176	.11246	8.8919	.99374	35
26	.11205	.11276	8.8686	.99370	34
27	.11234	.11305	8.8455	.99367	33
28	.11263	.11335	8.8225	.99364	32
29	.11291	.11364	8.7996	.99360	31
30	.11320	.11394	8.7769	.99357	30
31	.11349	.11423	8.7542	.99354	29
32	.11378	.11452	8.7317	.99351	28
33	.11407	.11482	8.7093	.99347	27
34	.11436	.11511	8.6870	.99344	26
35	.11465	.11541	8.6648	.99341	25
36	.11494	.11570	8.6427	.99337	24
37	.11523	.11600	8.6208	.99334	23
38	.11552	.11629	8.5989	.99331	22
39	.11580	.11659	8.5772	.99327	21
40	.11609	.11688	8.5555	.99324	20
41	.11638	.11718	8.5340	.99320	19
42	.11667	.11747	8.5126	.99317	18
43	.11696	.11777	8.4913	.99314	17
44	.11725	.11806	8.4701	.99310	16
45	.11754	.11836	8.4490	.99307	15
46	.11783	.11865	8.4280	.99303	14
47	.11812	.11895	8.4071	.99300	13
48	.11840	.11924	8.3863	.99297	12
49	.11869	.11954	8.3656	.99293	11
50	.11898	.11983	8.3450	.99290	10
51	.11927	.12013	8.3245	.99286	9
52	.11956	.12042	8.3041	.99283	8
53	.11985	.12072	8.2838	.99279	7
54	.12014	.12101	8.2636	.99276	6
55	.12043	.12131	8.2434	.99272	5
56	.12071	.12160	8.2234	.99269	4
57	.12100	.12190	8.2035	.99265	3
58	.12129	.12219	8.1837	.99262	2
59	.12158	.12249	8.1640	.99258	1
60	.12187	.12278	8.1443	.99255	0
	Cos	Ctn	Tan	Sin	′

96° 83°

7° (172°)

′	Sin	Tan	Ctn	Cos	
0	.12187	.12278	8.1443	.99255	60
1	.12216	.12308	8.1248	.99251	59
2	.12245	.12338	8.1054	.99248	58
3	.12274	.12367	8.0860	.99244	57
4	.12302	.12397	8.0667	.99240	56
5	.12331	.12426	8.0476	.99237	55
6	.12360	.12456	8.0285	.99233	54
7	.12389	.12485	8.0095	.99230	53
8	.12418	.12515	7.9906	.99226	52
9	.12447	.12544	7.9718	.99222	51
10	.12476	.12574	7.9530	.99219	50
11	.12504	.12603	7.9344	.99215	49
12	.12533	.12633	7.9158	.99211	48
13	.12562	.12662	7.8973	.99208	47
14	.12591	.12692	7.8789	.99204	46
15	.12620	.12722	7.8606	.99200	45
16	.12649	.12751	7.8424	.99197	44
17	.12678	.12781	7.8243	.99193	43
18	.12706	.12810	7.8062	.99189	42
19	.12735	.12840	7.7882	.99186	41
20	.12764	.12869	7.7704	.99182	40
21	.12793	.12899	7.7525	.99178	39
22	.12822	.12929	7.7348	.99175	38
23	.12851	.12958	7.7171	.99171	37
24	.12880	.12988	7.6996	.99167	36
25	.12908	.13017	7.6821	.99163	35
26	.12937	.13047	7.6647	.99160	34
27	.12966	.13076	7.6473	.99156	33
28	.12995	.13106	7.6301	.99152	32
29	.13024	.13136	7.6129	.99148	31
30	.13053	.13165	7.5958	.99144	30
31	.13081	.13195	7.5787	.99141	29
32	.13110	.13224	7.5618	.99137	28
33	.13139	.13254	7.5449	.99133	27
34	.13168	.13284	7.5281	.99129	26
35	.13197	.13313	7.5113	.99125	25
36	.13226	.13343	7.4947	.99122	24
37	.13254	.13372	7.4781	.99118	23
38	.13283	.13402	7.4615	.99114	22
39	.13312	.13432	7.4451	.99110	21
40	.13341	.13461	7.4287	.99106	20
41	.13370	.13491	7.4124	.99102	19
42	.13399	.13521	7.3962	.99098	18
43	.13427	.13550	7.3800	.99094	17
44	.13456	.13580	7.3639	.99091	16
45	.13485	.13609	7.3479	.99087	15
46	.13514	.13639	7.3319	.99083	14
47	.13543	.13669	7.3160	.99079	13
48	.13572	.13698	7.3002	.99075	12
49	.13600	.13728	7.2844	.99071	11
50	.13629	.13758	7.2687	.99067	10
51	.13658	.13787	7.2531	.99063	9
52	.13687	.13817	7.2375	.99059	8
53	.13716	.13846	7.2220	.99055	7
54	.13744	.13876	7.2066	.99051	6
55	.13773	.13906	7.1912	.99047	5
56	.13802	.13935	7.1759	.99043	4
57	.13831	.13965	7.1607	.99039	3
58	.13860	.13995	7.1455	.99035	2
59	.13889	.14024	7.1304	.99031	1
60	.13917	.14054	7.1154	.99027	0
	Cos	Ctn	Tan	Sin	′

97° 82°

8° (171°)

′	Sin	Tan	Ctn	Cos	
0	.13917	.14054	7.1154	.99027	60
1	.13946	.14084	7.1004	.99023	59
2	.13975	.14113	7.0855	.99019	58
3	.14004	.14143	7.0706	.99015	57
4	.14033	.14173	7.0558	.99011	56
5	.14061	.14202	7.0410	.99006	55
6	.14090	.14232	7.0264	.99002	54
7	.14119	.14262	7.0117	.98998	53
8	.14148	.14291	6.9972	.98994	52
9	.14177	.14321	6.9827	.98990	51
10	.14205	.14351	6.9682	.98986	50
11	.14234	.14381	6.9538	.98982	49
12	.14263	.14410	6.9395	.98978	48
13	.14292	.14440	6.9252	.98973	47
14	.14320	.14470	6.9110	.98969	46
15	.14349	.14499	6.8969	.98965	45
16	.14378	.14529	6.8828	.98961	44
17	.14407	.14559	6.8687	.98957	43
18	.14436	.14588	6.8548	.98953	42
19	.14464	.14618	6.8408	.98948	41
20	.14493	.14648	6.8269	.98944	40
21	.14522	.14678	6.8131	.98940	39
22	.14551	.14707	6.7994	.98936	38
23	.14580	.14737	6.7856	.98931	37
24	.14608	.14767	6.7720	.98927	36
25	.14637	.14796	6.7584	.98923	35
26	.14666	.14826	6.7448	.98919	34
27	.14695	.14856	6.7313	.98914	33
28	.14723	.14886	6.7179	.98910	32
29	.14752	.14915	6.7045	.98906	31
30	.14781	.14945	6.6912	.98902	30
31	.14810	.14975	6.6779	.98897	29
32	.14838	.15005	6.6646	.98893	28
33	.14867	.15034	6.6514	.98889	27
34	.14896	.15064	6.6383	.98884	26
35	.14925	.15094	6.6252	.98880	25
36	.14954	.15124	6.6122	.98876	24
37	.14982	.15153	6.5992	.98871	23
38	.15011	.15183	6.5863	.98867	22
39	.15040	.15213	6.5734	.98863	21
40	.15069	.15243	6.5606	.98858	20
41	.15097	.15272	6.5478	.98854	19
42	.15126	.15302	6.5350	.98849	18
43	.15155	.15332	6.5223	.98845	17
44	.15184	.15362	6.5097	.98841	16
45	.15212	.15391	6.4971	.98836	15
46	.15241	.15421	6.4846	.98832	14
47	.15270	.15451	6.4721	.98827	13
48	.15299	.15481	6.4596	.98823	12
49	.15327	.15511	6.4472	.98818	11
50	.15356	.15540	6.4348	.98814	10
51	.15385	.15570	6.4225	.98809	9
52	.15414	.15600	6.4103	.98805	8
53	.15442	.15630	6.3980	.98800	7
54	.15471	.15660	6.3859	.98796	6
55	.15500	.15689	6.3737	.98791	5
56	.15529	.15719	6.3617	.98787	4
57	.15557	.15749	6.3496	.98782	3
58	.15586	.15779	6.3376	.98778	2
59	.15615	.15809	6.3257	.98773	1
60	.15643	.15838	6.3138	.98769	0
	Cos	Ctn	Tan	Sin	′

98° (81°)

9° (170°)

′	Sin	Tan	Ctn	Cos	
0	.15643	.15838	6.3138	.98769	60
1	.15672	.15868	6.3019	.98764	59
2	.15701	.15898	6.2901	.98760	58
3	.15730	.15928	6.2783	.98755	57
4	.15758	.15958	6.2666	.98751	56
5	.15787	.15988	6.2549	.98746	55
6	.15816	.16017	6.2432	.98741	54
7	.15845	.16047	6.2316	.98737	53
8	.15873	.16077	6.2200	.98732	52
9	.15902	.16107	6.2085	.98728	51
10	.15931	.16137	6.1970	.98723	50
11	.15959	.16167	6.1856	.98718	49
12	.15988	.16196	6.1742	.98714	48
13	.16017	.16226	6.1628	.98709	47
14	.16046	.16256	6.1515	.98704	46
15	.16074	.16286	6.1402	.98700	45
16	.16103	.16316	6.1290	.98695	44
17	.16132	.16346	6.1178	.98690	43
18	.16160	.16376	6.1066	.98686	42
19	.16189	.16405	6.0955	.98681	41
20	.16218	.16435	6.0844	.98676	40
21	.16246	.16465	6.0734	.98671	39
22	.16275	.16495	6.0624	.98667	38
23	.16304	.16525	6.0514	.98662	37
24	.16333	.16555	6.0405	.98657	36
25	.16361	.16585	6.0296	.98652	35
26	.16390	.16615	6.0188	.98648	34
27	.16419	.16645	6.0080	.98643	33
28	.16447	.16674	5.9972	.98638	32
29	.16476	.16704	5.9865	.98633	31
30	.16505	.16734	5.9758	.98629	30
31	.16533	.16764	5.9651	.98624	29
32	.16562	.16794	5.9545	.98619	28
33	.16591	.16824	5.9439	.98614	27
34	.16620	.16854	5.9333	.98609	26
35	.16648	.16884	5.9228	.98604	25
36	.16677	.16914	5.9124	.98600	24
37	.16706	.16944	5.9019	.98595	23
38	.16734	.16974	5.8915	.98590	22
39	.16763	.17004	5.8811	.98585	21
40	.16792	.17033	5.8708	.98580	20
41	.16820	.17063	5.8605	.98575	19
42	.16849	.17093	5.8502	.98570	18
43	.16878	.17123	5.8400	.98565	17
44	.16906	.17153	5.8298	.98561	16
45	.16935	.17183	5.8197	.98556	15
46	.16964	.17213	5.8095	.98551	14
47	.16992	.17243	5.7994	.98546	13
48	.17021	.17273	5.7894	.98541	12
49	.17050	.17303	5.7794	.98536	11
50	.17078	.17333	5.7694	.98531	10
51	.17107	.17363	5.7594	.98526	9
52	.17136	.17393	5.7495	.98521	8
53	.17164	.17423	5.7396	.98516	7
54	.17193	.17453	5.7297	.98511	6
55	.17222	.17483	5.7199	.98506	5
56	.17250	.17513	5.7101	.98501	4
57	.17279	.17543	5.7004	.98496	3
58	.17308	.17573	5.6906	.98491	2
59	.17336	.17603	5.6809	.98486	1
60	.17365	.17633	5.6713	.98481	0
	Cos	Ctn	Tan	Sin	′

99° (80°)

10° — 169°

′	Sin	Tan	Ctn	Cos	
0	.17365	.17633	5.6713	.98481	60
1	.17393	.17663	5.6617	.98476	59
2	.17422	.17693	5.6521	.98471	58
3	.17451	.17723	5.6425	.98466	57
4	.17479	.17753	5.6329	.98461	56
5	.17508	.17783	5.6234	.98455	55
6	.17537	.17813	5.6140	.98450	54
7	.17565	.17843	5.6045	.98445	53
8	.17594	.17873	5.5951	.98440	52
9	.17623	.17903	5.5857	.98435	51
10	.17651	.17933	5.5764	.98430	50
11	.17680	.17963	5.5671	.98425	49
12	.17708	.17993	5.5578	.98420	48
13	.17737	.18023	5.5485	.98414	47
14	.17766	.18053	5.5393	.98409	46
15	.17794	.18083	5.5301	.98404	45
16	.17823	.18113	5.5209	.98399	44
17	.17852	.18143	5.5118	.98394	43
18	.17880	.18173	5.5026	.98389	42
19	.17909	.18203	5.4936	.98383	41
20	.17937	.18233	5.4845	.98378	40
21	.17966	.18263	5.4755	.98373	39
22	.17995	.18293	5.4665	.98368	38
23	.18023	.18323	5.4575	.98362	37
24	.18052	.18353	5.4486	.98357	36
25	.18081	.18384	5.4397	.98352	35
26	.18109	.18414	5.4308	.98347	34
27	.18138	.18444	5.4219	.98341	33
28	.18166	.18474	5.4131	.98336	32
29	.18195	.18504	5.4043	.98331	31
30	.18224	.18534	5.3955	.98325	30
31	.18252	.18564	5.3868	.98320	29
32	.18281	.18594	5.3781	.98315	28
33	.18309	.18624	5.3694	.98310	27
34	.18338	.18654	5.3607	.98304	26
35	.18367	.18684	5.3521	.98299	25
36	.18395	.18714	5.3435	.98294	24
37	.18424	.18745	5.3349	.98288	23
38	.18452	.18775	5.3263	.98283	22
39	.18481	.18805	5.3178	.98277	21
40	.18509	.18835	5.3093	.98272	20
41	.18538	.18865	5.3008	.98267	19
42	.18567	.18895	5.2924	.98261	18
43	.18595	.18925	5.2839	.98256	17
44	.18624	.18955	5.2755	.98250	16
45	.18652	.18986	5.2672	.98245	15
46	.18681	.19016	5.2588	.98240	14
47	.18710	.19046	5.2505	.98234	13
48	.18738	.19076	5.2422	.98229	12
49	.18767	.19106	5.2339	.98223	11
50	.18795	.19136	5.2257	.98218	10
51	.18824	.19166	5.2174	.98212	9
52	.18852	.19197	5.2092	.98207	8
53	.18881	.19227	5.2011	.98201	7
54	.18910	.19257	5.1929	.98196	6
55	.18938	.19287	5.1848	.98190	5
56	.18967	.19317	5.1767	.98185	4
57	.18995	.19347	5.1686	.98179	3
58	.19024	.19378	5.1606	.98174	2
59	.19052	.19408	5.1526	.98168	1
60	.19081	.19438	5.1446	.98163	0
	Cos	Ctn	Tan	Sin	′

100° — 79°

11° — 168°

′	Sin	Tan	Ctn	Cos	
0	.19081	.19438	5.1446	.98163	60
1	.19109	.19468	5.1366	.98157	59
2	.19138	.19498	5.1286	.98152	58
3	.19167	.19529	5.1207	.98146	57
4	.19195	.19559	5.1128	.98140	56
5	.19224	.19589	5.1049	.98135	55
6	.19252	.19619	5.0970	.98129	54
7	.19281	.19649	5.0892	.98124	53
8	.19309	.19680	5.0814	.98118	52
9	.19338	.19710	5.0736	.98112	51
10	.19366	.19740	5.0658	.98107	50
11	.19395	.19770	5.0581	.98101	49
12	.19423	.19801	5.0504	.98096	48
13	.19452	.19831	5.0427	.98090	47
14	.19481	.19861	5.0350	.98084	46
15	.19509	.19891	5.0273	.98079	45
16	.19538	.19921	5.0197	.98073	44
17	.19566	.19952	5.0121	.98067	43
18	.19595	.19982	5.0045	.98061	42
19	.19623	.20012	4.9969	.98056	41
20	.19652	.20042	4.9894	.98050	40
21	.19680	.20073	4.9819	.98044	39
22	.19709	.20103	4.9744	.98039	38
23	.19737	.20133	4.9669	.98033	37
24	.19766	.20164	4.9594	.98027	36
25	.19794	.20194	4.9520	.98021	35
26	.19823	.20224	4.9446	.98016	34
27	.19851	.20254	4.9372	.98010	33
28	.19880	.20285	4.9298	.98004	32
29	.19908	.20315	4.9225	.97998	31
30	.19937	.20345	4.9152	.97992	30
31	.19965	.20376	4.9078	.97987	29
32	.19994	.20406	4.9006	.97981	28
33	.20022	.20436	4.8933	.97975	27
34	.20051	.20466	4.8860	.97969	26
35	.20079	.20497	4.8788	.97963	25
36	.20108	.20527	4.8716	.97958	24
37	.20136	.20557	4.8644	.97952	23
38	.20165	.20588	4.8573	.97946	22
39	.20193	.20618	4.8501	.97940	21
40	.20222	.20648	4.8430	.97934	20
41	.20250	.20679	4.8359	.97928	19
42	.20279	.20709	4.8288	.97922	18
43	.20307	.20739	4.8218	.97916	17
44	.20336	.20770	4.8147	.97910	16
45	.20364	.20800	4.8077	.97905	15
46	.20393	.20830	4.8007	.97899	14
47	.20421	.20861	4.7937	.97893	13
48	.20450	.20891	4.7867	.97887	12
49	.20478	.20921	4.7798	.97881	11
50	.20507	.20952	4.7729	.97875	10
51	.20535	.20982	4.7659	.97869	9
52	.20563	.21013	4.7591	.97863	8
53	.20592	.21043	4.7522	.97857	7
54	.20620	.21073	4.7453	.97851	6
55	.20649	.21104	4.7385	.97845	5
56	.20677	.21134	4.7317	.97839	4
57	.20706	.21164	4.7249	.97833	3
58	.20734	.21195	4.7181	.97827	2
59	.20763	.21225	4.7114	.97821	1
60	.20791	.21256	4.7046	.97815	0
	Cos	Ctn	Tan	Sin	′

101° — 78°

12° (167°)

′	Sin	Tan	Ctn	Cos	
0	.20791	.21256	4.7046	.97815	60
1	.20820	.21286	4.6979	.97809	59
2	.20848	.21316	4.6912	.97803	58
3	.20877	.21347	4.6845	.97797	57
4	.20905	.21377	4.6779	.97791	56
5	.20933	.21408	4.6712	.97784	55
6	.20962	.21438	4.6646	.97778	54
7	.20990	.21469	4.6580	.97772	53
8	.21019	.21499	4.6514	.97766	52
9	.21047	.21529	4.6448	.97760	51
10	.21076	.21560	4.6382	.97754	50
11	.21104	.21590	4.6317	.97748	49
12	.21132	.21621	4.6252	.97742	48
13	.21161	.21651	4.6187	.97735	47
14	.21189	.21682	4.6122	.97729	46
15	.21218	.21712	4.6057	.97723	45
16	.21246	.21743	4.5993	.97717	44
17	.21275	.21773	4.5928	.97711	43
18	.21303	.21804	4.5864	.97705	42
19	.21331	.21834	4.5800	.97698	41
20	.21360	.21864	4.5736	.97692	40
21	.21388	.21895	4.5673	.97686	39
22	.21417	.21925	4.5609	.97680	38
23	.21445	.21956	4.5546	.97673	37
24	.21474	.21986	4.5483	.97667	36
25	.21502	.22017	4.5420	.97661	35
26	.21530	.22047	4.5357	.97655	34
27	.21559	.22078	4.5294	.97648	33
28	.21587	.22108	4.5232	.97642	32
29	.21616	.22139	4.5169	.97636	31
30	.21644	.22169	4.5107	.97630	30
31	.21672	.22200	4.5045	.97623	29
32	.21701	.22231	4.4983	.97617	28
33	.21729	.22261	4.4922	.97611	27
34	.21758	.22292	4.4860	.97604	26
35	.21786	.22322	4.4799	.97598	25
36	.21814	.22353	4.4737	.97592	24
37	.21843	.22383	4.4676	.97585	23
38	.21871	.22414	4.4615	.97579	22
39	.21899	.22444	4.4555	.97573	21
40	.21928	.22475	4.4494	.97566	20
41	.21956	.22505	4.4434	.97560	19
42	.21985	.22536	4.4373	.97553	18
43	.22013	.22567	4.4313	.97547	17
44	.22041	.22597	4.4253	.97541	16
45	.22070	.22628	4.4194	.97534	15
46	.22098	.22658	4.4134	.97528	14
47	.22126	.22689	4.4075	.97521	13
48	.22155	.22719	4.4015	.97515	12
49	.22183	.22750	4.3956	.97508	11
50	.22212	.22781	4.3897	.97502	10
51	.22240	.22811	4.3838	.97496	9
52	.22268	.22842	4.3779	.97489	8
53	.22297	.22872	4.3721	.97483	7
54	.22325	.22903	4.3662	.97476	6
55	.22353	.22934	4.3604	.97470	5
56	.22382	.22964	4.3546	.97463	4
57	.22410	.22995	4.3488	.97457	3
58	.22438	.23026	4.3430	.97450	2
59	.22467	.23056	4.3372	.97444	1
60	.22495	.23087	4.3315	.97437	0
	Cos	Ctn	Tan	Sin	′

102° (77°)

13° (166°)

′	Sin	Tan	Ctn	Cos	
0	.22495	.23087	4.3315	.97437	60
1	.22523	.23117	4.3257	.97430	59
2	.22552	.23148	4.3200	.97424	58
3	.22580	.23179	4.3143	.97417	57
4	.22608	.23209	4.3086	.97411	56
5	.22637	.23240	4.3029	.97404	55
6	.22665	.23271	4.2972	.97398	54
7	.22693	.23301	4.2916	.97391	53
8	.22722	.23332	4.2859	.97384	52
9	.22750	.23363	4.2803	.97378	51
10	.22778	.23393	4.2747	.97371	50
11	.22807	.23424	4.2691	.97365	49
12	.22835	.23455	4.2635	.97358	48
13	.22863	.23485	4.2580	.97351	47
14	.22892	.23516	4.2524	.97345	46
15	.22920	.23547	4.2468	.97338	45
16	.22948	.23578	4.2413	.97331	44
17	.22977	.23608	4.2358	.97325	43
18	.23005	.23639	4.2303	.97318	42
19	.23033	.23670	4.2248	.97311	41
20	.23062	.23700	4.2193	.97304	40
21	.23090	.23731	4.2139	.97298	39
22	.23118	.23762	4.2084	.97291	38
23	.23146	.23793	4.2030	.97284	37
24	.23175	.23823	4.1976	.97278	36
25	.23203	.23854	4.1922	.97271	35
26	.23231	.23885	4.1868	.97264	34
27	.23260	.23916	4.1814	.97257	33
28	.23288	.23946	4.1760	.97251	32
29	.23316	.23977	4.1706	.97244	31
30	.23345	.24008	4.1653	.97237	30
31	.23373	.24039	4.1600	.97230	29
32	.23401	.24069	4.1547	.97223	28
33	.23429	.24100	4.1493	.97217	27
34	.23458	.24131	4.1441	.97210	26
35	.23486	.24162	4.1388	.97203	25
36	.23514	.24193	4.1335	.97196	24
37	.23542	.24223	4.1282	.97189	23
38	.23571	.24254	4.1230	.97182	22
39	.23599	.24285	4.1178	.97176	21
40	.23627	.24316	4.1126	.97169	20
41	.23656	.24347	4.1074	.97162	19
42	.23684	.24377	4.1022	.97155	18
43	.23712	.24408	4.0970	.97148	17
44	.23740	.24439	4.0918	.97141	16
45	.23769	.24470	4.0867	.97134	15
46	.23797	.24501	4.0815	.97127	14
47	.23825	.24532	4.0764	.97120	13
48	.23853	.24562	4.0713	.97113	12
49	.23882	.24593	4.0662	.97106	11
50	.23910	.24624	4.0611	.97100	10
51	.23938	.24655	4.0560	.97093	9
52	.23966	.24686	4.0509	.97086	8
53	.23995	.24717	4.0459	.97079	7
54	.24023	.24747	4.0408	.97072	6
55	.24051	.24778	4.0358	.97065	5
56	.24079	.24809	4.0308	.97058	4
57	.24108	.24840	4.0257	.97051	3
58	.24136	.24871	4.0207	.97044	2
59	.24164	.24902	4.0158	.97037	1
60	.24192	.24933	4.0108	.97030	0
	Cos	Ctn	Tan	Sin	′

103° (76°)

14° — 165°

′	Sin	Tan	Ctn	Cos	
0	.24192	.24933	4.0108	.97030	60
1	.24220	.24964	4.0058	.97023	59
2	.24249	.24995	4.0009	.97015	58
3	.24277	.25026	3.9959	.97008	57
4	.24305	.25056	3.9910	.97001	56
5	.24333	.25087	3.9861	.96994	55
6	.24362	.25118	3.9812	.96987	54
7	.24390	.25149	3.9763	.96980	53
8	.24418	.25180	3.9714	.96973	52
9	.24446	.25211	3.9665	.96966	51
10	.24474	.25242	3.9617	.96959	50
11	.24503	.25273	3.9568	.96952	49
12	.24531	.25304	3.9520	.96945	48
13	.24559	.25335	3.9471	.96937	47
14	.24587	.25366	3.9423	.96930	46
15	.24615	.25397	3.9375	.96923	45
16	.24644	.25428	3.9327	.96916	44
17	.24672	.25459	3.9279	.96909	43
18	.24700	.25490	3.9232	.96902	42
19	.24728	.25521	3.9184	.96894	41
20	.24756	.25552	3.9136	.96887	40
21	.24784	.25583	3.9089	.96880	39
22	.24813	.25614	3.9042	.96873	38
23	.24841	.25645	3.8995	.96866	37
24	.24869	.25676	3.8947	.96858	36
25	.24897	.25707	3.8900	.96851	35
26	.24925	.25738	3.8854	.96844	34
27	.24954	.25769	3.8807	.96837	33
28	.24982	.25800	3.8760	.96829	32
29	.25010	.25831	3.8714	.96822	31
30	.25038	.25862	3.8667	.96815	30
31	.25066	.25893	3.8621	.96807	29
32	.25094	.25924	3.8575	.96800	28
33	.25122	.25955	3.8528	.96793	27
34	.25151	.25986	3.8482	.96786	26
35	.25179	.26017	3.8436	.96778	25
36	.25207	.26048	3.8391	.96771	24
37	.25235	.26079	3.8345	.96764	23
38	.25263	.26110	3.8299	.96756	22
39	.25291	.26141	3.8254	.96749	21
40	.25320	.26172	3.8208	.96742	20
41	.25348	.26203	3.8163	.96734	19
42	.25376	.26235	3.8118	.96727	18
43	.25404	.26266	3.8073	.96719	17
44	.25432	.26297	3.8028	.96712	16
45	.25460	.26328	3.7983	.96705	15
46	.25488	.26359	3.7938	.96697	14
47	.25516	.26390	3.7893	.96690	13
48	.25545	.26421	3.7848	.96682	12
49	.25573	.26452	3.7804	.96675	11
50	.25601	.26483	3.7760	.96667	10
51	.25629	.26515	3.7715	.96660	9
52	.25657	.26546	3.7671	.96653	8
53	.25685	.26577	3.7627	.96645	7
54	.25713	.26608	3.7583	.96638	6
55	.25741	.26639	3.7539	.96630	5
56	.25769	.26670	3.7495	.96623	4
57	.25798	.26701	3.7451	.96615	3
58	.25826	.26733	3.7408	.96608	2
59	.25854	.26764	3.7364	.96600	1
60	.25882	.26795	3.7321	.96593	0
	Cos	Ctn	Tan	Sin	′

104° — 75°

15° — 164°

′	Sin	Tan	Ctn	Cos	
0	.25882	.26795	3.7321	.96593	60
1	.25910	.26826	3.7277	.96585	59
2	.25938	.26857	3.7234	.96578	58
3	.25966	.26888	3.7191	.96570	57
4	.25994	.26920	3.7148	.96562	56
5	.26022	.26951	3.7105	.96555	55
6	.26050	.26982	3.7062	.96547	54
7	.26079	.27013	3.7019	.96540	53
8	.26107	.27044	3.6976	.96532	52
9	.26135	.27076	3.6933	.96524	51
10	.26163	.27107	3.6891	.96517	50
11	.26191	.27138	3.6848	.96509	49
12	.26219	.27169	3.6806	.96502	48
13	.26247	.27201	3.6764	.96494	47
14	.26275	.27232	3.6722	.96486	46
15	.26303	.27263	3.6680	.96479	45
16	.26331	.27294	3.6638	.96471	44
17	.26359	.27326	3.6596	.96463	43
18	.26387	.27357	3.6554	.96456	42
19	.26415	.27388	3.6512	.96448	41
20	.26443	.27419	3.6470	.96440	40
21	.26471	.27451	3.6429	.96433	39
22	.26500	.27482	3.6387	.96425	38
23	.26528	.27513	3.6346	.96417	37
24	.26556	.27545	3.6305	.96410	36
25	.26584	.27576	3.6264	.96402	35
26	.26612	.27607	3.6222	.96394	34
27	.26640	.27638	3.6181	.96386	33
28	.26668	.27670	3.6140	.96379	32
29	.26696	.27701	3.6100	.96371	31
30	.26724	.27732	3.6059	.96363	30
31	.26752	.27764	3.6018	.96355	29
32	.26780	.27795	3.5978	.96347	28
33	.26808	.27826	3.5937	.96340	27
34	.26836	.27858	3.5897	.96332	26
35	.26864	.27889	3.5856	.96324	25
36	.26892	.27921	3.5816	.96316	24
37	.26920	.27952	3.5776	.96308	23
38	.26948	.27983	3.5736	.96301	22
39	.26976	.28015	3.5696	.96293	21
40	.27004	.28046	3.5656	.96285	20
41	.27032	.28077	3.5616	.96277	19
42	.27060	.28109	3.5576	.96269	18
43	.27088	.28140	3.5536	.96261	17
44	.27116	.28172	3.5497	.96253	16
45	.27144	.28203	3.5457	.96246	15
46	.27172	.28234	3.5418	.96238	14
47	.27200	.28266	3.5379	.96230	13
48	.27228	.28297	3.5339	.96222	12
49	.27256	.28329	3.5300	.96214	11
50	.27284	.28360	3.5261	.96206	10
51	.27312	.28391	3.5222	.96198	9
52	.27340	.28423	3.5183	.96190	8
53	.27368	.28454	3.5144	.96182	7
54	.27396	.28486	3.5105	.96174	6
55	.27424	.28517	3.5067	.96166	5
56	.27452	.28549	3.5028	.96158	4
57	.27480	.28580	3.4989	.96150	3
58	.27508	.28612	3.4951	.96142	2
59	.27536	.28643	3.4912	.96134	1
60	.27564	.28675	3.4874	.96126	0
	Cos	Ctn	Tan	Sin	′

105° — 74°

NATURAL TRIGONOMETRIC FUNCTIONS

16° / 163°

′	Sin	Tan	Ctn	Cos	
0	.27564	.28675	3.4874	.96126	60
1	.27592	.28706	3.4836	.96118	59
2	.27620	.28738	3.4798	.96110	58
3	.27648	.28769	3.4760	.96102	57
4	.27676	.28801	3.4722	.96094	56
5	.27704	.28832	3.4684	.96086	55
6	.27731	.28864	3.4646	.96078	54
7	.27759	.28895	3.4608	.96070	53
8	.27787	.28927	3.4570	.96062	52
9	.27815	.28958	3.4533	.96054	51
10	.27843	.28990	3.4495	.96046	50
11	.27871	.29021	3.4458	.96037	49
12	.27899	.29053	3.4420	.96029	48
13	.27927	.29084	3.4383	.96021	47
14	.27955	.29116	3.4346	.96013	46
15	.27983	.29147	3.4308	.96005	45
16	.28011	.29179	3.4271	.95997	44
17	.28039	.29210	3.4234	.95989	43
18	.28067	.29242	3.4197	.95981	42
19	.28095	.29274	3.4160	.95972	41
20	.28123	.29305	3.4124	.95964	40
21	.28150	.29337	3.4087	.95956	39
22	.28178	.29368	3.4050	.95948	38
23	.28206	.29400	3.4014	.95940	37
24	.28234	.29432	3.3977	.95931	36
25	.28262	.29463	3.3941	.95923	35
26	.28290	.29495	3.3904	.95915	34
27	.28318	.29526	3.3868	.95907	33
28	.28346	.29558	3.3832	.95898	32
29	.28374	.29590	3.3796	.95890	31
30	.28402	.29621	3.3759	.95882	30
31	.28429	.29653	3.3723	.95874	29
32	.28457	.29685	3.3687	.95865	28
33	.28485	.29716	3.3652	.95857	27
34	.28513	.29748	3.3616	.95849	26
35	.28541	.29780	3.3580	.95841	25
36	.28569	.29811	3.3544	.95832	24
37	.28597	.29843	3.3509	.95824	23
38	.28625	.29875	3.3473	.95816	22
39	.28652	.29906	3.3438	.95807	21
40	.28680	.29938	3.3402	.95799	20
41	.28708	.29970	3.3367	.95791	19
42	.28736	.30001	3.3332	.95782	18
43	.28764	.30033	3.3297	.95774	17
44	.28792	.30065	3.3261	.95766	16
45	.28820	.30097	3.3226	.95757	15
46	.28847	.30128	3.3191	.95749	14
47	.28875	.30160	3.3156	.95740	13
48	.28903	.30192	3.3122	.95732	12
49	.28931	.30224	3.3087	.95724	11
50	.28959	.30255	3.3052	.95715	10
51	.28987	.30287	3.3017	.95707	9
52	.29015	.30319	3.2983	.95698	8
53	.29042	.30351	3.2948	.95690	7
54	.29070	.30382	3.2914	.95681	6
55	.29098	.30414	3.2879	.95673	5
56	.29126	.30446	3.2845	.95664	4
57	.29154	.30478	3.2811	.95656	3
58	.29182	.30509	3.2777	.95647	2
59	.29209	.30541	3.2743	.95639	1
60	.29237	.30573	3.2709	.95630	0
	Cos	Ctn	Tan	Sin	′

17° / 162°

′	Sin	Tan	Ctn	Cos	
0	.29237	.30573	3.2709	.95630	60
1	.29265	.30605	3.2675	.95622	59
2	.29293	.30637	3.2641	.95613	58
3	.29321	.30669	3.2607	.95605	57
4	.29348	.30700	3.2573	.95596	56
5	.29376	.30732	3.2539	.95588	55
6	.29404	.30764	3.2506	.95579	54
7	.29432	.30796	3.2472	.95571	53
8	.29460	.30828	3.2438	.95562	52
9	.29487	.30860	3.2405	.95554	51
10	.29515	.30891	3.2371	.95545	50
11	.29543	.30923	3.2338	.95536	49
12	.29571	.30955	3.2305	.95528	48
13	.29599	.30987	3.2272	.95519	47
14	.29626	.31019	3.2238	.95511	46
15	.29654	.31051	3.2205	.95502	45
16	.29682	.31083	3.2172	.95493	44
17	.29710	.31115	3.2139	.95485	43
18	.29737	.31147	3.2106	.95476	42
19	.29765	.31178	3.2073	.95467	41
20	.29793	.31210	3.2041	.95459	40
21	.29821	.31242	3.2008	.95450	39
22	.29849	.31274	3.1975	.95441	38
23	.29876	.31306	3.1943	.95433	37
24	.29904	.31338	3.1910	.95424	36
25	.29932	.31370	3.1878	.95415	35
26	.29960	.31402	3.1845	.95407	34
27	.29987	.31434	3.1813	.95398	33
28	.30015	.31466	3.1780	.95389	32
29	.30043	.31498	3.1748	.95380	31
30	.30071	.31530	3.1716	.95372	30
31	.30098	.31562	3.1684	.95363	29
32	.30126	.31594	3.1652	.95354	28
33	.30154	.31626	3.1620	.95345	27
34	.30182	.31658	3.1588	.95337	26
35	.30209	.31690	3.1556	.95328	25
36	.30237	.31722	3.1524	.95319	24
37	.30265	.31754	3.1492	.95310	23
38	.30292	.31786	3.1460	.95301	22
39	.30320	.31818	3.1429	.95293	21
40	.30348	.31850	3.1397	.95284	20
41	.30376	.31882	3.1366	.95275	19
42	.30403	.31914	3.1334	.95266	18
43	.30431	.31946	3.1303	.95257	17
44	.30459	.31978	3.1271	.95248	16
45	.30486	.32010	3.1240	.95240	15
46	.30514	.32042	3.1209	.95231	14
47	.30542	.32074	3.1178	.95222	13
48	.30570	.32106	3.1146	.95213	12
49	.30597	.32139	3.1115	.95204	11
50	.30625	.32171	3.1084	.95195	10
51	.30653	.32203	3.1053	.95186	9
52	.30680	.32235	3.1022	.95177	8
53	.30708	.32267	3.0991	.95168	7
54	.30736	.32299	3.0961	.95159	6
55	.30763	.32331	3.0930	.95150	5
56	.30791	.32363	3.0899	.95142	4
57	.30819	.32396	3.0868	.95133	3
58	.30846	.32428	3.0838	.95124	2
59	.30874	.32460	3.0807	.95115	1
60	.30902	.32492	3.0777	.95106	0
	Cos	Ctn	Tan	Sin	′

18° — 161°

′	Sin	Tan	Ctn	Cos	
0	.30902	.32492	3.0777	.95106	60
1	.30929	.32524	3.0746	.95097	59
2	.30957	.32556	3.0716	.95088	58
3	.30985	.32588	3.0686	.95079	57
4	.31012	.32621	3.0655	.95070	56
5	.31040	.32653	3.0625	.95061	55
6	.31068	.32685	3.0595	.95052	54
7	.31095	.32717	3.0565	.95043	53
8	.31123	.32749	3.0535	.95033	52
9	.31151	.32782	3.0505	.95024	51
10	.31178	.32814	3.0475	.95015	50
11	.31206	.32846	3.0445	.95006	49
12	.31233	.32878	3.0415	.94997	48
13	.31261	.32911	3.0385	.94988	47
14	.31289	.32943	3.0356	.94979	46
15	.31316	.32975	3.0326	.94970	45
16	.31344	.33007	3.0296	.94961	44
17	.31372	.33040	3.0267	.94952	43
18	.31399	.33072	3.0237	.94943	42
19	.31427	.33104	3.0208	.94933	41
20	.31454	.33136	3.0178	.94924	40
21	.31482	.33169	3.0149	.94915	39
22	.31510	.33201	3.0120	.94906	38
23	.31537	.33233	3.0090	.94897	37
24	.31565	.33266	3.0061	.94888	36
25	.31593	.33298	3.0032	.94878	35
26	.31620	.33330	3.0003	.94869	34
27	.31648	.33363	2.9974	.94860	33
28	.31675	.33395	2.9945	.94851	32
29	.31703	.33427	2.9916	.94842	31
30	.31730	.33460	2.9887	.94832	30
31	.31758	.33492	2.9858	.94823	29
32	.31786	.33524	2.9829	.94814	28
33	.31813	.33557	2.9800	.94805	27
34	.31841	.33589	2.9772	.94795	26
35	.31868	.33621	2.9743	.94786	25
36	.31896	.33654	2.9714	.94777	24
37	.31923	.33686	2.9686	.94768	23
38	.31951	.33718	2.9657	.94758	22
39	.31979	.33751	2.9629	.94749	21
40	.32006	.33783	2.9600	.94740	20
41	.32034	.33816	2.9572	.94730	19
42	.32061	.33848	2.9544	.94721	18
43	.32089	.33881	2.9515	.94712	17
44	.32116	.33913	2.9487	.94702	16
45	.32144	.33945	2.9459	.94693	15
46	.32171	.33978	2.9431	.94684	14
47	.32199	.34010	2.9403	.94674	13
48	.32227	.34043	2.9375	.94665	12
49	.32254	.34075	2.9347	.94656	11
50	.32282	.34108	2.9319	.94646	10
51	.32309	.34140	2.9291	.94637	9
52	.32337	.34173	2.9263	.94627	8
53	.32364	.34205	2.9235	.94618	7
54	.32392	.34238	2.9208	.94609	6
55	.32419	.34270	2.9180	.94599	5
56	.32447	.34303	2.9152	.94590	4
57	.32474	.34335	2.9125	.94580	3
58	.32502	.34368	2.9097	.94571	2
59	.32529	.34400	2.9070	.94561	1
60	.32557	.34433	2.9042	.94552	0
	Cos	Ctn	Tan	Sin	′

108° — 71°

19° — 160°

′	Sin	Tan	Ctn	Cos	
0	.32557	.34433	2.9042	.94552	60
1	.32584	.34465	2.9015	.94542	59
2	.32612	.34498	2.8987	.94533	58
3	.32639	.34530	2.8960	.94523	57
4	.32667	.34563	2.8933	.94514	56
5	.32694	.34596	2.8905	.94504	55
6	.32722	.34628	2.8878	.94495	54
7	.32749	.34661	2.8851	.94485	53
8	.32777	.34693	2.8824	.94476	52
9	.32804	.34726	2.8797	.94466	51
10	.32832	.34758	2.8770	.94457	50
11	.32859	.34791	2.8743	.94447	49
12	.32887	.34824	2.8716	.94438	48
13	.32914	.34856	2.8689	.94428	47
14	.32942	.34889	2.8662	.94418	46
15	.32969	.34922	2.8636	.94409	45
16	.32997	.34954	2.8609	.94399	44
17	.33024	.34987	2.8582	.94390	43
18	.33051	.35020	2.8556	.94380	42
19	.33079	.35052	2.8529	.94370	41
20	.33106	.35085	2.8502	.94361	40
21	.33134	.35118	2.8476	.94351	39
22	.33161	.35150	2.8449	.94342	38
23	.33189	.35183	2.8423	.94332	37
24	.33216	.35216	2.8397	.94322	36
25	.33244	.35248	2.8370	.94313	35
26	.33271	.35281	2.8344	.94303	34
27	.33298	.35314	2.8318	.94293	33
28	.33326	.35346	2.8291	.94284	32
29	.33353	.35379	2.8265	.94274	31
30	.33381	.35412	2.8239	.94264	30
31	.33408	.35445	2.8213	.94254	29
32	.33436	.35477	2.8187	.94245	28
33	.33463	.35510	2.8161	.94235	27
34	.33490	.35543	2.8135	.94225	26
35	.33518	.35576	2.8109	.94215	25
36	.33545	.35608	2.8083	.94206	24
37	.33573	.35641	2.8057	.94196	23
38	.33600	.35674	2.8032	.94186	22
39	.33627	.35707	2.8006	.94176	21
40	.33655	.35740	2.7980	.94167	20
41	.33682	.35772	2.7955	.94157	19
42	.33710	.35805	2.7929	.94147	18
43	.33737	.35838	2.7903	.94137	17
44	.33764	.35871	2.7878	.94127	16
45	.33792	.35904	2.7852	.94118	15
46	.33819	.35937	2.7827	.94108	14
47	.33846	.35969	2.7801	.94098	13
48	.33874	.36002	2.7776	.94088	12
49	.33901	.36035	2.7751	.94078	11
50	.33929	.36068	2.7725	.94068	10
51	.33956	.36101	2.7700	.94058	9
52	.33983	.36134	2.7675	.94049	8
53	.34011	.36167	2.7650	.94039	7
54	.34038	.36199	2.7625	.94029	6
55	.34065	.36232	2.7600	.94019	5
56	.34093	.36265	2.7575	.94009	4
57	.34120	.36298	2.7550	.93999	3
58	.34147	.36331	2.7525	.93989	2
59	.34175	.36364	2.7500	.93979	1
60	.34202	.36397	2.7475	.93969	0
	Cos	Ctn	Tan	Sin	′

109° — 70°

NATURAL TRIGONOMETRIC FUNCTIONS

20° — 159°

′	Sin	Tan	Ctn	Cos	
0	.34202	.36397	2.7475	.93969	60
1	.34229	.36430	2.7450	.93959	59
2	.34257	.36463	2.7425	.93949	58
3	.34284	.36496	2.7400	.93939	57
4	.34311	.36529	2.7376	.93929	56
5	.34339	.36562	2.7351	.93919	55
6	.34366	.36595	2.7326	.93909	54
7	.34393	.36628	2.7302	.93899	53
8	.34421	.36661	2.7277	.93889	52
9	.34448	.36694	2.7253	.93879	51
10	.34475	.36727	2.7228	.93869	50
11	.34503	.36760	2.7204	.93859	49
12	.34530	.36793	2.7179	.93849	48
13	.34557	.36826	2.7155	.93839	47
14	.34584	.36859	2.7130	.93829	46
15	.34612	.36892	2.7106	.93819	45
16	.34639	.36925	2.7082	.93809	44
17	.34666	.36958	2.7058	.93799	43
18	.34694	.36991	2.7034	.93789	42
19	.34721	.37024	2.7009	.93779	41
20	.34748	.37057	2.6985	.93769	40
21	.34775	.37090	2.6961	.93759	39
22	.34803	.37123	2.6937	.93748	38
23	.34830	.37157	2.6913	.93738	37
24	.34857	.37190	2.6889	.93728	36
25	.34884	.37223	2.6865	.93718	35
26	.34912	.37256	2.6841	.93708	34
27	.34939	.37289	2.6818	.93698	33
28	.34966	.37322	2.6794	.93688	32
29	.34993	.37355	2.6770	.93677	31
30	.35021	.37388	2.6746	.93667	30
31	.35048	.37422	2.6723	.93657	29
32	.35075	.37455	2.6699	.93647	28
33	.35102	.37488	2.6675	.93637	27
34	.35130	.37521	2.6652	.93626	26
35	.35157	.37554	2.6628	.93616	25
36	.35184	.37588	2.6605	.93606	24
37	.35211	.37621	2.6581	.93596	23
38	.35239	.37654	2.6558	.93585	22
39	.35266	.37687	2.6534	.93575	21
40	.35293	.37720	2.6511	.93565	20
41	.35320	.37754	2.6488	.93555	19
42	.35347	.37787	2.6464	.93544	18
43	.35375	.37820	2.6441	.93534	17
44	.35402	.37853	2.6418	.93524	16
45	.35429	.37887	2.6395	.93514	15
46	.35456	.37920	2.6371	.93503	14
47	.35484	.37953	2.6348	.93493	13
48	.35511	.37986	2.6325	.93483	12
49	.35538	.38020	2.6302	.93472	11
50	.35565	.38053	2.6279	.93462	10
51	.35592	.38086	2.6256	.93452	9
52	.35619	.38120	2.6233	.93441	8
53	.35647	.38153	2.6210	.93431	7
54	.35674	.38186	2.6187	.93420	6
55	.35701	.38220	2.6165	.93410	5
56	.35728	.38253	2.6142	.93400	4
57	.35755	.38286	2.6119	.93389	3
58	.35782	.38320	2.6096	.93379	2
59	.35810	.38353	2.6074	.93368	1
60	.35837	.38386	2.6051	.93358	0
	Cos	Ctn	Tan	Sin	′

110° — 69°

21° — 158°

′	Sin	Tan	Ctn	Cos	
0	.35837	.38386	2.6051	.93358	60
1	.35864	.38420	2.6028	.93348	59
2	.35891	.38453	2.6006	.93337	58
3	.35918	.38487	2.5983	.93327	57
4	.35945	.38520	2.5961	.93316	56
5	.35973	.38553	2.5938	.93306	55
6	.36000	.38587	2.5916	.93295	54
7	.36027	.38620	2.5893	.93285	53
8	.36054	.38654	2.5871	.93274	52
9	.36081	.38687	2.5848	.93264	51
10	.36108	.38721	2.5826	.93253	50
11	.36135	.38754	2.5804	.93243	49
12	.36162	.38787	2.5782	.93232	48
13	.36190	.38821	2.5759	.93222	47
14	.36217	.38854	2.5737	.93211	46
15	.36244	.38888	2.5715	.93201	45
16	.36271	.38921	2.5693	.93190	44
17	.36298	.38955	2.5671	.93180	43
18	.36325	.38988	2.5649	.93169	42
19	.36352	.39022	2.5627	.93159	41
20	.36379	.39055	2.5605	.93148	40
21	.36406	.39089	2.5583	.93137	39
22	.36434	.39122	2.5561	.93127	38
23	.36461	.39156	2.5539	.93116	37
24	.36488	.39190	2.5517	.93106	36
25	.36515	.39223	2.5495	.93095	35
26	.36542	.39257	2.5473	.93084	34
27	.36569	.39290	2.5452	.93074	33
28	.36596	.39324	2.5430	.93063	32
29	.36623	.39357	2.5408	.93052	31
30	.36650	.39391	2.5386	.93042	30
31	.36677	.39425	2.5365	.93031	29
32	.36704	.39458	2.5343	.93020	28
33	.36731	.39492	2.5322	.93010	27
34	.36758	.39526	2.5300	.92999	26
35	.36785	.39559	2.5279	.92988	25
36	.36812	.39593	2.5257	.92978	24
37	.36839	.39626	2.5236	.92967	23
38	.36867	.39660	2.5214	.92956	22
39	.36894	.39694	2.5193	.92945	21
40	.36921	.39727	2.5172	.92935	20
41	.36948	.39761	2.5150	.92924	19
42	.36975	.39795	2.5129	.92913	18
43	.37002	.39829	2.5108	.92902	17
44	.37029	.39862	2.5086	.92892	16
45	.37056	.39896	2.5065	.92881	15
46	.37083	.39930	2.5044	.92870	14
47	.37110	.39963	2.5023	.92859	13
48	.37137	.39997	2.5002	.92849	12
49	.37164	.40031	2.4981	.92838	11
50	.37191	.40065	2.4960	.92827	10
51	.37218	.40098	2.4939	.92816	9
52	.37245	.40132	2.4918	.92805	8
53	.37272	.40166	2.4897	.92794	7
54	.37299	.40200	2.4876	.92784	6
55	.37326	.40234	2.4855	.92773	5
56	.37353	.40267	2.4834	.92762	4
57	.37380	.40301	2.4813	.92751	3
58	.37407	.40335	2.4792	.92740	2
59	.37434	.40369	2.4772	.92729	1
60	.37461	.40403	2.4751	.92718	0
	Cos	Ctn	Tan	Sin	′

111° — 68°

22° — 157°

′	Sin	Tan	Ctn	Cos	
0	.37461	.40403	2.4751	.92718	60
1	.37488	.40436	2.4730	.92707	59
2	.37515	.40470	2.4709	.92697	58
3	.37542	.40504	2.4689	.92686	57
4	.37569	.40538	2.4668	.92675	56
5	.37595	.40572	2.4648	.92664	55
6	.37622	.40606	2.4627	.92653	54
7	.37649	.40640	2.4606	.92642	53
8	.37676	.40674	2.4586	.92631	52
9	.37703	.40707	2.4566	.92620	51
10	.37730	.40741	2.4545	.92609	50
11	.37757	.40775	2.4525	.92598	49
12	.37784	.40809	2.4504	.92587	48
13	.37811	.40843	2.4484	.92576	47
14	.37838	.40877	2.4464	.92565	46
15	.37865	.40911	2.4443	.92554	45
16	.37892	.40945	2.4423	.92543	44
17	.37919	.40979	2.4403	.92532	43
18	.37946	.41013	2.4383	.92521	42
19	.37973	.41047	2.4362	.92510	41
20	.37999	.41081	2.4342	.92499	40
21	.38026	.41115	2.4322	.92488	39
22	.38053	.41149	2.4302	.92477	38
23	.38080	.41183	2.4282	.92466	37
24	.38107	.41217	2.4262	.92455	36
25	.38134	.41251	2.4242	.92444	35
26	.38161	.41285	2.4222	.92432	34
27	.38188	.41319	2.4202	.92421	33
28	.38215	.41353	2.4182	.92410	32
29	.38241	.41387	2.4162	.92399	31
30	.38268	.41421	2.4142	.92388	30
31	.38295	.41455	2.4122	.92377	29
32	.38322	.41490	2.4102	.92366	28
33	.38349	.41524	2.4083	.92355	27
34	.38376	.41558	2.4063	.92343	26
35	.38403	.41592	2.4043	.92332	25
36	.38430	.41626	2.4023	.92321	24
37	.38456	.41660	2.4004	.92310	23
38	.38483	.41694	2.3984	.92299	22
39	.38510	.41728	2.3964	.92287	21
40	.38537	.41763	2.3945	.92276	20
41	.38564	.41797	2.3925	.92265	19
42	.38591	.41831	2.3906	.92254	18
43	.38617	.41865	2.3886	.92243	17
44	.38644	.41899	2.3867	.92231	16
45	.38671	.41933	2.3847	.92220	15
46	.38698	.41968	2.3828	.92209	14
47	.38725	.42002	2.3808	.92198	13
48	.38752	.42036	2.3789	.92186	12
49	.38778	.42070	2.3770	.92175	11
50	.38805	.42105	2.3750	.92164	10
51	.38832	.42139	2.3731	.92152	9
52	.38859	.42173	2.3712	.92141	8
53	.38886	.42207	2.3693	.92130	7
54	.38912	.42242	2.3673	.92119	6
55	.38939	.42276	2.3654	.92107	5
56	.38966	.42310	2.3635	.92096	4
57	.38993	.42345	2.3616	.92085	3
58	.39020	.42379	2.3597	.92073	2
59	.39046	.42413	2.3578	.92062	1
60	.39073	.42447	2.3559	.92050	0
	Cos	Ctn	Tan	Sin	′

112° — 67°

23° — 156°

′	Sin	Tan	Ctn	Cos	
0	.39073	.42447	2.3559	.92050	60
1	.39100	.42482	2.3539	.92039	59
2	.39127	.42516	2.3520	.92028	58
3	.39153	.42551	2.3501	.92016	57
4	.39180	.42585	2.3483	.92005	56
5	.39207	.42619	2.3464	.91994	55
6	.39234	.42654	2.3445	.91982	54
7	.39260	.42688	2.3426	.91971	53
8	.39287	.42722	2.3407	.91959	52
9	.39314	.42757	2.3388	.91948	51
10	.39341	.42791	2.3369	.91936	50
11	.39367	.42826	2.3351	.91925	49
12	.39394	.42860	2.3332	.91914	48
13	.39421	.42894	2.3313	.91902	47
14	.39448	.42929	2.3294	.91891	46
15	.39474	.42963	2.3276	.91879	45
16	.39501	.42998	2.3257	.91868	44
17	.39528	.43032	2.3238	.91856	43
18	.39555	.43067	2.3220	.91845	42
19	.39581	.43101	2.3201	.91833	41
20	.39608	.43136	2.3183	.91822	40
21	.39635	.43170	2.3164	.91810	39
22	.39661	.43205	2.3146	.91799	38
23	.39688	.43239	2.3127	.91787	37
24	.39715	.43274	2.3109	.91775	36
25	.39741	.43308	2.3090	.91764	35
26	.39768	.43343	2.3072	.91752	34
27	.39795	.43378	2.3053	.91741	33
28	.39822	.43412	2.3035	.91729	32
29	.39848	.43447	2.3017	.91718	31
30	.39875	.43481	2.2998	.91706	30
31	.39902	.43516	2.2980	.91694	29
32	.39928	.43550	2.2962	.91683	28
33	.39955	.43585	2.2944	.91671	27
34	.39982	.43620	2.2925	.91660	26
35	.40008	.43654	2.2907	.91648	25
36	.40035	.43689	2.2889	.91636	24
37	.40062	.43724	2.2871	.91625	23
38	.40088	.43758	2.2853	.91613	22
39	.40115	.43793	2.2835	.91601	21
40	.40141	.43828	2.2817	.91590	20
41	.40168	.43862	2.2799	.91578	19
42	.40195	.43897	2.2781	.91566	18
43	.40221	.43932	2.2763	.91555	17
44	.40248	.43966	2.2745	.91543	16
45	.40275	.44001	2.2727	.91531	15
46	.40301	.44036	2.2709	.91519	14
47	.40328	.44071	2.2691	.91508	13
48	.40355	.44105	2.2673	.91496	12
49	.40381	.44140	2.2655	.91484	11
50	.40408	.44175	2.2637	.91472	10
51	.40434	.44210	2.2620	.91461	9
52	.40461	.44244	2.2602	.91449	8
53	.40488	.44279	2.2584	.91437	7
54	.40514	.44314	2.2566	.91425	6
55	.40541	.44349	2.2549	.91414	5
56	.40567	.44384	2.2531	.91402	4
57	.40594	.44418	2.2513	.91390	3
58	.40621	.44453	2.2496	.91378	2
59	.40647	.44488	2.2478	.91366	1
60	.40674	.44523	2.2460	.91355	0
	Cos	Ctn	Tan	Sin	′

113° — 66°

24° (155°)

′	Sin	Tan	Ctn	Cos	
0	.40674	.44523	2.2460	.91355	60
1	.40700	.44558	2.2443	.91343	59
2	.40727	.44593	2.2425	.91331	58
3	.40753	.44627	2.2408	.91319	57
4	.40780	.44662	2.2390	.91307	56
5	.40806	.44697	2.2373	.91295	55
6	.40833	.44732	2.2355	.91283	54
7	.40860	.44767	2.2338	.91272	53
8	.40886	.44802	2.2320	.91260	52
9	.40913	.44837	2.2303	.91248	51
10	.40939	.44872	2.2286	.91236	50
11	.40966	.44907	2.2268	.91224	49
12	.40992	.44942	2.2251	.91212	48
13	.41019	.44977	2.2234	.91200	47
14	.41045	.45012	2.2216	.91188	46
15	.41072	.45047	2.2199	.91176	45
16	.41098	.45082	2.2182	.91164	44
17	.41125	.45117	2.2165	.91152	43
18	.41151	.45152	2.2148	.91140	42
19	.41178	.45187	2.2130	.91128	41
20	.41204	.45222	2.2113	.91116	40
21	.41231	.45257	2.2096	.91104	39
22	.41257	.45292	2.2079	.91092	38
23	.41284	.45327	2.2062	.91080	37
24	.41310	.45362	2.2045	.91068	36
25	.41337	.45397	2.2028	.91056	35
26	.41363	.45432	2.2011	.91044	34
27	.41390	.45467	2.1994	.91032	33
28	.41416	.45502	2.1977	.91020	32
29	.41443	.45538	2.1960	.91008	31
30	.41469	.45573	2.1943	.90996	30
31	.41496	.45608	2.1926	.90984	29
32	.41522	.45643	2.1909	.90972	28
33	.41549	.45678	2.1892	.90960	27
34	.41575	.45713	2.1876	.90948	26
35	.41602	.45748	2.1859	.90936	25
36	.41628	.45784	2.1842	.90924	24
37	.41655	.45819	2.1825	.90911	23
38	.41681	.45854	2.1808	.90899	22
39	.41707	.45889	2.1792	.90887	21
40	.41734	.45924	2.1775	.90875	20
41	.41760	.45960	2.1758	.90863	19
42	.41787	.45995	2.1742	.90851	18
43	.41813	.46030	2.1725	.90839	17
44	.41840	.46065	2.1708	.90826	16
45	.41866	.46101	2.1692	.90814	15
46	.41892	.46136	2.1675	.90802	14
47	.41919	.46171	2.1659	.90790	13
48	.41945	.46206	2.1642	.90778	12
49	.41972	.46242	2.1625	.90766	11
50	.41998	.46277	2.1609	.90753	10
51	.42024	.46312	2.1592	.90741	9
52	.42051	.46348	2.1576	.90729	8
53	.42077	.46383	2.1560	.90717	7
54	.42104	.46418	2.1543	.90704	6
55	.42130	.46454	2.1527	.90692	5
56	.42156	.46489	2.1510	.90680	4
57	.42183	.46525	2.1494	.90668	3
58	.42209	.46560	2.1478	.90655	2
59	.42235	.46595	2.1461	.90643	1
60	.42262	.46631	2.1445	.90631	0
	Cos	Ctn	Tan	Sin	′

114° (65°)

25° (154°)

′	Sin	Tan	Ctn	Cos	
0	.42262	.46631	2.1445	.90631	60
1	.42288	.46666	2.1429	.90618	59
2	.42315	.46702	2.1413	.90606	58
3	.42341	.46737	2.1396	.90594	57
4	.42367	.46772	2.1380	.90582	56
5	.42394	.46808	2.1364	.90569	55
6	.42420	.46843	2.1348	.90557	54
7	.42446	.46879	2.1332	.90545	53
8	.42473	.46914	2.1315	.90532	52
9	.42499	.46950	2.1299	.90520	51
10	.42525	.46985	2.1283	.90507	50
11	.42552	.47021	2.1267	.90495	49
12	.42578	.47056	2.1251	.90483	48
13	.42604	.47092	2.1235	.90470	47
14	.42631	.47128	2.1219	.90458	46
15	.42657	.47163	2.1203	.90446	45
16	.42683	.47199	2.1187	.90433	44
17	.42709	.47234	2.1171	.90421	43
18	.42736	.47270	2.1155	.90408	42
19	.42762	.47305	2.1139	.90396	41
20	.42788	.47341	2.1123	.90383	40
21	.42815	.47377	2.1107	.90371	39
22	.42841	.47412	2.1092	.90358	38
23	.42867	.47448	2.1076	.90346	37
24	.42894	.47483	2.1060	.90334	36
25	.42920	.47519	2.1044	.90321	35
26	.42946	.47555	2.1028	.90309	34
27	.42972	.47590	2.1013	.90296	33
28	.42999	.47626	2.0997	.90284	32
29	.43025	.47662	2.0981	.90271	31
30	.43051	.47698	2.0965	.90259	30
31	.43077	.47733	2.0950	.90246	29
32	.43104	.47769	2.0934	.90233	28
33	.43130	.47805	2.0918	.90221	27
34	.43156	.47840	2.0903	.90208	26
35	.43182	.47876	2.0887	.90196	25
36	.43209	.47912	2.0872	.90183	24
37	.43235	.47948	2.0856	.90171	23
38	.43261	.47984	2.0840	.90158	22
39	.43287	.48019	2.0825	.90146	21
40	.43313	.48055	2.0809	.90133	20
41	.43340	.48091	2.0794	.90120	19
42	.43366	.48127	2.0778	.90108	18
43	.43392	.48163	2.0763	.90095	17
44	.43418	.48198	2.0748	.90082	16
45	.43445	.48234	2.0732	.90070	15
46	.43471	.48270	2.0717	.90057	14
47	.43497	.48306	2.0701	.90045	13
48	.43523	.48342	2.0686	.90032	12
49	.43549	.48378	2.0671	.90019	11
50	.43575	.48414	2.0655	.90007	10
51	.43602	.48450	2.0640	.89994	9
52	.43628	.48486	2.0625	.89981	8
53	.43654	.48521	2.0609	.89968	7
54	.43680	.48557	2.0594	.89956	6
55	.43706	.48593	2.0579	.89943	5
56	.43733	.48629	2.0564	.89930	4
57	.43759	.48665	2.0549	.89918	3
58	.43785	.48701	2.0533	.89905	2
59	.43811	.48737	2.0518	.89892	1
60	.43837	.48773	2.0503	.89879	0
	Cos	Ctn	Tan	Sin	′

115° (64°)

26° — 153°

′	Sin	Tan	Ctn	Cos	
0	.43837	.48773	2.0503	.89879	60
1	.43863	.48809	2.0488	.89867	59
2	.43889	.48845	2.0473	.89854	58
3	.43916	.48881	2.0458	.89841	57
4	.43942	.48917	2.0443	.89828	56
5	.43968	.48953	2.0428	.89816	55
6	.43994	.48989	2.0413	.89803	54
7	.44020	.49026	2.0398	.89790	53
8	.44046	.49062	2.0383	.89777	52
9	.44072	.49098	2.0368	.89764	51
10	.44098	.49134	2.0353	.89752	50
11	.44124	.49170	2.0338	.89739	49
12	.44151	.49206	2.0323	.89726	48
13	.44177	.49242	2.0308	.89713	47
14	.44203	.49278	2.0293	.89700	46
15	.44229	.49315	2.0278	.89687	45
16	.44255	.49351	2.0263	.89674	44
17	.44281	.49387	2.0248	.89662	43
18	.44307	.49423	2.0233	.89649	42
19	.44333	.49459	2.0219	.89636	41
20	.44359	.49495	2.0204	.89623	40
21	.44385	.49532	2.0189	.89610	39
22	.44411	.49568	2.0174	.89597	38
23	.44437	.49604	2.0160	.89584	37
24	.44464	.49640	2.0145	.89571	36
25	.44490	.49677	2.0130	.89558	35
26	.44516	.49713	2.0115	.89545	34
27	.44542	.49749	2.0101	.89532	33
28	.44568	.49786	2.0086	.89519	32
29	.44594	.49822	2.0072	.89506	31
30	.44620	.49858	2.0057	.89493	30
31	.44646	.49894	2.0042	.89480	29
32	.44672	.49931	2.0028	.89467	28
33	.44698	.49967	2.0013	.89454	27
34	.44724	.50004	1.9999	.89441	26
35	.44750	.50040	1.9984	.89428	25
36	.44776	.50076	1.9970	.89415	24
37	.44802	.50113	1.9955	.89402	23
38	.44828	.50149	1.9941	.89389	22
39	.44854	.50185	1.9926	.89376	21
40	.44880	.50222	1.9912	.89363	20
41	.44906	.50258	1.9897	.89350	19
42	.44932	.50295	1.9883	.89337	18
43	.44958	.50331	1.9868	.89324	17
44	.44984	.50368	1.9854	.89311	16
45	.45010	.50404	1.9840	.89298	15
46	.45036	.50441	1.9825	.89285	14
47	.45062	.50477	1.9811	.89272	13
48	.45088	.50514	1.9797	.89259	12
49	.45114	.50550	1.9782	.89245	11
50	.45140	.50587	1.9768	.89232	10
51	.45166	.50623	1.9754	.89219	9
52	.45192	.50660	1.9740	.89206	8
53	.45218	.50696	1.9725	.89193	7
54	.45243	.50733	1.9711	.89180	6
55	.45269	.50769	1.9697	.89167	5
56	.45295	.50806	1.9683	.89153	4
57	.45321	.50843	1.9669	.89140	3
58	.45347	.50879	1.9654	.89127	2
59	.45373	.50916	1.9640	.89114	1
60	.45399	.50953	1.9626	.89101	0
	Cos	Ctn	Tan	Sin	′

116° — 63°

27° — 152°

′	Sin	Tan	Ctn	Cos	
0	.45399	.50953	1.9626	.89101	60
1	.45425	.50989	1.9612	.89087	59
2	.45451	.51026	1.9598	.89074	58
3	.45477	.51063	1.9584	.89061	57
4	.45503	.51099	1.9570	.89048	56
5	.45529	.51136	1.9556	.89035	55
6	.45554	.51173	1.9542	.89021	54
7	.45580	.51209	1.9528	.89008	53
8	.45606	.51246	1.9514	.88995	52
9	.45632	.51283	1.9500	.88981	51
10	.45658	.51319	1.9486	.88968	50
11	.45684	.51356	1.9472	.88955	49
12	.45710	.51393	1.9458	.88942	48
13	.45736	.51430	1.9444	.88928	47
14	.45762	.51467	1.9430	.88915	46
15	.45787	.51503	1.9416	.88902	45
16	.45813	.51540	1.9402	.88888	44
17	.45839	.51577	1.9388	.88875	43
18	.45865	.51614	1.9375	.88862	42
19	.45891	.51651	1.9361	.88848	41
20	.45917	.51688	1.9347	.88835	40
21	.45942	.51724	1.9333	.88822	39
22	.45968	.51761	1.9319	.88808	38
23	.45994	.51798	1.9306	.88795	37
24	.46020	.51835	1.9292	.88782	36
25	.46046	.51872	1.9278	.88768	35
26	.46072	.51909	1.9265	.88755	34
27	.46097	.51946	1.9251	.88741	33
28	.46123	.51983	1.9237	.88728	32
29	.46149	.52020	1.9223	.88715	31
30	.46175	.52057	1.9210	.88701	30
31	.46201	.52094	1.9196	.88688	29
32	.46226	.52131	1.9183	.88674	28
33	.46252	.52168	1.9169	.88661	27
34	.46278	.52205	1.9155	.88647	26
35	.46304	.52242	1.9142	.88634	25
36	.46330	.52279	1.9128	.88620	24
37	.46355	.52316	1.9115	.88607	23
38	.46381	.52353	1.9101	.88593	22
39	.46407	.52390	1.9088	.88580	21
40	.46433	.52427	1.9074	.88566	20
41	.46458	.52464	1.9061	.88553	19
42	.46484	.52501	1.9047	.88539	18
43	.46510	.52538	1.9034	.88526	17
44	.46536	.52575	1.9020	.88512	16
45	.46561	.52613	1.9007	.88499	15
46	.46587	.52650	1.8993	.88485	14
47	.46613	.52687	1.8980	.88472	13
48	.46639	.52724	1.8967	.88458	12
49	.46664	.52761	1.8953	.88445	11
50	.46690	.52798	1.8940	.88431	10
51	.46716	.52836	1.8927	.88417	9
52	.46742	.52873	1.8913	.88404	8
53	.46767	.52910	1.8900	.88390	7
54	.46793	.52947	1.8887	.88377	6
55	.46819	.52985	1.8873	.88363	5
56	.46844	.53022	1.8860	.88349	4
57	.46870	.53059	1.8847	.88336	3
58	.46896	.53096	1.8834	.88322	2
59	.46921	.53134	1.8820	.88308	1
60	.46947	.53171	1.8807	.88295	0
	Cos	Ctn	Tan	Sin	′

117° — 62°

NATURAL TRIGONOMETRIC FUNCTIONS

28° / 151°

′	Sin	Tan	Ctn	Cos	
0	.46947	.53171	1.8807	.88295	60
1	.46973	.53208	1.8794	.88281	59
2	.46999	.53246	1.8781	.88267	58
3	.47024	.53283	1.8768	.88254	57
4	.47050	.53320	1.8755	.88240	56
5	.47076	.53358	1.8741	.88226	55
6	.47101	.53395	1.8728	.88213	54
7	.47127	.53432	1.8715	.88199	53
8	.47153	.53470	1.8702	.88185	52
9	.47178	.53507	1.8689	.88172	51
10	.47204	.53545	1.8676	.88158	50
11	.47229	.53582	1.8663	.88144	49
12	.47255	.53620	1.8650	.88130	48
13	.47281	.53657	1.8637	.88117	47
14	.47306	.53694	1.8624	.88103	46
15	.47332	.53732	1.8611	.88089	45
16	.47358	.53769	1.8598	.88075	44
17	.47383	.53807	1.8585	.88062	43
18	.47409	.53844	1.8572	.88048	42
19	.47434	.53882	1.8559	.88034	41
20	.47460	.53920	1.8546	.88020	40
21	.47486	.53957	1.8533	.88006	39
22	.47511	.53995	1.8520	.87993	38
23	.47537	.54032	1.8507	.87979	37
24	.47562	.54070	1.8495	.87965	36
25	.47588	.54107	1.8482	.87951	35
26	.47614	.54145	1.8469	.87937	34
27	.47639	.54183	1.8456	.87923	33
28	.47665	.54220	1.8443	.87909	32
29	.47690	.54258	1.8430	.87896	31
30	.47716	.54296	1.8418	.87882	30
31	.47741	.54333	1.8405	.87868	29
32	.47767	.54371	1.8392	.87854	28
33	.47793	.54409	1.8379	.87840	27
34	.47818	.54446	1.8367	.87826	26
35	.47844	.54484	1.8354	.87812	25
36	.47869	.54522	1.8341	.87798	24
37	.47895	.54560	1.8329	.87784	23
38	.47920	.54597	1.8316	.87770	22
39	.47946	.54635	1.8303	.87756	21
40	.47971	.54673	1.8291	.87743	20
41	.47997	.54711	1.8278	.87729	19
42	.48022	.54748	1.8265	.87715	18
43	.48048	.54786	1.8253	.87701	17
44	.48073	.54824	1.8240	.87687	16
45	.48099	.54862	1.8228	.87673	15
46	.48124	.54900	1.8215	.87659	14
47	.48150	.54938	1.8202	.87645	13
48	.48175	.54975	1.8190	.87631	12
49	.48201	.55013	1.8177	.87617	11
50	.48226	.55051	1.8165	.87603	10
51	.48252	.55089	1.8152	.87589	9
52	.48277	.55127	1.8140	.87575	8
53	.48303	.55165	1.8127	.87561	7
54	.48328	.55203	1.8115	.87546	6
55	.48354	.55241	1.8103	.87532	5
56	.48379	.55279	1.8090	.87518	4
57	.48405	.55317	1.8078	.87504	3
58	.48430	.55355	1.8065	.87490	2
59	.48456	.55393	1.8053	.87476	1
60	.48481	.55431	1.8040	.87462	0
	Cos	Ctn	Tan	Sin	′

29° / 150°

′	Sin	Tan	Ctn	Cos	
0	.48481	.55431	1.8040	.87462	60
1	.48506	.55469	1.8028	.87448	59
2	.48532	.55507	1.8016	.87434	58
3	.48557	.55545	1.8003	.87420	57
4	.48583	.55583	1.7991	.87406	56
5	.48608	.55621	1.7979	.87391	55
6	.48634	.55659	1.7966	.87377	54
7	.48659	.55697	1.7954	.87363	53
8	.48684	.55736	1.7942	.87349	52
9	.48710	.55774	1.7930	.87335	51
10	.48735	.55812	1.7917	.87321	50
11	.48761	.55850	1.7905	.87306	49
12	.48786	.55888	1.7893	.87292	48
13	.48811	.55926	1.7881	.87278	47
14	.48837	.55964	1.7868	.87264	46
15	.48862	.56003	1.7856	.87250	45
16	.48888	.56041	1.7844	.87235	44
17	.48913	.56079	1.7832	.87221	43
18	.48938	.56117	1.7820	.87207	42
19	.48964	.56156	1.7808	.87193	41
20	.48989	.56194	1.7796	.87178	40
21	.49014	.56232	1.7783	.87164	39
22	.49040	.56270	1.7771	.87150	38
23	.49065	.56309	1.7759	.87136	37
24	.49090	.56347	1.7747	.87121	36
25	.49116	.56385	1.7735	.87107	35
26	.49141	.56424	1.7723	.87093	34
27	.49166	.56462	1.7711	.87079	33
28	.49192	.56501	1.7699	.87064	32
29	.49217	.56539	1.7687	.87050	31
30	.49242	.56577	1.7675	.87036	30
31	.49268	.56616	1.7663	.87021	29
32	.49293	.56654	1.7651	.87007	28
33	.49318	.56693	1.7639	.86993	27
34	.49344	.56731	1.7627	.86978	26
35	.49369	.56769	1.7615	.86964	25
36	.49394	.56808	1.7603	.86949	24
37	.49419	.56846	1.7591	.86935	23
38	.49445	.56885	1.7579	.86921	22
39	.49470	.56923	1.7567	.86906	21
40	.49495	.56962	1.7556	.86892	20
41	.49521	.57000	1.7544	.86878	19
42	.49546	.57039	1.7532	.86863	18
43	.49571	.57078	1.7520	.86849	17
44	.49596	.57116	1.7508	.86834	16
45	.49622	.57155	1.7496	.86820	15
46	.49647	.57193	1.7485	.86805	14
47	.49672	.57232	1.7473	.86791	13
48	.49697	.57271	1.7461	.86777	12
49	.49723	.57309	1.7449	.86762	11
50	.49748	.57348	1.7437	.86748	10
51	.49773	.57386	1.7426	.86733	9
52	.49798	.57425	1.7414	.86719	8
53	.49824	.57464	1.7402	.86704	7
54	.49849	.57503	1.7391	.86690	6
55	.49874	.57541	1.7379	.86675	5
56	.49899	.57580	1.7367	.86661	4
57	.49924	.57619	1.7355	.86646	3
58	.49950	.57657	1.7344	.86632	2
59	.49975	.57696	1.7332	.86617	1
60	.50000	.57735	1.7321	.86603	0
	Cos	Ctn	Tan	Sin	′

30° **149°** **31°** **148°**

′	Sin	Tan	Ctn	Cos	
0	.50000	.57735	1.7321	.86603	60
1	.50025	.57774	1.7309	.86588	59
2	.50050	.57813	1.7297	.86573	58
3	.50076	.57851	1.7286	.86559	57
4	.50101	.57890	1.7274	.86544	56
5	.50126	.57929	1.7262	.86530	55
6	.50151	.57968	1.7251	.86515	54
7	.50176	.58007	1.7239	.86501	53
8	.50201	.58046	1.7228	.86486	52
9	.50227	.58085	1.7216	.86471	51
10	.50252	.58124	1.7205	.86457	50
11	.50277	.58162	1.7193	.86442	49
12	.50302	.58201	1.7182	.86427	48
13	.50327	.58240	1.7170	.86413	47
14	.50352	.58279	1.7159	.86398	46
15	.50377	.58318	1.7147	.86384	45
16	.50403	.58357	1.7136	.86369	44
17	.50428	.58396	1.7124	.86354	43
18	.50453	.58435	1.7113	.86340	42
19	.50478	.58474	1.7102	.86325	41
20	.50503	.58513	1.7090	.86310	40
21	.50528	.58552	1.7079	.86295	39
22	.50553	.58591	1.7067	.86281	38
23	.50578	.58631	1.7056	.86266	37
24	.50603	.58670	1.7045	.86251	36
25	.50628	.58709	1.7033	.86237	35
26	.50654	.58748	1.7022	.86222	34
27	.50679	.58787	1.7011	.86207	33
28	.50704	.58826	1.6999	.86192	32
29	.50729	.58865	1.6988	.86178	31
30	.50754	.58905	1.6977	.86163	30
31	.50779	.58944	1.6965	.86148	29
32	.50804	.58983	1.6954	.86133	28
33	.50829	.59022	1.6943	.86119	27
34	.50854	.59061	1.6932	.86104	26
35	.50879	.59101	1.6920	.86089	25
36	.50904	.59140	1.6909	.86074	24
37	.50929	.59179	1.6898	.86059	23
38	.50954	.59218	1.6887	.86045	22
39	.50979	.59258	1.6875	.86030	21
40	.51004	.59297	1.6864	.86015	20
41	.51029	.59336	1.6853	.86000	19
42	.51054	.59376	1.6842	.85985	18
43	.51079	.59415	1.6831	.85970	17
44	.51104	.59454	1.6820	.85956	16
45	.51129	.59494	1.6808	.85941	15
46	.51154	.59533	1.6797	.85926	14
47	.51179	.59573	1.6786	.85911	13
48	.51204	.59612	1.6775	.85896	12
49	.51229	.59651	1.6764	.85881	11
50	.51254	.59691	1.6753	.85866	10
51	.51279	.59730	1.6742	.85851	9
52	.51304	.59770	1.6731	.85836	8
53	.51329	.59809	1.6720	.85821	7
54	.51354	.59849	1.6709	.85806	6
55	.51379	.59888	1.6698	.85792	5
56	.51404	.59928	1.6687	.85777	4
57	.51429	.59967	1.6676	.85762	3
58	.51454	.60007	1.6665	.85747	2
59	.51479	.60046	1.6654	.85732	1
60	.51504	.60086	1.6643	.85717	0
	Cos	Ctn	Tan	Sin	′

′	Sin	Tan	Ctn	Cos	
0	.51504	.60086	1.6643	.85717	60
1	.51529	.60126	1.6632	.85702	59
2	.51554	.60165	1.6621	.85687	58
3	.51579	.60205	1.6610	.85672	57
4	.51604	.60245	1.6599	.85657	56
5	.51628	.60284	1.6588	.85642	55
6	.51653	.60324	1.6577	.85627	54
7	.51678	.60364	1.6566	.85612	53
8	.51703	.60403	1.6555	.85597	52
9	.51728	.60443	1.6545	.85582	51
10	.51753	.60483	1.6534	.85567	50
11	.51778	.60522	1.6523	.85551	49
12	.51803	.60562	1.6512	.85536	48
13	.51828	.60602	1.6501	.85521	47
14	.51852	.60642	1.6490	.85506	46
15	.51877	.60681	1.6479	.85491	45
16	.51902	.60721	1.6469	.85476	44
17	.51927	.60761	1.6458	.85461	43
18	.51952	.60801	1.6447	.85446	42
19	.51977	.60841	1.6436	.85431	41
20	.52002	.60881	1.6426	.85416	40
21	.52026	.60921	1.6415	.85401	39
22	.52051	.60960	1.6404	.85385	38
23	.52076	.61000	1.6393	.85370	37
24	.52101	.61040	1.6383	.85355	36
25	.52126	.61080	1.6372	.85340	35
26	.52151	.61120	1.6361	.85325	34
27	.52175	.61160	1.6351	.85310	33
28	.52200	.61200	1.6340	.85294	32
29	.52225	.61240	1.6329	.85279	31
30	.52250	.61280	1.6319	.85264	30
31	.52275	.61320	1.6308	.85249	29
32	.52299	.61360	1.6297	.85234	28
33	.52324	.61400	1.6287	.85218	27
34	.52349	.61440	1.6276	.85203	26
35	.52374	.61480	1.6265	.85188	25
36	.52399	.61520	1.6255	.85173	24
37	.52423	.61561	1.6244	.85157	23
38	.52448	.61601	1.6234	.85142	22
39	.52473	.61641	1.6223	.85127	21
40	.52498	.61681	1.6212	.85112	20
41	.52522	.61721	1.6202	.85096	19
42	.52547	.61761	1.6191	.85081	18
43	.52572	.61801	1.6181	.85066	17
44	.52597	.61842	1.6170	.85051	16
45	.52621	.61882	1.6160	.85035	15
46	.52646	.61922	1.6149	.85020	14
47	.52671	.61962	1.6139	.85005	13
48	.52696	.62003	1.6128	.84989	12
49	.52720	.62043	1.6118	.84974	11
50	.52745	.62083	1.6107	.84959	10
51	.52770	.62124	1.6097	.84943	9
52	.52794	.62164	1.6087	.84928	8
53	.52819	.62204	1.6076	.84913	7
54	.52844	.62245	1.6066	.84897	6
55	.52869	.62285	1.6055	.84882	5
56	.52893	.62325	1.6045	.84866	4
57	.52918	.62366	1.6034	.84851	3
58	.52943	.62406	1.6024	.84836	2
59	.52967	.62446	1.6014	.84820	1
60	.52992	.62487	1.6003	.84805	0
	Cos	Ctn	Tan	Sin	′

120° **59°** **121°** **58°**

32°				147°
′	Sin	Tan	Ctn	Cos
0	.52992	.62487	1.6003	.84805
1	.53017	.62527	1.5993	.84789
2	.53041	.62568	1.5983	.84774
3	.53066	.62608	1.5972	.84759
4	.53091	.62649	1.5962	.84743
5	.53115	.62689	1.5952	.84728
6	.53140	.62730	1.5941	.84712
7	.53164	.62770	1.5931	.84697
8	.53189	.62811	1.5921	.84681
9	.53214	.62852	1.5911	.84666
10	.53238	.62892	1.5900	.84650
11	.53263	.62933	1.5890	.84635
12	.53288	.62973	1.5880	.84619
13	.53312	.63014	1.5869	.84604
14	.53337	.63055	1.5859	.84588
15	.53361	.63095	1.5849	.84573
16	.53386	.63136	1.5839	.84557
17	.53411	.63177	1.5829	.84542
18	.53435	.63217	1.5818	.84526
19	.53460	.63258	1.5808	.84511
20	.53484	.63299	1.5798	.84495
21	.53509	.63340	1.5788	.84480
22	.53534	.63380	1.5778	.84464
23	.53558	.63421	1.5768	.84448
24	.53583	.63462	1.5757	.84433
25	.53607	.63503	1.5747	.84417
26	.53632	.63544	1.5737	.84402
27	.53656	.63584	1.5727	.84386
28	.53681	.63625	1.5717	.84370
29	.53705	.63666	1.5707	.84355
30	.53730	.63707	1.5697	.84339
31	.53754	.63748	1.5687	.84324
32	.53779	.63789	1.5677	.84308
33	.53804	.63830	1.5667	.84292
34	.53828	.63871	1.5657	.84277
35	.53853	.63912	1.5647	.84261
36	.53877	.63953	1.5637	.84245
37	.53902	.63994	1.5627	.84230
38	.53926	.64035	1.5617	.84214
39	.53951	.64076	1.5607	.84198
40	.53975	.64117	1.5597	.84182
41	.54000	.64158	1.5587	.84167
42	.54024	.64199	1.5577	.84151
43	.54049	.64240	1.5567	.84135
44	.54073	.64281	1.5557	.84120
45	.54097	.64322	1.5547	.84104
46	.54122	.64363	1.5537	.84088
47	.54146	.64404	1.5527	.84072
48	.54171	.64446	1.5517	.84057
49	.54195	.64487	1.5507	.84041
50	.54220	.64528	1.5497	.84025
51	.54244	.64569	1.5487	.84009
52	.54269	.64610	1.5477	.83994
53	.54293	.64652	1.5468	.83978
54	.54317	.64693	1.5458	.83962
55	.54342	.64734	1.5448	.83946
56	.54366	.64775	1.5438	.83930
57	.54391	.64817	1.5428	.83915
58	.54415	.64858	1.5418	.83899
59	.54440	.64899	1.5408	.83883
60	.54464	.64941	1.5399	.83867
	Cos	Ctn	Tan	Sin
122°				57°

33°				146°
′	Sin	Tan	Ctn	Cos
0	.54464	.64941	1.5399	.83867
1	.54488	.64982	1.5389	.83851
2	.54513	.65024	1.5379	.83835
3	.54537	.65065	1.5369	.83819
4	.54561	.65106	1.5359	.83804
5	.54586	.65148	1.5350	.83788
6	.54610	.65189	1.5340	.83772
7	.54635	.65231	1.5330	.83756
8	.54659	.65272	1.5320	.83740
9	.54683	.65314	1.5311	.83724
10	.54708	.65355	1.5301	.83708
11	.54732	.65397	1.5291	.83692
12	.54756	.65438	1.5282	.83676
13	.54781	.65480	1.5272	.83660
14	.54805	.65521	1.5262	.83645
15	.54829	.65563	1.5253	.83629
16	.54854	.65604	1.5243	.83613
17	.54878	.65646	1.5233	.83597
18	.54902	.65688	1.5224	.83581
19	.54927	.65729	1.5214	.83565
20	.54951	.65771	1.5204	.83549
21	.54975	.65813	1.5195	.83533
22	.54999	.65854	1.5185	.83517
23	.55024	.65896	1.5175	.83501
24	.55048	.65938	1.5166	.83485
25	.55072	.65980	1.5156	.83469
26	.55097	.66021	1.5147	.83453
27	.55121	.66063	1.5137	.83437
28	.55145	.66105	1.5127	.83421
29	.55169	.66147	1.5118	.83405
30	.55194	.66189	1.5108	.83389
31	.55218	.66230	1.5099	.83373
32	.55242	.66272	1.5089	.83356
33	.55266	.66314	1.5080	.83340
34	.55291	.66356	1.5070	.83324
35	.55315	.66398	1.5061	.83308
36	.55339	.66440	1.5051	.83292
37	.55363	.66482	1.5042	.83276
38	.55388	.66524	1.5032	.83260
39	.55412	.66566	1.5023	.83244
40	.55436	.66608	1.5013	.83228
41	.55460	.66650	1.5004	.83212
42	.55484	.66692	1.4994	.83195
43	.55509	.66734	1.4985	.83179
44	.55533	.66776	1.4975	.83163
45	.55557	.66818	1.4966	.83147
46	.55581	.66860	1.4957	.83131
47	.55605	.66902	1.4947	.83115
48	.55630	.66944	1.4938	.83098
49	.55654	.66986	1.4928	.83082
50	.55678	.67028	1.4919	.83066
51	.55702	.67071	1.4910	.83050
52	.55726	.67113	1.4900	.83034
53	.55750	.67155	1.4891	.83017
54	.55775	.67197	1.4882	.83001
55	.55799	.67239	1.4872	.82985
56	.55823	.67282	1.4863	.82969
57	.55847	.67324	1.4854	.82953
58	.55871	.67366	1.4844	.82936
59	.55895	.67409	1.4835	.82920
60	.55919	.67451	1.4826	.82904
	Cos	Ctn	Tan	Sin
123°				56°

34° **145°** **35°** **144°**

′	Sin	Tan	Ctn	Cos	
0	.55919	.67451	1.4826	.82904	60
1	.55943	.67493	1.4816	.82887	59
2	.55968	.67536	1.4807	.82871	58
3	.55992	.67578	1.4798	.82855	57
4	.56016	.67620	1.4788	.82839	56
5	.56040	.67663	1.4779	.82822	55
6	.56064	.67705	1.4770	.82806	54
7	.56088	.67748	1.4761	.82790	53
8	.56112	.67790	1.4751	.82773	52
9	.56136	.67832	1.4742	.82757	51
10	.56160	.67875	1.4733	.82741	50
11	.56184	.67917	1.4724	.82724	49
12	.56208	.67960	1.4715	.82708	48
13	.56232	.68002	1.4705	.82692	47
14	.56256	.68045	1.4696	.82675	46
15	.56280	.68088	1.4687	.82659	45
16	.56305	.68130	1.4678	.82643	44
17	.56329	.68173	1.4669	.82626	43
18	.56353	.68215	1.4659	.82610	42
19	.56377	.68258	1.4650	.82593	41
20	.56401	.68301	1.4641	.82577	40
21	.56425	.68343	1.4632	.82561	39
22	.56449	.68386	1.4623	.82544	38
23	.56473	.68429	1.4614	.82528	37
24	.56497	.68471	1.4605	.82511	36
25	.56521	.68514	1.4596	.82495	35
26	.56545	.68557	1.4586	.82478	34
27	.56569	.68600	1.4577	.82462	33
28	.56593	.68642	1.4568	.82446	32
29	.56617	.68685	1.4559	.82429	31
30	.56641	.68728	1.4550	.82413	30
31	.56665	.68771	1.4541	.82396	29
32	.56689	.68814	1.4532	.82380	28
33	.56713	.68857	1.4523	.82363	27
34	.56736	.68900	1.4514	.82347	26
35	.56760	.68942	1.4505	.82330	25
36	.56784	.68985	1.4496	.82314	24
37	.56808	.69028	1.4487	.82297	23
38	.56832	.69071	1.4478	.82281	22
39	.56856	.69114	1.4469	.82264	21
40	.56880	.69157	1.4460	.82248	20
41	.56904	.69200	1.4451	.82231	19
42	.56928	.69243	1.4442	.82214	18
43	.56952	.69286	1.4433	.82198	17
44	.56976	.69329	1.4424	.82181	16
45	.57000	.69372	1.4415	.82165	15
46	.57024	.69416	1.4406	.82148	14
47	.57047	.69459	1.4397	.82132	13
48	.57071	.69502	1.4388	.82115	12
49	.57095	.69545	1.4379	.82098	11
50	.57119	.69588	1.4370	.82082	10
51	.57143	.69631	1.4361	.82065	9
52	.57167	.69675	1.4352	.82048	8
53	.57191	.69718	1.4344	.82032	7
54	.57215	.69761	1.4335	.82015	6
55	.57238	.69804	1.4326	.81999	5
56	.57262	.69847	1.4317	.81982	4
57	.57286	.69891	1.4308	.81965	3
58	.57310	.69934	1.4299	.81949	2
59	.57334	.69977	1.4290	.81932	1
60	.57358	.70021	1.4281	.81915	0
	Cos	Ctn	Tan	Sin	′

′	Sin	Tan	Ctn	Cos	
0	.57358	.70021	1.4281	.81915	60
1	.57381	.70064	1.4273	.81899	59
2	.57405	.70107	1.4264	.81882	58
3	.57429	.70151	1.4255	.81865	57
4	.57453	.70194	1.4246	.81848	56
5	.57477	.70238	1.4237	.81832	55
6	.57501	.70281	1.4229	.81815	54
7	.57524	.70325	1.4220	.81798	53
8	.57548	.70368	1.4211	.81782	52
9	.57572	.70412	1.4202	.81765	51
10	.57596	.70455	1.4193	.81748	50
11	.57619	.70499	1.4185	.81731	49
12	.57643	.70542	1.4176	.81714	48
13	.57667	.70586	1.4167	.81698	47
14	.57691	.70629	1.4158	.81681	46
15	.57715	.70673	1.4150	.81664	45
16	.57738	.70717	1.4141	.81647	44
17	.57762	.70760	1.4132	.81631	43
18	.57786	.70804	1.4124	.81614	42
19	.57810	.70848	1.4115	.81597	41
20	.57833	.70891	1.4106	.81580	40
21	.57857	.70935	1.4097	.81563	39
22	.57881	.70979	1.4089	.81546	38
23	.57904	.71023	1.4080	.81530	37
24	.57928	.71066	1.4071	.81513	36
25	.57952	.71110	1.4063	.81496	35
26	.57976	.71154	1.4054	.81479	34
27	.57999	.71198	1.4045	.81462	33
28	.58023	.71242	1.4037	.81445	32
29	.58047	.71285	1.4028	.81428	31
30	.58070	.71329	1.4019	.81412	30
31	.58094	.71373	1.4011	.81395	29
32	.58118	.71417	1.4002	.81378	28
33	.58141	.71461	1.3994	.81361	27
34	.58165	.71505	1.3985	.81344	26
35	.58189	.71549	1.3976	.81327	25
36	.58212	.71593	1.3968	.81310	24
37	.58236	.71637	1.3959	.81293	23
38	.58260	.71681	1.3951	.81276	22
39	.58283	.71725	1.3942	.81259	21
40	.58307	.71769	1.3934	.81242	20
41	.58330	.71813	1.3925	.81225	19
42	.58354	.71857	1.3916	.81208	18
43	.58378	.71901	1.3908	.81191	17
44	.58401	.71946	1.3899	.81174	16
45	.58425	.71990	1.3891	.81157	15
46	.58449	.72034	1.3882	.81140	14
47	.58472	.72078	1.3874	.81123	13
48	.58496	.72122	1.3865	.81106	12
49	.58519	.72167	1.3857	.81089	11
50	.58543	.72211	1.3848	.81072	10
51	.58567	.72255	1.3840	.81055	9
52	.58590	.72299	1.3831	.81038	8
53	.58614	.72344	1.3823	.81021	7
54	.58637	.72388	1.3814	.81004	6
55	.58661	.72432	1.3806	.80987	5
56	.58684	.72477	1.3798	.80970	4
57	.58708	.72521	1.3789	.80953	3
58	.58731	.72565	1.3781	.80936	2
59	.58755	.72610	1.3772	.80919	1
60	.58779	.72654	1.3764	.80902	0
	Cos	Ctn	Tan	Sin	′

124° **55°** **125°** **54°**

NATURAL TRIGONOMETRIC FUNCTIONS

36° / 143°

′	Sin	Tan	Ctn	Cos	
0	.58779	.72654	1.3764	.80902	60
1	.58802	.72699	1.3755	.80885	59
2	.58826	.72743	1.3747	.80867	58
3	.58849	.72788	1.3739	.80850	57
4	.58873	.72832	1.3730	.80833	56
5	.58896	.72877	1.3722	.80816	55
6	.58920	.72921	1.3713	.80799	54
7	.58943	.72966	1.3705	.80782	53
8	.58967	.73010	1.3697	.80765	52
9	.58990	.73055	1.3688	.80748	51
10	.59014	.73100	1.3680	.80730	50
11	.59037	.73144	1.3672	.80713	49
12	.59061	.73189	1.3663	.80696	48
13	.59084	.73234	1.3655	.80679	47
14	.59108	.73278	1.3647	.80662	46
15	.59131	.73323	1.3638	.80644	45
16	.59154	.73368	1.3630	.80627	44
17	.59178	.73413	1.3622	.80610	43
18	.59201	.73457	1.3613	.80593	42
19	.59225	.73502	1.3605	.80576	41
20	.59248	.73547	1.3597	.80558	40
21	.59272	.73592	1.3588	.80541	39
22	.59295	.73637	1.3580	.80524	38
23	.59318	.73681	1.3572	.80507	37
24	.59342	.73726	1.3564	.80489	36
25	.59365	.73771	1.3555	.80472	35
26	.59389	.73816	1.3547	.80455	34
27	.59412	.73861	1.3539	.80438	33
28	.59436	.73906	1.3531	.80420	32
29	.59459	.73951	1.3522	.80403	31
30	.59482	.73996	1.3514	.80386	30
31	.59506	.74041	1.3506	.80368	29
32	.59529	.74086	1.3498	.80351	28
33	.59552	.74131	1.3490	.80334	27
34	.59576	.74176	1.3481	.80316	26
35	.59599	.74221	1.3473	.80299	25
36	.59622	.74267	1.3465	.80282	24
37	.59646	.74312	1.3457	.80264	23
38	.59669	.74357	1.3449	.80247	22
39	.59693	.74402	1.3440	.80230	21
40	.59716	.74447	1.3432	.80212	20
41	.59739	.74492	1.3424	.80195	19
42	.59763	.74538	1.3416	.80178	18
43	.59786	.74583	1.3408	.80160	17
44	.59809	.74628	1.3400	.80143	16
45	.59832	.74674	1.3392	.80125	15
46	.59856	.74719	1.3384	.80108	14
47	.59879	.74764	1.3375	.80091	13
48	.59902	.74810	1.3367	.80073	12
49	.59926	.74855	1.3359	.80056	11
50	.59949	.74900	1.3351	.80038	10
51	.59972	.74946	1.3343	.80021	9
52	.59995	.74991	1.3335	.80003	8
53	.60019	.75037	1.3327	.79986	7
54	.60042	.75082	1.3319	.79968	6
55	.60065	.75128	1.3311	.79951	5
56	.60089	.75173	1.3303	.79934	4
57	.60112	.75219	1.3295	.79916	3
58	.60135	.75264	1.3287	.79899	2
59	.60158	.75310	1.3278	.79881	1
60	.60182	.75355	1.3270	.79864	0
	Cos	Ctn	Tan	Sin	′

126° / 53°

37° / 142°

′	Sin	Tan	Ctn	Cos	
0	.60182	.75355	1.3270	.79864	60
1	.60205	.75401	1.3262	.79846	59
2	.60228	.75447	1.3254	.79829	58
3	.60251	.75492	1.3246	.79811	57
4	.60274	.75538	1.3238	.79793	56
5	.60298	.75584	1.3230	.79776	55
6	.60321	.75629	1.3222	.79758	54
7	.60344	.75675	1.3214	.79741	53
8	.60367	.75721	1.3206	.79723	52
9	.60390	.75767	1.3198	.79706	51
10	.60414	.75812	1.3190	.79688	50
11	.60437	.75858	1.3182	.79671	49
12	.60460	.75904	1.3175	.79653	48
13	.60483	.75950	1.3167	.79635	47
14	.60506	.75996	1.3159	.79618	46
15	.60529	.76042	1.3151	.79600	45
16	.60553	.76088	1.3143	.79583	44
17	.60576	.76134	1.3135	.79565	43
18	.60599	.76180	1.3127	.79547	42
19	.60622	.76226	1.3119	.79530	41
20	.60645	.76272	1.3111	.79512	40
21	.60668	.76318	1.3103	.79494	39
22	.60691	.76364	1.3095	.79477	38
23	.60714	.76410	1.3087	.79459	37
24	.60738	.76456	1.3079	.79441	36
25	.60761	.76502	1.3072	.79424	35
26	.60784	.76548	1.3064	.79406	34
27	.60807	.76594	1.3056	.79388	33
28	.60830	.76640	1.3048	.79371	32
29	.60853	.76686	1.3040	.79353	31
30	.60876	.76733	1.3032	.79335	30
31	.60899	.76779	1.3024	.79318	29
32	.60922	.76825	1.3017	.79300	28
33	.60945	.76871	1.3009	.79282	27
34	.60968	.76918	1.3001	.79264	26
35	.60991	.76964	1.2993	.79247	25
36	.61015	.77010	1.2985	.79229	24
37	.61038	.77057	1.2977	.79211	23
38	.61061	.77103	1.2970	.79193	22
39	.61084	.77149	1.2962	.79176	21
40	.61107	.77196	1.2954	.79158	20
41	.61130	.77242	1.2946	.79140	19
42	.61153	.77289	1.2938	.79122	18
43	.61176	.77335	1.2931	.79105	17
44	.61199	.77382	1.2923	.79087	16
45	.61222	.77428	1.2915	.79069	15
46	.61245	.77475	1.2907	.79051	14
47	.61268	.77521	1.2900	.79033	13
48	.61291	.77568	1.2892	.79016	12
49	.61314	.77615	1.2884	.78998	11
50	.61337	.77661	1.2876	.78980	10
51	.61360	.77708	1.2869	.78962	9
52	.61383	.77754	1.2861	.78944	8
53	.61406	.77801	1.2853	.78926	7
54	.61429	.77848	1.2846	.78908	6
55	.61451	.77895	1.2838	.78891	5
56	.61474	.77941	1.2830	.78873	4
57	.61497	.77988	1.2822	.78855	3
58	.61520	.78035	1.2815	.78837	2
59	.61543	.78082	1.2807	.78819	1
60	.61566	.78129	1.2799	.78801	0
	Cos	Ctn	Tan	Sin	′

127° / 52°

38° **141°**

′	Sin	Tan	Ctn	Cos	
0	.61566	.78129	1.2799	.78801	60
1	.61589	.78175	1.2792	.78783	59
2	.61612	.78222	1.2784	.78765	58
3	.61635	.78269	1.2776	.78747	57
4	.61658	.78316	1.2769	.78729	56
5	.61681	.78363	1.2761	.78711	55
6	.61704	.78410	1.2753	.78694	54
7	.61726	.78457	1.2746	.78676	53
8	.61749	.78504	1.2738	.78658	52
9	.61772	.78551	1.2731	.78640	51
10	.61795	.78598	1.2723	.78622	50
11	.61818	.78645	1.2715	.78604	49
12	.61841	.78692	1.2708	.78586	48
13	.61864	.78739	1.2700	.78568	47
14	.61887	.78786	1.2693	.78550	46
15	.61909	.78834	1.2685	.78532	45
16	.61932	.78881	1.2677	.78514	44
17	.61955	.78928	1.2670	.78496	43
18	.61978	.78975	1.2662	.78478	42
19	.62001	.79022	1.2655	.78460	41
20	.62024	.79070	1.2647	.78442	40
21	.62046	.79117	1.2640	.78424	39
22	.62069	.79164	1.2632	.78405	38
23	.62092	.79212	1.2624	.78387	37
24	.62115	.79259	1.2617	.78369	36
25	.62138	.79306	1.2609	.78351	35
26	.62160	.79354	1.2602	.78333	34
27	.62183	.79401	1.2594	.78315	33
28	.62206	.79449	1.2587	.78297	32
29	.62229	.79496	1.2579	.78279	31
30	.62251	.79544	1.2572	.78261	30
31	.62274	.79591	1.2564	.78243	29
32	.62297	.79639	1.2557	.78225	28
33	.62320	.79686	1.2549	.78206	27
34	.62342	.79734	1.2542	.78188	26
35	.62365	.79781	1.2534	.78170	25
36	.62388	.79829	1.2527	.78152	24
37	.62411	.79877	1.2519	.78134	23
38	.62433	.79924	1.2512	.78116	22
39	.62456	.79972	1.2504	.78098	21
40	.62479	.80020	1.2497	.78079	20
41	.62502	.80067	1.2489	.78061	19
42	.62524	.80115	1.2482	.78043	18
43	.62547	.80163	1.2475	.78025	17
44	.62570	.80211	1.2467	.78007	16
45	.62592	.80258	1.2460	.77988	15
46	.62615	.80306	1.2452	.77970	14
47	.62638	.80354	1.2445	.77952	13
48	.62660	.80402	1.2437	.77934	12
49	.62683	.80450	1.2430	.77916	11
50	.62706	.80498	1.2423	.77897	10
51	.62728	.80546	1.2415	.77879	9
52	.62751	.80594	1.2408	.77861	8
53	.62774	.80642	1.2401	.77843	7
54	.62796	.80690	1.2393	.77824	6
55	.62819	.80738	1.2386	.77806	5
56	.62842	.80786	1.2378	.77788	4
57	.62864	.80834	1.2371	.77769	3
58	.62887	.80882	1.2364	.77751	2
59	.62909	.80930	1.2356	.77733	1
60	.62932	.80978	1.2349	.77715	0
	Cos	Ctn	Tan	Sin	′

128° **51°**

39° **140°**

′	Sin	Tan	Ctn	Cos	
0	.62932	.80978	1.2349	.77715	60
1	.62955	.81027	1.2342	.77696	59
2	.62977	.81075	1.2334	.77678	58
3	.63000	.81123	1.2327	.77660	57
4	.63022	.81171	1.2320	.77641	56
5	.63045	.81220	1.2312	.77623	55
6	.63068	.81268	1.2305	.77605	54
7	.63090	.81316	1.2298	.77586	53
8	.63113	.81364	1.2290	.77568	52
9	.63135	.81413	1.2283	.77550	51
10	.63158	.81461	1.2276	.77531	50
11	.63180	.81510	1.2268	.77513	49
12	.63203	.81558	1.2261	.77494	48
13	.63225	.81606	1.2254	.77476	47
14	.63248	.81655	1.2247	.77458	46
15	.63271	.81703	1.2239	.77439	45
16	.63293	.81752	1.2232	.77421	44
17	.63316	.81800	1.2225	.77402	43
18	.63338	.81849	1.2218	.77384	42
19	.63361	.81898	1.2210	.77366	41
20	.63383	.81946	1.2203	.77347	40
21	.63406	.81995	1.2196	.77329	39
22	.63428	.82044	1.2189	.77310	38
23	.63451	.82092	1.2181	.77292	37
24	.63473	.82141	1.2174	.77273	36
25	.63496	.82190	1.2167	.77255	35
26	.63518	.82238	1.2160	.77236	34
27	.63540	.82287	1.2153	.77218	33
28	.63563	.82336	1.2145	.77199	32
29	.63585	.82385	1.2138	.77181	31
30	.63608	.82434	1.2131	.77162	30
31	.63630	.82483	1.2124	.77144	29
32	.63653	.82531	1.2117	.77125	28
33	.63675	.82580	1.2109	.77107	27
34	.63698	.82629	1.2102	.77088	26
35	.63720	.82678	1.2095	.77070	25
36	.63742	.82727	1.2088	.77051	24
37	.63765	.82776	1.2081	.77033	23
38	.63787	.82825	1.2074	.77014	22
39	.63810	.82874	1.2066	.76996	21
40	.63832	.82923	1.2059	.76977	20
41	.63854	.82972	1.2052	.76959	19
42	.63877	.83022	1.2045	.76940	18
43	.63899	.83071	1.2038	.76921	17
44	.63922	.83120	1.2031	.76903	16
45	.63944	.83169	1.2024	.76884	15
46	.63966	.83218	1.2017	.76866	14
47	.63989	.83268	1.2009	.76847	13
48	.64011	.83317	1.2002	.76828	12
49	.64033	.83366	1.1995	.76810	11
50	.64056	.83415	1.1988	.76791	10
51	.64078	.83465	1.1981	.76772	9
52	.64100	.83514	1.1974	.76754	8
53	.64123	.83564	1.1967	.76735	7
54	.64145	.83613	1.1960	.76717	6
55	.64167	.83662	1.1953	.76698	5
56	.64190	.83712	1.1946	.76679	4
57	.64212	.83761	1.1939	.76661	3
58	.64234	.83811	1.1932	.76642	2
59	.64256	.83860	1.1925	.76623	1
60	.64279	.83910	1.1918	.76604	0
	Cos	Ctn	Tan	Sin	′

129° **50°**

NATURAL TRIGONOMETRIC FUNCTIONS

40° — 139°

′	Sin	Tan	Ctn	Cos	
0	.64279	.83910	1.1918	.76604	60
1	.64301	.83960	1.1910	.76586	59
2	.64323	.84009	1.1903	.76567	58
3	.64346	.84059	1.1896	.76548	57
4	.64368	.84108	1.1889	.76530	56
5	.64390	.84158	1.1882	.76511	55
6	.64412	.84208	1.1875	.76492	54
7	.64435	.84258	1.1868	.76473	53
8	.64457	.84307	1.1861	.76455	52
9	.64479	.84357	1.1854	.76436	51
10	.64501	.84407	1.1847	.76417	50
11	.64524	.84457	1.1840	.76398	49
12	.64546	.84507	1.1833	.76380	48
13	.64568	.84556	1.1826	.76361	47
14	.64590	.84606	1.1819	.76342	46
15	.64612	.84656	1.1812	.76323	45
16	.64635	.84706	1.1806	.76304	44
17	.64657	.84756	1.1799	.76286	43
18	.64679	.84806	1.1792	.76267	42
19	.64701	.84856	1.1785	.76248	41
20	.64723	.84906	1.1778	.76229	40
21	.64746	.84956	1.1771	.76210	39
22	.64768	.85006	1.1764	.76192	38
23	.64790	.85057	1.1757	.76173	37
24	.64812	.85107	1.1750	.76154	36
25	.64834	.85157	1.1743	.76135	35
26	.64856	.85207	1.1736	.76116	34
27	.64878	.85257	1.1729	.76097	33
28	.64901	.85308	1.1722	.76078	32
29	.64923	.85358	1.1715	.76059	31
30	.64945	.85408	1.1708	.76041	30
31	.64967	.85458	1.1702	.76022	29
32	.64989	.85509	1.1695	.76003	28
33	.65011	.85559	1.1688	.75984	27
34	.65033	.85609	1.1681	.75965	26
35	.65055	.85660	1.1674	.75946	25
36	.65077	.85710	1.1667	.75927	24
37	.65100	.85761	1.1660	.75908	23
38	.65122	.85811	1.1653	.75889	22
39	.65144	.85862	1.1647	.75870	21
40	.65166	.85912	1.1640	.75851	20
41	.65188	.85963	1.1633	.75832	19
42	.65210	.86014	1.1626	.75813	18
43	.65232	.86064	1.1619	.75794	17
44	.65254	.86115	1.1612	.75775	16
45	.65276	.86166	1.1606	.75756	15
46	.65298	.86216	1.1599	.75738	14
47	.65320	.86267	1.1592	.75719	13
48	.65342	.86318	1.1585	.75700	12
49	.65364	.86368	1.1578	.75680	11
50	.65386	.86419	1.1571	.75661	10
51	.65408	.86470	1.1565	.75642	9
52	.65430	.86521	1.1558	.75623	8
53	.65452	.86572	1.1551	.75604	7
54	.65474	.86623	1.1544	.75585	6
55	.65496	.86674	1.1538	.75566	5
56	.65518	.86725	1.1531	.75547	4
57	.65540	.86776	1.1524	.75528	3
58	.65562	.86827	1.1517	.75509	2
59	.65584	.86878	1.1510	.75490	1
60	.65606	.86929	1.1504	.75471	0
	Cos	Ctn	Tan	Sin	′

130° — 49°

41° — 138°

′	Sin	Tan	Ctn	Cos	
0	.65606	.86929	1.1504	.75471	60
1	.65628	.86980	1.1497	.75452	59
2	.65650	.87031	1.1490	.75433	58
3	.65672	.87082	1.1483	.75414	57
4	.65694	.87133	1.1477	.75395	56
5	.65716	.87184	1.1470	.75375	55
6	.65738	.87236	1.1463	.75356	54
7	.65759	.87287	1.1456	.75337	53
8	.65781	.87338	1.1450	.75318	52
9	.65803	.87389	1.1443	.75299	51
10	.65825	.87441	1.1436	.75280	50
11	.65847	.87492	1.1430	.75261	49
12	.65869	.87543	1.1423	.75241	48
13	.65891	.87595	1.1416	.75222	47
14	.65913	.87646	1.1410	.75203	46
15	.65935	.87698	1.1403	.75184	45
16	.65956	.87749	1.1396	.75165	44
17	.65978	.87801	1.1389	.75146	43
18	.66000	.87852	1.1383	.75126	42
19	.66022	.87904	1.1376	.75107	41
20	.66044	.87955	1.1369	.75088	40
21	.66066	.88007	1.1363	.75069	39
22	.66088	.88059	1.1356	.75050	38
23	.66109	.88110	1.1349	.75030	37
24	.66131	.88162	1.1343	.75011	36
25	.66153	.88214	1.1336	.74992	35
26	.66175	.88265	1.1329	.74973	34
27	.66197	.88317	1.1323	.74953	33
28	.66218	.88369	1.1316	.74934	32
29	.66240	.88421	1.1310	.74915	31
30	.66262	.88473	1.1303	.74896	30
31	.66284	.88524	1.1296	.74876	29
32	.66306	.88576	1.1290	.74857	28
33	.66327	.88628	1.1283	.74838	27
34	.66349	.88680	1.1276	.74818	26
35	.66371	.88732	1.1270	.74799	25
36	.66393	.88784	1.1263	.74780	24
37	.66414	.88836	1.1257	.74760	23
38	.66436	.88888	1.1250	.74741	22
39	.66458	.88940	1.1243	.74722	21
40	.66480	.88992	1.1237	.74703	20
41	.66501	.89045	1.1230	.74683	19
42	.66523	.89097	1.1224	.74664	18
43	.66545	.89149	1.1217	.74644	17
44	.66566	.89201	1.1211	.74625	16
45	.66588	.89253	1.1204	.74606	15
46	.66610	.89306	1.1197	.74586	14
47	.66632	.89358	1.1191	.74567	13
48	.66653	.89410	1.1184	.74548	12
49	.66675	.89463	1.1178	.74528	11
50	.66697	.89515	1.1171	.74509	10
51	.66718	.89567	1.1165	.74489	9
52	.66740	.89620	1.1158	.74470	8
53	.66762	.89672	1.1152	.74451	7
54	.66783	.89725	1.1145	.74431	6
55	.66805	.89777	1.1139	.74412	5
56	.66827	.89830	1.1132	.74392	4
57	.66848	.89883	1.1126	.74373	3
58	.66870	.89935	1.1119	.74353	2
59	.66891	.89988	1.1113	.74334	1
60	.66913	.90040	1.1106	.74314	0
	Cos	Ctn	Tan	Sin	′

131° — 48°

42° 137°

′	Sin	Tan	Ctn	Cos	
0	.66913	.90040	1.1106	.74314	60
1	.66935	.90093	1.1100	.74295	59
2	.66956	.90146	1.1093	.74276	58
3	.66978	.90199	1.1087	.74256	57
4	.66999	.90251	1.1080	.74237	56
5	.67021	.90304	1.1074	.74217	55
6	.67043	.90357	1.1067	.74198	54
7	.67064	.90410	1.1061	.74178	53
8	.67086	.90463	1.1054	.74159	52
9	.67107	.90516	1.1048	.74139	51
10	.67129	.90569	1.1041	.74120	50
11	.67151	.90621	1.1035	.74100	49
12	.67172	.90674	1.1028	.74080	48
13	.67194	.90727	1.1022	.74061	47
14	.67215	.90781	1.1016	.74041	46
15	.67237	.90834	1.1009	.74022	45
16	.67258	.90887	1.1003	.74002	44
17	.67280	.90940	1.0996	.73983	43
18	.67301	.90993	1.0990	.73963	42
19	.67323	.91046	1.0983	.73944	41
20	.67344	.91099	1.0977	.73924	40
21	.67366	.91153	1.0971	.73904	39
22	.67387	.91206	1.0964	.73885	38
23	.67409	.91259	1.0958	.73865	37
24	.67430	.91313	1.0951	.73846	36
25	.67452	.91366	1.0945	.73826	35
26	.67473	.91419	1.0939	.73806	34
27	.67495	.91473	1.0932	.73787	33
28	.67516	.91526	1.0926	.73767	32
29	.67538	.91580	1.0919	.73747	31
30	.67559	.91633	1.0913	.73728	30
31	.67580	.91687	1.0907	.73708	29
32	.67602	.91740	1.0900	.73688	28
33	.67623	.91794	1.0894	.73669	27
34	.67645	.91847	1.0888	.73649	26
35	.67666	.91901	1.0881	.73629	25
36	.67688	.91955	1.0875	.73610	24
37	.67709	.92008	1.0869	.73590	23
38	.67730	.92062	1.0862	.73570	22
39	.67752	.92116	1.0856	.73551	21
40	.67773	.92170	1.0850	.73531	20
41	.67795	.92224	1.0843	.73511	19
42	.67816	.92277	1.0837	.73491	18
43	.67837	.92331	1.0831	.73472	17
44	.67859	.92385	1.0824	.73452	16
45	.67880	.92439	1.0818	.73432	15
46	.67901	.92493	1.0812	.73413	14
47	.67923	.92547	1.0805	.73393	13
48	.67944	.92601	1.0799	.73373	12
49	.67965	.92655	1.0793	.73353	11
50	.67987	.92709	1.0786	.73333	10
51	.68008	.92763	1.0780	.73314	9
52	.68029	.92817	1.0774	.73294	8
53	.68051	.92872	1.0768	.73274	7
54	.68072	.92926	1.0761	.73254	6
55	.68093	.92980	1.0755	.73234	5
56	.68115	.93034	1.0749	.73215	4
57	.68136	.93088	1.0742	.73195	3
58	.68157	.93143	1.0736	.73175	2
59	.68179	.93197	1.0730	.73155	1
60	.68200	.93252	1.0724	.73135	0
	Cos	Ctn	Tan	Sin	′

132° 47°

43° 136°

′	Sin	Tan	Ctn	Cos	
0	.68200	.93252	1.0724	.73135	60
1	.68221	.93306	1.0717	.73116	59
2	.68242	.93360	1.0711	.73096	58
3	.68264	.93415	1.0705	.73076	57
4	.68285	.93469	1.0699	.73056	56
5	.68306	.93524	1.0692	.73036	55
6	.68327	.93578	1.0686	.73016	54
7	.68349	.93633	1.0680	.72996	53
8	.68370	.93688	1.0674	.72976	52
9	.68391	.93742	1.0668	.72957	51
10	.68412	.93797	1.0661	.72937	50
11	.68434	.93852	1.0655	.72917	49
12	.68455	.93906	1.0649	.72897	48
13	.68476	.93961	1.0643	.72877	47
14	.68497	.94016	1.0637	.72857	46
15	.68518	.94071	1.0630	.72837	45
16	.68539	.94125	1.0624	.72817	44
17	.68561	.94180	1.0618	.72797	43
18	.68582	.94235	1.0612	.72777	42
19	.68603	.94290	1.0606	.72757	41
20	.68624	.94345	1.0599	.72737	40
21	.68645	.94400	1.0593	.72717	39
22	.68666	.94455	1.0587	.72697	38
23	.68688	.94510	1.0581	.72677	37
24	.68709	.94565	1.0575	.72657	36
25	.68730	.94620	1.0569	.72637	35
26	.68751	.94676	1.0562	.72617	34
27	.68772	.94731	1.0556	.72597	33
28	.68793	.94786	1.0550	.72577	32
29	.68814	.94841	1.0544	.72557	31
30	.68835	.94896	1.0538	.72537	30
31	.68857	.94952	1.0532	.72517	29
32	.68878	.95007	1.0526	.72497	28
33	.68899	.95062	1.0519	.72477	27
34	.68920	.95118	1.0513	.72457	26
35	.68941	.95173	1.0507	.72437	25
36	.68962	.95229	1.0501	.72417	24
37	.68983	.95284	1.0495	.72397	23
38	.69004	.95340	1.0489	.72377	22
39	.69025	.95395	1.0483	.72357	21
40	.69046	.95451	1.0477	.72337	20
41	.69067	.95506	1.0470	.72317	19
42	.69088	.95562	1.0464	.72297	18
43	.69109	.95618	1.0458	.72277	17
44	.69130	.95673	1.0452	.72257	16
45	.69151	.95729	1.0446	.72236	15
46	.69172	.95785	1.0440	.72216	14
47	.69193	.95841	1.0434	.72196	13
48	.69214	.95897	1.0428	.72176	12
49	.69235	.95952	1.0422	.72156	11
50	.69256	.96008	1.0416	.72136	10
51	.69277	.96064	1.0410	.72116	9
52	.69298	.96120	1.0404	.72095	8
53	.69319	.96176	1.0398	.72075	7
54	.69340	.96232	1.0392	.72055	6
55	.69361	.96288	1.0385	.72035	5
56	.69382	.96344	1.0379	.72015	4
57	.69403	.96400	1.0373	.71995	3
58	.69424	.96457	1.0367	.71974	2
59	.69445	.96513	1.0361	.71954	1
60	.69466	.96569	1.0355	.71934	0
	Cos	Ctn	Tan	Sin	′

133° 46°

NATURAL TRIGONOMETRIC FUNCTIONS

44° 135°

′	Sin	Tan	Ctn	Cos	
0	.69466	.96569	1.0355	.71934	60
1	.69487	.96625	1.0349	.71914	59
2	.69508	.96681	1.0343	.71894	58
3	.69529	.96738	1.0337	.71873	57
4	.69549	.96794	1.0331	.71853	56
5	.69570	.96850	1.0325	.71833	55
6	.69591	.96907	1.0319	.71813	54
7	.69612	.96963	1.0313	.71792	53
8	.69633	.97020	1.0307	.71772	52
9	.69654	.97076	1.0301	.71752	51
10	.69675	.97133	1.0295	.71732	50
11	.69696	.97189	1.0289	.71711	49
12	.69717	.97246	1.0283	.71691	48
13	.69737	.97302	1.0277	.71671	47
14	.69758	.97359	1.0271	.71650	46
15	.69779	.97416	1.0265	.71630	45
16	.69800	.97472	1.0259	.71610	44
17	.69821	.97529	1.0253	.71590	43
18	.69842	.97586	1.0247	.71569	42
19	.69862	.97643	1.0241	.71549	41
20	.69883	.97700	1.0235	.71529	40
21	.69904	.97756	1.0230	.71508	39
22	.69925	.97813	1.0224	.71488	38
23	.69946	.97870	1.0218	.71468	37
24	.69966	.97927	1.0212	.71447	36
25	.69987	.97984	1.0206	.71427	35
26	.70008	.98041	1.0200	.71407	34
27	.70029	.98098	1.0194	.71386	33
28	.70049	.98155	1.0188	.71366	32
29	.70070	.98213	1.0182	.71345	31
30	.70091	.98270	1.0176	.71325	30
31	.70112	.98327	1.0170	.71305	29
32	.70132	.98384	1.0164	.71284	28
33	.70153	.98441	1.0158	.71264	27
34	.70174	.98499	1.0152	.71243	26
35	.70195	.98556	1.0147	.71223	25
36	.70215	.98613	1.0141	.71203	24
37	.70236	.98671	1.0135	.71182	23
38	.70257	.98728	1.0129	.71162	22
39	.70277	.98786	1.0123	.71141	21
40	.70298	.98843	1.0117	.71121	20
41	.70319	.98901	1.0111	.71100	19
42	.70339	.98958	1.0105	.71080	18
43	.70360	.99016	1.0099	.71059	17
44	.70381	.99073	1.0094	.71039	16
45	.70401	.99131	1.0088	.71019	15
46	.70422	.99189	1.0082	.70998	14
47	.70443	.99247	1.0076	.70978	13
48	.70463	.99304	1.0070	.70957	12
49	.70484	.99362	1.0064	.70937	11
50	.70505	.99420	1.0058	.70916	10
51	.70525	.99478	1.0052	.70896	9
52	.70546	.99536	1.0047	.70875	8
53	.70567	.99594	1.0041	.70855	7
54	.70587	.99652	1.0035	.70834	6
55	.70608	.99710	1.0029	.70813	5
56	.70628	.99768	1.0023	.70793	4
57	.70649	.99826	1.0017	.70772	3
58	.70670	.99884	1.0012	.70752	2
59	.70690	.99942	1.0006	.70731	1
60	.70711	1.0000	1.0000	.70711	0
	Cos	Ctn	Tan	Sin	′

134° 45°

Table VI

DECIMAL EQUIVALENTS OF COMMON FRACTIONS

1/64	= 0.015625
1/32 = 2/64	= .03125
3/64	= .046875
1/16 = 2/32 = 4/64	= .0625
5/64	= .078125
3/32 = 6/64	= .09375
7/64	= .109375
1/8 = 4/32 = 8/64	= 0.125
9/64	= .140625
5/32 = 10/64	= .15625
11/64	= .171875
3/16 = 6/32 = 12/64	= .1875
13/64	= .203125
7/32 = 14/64	= .21875
15/64	= .234375
1/4 = 8/32 = 16/64	= 0.25
17/64	= .265625
9/32 = 18/64	= .28125
19/64	= .296875
5/16 = 10/32 = 20/64	= .3125
21/64	= .328125
11/32 = 22/64	= .34375
23/64	= .359375
3/8 = 12/32 = 24/64	= 0.375
25/64	= .390625
13/32 = 26/64	= .40625
27/64	= .421875
7/16 = 14/32 = 28/64	= .4375
29/64	= .453125
15/32 = 30/64	= .46875
31/64	= .484375
1/2 = 16/32 = 32/64	= 0.50
33/64	= .515625
17/32 = 34/64	= .53125
35/64	= .546875
9/16 = 18/32 = 36/64	= .5625
37/64	= .578125
19/32 = 38/64	= .59375
39/64	= .609375
5/8 = 20/32 = 40/64	= 0.625
41/64	= .640625
21/32 = 42/64	= .65625
43/64	= .671875
11/16 = 22/32 = 44/64	= .6875
45/64	= .703125
23/32 = 46/64	= .71875
47/64	= .734375
3/4 = 24/32 = 48/64	= 0.75
49/64	= .765625
25/32 = 50/64	= .78125
51/64	= .796875
13/16 = 26/32 = 52/64	= .8125
53/64	= .828125
27/32 = 54/64	= .84375
55/64	= .859375
7/8 = 28/32 = 56/64	= 0.875
57/64	= .890625
29/32 = 58/64	= .90625
59/64	= .921875
15/16 = 30/32 = 60/64	= .9375
61/64	= .953125
31/32 = 62/64	= .96875
63/64	= .984375

MINUTES AND SECONDS TO DECIMAL PARTS OF A DEGREE

MINUTES AND SECONDS TO DECIMAL PARTS OF A DEGREE

Min.	Degrees	Sec.	Degrees
0	0.00000	0	0.00000
1	.01667	1	.00028
2	.03333	2	.00055
3	.05000	3	.00083
4	.06667	4	.00111
5	.08333	5	.00139
6	.10000	6	.00167
7	.11667	7	.00194
8	.13333	8	.00222
9	.15000	9	.00250
10	0.16667	10	0.00278
11	.18333	11	.00305
12	.20000	12	.00333
13	.21667	13	.00361
14	.23333	14	.00389
15	.25000	15	.00417
16	.26667	16	.00444
17	.28333	17	.00472
18	.30000	18	.00500
19	.31667	19	.00527
20	0.33333	20	0.00556
21	.35000	21	.00583
22	.36667	22	.00611
23	.38333	23	.00639
24	.40000	24	.00667
25	.41667	25	.00694
26	.43333	26	.00722
27	.45000	27	.00750
28	.46667	28	.00778
29	.48333	29	.00805
30	0.50000	30	0.00833
31	.51667	31	.00861
32	.53333	32	.00889
33	.55000	33	.00916
34	.56667	34	.00944
35	.58333	35	.00972
36	.60000	36	.01000
37	.61667	37	.01028
38	.63333	38	.01055
39	.65000	39	.01083
40	0.66667	40	0.01111
41	.68333	41	.01139
42	.70000	42	.01167
43	.71666	43	.01194
44	.73333	44	.01222
45	.75000	45	.01250
46	.76667	46	.01278
47	.78333	47	.01305
48	.80000	48	.01333
49	.81667	49	.01361
50	0.83333	50	0.01389
51	.85000	51	.01416
52	.86667	52	.01444
53	.88333	53	.01472
54	.90000	54	.01500
55	.91667	55	.01527
56	.93333	56	.01555
57	.95000	57	.01583
58	.96667	58	.01611
59	.98333	59	.01639
60	1.00000	60	0.01667

DECIMAL PARTS OF A DEGREE TO MINUTES AND SECONDS

Deg.	′	″	Deg.	′	″
0.00	0	00	0.60	36	00
.01	0	36	.61	36	36
.02	1	12	.62	37	12
.03	1	48	.63	37	48
.04	2	24	.64	38	24
.05	3	00	.65	39	00
.06	3	36	.66	39	36
.07	4	12	.67	40	12
.08	4	48	.68	40	48
.09	5	24	.69	41	24
0.10	6	00	0.70	42	00
.11	6	36	.71	42	36
.12	7	12	.72	43	12
.13	7	48	.73	43	48
.14	8	24	.74	44	24
.15	9	00	.75	45	00
.16	9	36	.76	45	36
.17	10	12	.77	46	12
.18	10	48	.78	46	48
.19	11	24	.79	47	24
0.20	12	00	0.80	48	00
.21	12	36	.81	48	36
.22	13	12	.82	49	12
.23	13	48	.83	49	48
.24	14	24	.84	50	24
.25	15	00	.85	51	00
.26	15	36	.86	51	36
.27	16	12	.87	52	12
.28	16	48	.88	52	48
.29	17	24	.89	53	24
0.30	18	00	0.90	54	00
.31	18	36	.91	54	36
.32	19	12	.92	55	12
.33	19	48	.93	55	48
.34	20	24	.94	56	24
.35	21	00	.95	57	00
.36	21	36	.96	57	36
.37	22	12	.97	58	12
.38	22	48	.98	58	48
.39	23	24	.99	59	24
0.40	24	00	1.00	60	00
.41	24	36			
.42	25	12			
.43	25	48			
.44	26	24			
.45	27	00			
.46	27	36			
.47	28	12			
.48	28	48			
.49	29	24			
0.50	30	00			
.51	30	36			
.52	31	12			
.53	31	48			
.54	32	24			
.55	33	00			
.56	33	36			
.57	34	12			
.58	34	48			
.59	35	24			
0.60	36				

Deg.	Sec.
0.000	0.0
.001	3.6
.002	7.2
.003	10.8
.004	14.4
.005	18.0
.006	21.6
.007	25.2
.008	28.8
.009	32.4
0.010	36.0

Table VIII

NATURAL TRIGONOMETRIC FUNCTIONS FOR DECIMAL FRACTIONS OF A DEGREE

Deg.	Sin	Tan	Ctn	Cos	
0.0	.00000	.00000	∞	1.00000	90.0
.1	.00175	.00175	572.96	1.00000	.9
.2	.00349	.00349	286.48	0.99999	.8
.3	.00524	.00524	190.98	.99999	.7
.4	.00698	.00698	143.24	.99998	.6
.5	.00873	.00873	114.59	.99996	.5
.6	.01047	.01047	95.489	.99995	.4
.7	.01222	.01222	81.847	.99993	.3
.8	.01396	.01396	71.615	.99990	.2
.9	.01571	.01571	63.657	.99988	.1
1.0	.01745	.01746	57.290	.99985	89.0
.1	.01920	.01920	52.081	.99982	.9
.2	.02094	.02095	47.740	.99978	.8
.3	.02269	.02269	44.066	.99974	.7
.4	.02443	.02444	40.917	.99970	.6
.5	.02618	.02619	38.188	.99966	.5
.6	.02792	.02793	35.801	.99961	.4
.7	.02967	.02968	33.694	.99956	.3
.8	.03141	.03143	31.821	.99951	.2
.9	.03316	.03317	30.145	.99945	.1
2.0	.03490	.03492	28.636	.99939	88.0
.1	.03664	.03667	27.271	.99933	.9
.2	.03839	.03842	26.031	.99926	.8
.3	.04013	.04016	24.898	.99919	.7
.4	.04188	.04191	23.859	.99912	.6
.5	.04362	.04366	22.904	.99905	.5
.6	.04536	.04541	22.022	.99897	.4
.7	.04711	.04716	21.205	.99889	.3
.8	.04885	.04891	20.446	.99881	.2
.9	.05059	.05066	19.740	.99872	.1
3.0	.05234	.05241	19.081	.99863	87.0
.1	.05408	.05416	18.464	.99854	.9
.2	.05582	.05591	17.886	.99844	.8
.3	.05756	.05766	17.343	.99834	.7
.4	.05931	.05941	16.832	.99824	.6
.5	.06105	.06116	16.350	.99813	.5
.6	.06279	.06291	15.895	.99803	.4
.7	.06453	.06467	15.464	.99792	.3
.8	.06627	.06642	15.056	.99780	.2
.9	.06802	.06817	14.669	.99768	.1
4.0	.06976	.06993	14.301	.99756	86.0
.1	.07150	.07168	13.951	.99744	.9
.2	.07324	.07344	13.617	.99731	.8
.3	.07498	.07519	13.300	.99719	.7
.4	.07672	.07695	12.996	.99705	.6
.5	.07846	.07870	12.706	.99692	.5
.6	.08020	.08046	12.429	.99678	.4
.7	.08194	.08221	12.163	.99664	.3
.8	.08368	.08397	11.909	.99649	.2
.9	.08542	.08573	11.664	.99635	.1
5.0	.08716	.08749	11.430	.99619	85.0
.1	.08889	.08925	11.205	.99604	.9
.2	.09063	.09101	10.988	.99588	.8
.3	.09237	.09277	10.780	.99572	.7
.4	.09411	.09453	10.579	.99556	.6
.5	.09585	.09629	10.385	.99540	.5
.6	.09758	.09805	10.199	.99523	.4
.7	.09932	.09981	10.019	.99506	.3
.8	.10106	.10158	9.8448	.99488	.2
.9	.10279	.10334	9.6768	.99470	.1
6.0	.10453	.10510	9.5144	.99452	84.0
	Cos	Ctn	Tan	Sin	Deg.

Deg.	Sin	Tan	Ctn	Cos	
6.0	.10453	.10510	9.5144	.99452	84.0
.1	.10626	.10687	9.3572	.99434	.9
.2	.10800	.10863	9.2052	.99415	.8
.3	.10973	.11040	9.0579	.99396	.7
.4	.11147	.11217	8.9152	.99377	.6
.5	.11320	.11394	8.7769	.99357	.5
.6	.11494	.11570	8.6427	.99337	.4
.7	.11667	.11747	8.5126	.99317	.3
.8	.11840	.11924	8.3863	.99297	.2
.9	.12014	.12101	8.2636	.99276	.1
7.0	.12187	.12278	8.1443	.99255	83.0
.1	.12360	.12456	8.0285	.99233	.9
.2	.12533	.12633	7.9158	.99211	.8
.3	.12706	.12810	7.8062	.99189	.7
.4	.12880	.12988	7.6996	.99167	.6
.5	.13053	.13165	7.5958	.99144	.5
.6	.13226	.13343	7.4947	.99122	.4
.7	.13399	.13521	7.3962	.99098	.3
.8	.13572	.13698	7.3002	.99075	.2
.9	.13744	.13876	7.2066	.99051	.1
8.0	.13917	.14054	7.1154	.99027	82.0
.1	.14090	.14232	7.0264	.99002	.9
.2	.14263	.14410	6.9395	.98978	.8
.3	.14436	.14588	6.8548	.98953	.7
.4	.14608	.14767	6.7720	.98927	.6
.5	.14781	.14945	6.6912	.98902	.5
.6	.14954	.15124	6.6122	.98876	.4
.7	.15126	.15302	6.5350	.98849	.3
.8	.15299	.15481	6.4596	.98823	.2
.9	.15471	.15660	6.3859	.98796	.1
9.0	.15643	.15838	6.3138	.98769	81.0
.1	.15816	.16017	6.2432	.98741	.9
.2	.15988	.16196	6.1742	.98714	.8
.3	.16160	.16376	6.1066	.98686	.7
.4	.16333	.16555	6.0405	.98657	.6
.5	.16505	.16734	5.9758	.98629	.5
.6	.16677	.16914	5.9124	.98600	.4
.7	.16849	.17093	5.8502	.98570	.3
.8	.17021	.17273	5.7894	.98541	.2
.9	.17193	.17453	5.7297	.98511	.1
10.0	.17365	.17633	5.6713	.98481	80.0
.1	.17537	.17813	5.6140	.98450	.9
.2	.17708	.17993	5.5578	.98420	.8
.3	.17880	.18173	5.5026	.98389	.7
.4	.18052	.18353	5.4486	.98357	.6
.5	.18224	.18534	5.3955	.98325	.5
.6	.18395	.18714	5.3435	.98294	.4
.7	.18567	.18895	5.2924	.98261	.3
.8	.18738	.19076	5.2422	.98229	.2
.9	.18910	.19257	5.1929	.98196	.1
11.0	.19081	.19438	5.1446	.98163	79.0
.1	.19252	.19619	5.0970	.98129	.9
.2	.19423	.19801	5.0504	.98096	.8
.3	.19595	.19982	5.0045	.98061	.7
.4	.19766	.20164	4.9594	.98027	.6
.5	.19937	.20345	4.9152	.97992	.5
.6	.20108	.20527	4.8716	.97958	.4
.7	.20279	.20709	4.8288	.97922	.3
.8	.20450	.20891	4.7867	.97887	.2
.9	.20620	.21073	4.7453	.97851	.1
12.0	.20791	.21256	4.7046	.97815	78.0
	Cos	Ctn	Tan	Sin	Deg.

NATURAL TRIGONOMETRIC FUNCTIONS FOR DECIMAL FRACTIONS OF A DEGREE

Deg.	Sin	Tan	Ctn	Cos	
12.0	.20791	.21256	4.7046	.97815	78.0
.1	.20962	.21438	4.6646	.97778	.9
.2	.21132	.21621	4.6252	.97742	.8
.3	.21303	.21804	4.5864	.97705	.7
.4	.21474	.21986	4.5483	.97667	.6
.5	.21644	.22169	4.5107	.97630	.5
.6	.21814	.22353	4.4737	.97592	.4
.7	.21985	.22536	4.4373	.97553	.3
.8	.22155	.22719	4.4015	.97515	.2
.9	.22325	.22903	4.3662	.97476	.1
13.0	.22495	.23087	4.3315	.97437	77.0
.1	.22665	.23271	4.2972	.97398	.9
.2	.22835	.23455	4.2635	.97358	.8
.3	.23005	.23639	4.2303	.97318	.7
.4	.23175	.23823	4.1976	.97278	.6
.5	.23345	.24008	4.1653	.97237	.5
.6	.23514	.24193	4.1335	.97196	.4
.7	.23684	.24377	4.1022	.97155	.3
.8	.23853	.24562	4.0713	.97113	.2
.9	.24023	.24747	4.0408	.97072	.1
14.0	.24192	.24933	4.0108	.97030	76.0
.1	.24362	.25118	3.9812	.96987	.9
.2	.24531	.25304	3.9520	.96945	.8
.3	.24700	.25490	3.9232	.96902	.7
.4	.24869	.25676	3.8947	.96858	.6
.5	.25038	.25862	3.8667	.96815	.5
.6	.25207	.26048	3.8391	.96771	.4
.7	.25376	.26235	3.8118	.96727	.3
.8	.25545	.26421	3.7848	.96682	.2
.9	.25713	.26608	3.7583	.96638	.1
15.0	.25882	.26795	3.7321	.96593	75.0
.1	.26050	.26982	3.7062	.96547	.9
.2	.26219	.27169	3.6806	.96502	.8
.3	.26387	.27357	3.6554	.96456	.7
.4	.26556	.27545	3.6305	.96410	.6
.5	.26724	.27732	3.6059	.96363	.5
.6	.26892	.27921	3.5816	.96316	.4
.7	.27060	.28109	3.5576	.96269	.3
.8	.27228	.28297	3.5339	.96222	.2
.9	.27396	.28486	3.5105	.96174	.1
16.0	.27564	.28675	3.4874	.96126	74.0
.1	.27731	.28864	3.4646	.96078	.9
.2	.27899	.29053	3.4420	.96029	.8
.3	.28067	.29242	3.4197	.95981	.7
.4	.28234	.29432	3.3977	.95931	.6
.5	.28402	.29621	3.3759	.95882	.5
.6	.28569	.29811	3.3544	.95832	.4
.7	.28736	.30001	3.3332	.95782	.8
.8	.28903	.30192	3.3122	.95732	.2
.9	.29070	.30382	3.2914	.95681	.1
17.0	.29237	.30578	3.2709	.95630	73.0
.1	.29404	.30764	3.2506	.95579	.9
.2	.29571	.30955	3.2305	.95528	.8
.3	.29737	.31147	3.2106	.95476	.7
.4	.29904	.31338	3.1910	.95424	.6
.5	.30071	.31530	3.1716	.95372	.5
.6	.30237	.31722	3.1524	.95319	.4
.7	.30403	.31914	3.1334	.95266	.3
.8	.30570	.32106	3.1146	.95213	.2
.9	.30736	.32299	3.0961	.95159	.1
18.0	.30902	.32492	3.0777	.95106	72.0
	Cos	Ctn	Tan	Sin	Deg.

Deg.	Sin	Tan	Ctn	Cos	
18.0	.30902	.32492	3.0777	.95106	72.0
.1	.31068	.32685	3.0595	.95052	.9
.2	.31233	.32878	3 0415	.94997	.8
.3	.31399	.33072	3.0237	.94943	.7
.4	.31565	.33266	3.0061	.94888	.6
.5	.31730	.33460	2.9887	.94832	.5
.6	.31896	.33654	2.9714	.94777	.4
.7	.32061	.33848	2.9544	.94721	.3
.8	.32227	.34043	2.9375	.94665	.2
.9	.32392	.34238	2.9208	.94609	.1
19.0	.32557	.34433	2.9042	.94552	71.0
.1	.32722	.34628	2.8878	.94495	.9
.2	.32887	.34824	2.8716	.94438	.8
.3	.33051	.35020	2.8556	.94380	.7
.4	.33216	.35216	2.8397	.94322	.6
.5	.33381	.35412	2.8239	.94264	.5
.6	.33545	.35608	2.8083	.94206	.4
.7	.33710	.35805	2.7929	.94147	.3
.8	.33874	.36002	2.7776	.94088	.2
.9	.34038	.36199	2.7625	.94029	.1
20.0	.34202	.36397	2.7475	.93969	70.0
.1	.34366	.36595	2.7326	.93909	.9
.2	.34530	.36793	2.7179	.93849	.8
.3	.34694	.36991	2.7034	.93789	.7
.4	.34857	.37190	2.6889	.93728	.6
.5	.35021	.37388	2.6746	.93667	.5
.6	.35184	.37588	2.6605	.93606	.4
.7	.35347	.37787	2.6464	.93544	.3
.8	.35511	.37986	2.6325	.93483	.2
.9	.35674	.38186	2.6187	.93420	.1
21.0	.35837	.38386	2.6051	.93358	69.0
.1	.36000	.38587	2.5916	.93295	.9
.2	.36162	.38787	2.5782	.93232	.8
.3	.36325	.38988	2.5649	.93169	.7
.4	.36488	.39190	2.5517	.93106	.6
.5	.36650	.39391	2.5386	.93042	.5
.6	.36812	.39593	2.5257	.92978	.4
.7	.36975	.39795	2.5129	.92913	.3
.8	.37137	.39997	2.5002	.92849	.2
.9	.37299	.40200	2.4876	.92784	.1
22.0	.37461	.40403	2.4751	.92718	68.0
.1	.37622	.40606	2.4627	.92653	.9
.2	.37784	.40809	2.4504	.92587	.8
.3	.37946	.41013	2.4383	.92521	.7
.4	.38107	.41217	2.4262	.92455	.6
.5	.38268	.41421	2.4142	.92388	.5
.6	.38430	.41626	2.4023	.92321	.4
.7	.38591	.41831	2.3906	.92254	.3
.8	.38752	.42036	2.3789	.92186	.2
.9	.38912	.42242	2.3673	.92119	.1
23.0	.39073	.42447	2.3559	.92050	67.0
.1	.39234	.42654	2.3445	.91982	.9
.2	.39394	.42860	2.3332	.91914	.8
.3	.39555	.43067	2.3220	.91845	.7
.4	.39715	.43274	2.3109	.91775	.6
.5	.39875	.43481	2.2998	.91706	.5
.6	.40035	.43689	2.2889	.91636	.4
.7	.40195	.43897	2.2781	.91566	.3
.8	.40355	.44105	2.2673	.91496	.2
.9	.40514	.44314	2.2566	.91425	.1
24.0	.40674	.44523	2.2460	.91355	66.0
	Cos	Ctn	Tan	Sin	Deg.

NATURAL TRIGONOMETRIC FUNCTIONS FOR DECIMAL FRACTIONS OF A DEGREE

Deg.	Sin	Tan	Ctn	Cos	
24.0	.40674	.44523	2.2460	.91355	66.0
.1	.40833	.44732	2.2355	.91283	.9
.2	.40992	.44942	2.2251	.91212	.8
.3	.41151	.45152	2.2148	.91140	.7
.4	.41310	.45362	2.2045	.91068	.6
.5	.41469	.45573	2.1943	.90996	.5
.6	.41628	.45784	2.1842	.90924	.4
.7	.41787	.45995	2.1742	.90851	.3
.8	.41945	.46206	2.1642	.90778	.2
.9	.42104	.46418	2.1543	.90704	.1
25.0	.42262	.46631	2.1445	.90631	65.0
.1	.42420	.46843	2.1348	.90557	.9
.2	.42578	.47056	2.1251	.90483	.8
.3	.42736	.47270	2.1155	.90408	.7
.4	.42894	.47483	2.1060	.90334	.6
.5	.43051	.47698	2.0965	.90259	.5
.6	.43209	.47912	2.0872	.90183	.4
.7	.43366	.48127	2.0778	.90108	.3
.8	.43523	.48342	2.0686	.90032	.2
.9	.43680	.48557	2.0594	.89956	.1
26.0	.43837	.48773	2.0503	.89879	64.0
.1	.43994	.48989	2.0413	.89803	.9
.2	.44151	.49206	2.0323	.89726	.8
.3	.44307	.49423	2.0233	.89649	.7
.4	.44464	.49640	2.0145	.89571	.6
.5	.44620	.49858	2.0057	.89493	.5
.6	.44776	.50076	1.9970	.89415	.4
.7	.44932	.50295	1.9883	.89337	.3
.8	.45088	.50514	1.9797	.89259	.2
.9	.45243	.50733	1.9711	.89180	.1
27.0	.45399	.50953	1.9626	.89101	63.0
.1	.45554	.51173	1.9542	.89021	.9
.2	.45710	.51393	1.9458	.88942	.8
.3	.45865	.51614	1.9375	.88862	.7
.4	.46020	.51835	1.9292	.88782	.6
.5	.46175	.52057	1.9210	.88701	.5
.6	.46330	.52279	1.9128	.88620	.4
.7	.46484	.52501	1.9047	.88539	.3
.8	.46639	.52724	1.8967	.88458	.2
.9	.46793	.52947	1.8887	.88377	.1
28.0	.46947	.53171	1.8807	.88295	62.0
.1	.47101	.53395	1.8728	.88213	.9
.2	.47255	.53620	1.8650	.88130	.8
.3	.47409	.53844	1.8572	.88048	.7
.4	.47562	.54070	1.8495	.87965	.6
.5	.47716	.54296	1.8418	.87882	.5
.6	.47869	.54522	1.8341	.87798	.4
.7	.48022	.54748	1.8265	.87715	.3
.8	.48175	.54975	1.8190	.87631	.2
.9	.48328	.55203	1.8115	.87546	.1
29.0	.48481	.55431	1.8040	.87462	61.0
.1	.48634	.55659	1.7966	.87377	.9
.2	.48786	.55888	1.7893	.87292	.8
.3	.48938	.56117	1.7820	.87207	.7
.4	.49090	.56347	1.7747	.87121	.6
.5	.49242	.56577	1.7675	.87036	.5
.6	.49394	.56808	1.7603	.86949	.4
.7	.49546	.57039	1.7532	.86863	.3
.8	.49697	.57271	1.7461	.86777	.2
.9	.49849	.57503	1.7391	.86690	.1
30.0	.50000	.57735	1.7321	.86603	60.0
	Cos	Ctn	Tan	Sin	Deg.

Deg.	Sin	Tan	Ctn	Cos	
30.0	.50000	.57735	1.7321	.86603	60.0
.1	.50151	.57968	1.7251	.86515	.9
.2	.50302	.58201	1.7182	.86427	.8
.3	.50453	.58435	1.7113	.86340	.7
.4	.50603	.58670	1.7045	.86251	.6
.5	.50754	.58905	1.6977	.86163	.5
.6	.50904	.59140	1.6909	.86074	.4
.7	.51054	.59376	1.6842	.85985	.3
.8	.51204	.59612	1.6775	.85896	.2
.9	.51354	.59849	1.6709	.85806	.1
31.0	.51504	.60086	1.6643	.85717	59.0
.1	.51653	.60324	1.6577	.85627	.9
.2	.51803	.60562	1.6512	.85536	.8
.3	.51952	.60801	1.6447	.85446	.7
.4	.52101	.61040	1.6383	.85355	.6
.5	.52250	.61280	1.6319	.85264	.5
.6	.52399	.61520	1.6255	.85173	.4
.7	.52547	.61761	1.6191	.85081	.3
.8	.52696	.62003	1.6128	.84989	.2
.9	.52844	.62245	1.6066	.84897	.1
32.0	.52992	.62487	1.6003	.84805	58.0
.1	.53140	.62730	1.5941	.84712	.9
.2	.53288	.62973	1.5880	.84619	.8
.3	.53435	.63217	1.5818	.84526	.7
.4	.53583	.63462	1.5757	.84433	.6
.5	.53730	.63707	1.5697	.84339	.5
.6	.53877	.63953	1.5637	.84245	.4
.7	.54024	.64199	1.5577	.84151	.3
.8	.54171	.64446	1.5517	.84057	.2
.9	.54317	.64693	1.5458	.83962	.1
33.0	.54464	.64941	1.5399	.83867	57.0
.1	.54610	.65189	1.5340	.83772	.9
.2	.54756	.65438	1.5282	.83676	.8
.3	.54902	.65688	1.5224	.83581	.7
.4	.55048	.65938	1.5166	.83485	.6
.5	.55194	.66189	1.5108	.83389	.5
.6	.55339	.66440	1.5051	.83292	.4
.7	.55484	.66692	1.4994	.83195	.3
.8	.55630	.66944	1.4938	.83098	.2
.9	.55775	.67197	1.4882	.83001	.1
34.0	.55919	.67451	1.4826	.82904	56.0
.1	.56064	.67705	1.4770	.82806	.9
.2	.56208	.67960	1.4715	.82708	.8
.3	.56353	.68215	1.4659	.82610	.7
.4	.56497	.68471	1.4605	.82511	.6
.5	.56641	.68728	1.4550	.82413	.5
.6	.56784	.68985	1.4496	.82314	.4
.7	.56928	.69243	1.4442	.82214	.3
.8	.57071	.69502	1.4388	.82115	.2
.9	.57215	.69761	1.4335	.82015	.1
35.0	.57358	.70021	1.4281	.81915	55.0
.1	.57501	.70281	1.4229	.81815	.9
.2	.57643	.70542	1.4176	.81714	.8
.3	.57786	.70804	1.4124	.81614	.7
.4	.57928	.71066	1.4071	.81513	.6
.5	.58070	.71329	1.4019	.81412	.5
.6	.58212	.71593	1.3968	.81310	.4
.7	.58354	.71857	1.3916	.81208	.3
.8	.58496	.72122	1.3865	.81106	.2
.9	.58637	.72388	1.3814	.81004	.1
36.0	.58779	.72654	1.3764	.80902	54.0
	Cos	Ctn	Tan	Sin	Deg.

NATURAL TRIGONOMETRIC FUNCTIONS FOR DECIMAL FRACTIONS OF A DEGREE

Deg.	Sin	Tan	Ctn	Cos	
36.0	.58779	.72654	1.3764	.80902	54.0
.1	.58920	.72921	1.3713	.80799	.9
.2	.59061	.73189	1.3663	.80696	.8
.3	.59201	.73457	1.3613	.80593	.7
.4	.59342	.73726	1.3564	.80489	.6
.5	.59482	.73996	1.3514	.80386	.5
.6	.59622	.74267	1.3465	.80282	.4
.7	.59763	.74538	1.3416	.80178	.3
.8	.59902	.74810	1.3367	.80073	.2
.9	.60042	.75082	1.3319	.79968	.1
37.0	.60182	.75355	1.3270	.79864	53.0
.1	.60321	.75629	1.3222	.79758	.9
.2	.60460	.75904	1.3175	.79653	.8
.3	.60599	.76180	1.3127	.79547	.7
.4	.60738	.76456	1.3079	.79441	.6
.5	.60876	.76733	1.3032	.79335	.5
.6	.61015	.77010	1.2985	.79229	.4
.7	.61153	.77289	1.2938	.79122	.3
.8	.61291	.77568	1.2892	.79016	.2
.9	.61429	.77848	1.2846	.78908	.1
38.0	.61566	.78129	1.2799	.78801	52.0
.1	.61704	.78410	1.2753	.78694	.9
.2	.61841	.78692	1.2708	.78586	.8
.3	.61978	.78975	1.2662	.78478	.7
.4	.62115	.79259	1.2617	.78369	.6
.5	.62251	.79544	1.2572	.78261	.5
.6	.62388	.79829	1.2527	.78152	.4
.7	.62524	.80115	1.2482	.78043	.3
.8	.62660	.80402	1.2437	.77934	.2
.9	.62796	.80690	1.2393	.77824	.1
39.0	.62932	.80978	1.2349	.77715	51.0
.1	.63068	.81268	1.2305	.77605	.9
.2	.63203	.81558	1.2261	.77494	.8
.3	.63338	.81849	1.2218	.77384	.7
.4	.63473	.82141	1.2174	.77273	.6
.5	.63608	.82434	1.2131	.77162	.5
.6	.63742	.82727	1.2088	.77051	.4
.7	.63877	.83022	1.2045	.76940	.3
.8	.64011	.83317	1.2002	.76828	.2
.9	.64145	.83613	1.1960	.76717	.1
40.0	.64279	.83910	1.1918	.76604	50.0
.1	.64412	.84208	1.1875	.76492	.9
.2	.64546	.84507	1.1833	.76380	.8
.3	.64679	.84806	1.1792	.76267	.7
.4	.64812	.85107	1.1750	.76154	.6
40.5	.64945	.85408	1.1708	.76041	49.5
	Cos	Ctn	Tan	Sin	Deg.

Deg.	Sin	Tan	Ctn	Cos	
40.5	.64945	.85408	1.1708	.76041	49.5
.6	.65077	.85710	1.1667	.75927	.4
.7	.65210	.86014	1.1626	.75813	.3
.8	.65342	.86318	1.1585	.75700	.2
.9	.65474	.86623	1.1544	.75585	.1
41.0	.65606	.86929	1.1504	.75471	49.0
.1	.65738	.87236	1.1463	.75356	9
.2	.65869	.87543	1.1423	.75241	.8
.3	.66000	.87852	1.1383	.75126	.7
.4	.66131	.88162	1.1343	.75011	.6
.5	.66262	.88473	1.1303	.74896	.5
.6	.66393	.88784	1.1263	.74780	.4
.7	.66523	.89097	1.1224	.74664	.3
.8	.66653	.89410	1.1184	.74548	.2
.9	.66783	.89725	1.1145	.74431	.1
42.0	.66913	.90040	1.1106	.74314	48.0
.1	.67043	.90357	1.1067	.74198	.9
.2	.67172	.90674	1.1028	.74080	.8
.3	.67301	.90993	1.0990	.73963	.7
.4	.67430	.91313	1.0951	.73846	.6
.5	.67559	.91633	1.0913	.73728	.5
.6	.67688	.91955	1.0875	.73610	.4
.7	.67816	.92277	1.0837	.73491	.3
.8	.67944	.92601	1.0799	.73373	.2
.9	.68072	.92926	1.0761	.73254	.1
43.0	.68200	.93252	1.0724	.73135	47.0
.1	.68327	.93578	1.0686	.73016	.9
.2	.68455	.93906	1.0649	.72897	.8
.3	.68582	.94235	1.0612	.72777	.7
.4	.68709	.94565	1.0575	.72657	.6
.5	.68835	.94896	1.0538	.72537	.5
.6	.68962	.95229	1.0501	.72417	.4
.7	.69088	.95562	1.0464	.72297	.3
.8	.69214	.95897	1.0428	.72176	.2
.9	.69340	.96232	1.0392	.72055	.1
44.0	.69466	.96569	1.0355	.71934	46.0
.1	.69591	.96907	1.0319	.71813	.9
.2	.69717	.97246	1.0283	.71691	.8
.3	.69842	.97586	1.0247	.71569	.7
.4	.69966	.97927	1.0212	.71447	.6
.5	.70091	.98270	1.0176	.71325	.5
.6	.70215	.98613	1.0141	.71203	.4
.7	.70339	.98958	1.0105	.71080	.3
.8	.70463	.99304	1.0070	.70957	.2
.9	.70587	.99652	1.0035	.70834	.1
45.0	.70711	1.00000	1.0000	.70711	45.0
	Cos	Ctn	Tan	Sin	Deg.

Table XI

TRIGONOMETRIC FUNCTIONS IN RADIAN MEASURE

Rad	Sin	Tan	Ctn	Cos
.00	.0000	.0000	.....	1.0000
.01	.0100	.0100	99.997	1.0000
.02	.0200	.0200	49.993	.9998
.03	.0300	.0300	33.323	.9996
.04	.0400	.0400	24.987	.9992
.05	.0500	.0500	19.983	.9988
.06	.0600	.0601	16.647	.9982
.07	.0699	.0701	14.262	.9976
.08	.0799	.0802	12.473	.9968
.09	.0899	.0902	11.081	.9960
.10	.0998	.1003	9.967	.9950
.11	.1098	.1104	9.054	.9940
.12	.1197	.1206	8.293	.9928
.13	.1296	.1307	7.649	.9916
.14	.1395	.1409	7.096	.9902
.15	.1494	.1511	6.617	.9888
.16	.1593	.1614	6.197	.9872
.17	.1692	.1717	5.826	.9856
.18	.1790	.1820	5.495	.9838
.19	.1889	.1923	5.200	.9820
.20	.1987	.2027	4.933	.9801
.21	.2085	.2131	4.692	.9780
.22	.2182	.2236	4.472	.9759
.23	.2280	.2341	4.271	.9737
.24	.2377	.2447	4.086	.9713
.25	.2474	.2553	3.916	.9689
.26	.2571	.2660	3.759	.9664
.27	.2667	.2768	3.613	.9638
.28	.2764	.2876	3.478	.9611
.29	.2860	.2984	3.351	.9582
.30	.2955	.3093	3.233	.9553
.31	.3051	.3203	3.122	.9523
.32	.3146	.3314	3.018	.9492
.33	.3240	.3425	2.920	.9460
.34	.3335	.3537	2.827	.9428
.35	.3429	.3650	2.740	.9394
.36	.3523	.3764	2.657	.9359
.37	.3616	.3879	2.578	.9323
.38	.3709	.3994	2.504	.9287
.39	.3802	.4111	2.433	.9249
.40	.3894	.4228	2.365	.9211
.41	.3986	.4346	2.301	.9171
.42	.4078	.4466	2.239	.9131
.43	.4169	.4586	2.180	.9090
.44	.4259	.4708	2.124	.9048
.45	.4350	.4831	2.070	.9004
.46	.4439	.4954	2.018	.8961
.47	.4529	.5080	1.969	.8916
.48	.4618	.5206	1.921	.8870
.49	.4706	.5334	1.875	.8823
.50	.4794	.5463	1.830	.8776

Rad	Sin	Tan	Ctn	Cos
.50	.4794	.5463	1.830	.8776
.51	.4882	.5594	1.788	.8727
.52	.4969	.5726	1.747	.8678
.53	.5055	.5859	1.707	.8628
.54	.5141	.5994	1.668	.8577
.55	.5227	.6131	1.631	.8525
.56	.5312	.6269	1.595	.8473
.57	.5396	.6410	1.560	.8419
.58	.5480	.6552	1.526	.8365
.59	.5564	.6696	1.494	.8309
.60	.5646	.6841	1.462	.8253
.61	.5729	.6989	1.431	.8196
.62	.5810	.7139	1.401	.8139
.63	.5891	.7291	1.372	.8080
.64	.5972	.7445	1.343	.8021
.65	.6052	.7602	1.315	.7961
.66	.6131	.7761	1.288	.7900
.67	.6210	.7923	1.262	.7838
.68	.6288	.8087	1.237	.7776
.69	.6365	.8253	1.212	.7712
.70	.6442	.8423	1.187	.7648
.71	.6518	.8595	1.163	.7584
.72	.6594	.8771	1.140	.7518
.73	.6669	.8949	1.117	.7452
.74	.6743	.9131	1.095	.7385
.75	.6816	.9316	1.073	.7317
.76	.6889	.9505	1.052	.7248
.77	.6961	.9697	1.031	.7179
.78	.7033	.9893	1.011	.7109
.79	.7104	1.009	.9908	.7038
.80	.7174	1.030	.9712	.6967
.81	.7243	1.050	.9520	.6895
.82	.7311	1.072	.9331	.6822
.83	.7379	1.093	.9146	.6749
.84	.7446	1.116	.8964	.6675
.85	.7513	1.138	.8785	.6600
.86	.7578	1.162	.8609	.6524
.87	.7643	1.185	.8437	.6448
.88	.7707	1.210	.8267	.6372
.89	.7771	1.235	.8100	.6294
.90	.7833	1.260	.7936	.6216
.91	.7895	1.286	.7774	.6137
.92	.7956	1.313	.7615	.6058
.93	.8016	1.341	.7458	.5978
.94	.8076	1.369	.7303	.5898
.95	.8134	1.398	.7151	.5817
.96	.8192	1.428	.7001	.5735
.97	.8249	1.459	.6853	.5653
.98	.8305	1.491	.6707	.5570
.99	.8360	1.524	.6563	.5487
1.00	.8415	1.557	.6421	.5403

TRIGONOMETRIC FUNCTIONS IN RADIAN MEASURE

Rad	Sin	Tan	Ctn	Cos
1.00	.8415	1.557	.6421	.5403
1.01	.8468	1.592	.6281	.5319
1.02	.8521	1.628	.6142	.5234
1.03	.8573	1.665	.6005	.5148
1.04	.8624	1.704	.5870	.5062
1.05	.8674	1.743	.5736	.4976
1.06	.8724	1.784	.5604	.4889
1.07	.8772	1.827	.5473	.4801
1.08	.8820	1.871	.5344	.4713
1.09	.8866	1.917	.5216	.4625
1.10	.8912	1.965	.5090	.4536
1.11	.8957	2.014	.4964	.4447
1.12	.9001	2.066	.4840	.4357
1.13	.9044	2.120	.4718	.4267
1.14	.9086	2.176	.4596	.4176
1.15	.9128	2.234	.4475	.4085
1.16	.9168	2.296	.4356	.3993
1.17	.9208	2.360	.4237	.3902
1.18	.9246	2.427	.4120	.3809
1.19	.9284	2.498	.4003	.3717
1.20	.9320	2.572	.3888	.3624
1.21	.9356	2.650	.3773	.3530
1.22	.9391	2.733	.3659	.3436
1.23	.9425	2.820	.3546	.3342
1.24	.9458	2.912	.3434	.3248
1.25	.9490	3.010	.3323	.3153
1.26	.9521	3.113	.3212	.3058
1.27	.9551	3.224	.3102	.2963
1.28	.9580	3.341	.2993	.2867
1.29	.9608	3.467	.2884	.2771
1.30	.9636	3.602	.2776	.2675

Rad	Sin	Tan	Ctn	Cos
1.30	.9636	3.602	.2776	.2675
1.31	.9662	3.747	.2669	.2579
1.32	.9687	3.903	.2562	.2482
1.33	.9711	4.072	.2456	.2385
1.34	.9735	4.256	.2350	.2288
1.35	.9757	4.455	.2245	.2190
1.36	.9779	4.673	.2140	.2092
1.37	.9799	4.913	.2035	.1994
1.38	.9819	5.177	.1931	.1896
1.39	.9837	5.471	.1828	.1798
1.40	.9854	5.798	.1725	.1700
1.41	.9871	6.165	.1622	.1601
1.42	.9887	6.581	.1519	.1502
1.43	.9901	7.055	.1417	.1403
1.44	.9915	7.602	.1315	.1304
1.45	.9927	8.238	.1214	.1205
1.46	.9939	8.989	.1113	.1106
1.47	.9949	9.887	.1011	.1006
1.48	.9959	10.983	.0910	.0907
1.49	.9967	12.350	.0810	.0807
1.50	.9975	14.101	.0709	.0707
1.51	.9982	16.428	.0609	.0608
1.52	.9987	19.670	.0508	.0508
1.53	.9992	24.498	.0408	.0408
1.54	.9995	32.461	.0308	.0308
1.55	.9998	48.078	.0208	.0208
1.56	.9999	92.620	.0108	.0108
1.57	1.0000	1255.8	.0008	.0008
1.58	1.0000	—108.65	—.0092	—.0092
1.59	.9998	—52.067	—.0192	—.0192
1.60	.9996	—34.233	—.0292	—.0292

π radians = 180° π = 3.14159265
1 radian = 57°17′44″ .806 = 57°.2957795
3600″ = 60′ = 1° = .01745329 radian

Table XII

RADIANS TO DEGREES, MINUTES AND SECONDS

	Radians	Tenths	Hundredths	Thousandths	Ten-thousandths
1	57°17′44″.8	5°43′46″.5	0°34′22″.6	0° 3′26″.3	0°0′20″.6
2	114°35′29″.6	11°27′33″.0	1° 8′45″.3	0° 6′52″.5	0°0′41″.3
3	171°53′14″.4	17°11′19″.4	1°43′07″.9	0°10′18″.8	0°1′01″.9
4	229°10′59″.2	22°55′05″.9	2°17′30″.6	0°13′45″.1	0°1′22″.5
5	286°28′44″.0	28°38′52″.4	2°51′53″.2	0°17′11″.3	0°1′43″.1
6	343°46′28″.8	34°22′38″.9	3°26′15″.9	0°20′37″.6	0°2′03″.8
7	401° 4′13″.6	40° 6′25″.4	4° 0′38″.5	0°24′03″.9	0°2′24″.4
8	458°21′58″.4	45°50′11″.8	4°35′01″.2	0°27′30″.1	0°2′45″.0
9	515°39′43″.3	51°33′58″.3	5° 9′23″.8	0°30′56″.4	0°3′05″.6

Table XIII

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
1	1	1	1.000 000	3.162 278	1.000 000	2.154 435	4.641 589
2	4	8	1.414 214	4.472 136	1.259 921	2.714 418	5.848 035
3	9	27	1.732 051	5.477 226	1.442 250	3.107 233	6.694 330
4	16	64	2.000 000	6.324 555	1.587 401	3.419 952	7.368 063
5	25	125	2.236 068	7.071 068	1.709 976	3.684 031	7.937 005
6	36	216	2.449 490	7.745 967	1.817 121	3.914 868	8.434 327
7	49	343	2.645 751	8.366 600	1.912 931	4.121 285	8.879 040
8	64	512	2.828 427	8.944 272	2.000 000	4.308 869	9.283 178
9	81	729	3.000 000	9.486 833	2.080 084	4.481 405	9.654 894
10	100	1 000	3.162 278	10.000 00	2.154 435	4.641 589	10.000 00
11	121	1 331	3.316 625	10.488 09	2.223 980	4.791 420	10.322 80
12	144	1 728	3.464 102	10.954 45	2.289 428	4.932 424	10.626 59
13	169	2 197	3.605 551	11.401 75	2.351 335	5.065 797	10.913 93
14	196	2 744	3.741 657	11.832 16	2.410 142	5.192 494	11.186 89
15	225	3 375	3 872 983	12.247 45	2.466 212	5.313 293	11.447 14
16	256	4 096	4.000 000	12.649 11	2.519 842	5.428 835	11.696 07
17	289	4 913	4.123 106	13.038 40	2.571 282	5.539 658	11.934 83
18	324	5 832	4.242 641	13.416 41	2.620 741	5.646 216	12.164 40
19	361	6 859	4.358 899	13.784 05	2.668 402	5.748 897	12.385 62
20	400	8 000	4.472 136	14.142 14	2.714 418	5.848 035	12.599 21
21	441	9 261	4.582 576	14.491 38	2.758 924	5.943 922	12.805 79
22	484	10 648	4.690 416	14.832 40	2.802 039	6.036 811	13.005 91
23	529	12 167	4.795 832	15.165 75	2.843 867	6.126 926	13.200 06
24	576	13 824	4.898 979	15.491 93	2.884 499	6.214 465	13.388 66
25	625	15 625	5.000 000	15.811 39	2.924 018	6.299 605	13.572 09
26	676	17 576	5.099 020	16.124 52	2.962 496	6.382 504	13.750 69
27	729	19 683	5.196 152	16.431 68	3.000 000	6.463 304	13.924 77
28	784	21 952	5.291 503	16.733 20	3.036 589	6.542 133	14.094 60
29	841	24 389	5.385 165	17.029 39	3.072 317	6.619 106	14.260 43
30	900	27 000	5.477 226	17.320 51	3.107 233	6.694 330	14.422 50
31	961	29 791	5.567 764	17.606 82	3.141 381	6.767 899	14.581 00
32	1 024	32 768	5.656 854	17.888 54	3.174 802	6.839 904	14.736 13
33	1 089	35 937	5.744 563	18.165 90	3.207 534	6.910 423	14.888 06
34	1 156	39 304	5.830 952	18.439 09	3.239 612	6.979 532	15.036 95
35	1 225	42 875	5.916 080	18.708 29	3.271 066	7.047 299	15.182 94
36	1 296	46 656	6.000 000	18.973 67	3.301 927	7.113 787	15.326 19
37	1 369	50 653	6.082 763	19.235 38	3.332 222	7.179 054	15.466 80
38	1 444	54 872	6.164 414	19.493 59	3.361 975	7.243 156	15.604 91
39	1 521	59 319	6.244 998	19.748 42	3.391 211	7.306 144	15.740 61
40	1 600	64 000	6.324 555	20.000 00	3.419 952	7.368 063	15.874 01
41	1 681	68 921	6.403 124	20.248 46	3.448 217	7.428 959	16.005 21
42	1 764	74 088	6.480 741	20.493 90	3.476 027	7.488 872	16.134 29
43	1 849	79 507	6.557 439	20.736 44	3.503 398	7.547 842	16.261 33
44	1 936	85 184	6.633 250	20.976 18	3.530 348	7.605 905	16.386 43
45	2 025	91 125	6.708 204	21.213 20	3.556 893	7.663 094	16.509 64
46	2 116	97 336	6.782 330	21.447 61	3.583 048	7.719 443	16.631 03
47	2 209	103 823	6.855 655	21.679 48	3.608 826	7.774 980	16.750 69
48	2 304	110 592	6.928 203	21.908 90	3.634 241	7.829 735	16.868 65
49	2 401	117 649	7.000 000	22.135 94	3.659 306	7.883 735	16.984 99

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
50	2 500	125 000	7.071 068	22.360 68	3.684 031	7.937 005	17.099 76
51	2 601	132 651	7.141 428	22.583 18	3.708 430	7.989 570	17.213 01
52	2 704	140 608	7.211 103	22.803 51	3.732 511	8.041 452	17.324 78
53	2 809	148 877	7.280 110	23.021 73	3.756 286	8.092 672	17.435 13
54	2 916	157 464	7.348 469	23.237 90	3.779 763	8.143 253	17.544 11
55	3 025	166 375	7.416 198	23.452 08	3.802 952	8.193 213	17.651 74
56	3 136	175 616	7.483 315	23.664 32	3.825 862	8.242 571	17.758 08
57	3 249	185 193	7.549 834	23.874 67	3.848 501	8.291 344	17.863 16
58	3 364	195 112	7.615 773	24.083 19	3.870 877	8.339 551	17.967 02
59	3 481	205 379	7.681 146	24.289 92	3.892 996	8.387 207	18.069 69
60	3 600	216 000	7.745 967	24.494 90	3.914 868	8.434 327	18.171 21
61	3 721	226 981	7.810 250	24.698 18	3.936 497	8.480 926	18.271 60
62	3 844	238 328	7.874 008	24.899 80	3.957 892	8.527 019	18.370 91
63	3 969	250 047	7.937 254	25.099 80	3.979 057	8.572 619	18.469 15
64	4 096	262 144	8.000 000	25.298 22	4.000 000	8.617 739	18.566 36
65	4 225	274 625	8.062 258	25.495 10	4.020 726	8.662 391	18.662 56
66	4 356	287 496	8.124 038	25.690 47	4.041 240	8.706 588	18.757 77
67	4 489	300 763	8.185 353	25.884 36	4.061 548	8.750 340	18.852 04
68	4 624	314 432	8.246 211	26.076 81	4.081 655	8.793 659	18.945 36
69	4 761	328 509	8.306 624	26.267 85	4.101 566	8.836 556	19.037 78
70	4 900	343 000	8.366 600	26.457 51	4.121 285	8.879 040	19.129 31
71	5 041	357 911	8.426 150	26.645 83	4.140 818	8.921 121	19.219 97
72	5 184	373 248	8.485 281	26.832 82	4.160 168	8.962 809	19.309 79
73	5 329	389 017	8.544 004	27.018 51	4.179 339	9.004 113	19.398 77
74	5 476	405 224	8.602 325	27.202 94	4.198 336	9.045 042	19.486 95
75	5 625	421 875	8.660 254	27.386 13	4.217 163	9.085 603	19.574 34
76	5 776	438 976	8.717 798	27.568 10	4.235 824	9.125 805	19.660 95
77	5 929	456 533	8.774 964	27.748 87	4.254 321	9.165 656	19.746 81
78	6 084	474 552	8.831 761	27.928 48	4.272 659	9.205 164	19.831 92
79	6 241	493 039	8.888 194	28.106 94	4.290 840	9.244 335	19.916 32
80	6 400	512 000	8.944 272	28.284 27	4.308 869	9.283 178	20.000 00
81	6 561	531 441	9.000 000	28.460 50	4.326 749	9.321 698	20.082 99
82	6 724	551 368	9.055 385	28.635 64	4.344 481	9.359 902	20.165 30
83	6 889	571 787	9.110 434	28.809 72	4.362 071	9.397 796	20.246 94
84	7 056	592 704	9.165 151	28.982 75	4.379 519	9.435 388	20.327 93
85	7 225	614 125	9.219 544	29.154 76	4.396 830	9.472 682	20.408 28
86	7 396	636 056	9.273 618	29.325 76	4.414 005	9.509 685	20.488 00
87	7 569	658 503	9.327 379	29.495 76	4.431 048	9.546 403	20.567 10
88	7 744	681 472	9.380 832	29.664 79	4.447 960	9.582 840	20.645 60
89	7 921	704 969	9.433 981	29.832 87	4.464 745	9.619 002	20.723 51
90	8 100	729 000	9.486 833	30.000 00	4.481 405	9.654 894	20.800 84
91	8 281	753 571	9.539 392	30.166 21	4.497 941	9.690 521	20.877 59
92	8 464	778 688	9.591 663	30.331 50	4.514 357	9.725 888	20.953 79
93	8 649	804 357	9.643 651	30.495 90	4.530 655	9.761 000	21.029 44
94	8 836	830 584	9.695 360	30.659 42	4.546 836	9.795 861	21.104 54
95	9 025	857 375	9.746 794	30.822 07	4.562 903	9.830 476	21.179 12
96	9 216	884 736	9.797 959	30.983 87	4.578 857	9.864 848	21.253 17
97	9 409	912 673	9.848 858	31.144 82	4.594 701	9.898 983	21.326 71
98	9 604	941 192	9.899 495	31.304 95	4.610 436	9.932 884	21.399 75
99	9 801	970 299	9.949 874	31.464 27	4.626 065	9.966 555	21.472 29

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
100	10 000	1 000 000	10.000 00	31.622 78	4.641 589	10.000 00	21.544 35
101	10 201	1 030 301	10.049 88	31.780 50	4.657 010	10.033 22	21.615 92
102	10 404	1 061 208	10.099 50	31.937 44	4.672 329	10.066 23	21.687 03
103	10 609	1 092 727	10.148 89	32.093 61	4.687 548	10.099 02	21.757 67
104	10 816	1 124 864	10.198 04	32.249 03	4.702 669	10.131 59	21.827 86
105	11 025	1 157 625	10.246 95	32.403 70	4.717 694	10.163 96	21.897 60
106	11 236	1 191 016	10.295 63	32.557 64	4.732 623	10.196 13	21.966 89
107	11 449	1 225 043	10.344 08	32.710 85	4.747 459	10.228 09	22.035 75
108	11 664	1 259 712	10.392 30	32.863 35	4.762 203	10.259 86	22.104 19
109	11 881	1 295 029	10.440 31	33.015 15	4.776 856	10.291 42	22.172 20
110	12 100	1 331 000	10.488 09	33.166 25	4.791 420	10.322 80	22.239 80
111	12 321	1 367 631	10.535 65	33.316 66	4.805 896	10.353 99	22.306 99
112	12 544	1 404 928	10.583 01	33.466 40	4.820 285	10.384 99	22.373 78
113	12 769	1 442 897	10.630 15	33.615 47	4.834 588	10.415 80	22.440 17
114	12 996	1 481 544	10.677 08	33.763 89	4.848 808	10.446 44	22.506 17
115	13 225	1 520 875	10.723 81	33.911 65	4.862 944	10.476 90	22.571 79
116	13 456	1 560 896	10.770 33	34.058 77	4.876 999	10.507 18	22.637 02
117	13 689	1 601 613	10.816 65	34.205 26	4.890 973	10.537 28	22.701 89
118	13 924	1 643 032	10.862 78	34.351 13	4.904 868	10.567 22	22.766 38
119	14 161	1 685 159	10.908 71	34.496 38	4.918 685	10.596 99	22.830 51
120	14 400	1 728 000	10.954 45	34.641 02	4.932 424	10.626 59	22.894 28
121	14 641	1 771 561	11.000 00	34.785 05	4.946 087	10.656 02	22.957 70
122	14 884	1 815 848	11.045 36	34.928 50	4.959 676	10.685 30	23.020 78
123	15 129	1 860 867	11.090 54	35.071 36	4.973 190	10.714 41	23.083 50
124	15 376	1 906 624	11.135 53	35.213 63	4.986 631	10.743 37	23.145 89
125	15 625	1 953 125	11.180 34	35.355 34	5.000 000	10.772 17	23.207 94
126	15 876	2 000 376	11.224 97	35.496 48	5.013 298	10.800 82	23.269 67
127	16 129	2 048 383	11.269 43	35.637 06	5.026 526	10.829 32	23.331 07
128	16 384	2 097 152	11.313 71	35.777 09	5.039 684	10.857 67	23.392 14
129	16 641	2 146 689	11.357 82	35.916 57	5.052 774	10.885 87	23.452 90
130	16 900	2 197 000	11.401 75	36.055 51	5.065 797	10.913 93	23.513 35
131	17 161	2 248 091	11.445 52	36.193 92	5.078 753	10.941 84	23.573 48
132	17 424	2 299 968	11.489 13	36.331 80	5.091 643	10.969 61	23.633 32
133	17 689	2 352 637	11.532 56	36.469 17	5.104 469	10.997 24	23.692 85
134	17 956	2 406 104	11.575 84	36.606 01	5.117 230	11.024 74	23.752 08
135	18 225	2 460 375	11.618 95	36.742 35	5.129 928	11.052 09	23.811 02
136	18 496	2 515 456	11.661 90	36.878 18	5.142 563	11.079 32	23.869 66
137	18 769	2 571 353	11.704 70	37.013 51	5.155 137	11.106 41	23.928 03
138	19 044	2 628 072	11.747 34	37.148 35	5.167 649	11.133 36	23.986 10
139	19 321	2 685 619	11.789 83	37.282 70	5.180 101	11.160 19	24.043 90
140	19 600	2 744 000	11.832 16	37.416 57	5.192 494	11.186 89	24.101 42
141	19 881	2 803 221	11.874 34	37.549 97	5.204 828	11.213 46	24.158 67
142	20 164	2 863 288	11.916 38	37.682 89	5.217 103	11.239 91	24.215 65
143	20 449	2 924 207	11.958 26	37.815 34	5.229 322	11.266 23	24.272 36
144	20 736	2 985 984	12.000 00	37.947 33	5.241 483	11.292 43	24.328 81
145	21 025	3 048 625	12.041 59	38.078 87	5.253 588	11.318 51	24.384 99
146	21 316	3 112 136	12.083 05	38.209 95	5.265 637	11.344 47	24.440 92
147	21 609	3 176 523	12.124 36	38.340 58	5.277 632	11.370 31	24.496 60
148	21 904	3 241 792	12.165 53	38.470 77	5.289 572	11.396 04	24.552 02
149	22 201	3 307 949	12.206 56	38.600 52	5.301 459	11.421 65	24.607 19

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
150	22 500	3 375 000	12.247 45	38.729 83	5.313 293	11.447 14	24.662 12
151	22 801	3 442 951	12.288 21	38.858 72	5.325 074	11.472 52	24.716 80
152	23 104	3 511 808	12.328 83	38.987 18	5.336 803	11.497 79	24.771 25
153	23 409	3 581 577	12.369 32	39.115 21	5.348 481	11.522 95	24.825 45
154	23 716	3 652 264	12.409 67	39.242 83	5.360 108	11.548 00	24.879 42
155	24 025	3 723 875	12.449 90	39.370 04	5.371 685	11.572 95	24.933 15
156	24 336	3 796 416	12.490 00	39.496 84	5.383 213	11.597 78	24.986 66
157	24 649	3 869 893	12.529 96	39.623 23	5.394 691	11.622 51	25.039 94
158	24 964	3 944 312	12.569 81	39.749 21	5.406 120	11.647 13	25.092 99
159	25 281	4 019 679	12.609 52	39.874 80	5.417 502	11.671 65	25.145 81
160	25 600	4 096 000	12.649 11	40.000 00	5.428 835	11.696 07	25.198 42
161	25 921	4 173 281	12.688 58	40.124 81	5.440 122	11.720 39	25.250 81
162	26 244	4 251 528	12.727 92	40.249 22	5.451 362	11.744 60	25.302 98
163	26 569	4 330 747	12.767 15	40.373 26	5.462 556	11.768 72	25.354 94
164	26 896	4 410 944	12.806 25	40.496 91	5.473 704	11.792 74	25.406 68
165	27 225	4 492 125	12.845 23	40.620 19	5.484 807	11.816 66	25.458 22
166	27 556	4 574 296	12.884 10	40.743 10	5.495 865	11.840 48	25.509 54
167	27 889	4 657 463	12.922 85	40.865 63	5.506 878	11.864 21	25.560 67
168	28 224	4 741 632	12.961 48	40.987 80	5.517 848	11.887 84	25.611 58
169	28 561	4 826 809	13.000 00	41.109 61	5.528 775	11.911 38	25.662 30
170	28 900	4 913 000	13.038 40	41.231 06	5.539 658	11.934 83	25.712 82
171	29 241	5 000 211	13.076 70	41.352 15	5.550 499	11.958 19	25.763 13
172	29 584	5 088 448	13.114 88	41.472 88	5.561 298	11.981 45	25.813 26
173	29 929	5 177 717	13.152 95	41.593 27	5.572 055	12.004 63	25.863 19
174	30 276	5 268 024	13.190 91	41.713 31	5.582 770	12.027 71	25.912 92
175	30 625	5 359 375	13.228 76	41.833 00	5.593 445	12.050 71	25.962 47
176	30 976	5 451 776	13.266 50	41.952 35	5.604 079	12.073 62	26.011 83
177	31 329	5 545 233	13.304 13	42.071 37	5.614 672	12.096 45	26.061 00
178	31 684	5 639 752	13.341 66	42.190 05	5.625 226	12.119 18	26.109 99
179	32 041	5 735 339	13.379 09	42.308 39	5.635 741	12.141 84	26.158 79
180	32 400	5 832 000	13.416 41	42.426 41	5.646 216	12.164 40	26.207 41
181	32 761	5 929 741	13.453 62	42.544 09	5.656 653	12.186 89	26.255 86
182	33 124	6 028 568	13.490 74	42.661 46	5.667 051	12.209 29	26.304 12
183	33 489	6 128 487	13.527 75	42.778 50	5.677 411	12.231 61	26.352 21
184	33 856	6 229 504	13.564 66	42.895 22	5.687 734	12.253 85	26.400 12
185	34 225	6 331 625	13.601 47	43.011 63	5.698 019	12.276 01	26.447 86
186	34 596	6 434 856	13.638 18	43.127 72	5.708 267	12.298 09	26.495 43
187	34 969	6 539 203	13.674 79	43.243 50	5.718 479	12.320 09	26.542 83
188	35 344	6 644 672	13.711 31	43.358 97	5.728 654	12.342 01	26.590 06
189	35 721	6 751 269	13.747 73	43.474 13	5.738 794	12.363 86	26.637 12
190	36 100	6 859 000	13.784 05	43.588 99	5.748 897	12.385 62	26.684 02
191	36 481	6 967 871	13.820 27	43.703 55	5.758 965	12.407 31	26.730 75
192	36 864	7 077 888	13.856 41	43.817 80	5.768 998	12.428 93	26.777 32
193	37 249	7 189 057	13.892 44	43.931 77	5.778 997	12.450 47	26.823 73
194	37 636	7 301 384	13.928 39	44.045 43	5.788 960	12.471 94	26.869 97
195	38 025	7 414 875	13.964 24	44.158 80	5.798 890	12.493 33	26.916 06
196	38 416	7 529 536	14.000 00	44.271 89	5.808 786	12.514 65	26.961 99
197	38 809	7 645 373	14.035 67	44.384 68	5.818 648	12.535 90	27.007 77
198	39 204	7 762 392	14.071 25	44.497 19	5.828 477	12.557 07	27.053 39
199	39 601	7 880 599	14.106 74	44.609 42	5.838 272	12.578 18	27.098 86

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
200	40 000	8 000 000	14.142 14	44.721 36	5.848 035	12.599 21	27.144 18
201	40 401	8 120 601	14.177 45	44.833 02	5.857 766	12.620 17	27.189 34
202	40 804	8 242 408	14.212 67	44.944 41	5.867 464	12.641 07	27.234 36
203	41 209	8 365 427	14.247 81	45.055 52	5.877 131	12.661 89	27.279 22
204	41 616	8 489 664	14.282 86	45.166 36	5.886 765	12.682 65	27.323 94
205	42 025	8 615 125	14.317 82	45.276 93	5.896 369	12.703 34	27.368 52
206	42 436	8 741 816	14.352 70	45.387 22	5.905 941	12.723 96	27.412 95
207	42 849	8 869 743	14.387 49	45.497 25	5.915 482	12.744 52	27.457 23
208	43 264	8 998 912	14.422 21	45.607 02	5.924 992	12.765 01	27.501 38
209	43 681	9 129 329	14.456 83	45.716 52	5.934 472	12.785 43	27.545 38
210	44 100	9 261 000	14.491 38	45.825 76	5.943 922	12.805 79	27.589 24
211	44 521	9 393 931	14.525 84	45.934 74	5.953 342	12.826 09	27.632 96
212	44 944	9 528 128	14.560 22	46.043 46	5.962 732	12.846 32	27.676 55
213	45 369	9 663 597	14.594 52	46.151 92	5.972 093	12.866 48	27.720 00
214	45 796	9 800 344	14.628 74	46.260 13	5.981 424	12.886 59	27.763 31
215	46 225	9 938 375	14.662 88	46.368 09	5.990 726	12.906 63	27.806 49
216	46 656	10 077 696	14.696 94	46.475 80	6.000 000	12.926 61	27.849 53
217	47 089	10 218 313	14.730 92	46.583 26	6.009 245	12.946 53	27.892 44
218	47 524	10 360 232	14.764 82	46.690 47	6.018 462	12.966 38	27.935 22
219	47 961	10 503 459	14.798 65	46.797 44	6.027 650	12.986 18	27.977 87
220	48 400	10 648 000	14.832 40	46.904 16	6.036 811	13.005 91	28.020 39
221	48 841	10 793 861	14.866 07	47.010 64	6.045 944	13.025 59	28.062 78
222	49 284	10 941 048	14.899 66	47.116 88	6.055 049	13.045 21	28.105 05
223	49 729	11 089 567	14.933 18	47.222 88	6.064 127	13.064 77	28.147 18
224	50 176	11 239 424	14.966 63	47.328 64	6.073 178	13.084 27	28.189 19
225	50 625	11 390 625	15.000 00	47.434 16	6.082 202	13.103 71	28.231 08
226	51 076	11 543 176	15.033 30	47.539 46	6.091 199	13.123 09	28.272 84
227	51 529	11 697 083	15.066 52	47.644 52	6.100 170	13.142 42	28.314 48
228	51 984	11 852 352	15.099 67	47.749 35	6.109 115	13.161 69	28.356 00
229	52 441	12 008 989	15.132 75	47.853 94	6.118 033	13.180 90	28.397 39
230	52 900	12 167 000	15.165 75	47.958 32	6.126 926	13.200 06	28.438 67
231	53 361	12 326 391	15.198 68	48.062 46	6.135 792	13.219 16	28.479 83
232	53 824	12 487 168	15.231 55	48.166 38	6.144 634	13.238 21	28.520 86
233	54 289	12 649 337	15.264 34	48.270 07	6.153 449	13.257 21	28.561 78
234	54 756	12 812 904	15.297 06	48.373 55	6.162 240	13.276 14	28.602 59
235	55 225	12 977 875	15.329 71	48.476 80	6.171 006	13.295 03	28.643 27
236	55 696	13 144 256	15.362 29	48.579 83	6.179 747	13.313 86	28.683 84
237	56 169	13 312 053	15.394 80	48.682 65	6.188 463	13.332 64	28.724 30
238	56 644	13 481 272	15.427 25	48.785 24	6.197 154	13.351 36	28.764 64
239	57 121	13 651 919	15.459 62	48.887 63	6.205 822	13.370 04	28.804 87
240	57 600	13 824 000	15.491 93	48.989 79	6.214 465	13.388 66	28.844 99
241	58 081	13 997 521	15.524 17	49.091 75	6.223 084	13.407 23	28.885 00
242	58 564	14 172 488	15.556 35	49.193 50	6.231 680	13.425 75	28.924 89
243	59 049	14 348 907	15.588 46	49.295 03	6.240 251	13.444 21	28.964 68
244	59 536	14 526 784	15.620 50	49.396 36	6.248 800	13.462 63	29.004 36
245	60 025	14 706 125	15.652 48	49.497 47	6.257 325	13.481 00	29.043 93
246	60 516	14 886 936	15.684 39	49.598 39	6.265 827	13.499 31	29.083 39
247	61 009	15 069 223	15.716 23	49.699 09	6.274 305	13.517 58	29.122 75
248	61 504	15 252 992	15.748 02	49.799 60	6.282 761	13.535 80	29.161 99
249	62 001	15 438 249	15.779 73	49.899 90	6.291 195	13.553 97	29.201 14

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
250	62 500	15 625 000	15.811 39	50.000 00	6.299 605	13.572 09	29.240 18
251	63 001	15 813 251	15.842 98	50.099 90	6.307 994	13.590 16	29.279 11
252	63 504	16 003 008	15.874 51	50.199 60	6.316 360	13.608 18	29.317 94
253	64 009	16 194 277	15.905 97	50.299 11	6.324 704	13.626 16	29.356 67
254	64 516	16 387 064	15.937 38	50.398 41	6.333 026	13.644 09	29.395 30
255	65 025	16 581 375	15.968 72	50.497 52	6.341 326	13.661 97	29.433 83
256	65 536	16 777 216	16.000 00	50.596 44	6.349 604	13.679 81	29.472 25
257	66 049	16 974 593	16.031 22	50.695 17	6.357 861	13.697 60	29.510 58
258	66 564	17 173 512	16.062 38	50.793 70	6.366 097	13.715 34	29.548 80
259	67 081	17 373 979	16.093 48	50.892 04	6.374 311	13.733 04	29.586 93
260	67 600	17 576 000	16.124 52	50.990 20	6.382 504	13.750 69	29.624 96
261	68 121	17 779 581	16.155 49	51.088 16	6.390 677	13.768 30	29.662 89
262	68 644	17 984 728	16.186 41	51.185 94	6.398 828	13.785 86	29.700 73
263	69 169	18 191 447	16.217 27	51.283 53	6.406 959	13.803 37	29.738 47
264	69 696	18 399 744	16.248 08	51.380 93	6.415 069	13.820 85	29.776 11
265	70 225	18 609 625	16.278 82	51.478 15	6.423 158	13.838 28	29.813 66
266	70 756	18 821 096	16.309 51	51.575 19	6.431 228	13.855 66	29 851 11
267	71 289	19 034 163	16.340 13	51.672 04	6.439 277	13.873 00	29.888 47
268	71 824	19 248 832	16.370 71	51.768 72	6.447 306	13.890 30	29.925 74
269	72 361	19 465 109	16.401 22	51.865 21	6.455 315	13.907 55	29.962 92
270	72 900	19 683 000	16.431 68	51.961 52	6.463 304	13.924 77	30.000 00
271	73 441	19 902 511	16.462 08	52.057 66	6.471 274	13.941 94	30.036 99
272	73 984	20 123 648	16.492 42	52.153 62	6.479 224	13.959 06	30.073 89
273	74 529	20 346 417	16.522 71	52.249 40	6.487 154	13.976 15	30.110 70
274	75 076	20 570 824	16.552 95	52.345 01	6.495 065	13.993 19	30.147 42
275	75 625	20 796 875	16.583 12	52.440 44	6.502 957	14.010 20	30.184 05
276	76 176	21 024 576	16.613 25	52.535 70	6.510 830	14.027 16	30.220 60
277	76 729	21 253 933	16.643 32	52.630 79	6.518 684	14.044 08	30.257 05
278	77 284	21 484 952	16.673 33	52.725 71	6.526 519	14.060 96	30.293 42
279	77 841	21 717 639	16.703 29	52.820 45	6.534 335	14.077 80	30.329 70
280	78 400	21 952 000	16.733 20	52.915 03	6.542 133	14.094 60	30.365 89
281	78 961	22 188 041	16.763 05	53.009 43	6.549 912	14.111 36	30.402 00
282	79 524	22 425 768	16.792 86	53.103 67	6.557 672	14.128 08	30.438 02
283	80 089	22 665 187	16.822 60	53.197 74	6.565 414	14.144 76	30.473 95
284	80 656	22 906 304	16.852 30	53.291 65	6.573 138	14.161 40	30.509 81
285	81 225	23 149 125	16.881 94	53.385 39	6.580 844	14.178 00	30.545 57
286	81 796	23 393 656	16.911 53	53.478 97	6.588 532	14.194 56	30.581 26
287	82 369	23 639 903	16.941 07	53.572 38	6.596 202	14.211 09	30.616 86
288	82 944	23 887 872	16.970 56	53.665 63	6.603 854	14.227 57	30.652 38
289	83 521	24 137 569	17.000 00	53.758 72	6.611 489	14.244 02	30.687 81
290	84 100	24 389 000	17.029 39	53.851 65	6.619 106	14.260 43	30.723 17
291	84 681	24 642 171	17.058 72	53.944 42	6.626 705	14.276 80	30.758 44
292	85 264	24 897 088	17.088 01	54.037 02	6.634 287	14.293 14	30.793 63
293	85 849	25 153 757	17.117 24	54.129 47	6.641 852	14.309 44	30.828 75
294	86 436	25 412 184	17.146 43	54.221 77	6.649 400	14.325 70	30.863 78
295	87 025	25 672 375	17.175 56	54.313 90	6.656 930	14.341 92	30.898 73
296	87 616	25 934 336	17.204 65	54.405 88	6.664 444	14.358 11	30.933 61
297	88 209	26 198 073	17.233 69	54.497 71	6.671 940	14.374 26	30.968 40
298	88 804	26 463 592	17.262 68	54.589 38	6.679 420	14.390 37	31.003 12
299	89 401	26 730 899	17.291 62	54.680 89	6.686 883	14.406 45	31.037 76

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
300	90 000	27 000 000	17.320 51	54.772 26	6.694 330	14.422 50	31.072 33
301	90 601	27 270 901	17.349 35	54.863 47	6.701 759	14.438 50	31.106 81
302	91 204	27 543 608	17.378 15	54.954 53	6.709 173	14.454 47	31.141 22
303	91 809	27 818 127	17.406 90	55.045 44	6.716 570	14.470 41	31.175 56
304	92 416	28 094 464	17.435 60	55.136 20	6.723 951	14.486 31	31.209 82
305	93 025	28 372 625	17.464 25	55.226 81	6.731 315	14.502 18	31.244 00
306	93 636	28 652 616	17.492 86	55.317 27	6.738 664	14.518 01	31.278 11
307	94 249	28 934 443	17.521 42	55.407 58	6.745 997	14.533 81	31.312 14
308	94 864	29 218 112	17.549 93	55.497 75	6.753 313	14.549 57	31.346 10
309	95 481	29 503 629	17.578 40	55.587 77	6.760 614	14.565 30	31.379 99
310	96 100	29 791 000	17.606 82	55.677 64	6.767 899	14.581 00	31.413 81
311	96 721	30 080 231	17.635 19	55.767 37	6.775 169	14.596 66	31.447 55
312	97 344	30 371 328	17.663 52	55.856 96	6.782 423	14.612 29	31.481 22
313	97 969	30 664 297	17.691 81	55.946 40	6.789 661	14.627 88	31.514 82
314	98 596	30 959 144	17.720 05	56.035 70	6.796 884	14.643 44	31.548 34
315	99 225	31 255 875	17.748 24	56.124 86	6.804 092	14.658 97	31.581 80
316	99 856	31 554 496	17.776 39	56.213 88	6.811 285	14.674 47	31.615 18
317	100 489	31 855 013	17.804 49	56.302 75	6.818 462	14.689 93	31.648 50
318	101 124	32 157 432	17.832 55	56.391 49	6.825 624	14.705 36	31.681 74
319	101 761	32 461 759	17.860 57	56.480 08	6.832 771	14.720 76	31.714 92
320	102 400	32 768 000	17.888 54	56.568 54	6.839 904	14.736 13	31.748 02
321	103 041	33 076 161	17.916 47	56.656 86	6.847 021	14.751 46	31.781 06
322	103 684	33 386 248	17.944 36	56.745 04	6.854 124	14.766 76	31.814 03
323	104 329	33 698 267	17.972 20	56.833 09	6.861 212	14.782 03	31.846 93
324	104 976	34 012 224	18.000 00	56.921 00	6.868 285	14.797 27	31.879 76
325	105 625	34 328 125	18.027 76	57.008 77	6.875 344	14.812 48	31.912 52
326	106 276	34 645 976	18.055 47	57.096 41	6.882 389	14.827 66	31.945 22
327	106 929	34 965 783	18.083 14	57.183 91	6.889 419	14.842 80	31.977 85
328	107 584	35 287 552	18.110 77	57.271 28	6.896 434	14.857 92	32.010 41
329	108 241	35 611 289	18.138 36	57.358 52	6.903 436	14.873 00	32.042 91
330	108 900	35 937 000	18.165 90	57.445 63	6.910 423	14.888 06	32.075 34
331	109 561	36 264 691	18.193 41	57.532 60	6.917 396	14.903 08	32.107 71
332	110 224	36 594 368	18.220 87	57.619 44	6.924 356	14.918 07	32.140 01
333	110 889	36 926 037	18.248 29	57.706 15	6.931 301	14.933 03	32.172 25
334	111 556	37 259 704	18.275 67	57.792 73	6.938 232	14.947 97	32.204 42
335	112 225	37 595 375	18.303 01	57.879 18	6.945 150	14.962 87	32.236 53
336	112 896	37 933 056	18.330 30	57.965 51	6.952 053	14.977 74	32.268 57
337	113 569	38 272 753	18.357 56	58.051 70	6.958 943	14.992 59	32.300 55
338	114 244	38 614 472	18.384 78	58.137 77	6.965 820	15.007 40	32.332 47
339	114 921	38 958 219	18.411 95	58.223 71	6.972 683	15.022 19	32.364 33
340	115 600	39 304 000	18.439 09	58.309 52	6.979 532	15.036 95	32.396 12
341	116 281	39 651 821	18.466 19	58.395 21	6.986 368	15.051 67	32.427 85
342	116 964	40 001 688	18.493 24	58.480 77	6.993 191	15.066 37	32.459 52
343	117 649	40 353 607	18.520 26	58.566 20	7.000 000	15.081 04	32.491 12
344	118 336	40 707 584	18.547 24	58.651 51	7.006 796	15.095 68	32.522 67
345	119 025	41 063 625	18.574 18	58.736 70	7.013 579	15.110 30	32.554 15
346	119 716	41 421 736	18.601 08	58.821 76	7.020 349	15.124 88	32.585 57
347	120 409	41 781 923	18.627 94	58.906 71	7.027 106	15.139 44	32.616 94
348	121 104	42 144 192	18.654 76	58.991 52	7.033 850	15.153 97	32.648 24
349	121 801	42 508 549	18.681 54	59.076 22	7.040 581	15.168 47	32.679 48

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
350	122 500	42 875 000	18.708 29	59.160 80	7.047 299	15.182 94	32.710 66
351	123 201	43 243 551	18.734 99	59.245 25	7.054 004	15.197 39	32.741 79
352	123 904	43 614 208	18.761 66	59.329 59	7.060 697	15.211 81	32.772 85
353	124 609	43 986 977	18.788 29	59.413 80	7.067 377	15.226 20	32.803 86
354	125 316	44 361 864	18.814 89	59.497 90	7.074 044	15.240 57	32.834 80
355	126 025	44 738 875	18.841 44	59.581 88	7.080 699	15.254 90	32.865 69
356	126 736	45 118 016	18.867 96	59.665 74	7.087 341	15.269 21	32.896 52
357	127 449	45 499 293	18.894 44	59.749 48	7.093 971	15.283 50	32.927 30
358	128 164	45 882 712	18.920 89	59.833 10	7.100 588	15.297 75	32.958 01
359	128 881	46 268 279	18.947 30	59.916 61	7.107 194	15.311 98	32.988 67
360	129 600	46 656 000	18.973 67	60.000 00	7.113 787	15.326 19	33.019 27
361	130 321	47 045 881	19.000 00	60.083 28	7.120 367	15.340 37	33.049 82
362	131 044	47 437 928	19.026 30	60.166 44	7.126 936	15.354 52	33.080 31
363	131 769	47 832 147	19.052 56	60.249 48	7.133 492	15.368 64	33.110 74
364	132 496	48 228 544	19.078 78	60.332 41	7.140 037	15.382 74	33.141 12
365	133 225	48 627 125	19.104 97	60.415 23	7.146 569	15.396 82	33.171 44
366	133 956	49 027 896	19.131 13	60.497 93	7.153 090	15.410 87	33.201 70
367	134 689	49 430 863	19.157 24	60.580 52	7.159 599	15.424 89	33.231 91
368	135 424	49 836 032	19.183 33	60.663 00	7.166 096	15.438 89	33.262 07
369	136 161	50 243 409	19.209 37	60.745 37	7.172 581	15.452 86	33.292 17
370	136 900	50 653 000	19.235 38	60.827 63	7.179 054	15.466 80	33.322 22
371	137 641	51 064 811	19.261 36	60.909 77	7.185 516	15.480 73	33.352 21
372	138 384	51 478 848	19.287 30	60.991 80	7.191 966	15.494 62	33.382 15
373	139 129	51 895 117	19.313 21	61.073 73	7.198 405	15.508 49	33.412 04
374	139 876	52 313 624	19.339 08	61.155 54	7.204 832	15.522 34	33.441 87
375	140 625	52 734 375	19.364 92	61.237 24	7.211 248	15.536 16	33.471 65
376	141 376	53 157 376	19.390 72	61.318 84	7.217 652	15.549 96	33.501 37
377	142 129	53 582 633	19.416 49	61.400 33	7.224 045	15.563 73	33.531 05
378	142 884	54 010 152	19.442 22	61.481 70	7.230 427	15.577 48	33.560 67
379	143 641	54 439 939	19.467 92	61.562 98	7.236 797	15.591 21	33.590 24
380	144 400	54 872 000	19.493 59	61.644 14	7.243 156	15.604 91	33.619 75
381	145 161	55 306 341	19.519 22	61.725 20	7.249 505	15.618 58	33.649 22
382	145 924	55 742 968	19.544 82	61.806 15	7.255 842	15.632 24	33.678 63
383	146 689	56 181 887	19.570 39	61.886 99	7.262 167	15.645 87	33.708 00
384	147 456	56 623 104	19.595 92	61.967 73	7.268 482	15.659 47	33.737 31
385	148 225	57 066 625	19.621 42	62.048 37	7.274 786	15.673 05	33.766 57
386	148 996	57 512 456	19.646 88	62.128 90	7.281 079	15.686 61	33.795 78
387	149 769	57 960 603	19.672 32	62.209 32	7.287 362	15.700 14	33.824 94
388	150 544	58 411 072	19.697 72	62.289 65	7.293 633	15.713 66	33.854 05
389	151 321	58 863 869	19.723 08	62.369 86	7.299 894	15.727 14	33.883 10
390	152 100	59 319 000	19.748 42	62.449 98	7.306 144	15.740 61	33.912 11
391	152 881	59 776 471	19.773 72	62.529 99	7.312 383	15.754 05	33.941 07
392	153 664	60 236 288	19.798 99	62.609 90	7.318 611	15.767 47	33.969 99
393	154 449	60 698 457	19.824 23	62.689 71	7.324 829	15.780 87	33.998 85
394	155 236	61 162 984	19.849 43	62.769 42	7.331 037	15.794 24	34.027 66
395	156 025	61 629 875	19.874 61	62.849 03	7.337 234	15.807 59	34.056 42
396	156 816	62 099 136	19.899 75	62.928 53	7.343 420	15.820 92	34.085 14
397	157 609	62 570 773	19.924 86	63.007 94	7.349 597	15.834 23	34.113 81
398	158 404	63 044 792	19.949 94	63.087 24	7.355 762	15.847 51	34.142 42
399	159 201	63 521 199	19.974 98	63.166 45	7.361 918	15.860 77	34.171 00

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
400	160 000	64 000 000	20.000 00	63.245 55	7.368 063	15.874 01	34.199 52
401	160 801	64 481 201	20.024 98	63.324 56	7.374 198	15.887 23	34.227 99
402	161 604	64 964 808	20.049 94	63.403 47	7.380 323	15.900 42	34.256 42
403	162 409	65 450 827	20.074 86	63.482 28	7.386 437	15.913 60	34.284 80
404	163 216	65 939 264	20.099 75	63.560 99	7.392 542	15.926 75	34.313 14
405	164 025	66 430 125	20.124 61	63.639 61	7.398 636	15.939 88	34.341 43
406	164 836	66 923 416	20.149 44	63.718 13	7.404 721	15.952 99	34.369 67
407	165 649	67 419 143	20.174 24	63.796 55	7.410 795	15.966 07	34.397 86
408	166 464	67 917 312	20.199 01	63.874 88	7.416 860	15.979 14	34.426 01
409	167 281	68 417 929	20.223 75	63.953 11	7.422 914	15.992 18	34.454 12
410	168 100	68 921 000	20.248 46	64.031 24	7.428 959	16.005 21	34.482 17
411	168 921	69 426 531	20.273 13	64.109 28	7.434 994	16.018 21	34.510 18
412	169 744	69 934 528	20.297 78	64.187 23	7.441 019	16.031 19	34.538 15
413	170 569	70 444 997	20.322 40	64.265 08	7.447 034	16.044 15	34.566 07
414	171 396	70 957 944	20.346 99	64.342 83	7.453 040	16.057 09	34.593 95
415	172 225	71 473 375	20.371 55	64.420 49	7.459 036	16.070 01	34.621 78
416	173 056	71 991 296	20.396 08	64.498 06	7.465 022	16.082 90	34.649 56
417	173 889	72 511 713	20.420 58	64.575 54	7.470 999	16.095 78	34.677 31
418	174 724	73 034 632	20.445 05	64.652 92	7.476 966	16.108 64	34.705 00
419	175 561	73 560 059	20.469 49	64.730 21	7.482 924	16.121 47	34.732 66
420	176 400	74 088 000	20.493 90	64.807 41	7.488 872	16.134 29	34.760 27
421	177 241	74 618 461	20.518 28	64.884 51	7.494 811	16.147 08	34.787 83
422	178 084	75 151 448	20.542 64	64.961 53	7.500 741	16.159 86	34.815 35
423	178 929	75 686 967	20.566 96	65.038 45	7.506 661	16.172 61	34.842 83
424	179 776	76 225 024	20.591 26	65.115 28	7.512 572	16.185 34	34.870 27
425	180 625	76 765 625	20.615 53	65.192 02	7.518 473	16.198 06	34.897 66
426	181 476	77 308 776	20.639 77	65.268 68	7.524 365	16.210 75	34.925 01
427	182 329	77 854 483	20.663 98	65.345 24	7.530 248	16.223 43	34.952 32
428	183 184	78 402 752	20.688 16	65.421 71	7.536 122	16.236 08	34.979 58
429	184 041	78 953 589	20.712 32	65.498 09	7.541 987	16.248 72	35.006 80
430	184 900	79 507 000	20.736 44	65.574 39	7.547 842	16.261 33	35.033 98
431	185 761	80 062 991	20.760 54	65.650 59	7.553 689	16.273 93	35.061 12
432	186 624	80 621 568	20.784 61	65.726 71	7.559 526	16.286 51	35.088 21
433	187 489	81 182 737	20.808 65	65.802 74	7.565 355	16.299 06	35.115 27
434	188 356	81 746 504	20.832 67	65.878 68	7.571 174	16.311 60	35.142 28
435	189 225	82 312 875	20.856 65	65.954 53	7.576 985	16.324 12	35.169 25
436	190 096	82 881 856	20.880 61	66.030 30	7.582 787	16.336 62	35.196 18
437	190 969	83 453 453	20.904 54	66.105 98	7.588 579	16.349 10	35.223 07
438	191 844	84 027 672	20.928 45	66.181 57	7.594 363	16.361 56	35.249 91
439	192 721	84 604 519	20.952 33	66.257 08	7.600 139	16.374 00	35.276 72
440	193 600	85 184 000	20.976 18	66.332 50	7.605 905	16.386 43	35.303 48
441	194 481	85 766 121	21.000 00	66.407 83	7.611 663	16.398 83	35.330 21
442	195 364	86 350 888	21.023 80	66.483 08	7.617 412	16.411 22	35.356 89
443	196 249	86 938 307	21.047 57	66.558 25	7.623 152	16.423 58	35.383 54
444	197 136	87 528 384	21.071 31	66.633 32	7.628 884	16.435 93	35.410 14
445	198 025	88 121 125	21.095 02	66.708 32	7.634 607	16.448 26	35.436 71
446	198 916	88 716 536	21.118 71	66.783 23	7.640 321	16.460 57	35.463 23
447	199 809	89 314 623	21.142 37	66.858 06	7.646 027	16.472 87	35.489 71
448	200 704	89 915 392	21.166 01	66.932 80	7.651 725	16.485 14	35.516 16
449	201 601	90 518 849	21.189 62	67.007 46	7.657 414	16.497 40	35.542 57

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
450	202 500	91 125 000	21.213 20	67.082 04	7.663 094	16.509 64	35.568 93
451	203 401	91 733 851	21.236 76	67.156 53	7.668 766	16.521 86	35.595 26
452	204 304	92 345 408	21.260 29	67.230 95	7.674 430	16.534 06	35.621 55
453	205 209	92 959 677	21.283 80	67.305 27	7.680 086	16.546 24	35.647 80
454	206 116	93 576 664	21.307 28	67.379 52	7.685 733	16.558 41	35.674 01
455	207 025	94 196 375	21.330 73	67.453 69	7.691 372	16.570 56	35.700 18
456	207 936	94 818 816	21.354 16	67.527 77	7.697 002	16.582 69	35.726 32
457	208 849	95 443 993	21.377 56	67.601 78	7.702 625	16.594 80	35.752 42
458	209 764	96 071 912	21.400 93	67.675 70	7.708 239	16.606 90	35.778 48
459	210 681	96 702 579	21.424 29	67.749 54	7.713 845	16.618 97	35.804 50
460	211 600	97 336 000	21.447 61	67.823 30	7.719 443	16.631 03	35.830 48
461	212 521	97 972 181	21.470 91	67.896 98	7.725 032	16.643 08	35.856 42
462	213 444	98 611 128	21.494 19	67.970 58	7.730 614	16.655 10	35.882 33
463	214 369	99 252 847	21.517 43	68.044 10	7.736 188	16.667 11	35.908 20
464	215 296	99 897 344	21.540 66	68.117 55	7.741 753	16.679 10	35.934 04
465	216 225	100 544 625	21.563 86	68.190 91	7.747 311	16.691 08	35.959 83
466	217 156	101 194 696	21.587 03	68.264 19	7.752 861	16.703 03	35.985 59
467	218 089	101 847 563	21.610 18	68.337 40	7.758 402	16.714 97	36.011 31
468	219 024	102 503 232	21.633 31	68.410 53	7.763 936	16.726 89	36.037 00
469	219 961	103 161 709	21.656 41	68.483 57	7.769 462	16.738 80	36.062 65
470	220 900	103 823 000	21.679 48	68.556 55	7.774 980	16.750 69	36.088 26
471	221 841	104 487 111	21.702 53	68.629 44	7.780 490	16.762 56	36.113 84
472	222 784	105 154 048	21.725 56	68.702 26	7.785 993	16.774 41	36.139 38
473	223 729	105 823 817	21.748 56	68.775 00	7.791 488	16.786 25	36.164 88
474	224 676	106 496 424	21.771 54	68.847 66	7.796 975	16.798 07	36.190 35
475	225 625	107 171 875	21.794 49	68.920 24	7.802 454	16.809 88	36.215 78
476	226 576	107 850 176	21.817 42	68.992 75	7.807 925	16.821 67	36.241 18
477	227 529	108 531 333	21.840 33	69.065 19	7.813 389	16.833 44	36.266 54
478	228 484	109 215 352	21.863 21	69.137 54	7.818 846	16.845 19	36.291 87
479	229 441	109 902 239	21.886 07	69.209 83	7.824 294	16.856 93	36.317 16
480	230 400	110 592 000	21.908 90	69.282 03	7.829 735	16.868 65	36.342 41
481	231 361	111 284 641	21.931 71	69.354 16	7.835 169	16.880 36	36.367 63
482	232 324	111 980 168	21.954 50	69.426 22	7.840 595	16.892 05	36.392 82
483	233 289	112 678 587	21.977 26	69.498 20	7.846 013	16.903 72	36.417 97
484	234 256	113 379 904	22.000 00	69.570 11	7.851 424	16.915 38	36.443 08
485	235 225	114 084 125	22.022 72	69.641 94	7.856 828	16.927 02	36.468 17
486	236 196	114 791 256	22.045 41	69.713 70	7.862 224	16.938 65	36.493 21
487	237 169	115 501 303	22.068 08	69.785 39	7.867 613	16.950 26	36.518 22
488	238 144	116 214 272	22.090 72	69.857 00	7.872 994	16.961 85	36.543 20
489	239 121	116 930 169	22.113 34	69.928 53	7.878 368	16.973 43	36.568 15
490	240 100	117 649 000	22.135 94	70.000 00	7.883 735	16.984 99	36.593 06
491	241 081	118 370 771	22.158 52	70.071 39	7.889 095	16.996 54	36.617 93
492	242 064	119 095 488	22.181 07	70.142 71	7.894 447	17.008 07	36.642 78
493	243 049	119 823 157	22.203 60	70.213 96	7.899 792	17.019 59	36.667 58
494	244 036	120 553 784	22.226 11	70.285 13	7.905 129	17.031 08	36.692 36
495	245 025	121 287 375	22.248 60	70.356 24	7.910 460	17.042 57	36.717 10
496	246 016	122 023 936	22.271 06	70 427 27	7.915 783	17.054 04	36.741 81
497	247 009	122 763 473	22.293 50	70.498 23	7.921 099	17 065 49	36.766 49
498	248 004	123 505 992	22.315 91	70.569 12	7 926 408	17.076 93	36 791 13
499	249 001	124 251 499	22.338 31	70 639 93	7.931 710	17.088 35	36.815 74

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
500	250 000	125 000 000	22.360 68	70.710 68	7.937 005	17.099 76	36.840 31
501	251 001	125 751 501	22.383 03	70.781 35	7.942 293	17.111 15	36.864 86
502	252 004	126 506 008	22.405 36	70.851 96	7.947 574	17.122 53	36.889 37
503	253 009	127 263 527	22.427 66	70.922 49	7.952 848	17.133 89	36.913 85
504	254 016	128 024 064	22.449 94	70.992 96	7.958 114	17.145 24	36.938 30
505	255 025	128 787 625	22.472 21	71.063 35	7.963 374	17.156 57	36.962 71
506	256 036	129 554 216	22.494 44	71.133 68	7.968 627	17.167 89	36.987 09
507	257 049	130 323 843	22.516 66	71.203 93	7.973 873	17.179 19	37.011 44
508	258 064	131 096 512	22.538 86	71.274 12	7.979 112	17.190 48	37.035 76
509	259 081	131 872 229	22.561 03	71.344 24	7.984 344	17.201 75	37.060 04
510	260 100	132 651 000	22.583 18	71.414 28	7.989 570	17.213 01	37.084 30
511	261 121	133 432 831	22.605 31	71.484 26	7.994 788	17.224 25	37.108 52
512	262 144	134 217 728	22.627 42	71.554 18	8.000 000	17.235 48	37.132 71
513	263 169	135 005 697	22.649 50	71.624 02	8.005 205	17.246 69	37.156 87
514	264 196	135 796 744	22.671 57	71.693 79	8.010 403	17.257 89	37.181 00
515	265 225	136 590 875	22.693 61	71.763 50	8.015 595	17.269 08	37.205 09
516	266 256	137 388 096	22.715 63	71.833 14	8.020 779	17.280 25	37.229 16
517	267 289	138 188 413	22.737 63	71.902 71	8.025 957	17.291 40	37.253 19
518	268 324	138 991 832	22.759 61	71.972 22	8.031 129	17.302 54	37.277 20
519	269 361	139 798 359	22.781 57	72.041 65	8.036 293	17.313 67	37.301 17
520	270 400	140 608 000	22.803 51	72.111 03	8.041 452	17.324 78	37.325 11
521	271 441	141 420 761	22.825 42	72.180 33	8.046 603	17.335 88	37.349 02
522	272 484	142 236 648	22.847 32	72.249 57	8.051 748	17.346 96	37.372 90
523	273 529	143 055 667	22.869 19	72.318 74	8.056 886	17.358 04	37.396 75
524	274 576	143 877 824	22.891 05	72.387 84	8.062 018	17.369 09	37.420 57
525	275 625	144 703 125	22.912 88	72.456 88	8.067 143	17.380 13	37.444 36
526	276 676	145 531 576	22.934 69	72.525 86	8.072 262	17.391 16	37.468 12
527	277 729	146 363 183	22.956 48	72.594 77	8.077 374	17.402 18	37.491 85
528	278 784	147 197 952	22.978 25	72.663 61	8.082 480	17.413 18	37.515 55
529	279 841	148 035 889	23.000 00	72.732 39	8.087 579	17.424 16	37.539 22
530	280 900	148 877 000	23.021 73	72.801 10	8.092 672	17.435 13	37.562 86
531	281 961	149 721 291	23.043 44	72.869 75	8.097 759	17.446 09	37.586 47
532	283 024	150 568 768	23.065 13	72.938 33	8.102 839	17.457 04	37.610 05
533	284 089	151 419 437	23.086 79	73.006 85	8.107 913	17.467 97	37.633 60
534	285 156	152 273 304	23.108 44	73.075 30	8.112 980	17.478 89	37.657 12
535	286 225	153 130 375	23.130 07	73.143 69	8.118 041	17.489 79	37.680 61
536	287 296	153 990 656	23.151 67	73.212 02	8.123 096	17.500 68	37.704 07
537	288 369	154 854 153	23.173 26	73.280 28	8.128 145	17.511 56	37.727 51
538	289 444	155 720 872	23.194 83	73.348 48	8.133 187	17.522 42	37.750 91
539	290 521	156 590 819	23.216 37	73.416 62	8.138 223	17.533 27	37.774 29
540	291 600	157 464 000	23.237 90	73.484 69	8.143 253	17.544 11	37.797 63
541	292 681	158 340 421	23.259 41	73.552 70	8.148 276	17.554 93	37.820 95
542	293 764	159 220 088	23.280 89	73.620 65	8.153 294	17.565 74	37.844 24
543	294 849	160 103 007	23.302 36	73.688 53	8.158 305	17.576 54	37.867 50
544	295 936	160 989 184	23.323 81	73.756 36	8.163 310	17.587 32	37.890 73
545	297 025	161 878 625	23.345 24	73.824 12	8.168 309	17.598 09	37.913 93
546	298 116	162 771 336	23.366 64	73.891 81	8.173 302	17.608 85	37.937 11
547	299 209	163 667 323	23.388 03	73.959 45	8.178 289	17.619 59	37.960 25
548	300 304	164 566 592	23.409 40	74.027 02	8.183 269	17.630 32	37.983 37
549	301 401	165 469 149	23.430 75	74.094 53	8.188 244	17.641 04	38.006 46

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
550	302 500	166 375 000	23.452 08	74.161 98	8.193 213	17.651 74	38.029 52
551	303 601	167 284 151	23.473 39	74.229 37	8.198 175	17.662 43	38.052 56
552	304 704	168 196 608	23.494 68	74.296 70	8.203 132	17.673 11	38.075 57
553	305 809	169 112 377	23.515 95	74.363 97	8.208 082	17.683 78	38.098 54
554	306 916	170 031 464	23.537 20	74.431 18	8.213 027	17.694 43	38.121 49
555	308 025	170 953 875	23.558 44	74.498 32	8.217 966	17.705 07	38.144 42
556	309 136	171 879 616	23.579 65	74.565 41	8.222 899	17.715 70	38.167 31
557	310 249	172 808 693	23.600 85	74.632 43	8.227 825	17.726 31	38.190 18
558	311 364	173 741 112	23.622 02	74.699 40	8.232 746	17.736 91	38.213 02
559	312 481	174 676 879	23.643 18	74.766 30	8.237 661	17.747 50	38.235 84
560	313 600	175 616 000	23.664 32	74.833 15	8.242 571	17.758 08	38.258 62
561	314 721	176 558 481	23.685 44	74.899 93	8.247 474	17.768 64	38.281 38
562	315 844	177 504 328	23.706 54	74.966 66	8.252 372	17.779 20	38.304 12
563	316 969	178 453 547	23.727 62	75.033 33	8.257 263	17.789 73	38.326 82
564	318 096	179 406 144	23.748 68	75.099 93	8.262 149	17.800 26	38.349 50
565	319 225	180 362 125	23.769 73	75.166 48	8.267 029	17.810 77	38.372 15
566	320 356	181 321 496	23.790 75	75.232 97	8.271 904	17.821 28	38.394 78
567	321 489	182 284 263	23.811 76	75.299 40	8.276 773	17.831 77	38.417 37
568	322 624	183 250 432	23.832 75	75.365 77	8.281 635	17.842 24	38.439 95
569	323 761	184 220 009	23.853 72	75.432 09	8.286 493	17.852 71	38.462 49
570	324 900	185 193 000	23.874 67	75.498 34	8.291 344	17.863 16	38.485 01
571	326 041	186 169 411	23.895 61	75.564 54	8.296 190	17.873 60	38.507 50
572	327 184	187 149 248	23.916 52	75.630 68	8.301 031	17.884 03	38.529 97
573	328 329	188 132 517	23.937 42	75.696 76	8.305 865	17.894 44	38.552 41
574	329 476	189 119 224	23.958 30	75.762 79	8.310 694	17.904 85	38.574 82
575	330 625	190 109 375	23.979 16	75.828 75	8.315 517	17.915 24	38.597 21
576	331 776	191 102 976	24.000 00	75.894 66	8.320 335	17.925 62	38.619 58
577	332 929	192 100 033	24.020 82	75.960 52	8.325 148	17.935 99	38.641 91
578	334 084	193 100 552	24.041 63	76.026 31	8.329 954	17.946 34	38.664 22
579	335 241	194 104 539	24.062 42	76.092 05	8.334 755	17.956 69	38.686 51
580	336 400	195 112 000	24.083 19	76.157 73	8.339 551	17.967 02	38.708 77
581	337 561	196 122 941	24.103 94	76.223 36	8.344 341	17.977 34	38.731 00
582	338 724	197 137 368	24.124 68	76.288 92	8.349 126	17.987 65	38.753 21
583	339 889	198 155 287	24.145 39	76.354 44	8.353 905	17.997 94	38.775 39
584	341 056	199 176 704	24.166 09	76.419 89	8.358 678	18.008 23	38.797 55
585	342 225	200 201 625	24.186 77	76.485 29	8.363 447	18.018 50	38.819 68
586	343 396	201 230 056	24.207 44	76.550 64	8.368 209	18.028 76	38.841 79
587	344 569	202 262 003	24.228 08	76.615 93	8.372 967	18.039 01	38.863 87
588	345 744	203 297 472	24.248 71	76.681 16	8.377 719	18.049 25	38.885 93
589	346 921	204 336 469	24.269 32	76.746 34	8.382 465	18.059 47	38.907 96
590	348 100	205 379 000	24.289 92	76.811 46	8.387 207	18.069 69	38.929 96
591	349 281	206 425 071	24.310 49	76.876 52	8.391 942	18.079 89	38.951 95
592	350 464	207 474 688	24.331 05	76.941 54	8.396 673	18.090 08	38.973 90
593	351 649	208 527 857	24.351 59	77.006 49	8.401 398	18.100 26	38.995 84
594	352 836	209 584 584	24.372 12	77.071 40	8.406 118	18.110 43	39.017 74
595	354 025	210 644 875	24.392 62	77.136 24	8.410 833	18.120 59	39.039 63
596	355 216	211 708 736	24.413 11	77.201 04	8.415 542	18.130 74	39.061 49
597	356 409	212 776 173	24.433 58	77.265 78	8.420 246	18.140 87	39.083 32
598	357 604	213 847 192	24.454 04	77.330 46	8.424 945	18.150 99	39.105 13
599	358 801	214 921 799	24.474 48	77.395 09	8.429 638	18.161 11	39.126 92

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
600	360 000	216 000 000	24.494 90	77.459 67	8.434 327	18.171 21	39 148 68
601	361 201	217 081 801	24.515 30	77.524 19	8.439 010	18.181 30	39.170 41
602	362 404	218 167 208	24.535 69	77.588 66	8.443 688	18.191 37	39.192 13
603	363 609	219 256 227	24.556 06	77.653 07	8.448 361	18.201 44	39.213 82
604	364 816	220 348 864	24.576 41	77.717 44	8.453 028	18.211 50	39.235 48
605	366 025	221 445 125	24.596 75	77.781 75	8.457 691	18.221 54	39.257 12
606	367 236	222 545 016	24.617 07	77.846 00	8.462 348	18.231 58	39.278 74
607	368 449	223 648 543	24.637 37	77.910 20	8.467 000	18.241 60	39.300 33
608	369 664	224 755 712	24.657 66	77.974 35	8.471 647	18.251 61	39.321 90
609	370 881	225 866 529	24.677 93	78.038 45	8.476 289	18.261 61	39.343 45
610	372 100	226 981 000	24.698 18	78.102 50	8.480 926	18.271 60	39.364 97
611	373 321	228 099 131	24.718 41	78.166 49	8.485 558	18.281 58	39.386 47
612	374 544	229 220 928	24.738 63	78.230 43	8.490 185	18.291 55	39.407 95
613	375 769	230 346 397	24.758 84	78.294 32	8.494 807	18.301 51	39.429 40
614	376 996	231 475 544	24.779 02	78.358 15	8.499 423	18.311 45	39.450 83
615	378 225	232 608 375	24.799 19	78.421 94	8.504 035	18.321 39	39.472 23
616	379 456	233 744 896	24.819 35	78.485 67	8.508 642	18.331 31	39.493 62
617	380 689	234 885 113	24.839 48	78.549 35	8.513 243	18.341 23	39.514 98
618	381 924	236 029 032	24.859 61	78.612 98	8.517 840	18.351 13	39.536 31
619	383 161	237 176 659	24.879 71	78.676 55	8.522 432	18.361 02	39.557 63
620	384 400	238 328 000	24.899 80	78.740 08	8.527 019	18.370 91	39.578 92
621	385 641	239 483 061	24.919 87	78.803 55	8.531 601	18.380 78	39.600 18
622	386 884	240 641 848	24.939 93	78.866 98	8.536 178	18.390 64	39.621 43
623	388 129	241 804 367	24.959 97	78.930 35	8.540 750	18.400 49	39.642 65
624	389 376	242 970 624	24.979 99	78.993 67	8.545 317	18.410 33	39.663 85
625	390 625	244 140 625	25.000 00	79.056 94	8.549 880	18.420 16	39.685 03
626	391 876	245 314 376	25.019 99	79.120 16	8.554 437	18.429 98	39.706 18
627	393 129	246 491 883	25.039 97	79.183 33	8.558 990	18.439 78	39.727 31
628	394 384	247 673 152	25.059 93	79.246 45	8.563 538	18.449 58	39.748 42
629	395 641	248 858 189	25.079 87	79.309 52	8.568 081	18.459 37	39.769 51
630	396 900	250 047 000	25.099 80	79.372 54	8.572 619	18.469 15	39.790 57
631	398 161	251 239 591	25.119 71	79.435 51	8.577 152	18.478 91	39.811 61
632	399 424	252 435 968	25.139 61	79.498 43	8.581 681	18.488 67	39.832 63
633	400 689	253 636 137	25.159 49	79.561 30	8.586 205	18.498 42	39.853 63
634	401 956	254 840 104	25.179 36	79.624 12	8.590 724	18.508 15	39.874 61
635	403 225	256 047 875	25.199 21	79.686 89	8.595 238	18.517 88	39.895 56
636	404 496	257 259 456	25.219 04	79.749 61	8.599 748	18.527 59	39.916 49
637	405 769	258 474 853	25.238 86	79.812 28	8.604 252	18.537 30	39.937 40
638	407 044	259 694 072	25.258 66	79.874 90	8.608 753	18.547 00	39.958 29
639	408 321	260 917 119	25.278 45	79.937 48	8.613 248	18.556 68	39.979 16
640	409 600	262 144 000	25.298 22	80.000 00	8.617 739	18.566 36	40.000 00
641	410 881	263 374 721	25.317 98	80.062 48	8.622 225	18.576 02	40.020 82
642	412 164	264 609 288	25.337 72	80.124 90	8.626 706	18.585 68	40.041 62
643	413 449	265 847 707	25.357 44	80.187 28	8.631 183	18.595 32	40.062 40
644	414 736	267 089 984	25.377 16	80.249 61	8.635 655	18.604 95	40.083 16
645	416 025	268 336 125	25.396 85	80.311 89	8.640 123	18.614 58	40.103 90
646	417 316	269 586 136	25.416 53	80.374 13	8.644 585	18.624 19	40.124 61
647	418 609	270 840 023	25.436 19	80.436 31	8.649 044	18.633 80	40.145 30
648	419 904	272 097 792	25.455 84	80.498 45	8.653 497	18.643 40	40.165 98
649	421 201	273 359 449	25.475 48	80.560 54	8.657 947	18.652 98	40.186 63

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
650	422 500	274 625 000	25.495 10	80.622 58	8.662 391	18.662 56	40.207 26
651	423 801	275 894 451	25.514 70	80.684 57	8.666 831	18.672 12	40.227 87
652	425 104	277 167 808	25.534 29	80.746 52	8.671 266	18.681 68	40.248 45
653	426 409	278 445 077	25.553 86	80.808 42	8.675 697	18.691 22	40.269 02
654	427 716	279 726 264	25.573 42	80.870 27	8.680 124	18.700 76	40.289 57
655	429 025	281 011 375	25.592 97	80.932 07	8.684 546	18.710 29	40.310 09
656	430 336	282 300 416	25.612 50	80.993 83	8.688 963	18.719 80	40.330 59
657	431 649	283 593 393	25.632 01	81.055 54	8.693 376	18.729 31	40.351 08
658	432 964	284 890 312	25.651 51	81.117 20	8.697 784	18.738 81	40.371 54
659	434 281	286 191 179	25.671 00	81.178 81	8.702 188	18.748 30	40.391 98
660	435 600	287 496 000	25.690 47	81.240 38	8.706 588	18.757 77	40.412 40
661	436 921	288 804 781	25.709 92	81.301 91	8.710 983	18.767 24	40.432 80
662	438 244	290 117 528	25.729 36	81.363 38	8.715 373	18.776 70	40.453 18
663	439 569	291 434 247	25.748 79	81.424 81	8.719 760	18.786 15	40.473 54
664	440 896	292 754 944	25.768 20	81.486 20	8.724 141	18.795 59	40.493 88
665	442 225	294 079 625	25.787 59	81.547 53	8.728 519	18.805 02	40.514 20
666	443 556	295 408 296	25.806 98	81.608 82	8.732 892	18.814 44	40.534 49
667	444 889	296 740 963	25.826 34	81.670 07	8.737 260	18.823 86	40.554 77
668	446 224	298 077 632	25.845 70	81.731 27	8.741 625	18.833 26	40.575 03
669	447 561	299 418 309	25.865 03	81.792 42	8.745 985	18.842 65	40.595 26
670	448 900	300 763 000	25.884 36	81.853 53	8.750 340	18.852 04	40.615 48
671	450 241	302 111 711	25.903 67	81.914 59	8.754 691	18.861 41	40.635 68
672	451 584	303 464 448	25.922 96	81.975 61	8.759 038	18.870 78	40.655 85
673	452 929	304 821 217	25.942 24	82.036 58	8.763 381	18.880 13	40.676 01
674	454 276	306 182 024	25.961 51	82.097 50	8.767 719	18.889 48	40.696 15
675	455 625	307 546 875	25.980 76	82.158 38	8.772 053	18.898 82	40.716 26
676	456 976	308 915 776	26.000 00	82.219 22	8.776 383	18.908 14	40.736 36
677	458 329	310 288 733	26.019 22	82.280 01	8.780 708	18.917 46	40.756 44
678	459 684	311 665 752	26.038 43	82.340 76	8.785 030	18.926 77	40.776 50
679	461 041	313 046 839	26.057 63	82.401 46	8.789 347	18.936 07	40.796 53
680	462 400	314 432 000	26.076 81	82.462 11	8.793 659	18.945 36	40.816 55
681	463 761	315 821 241	26.095 98	82.522 72	8.797 968	18.954 65	40.836 55
682	465 124	317 214 568	26.115 13	82.583 29	8.802 272	18.963 92	40.856 53
683	466 489	318 611 987	26.134 27	82.643 81	8.806 572	18.973 18	40.876 49
684	467 856	320 013 504	26.153 39	82.704 29	8.810 868	18.982 44	40.896 43
685	469 225	321 419 125	26.172 50	82.764 73	8.815 160	18.991 69	40.916 35
686	470 596	322 828 856	26.191 60	82.825 12	8.819 447	19.000 92	40.936 25
687	471 969	324 242 703	26.210 68	82.885 46	8.823 731	19.010 15	40.956 13
688	473 344	325 660 672	26.229 75	82.945 77	8.828 010	19.019 37	40.975 99
689	474 721	327 082 769	26.248 81	83.006 02	8.832 285	19.028 58	40.995 84
690	476 100	328 509 000	26.267 85	83.066 24	8.836 556	19.037 78	41.015 66
691	477 481	329 939 371	26.286 88	83.126 41	8.840 823	19.046 98	41.035 46
692	478 864	331 373 888	26.305 89	83.186 54	8.845 085	19.056 16	41.055 25
693	480 249	332 812 557	26.324 89	83.246 62	8.849 344	19.065 33	41.075 02
694	481 636	334 255 384	26.343 88	83.306 66	8.853 599	19.074 50	41.094 76
695	483 025	335 702 375	26.362 85	83.366 66	8.857 849	19.083 66	41.114 49
696	484 416	337 153 536	26.381 81	83.426 61	8.862 095	19.092 81	41.134 20
697	485 809	338 608 873	26.400 76	83.486 53	8.866 338	19.101 95	41.153 89
698	487 204	340 068 392	26.419 69	83.546 39	8.870 576	19.111 08	41.173 57
699	488 601	341 532 099	26.438 61	83.606 22	8.874 810	19.120 20	41.193 22

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
700	490 000	343 000 000	26.457 51	83.666 00	8.879 040	19.129 31	41.212 85
701	491 401	344 472 101	26.476 40	83.725 74	8.883 266	19.138 42	41.232 47
702	492 804	345 948 408	26.495 28	83.785 44	8.887 488	19.147 51	41.252 07
703	494 209	347 428 927	26.514 15	83.845 10	8.891 706	19.156 60	41.271 64
704	495 616	348 913 664	26.533 00	83.904 71	8.895 920	19.165 68	41.291 20
705	497 025	350 402 625	26.551 84	83.964 28	8.900 130	19.174 75	41.310 75
706	498 436	351 895 816	26.570 66	84.023 81	8.904 337	19.183 81	41.330 27
707	499 849	353 393 243	26.589 47	84.083 29	8.908 539	19.192 86	41.349 77
708	501 264	354 894 912	26.608 27	84.142 74	8.912 737	19.201 91	41.369 26
709	502 681	356 400 829	26.627 05	84.202 14	8.916 931	19.210 95	41.388 73
710	504 100	357 911 000	26.645 83	84.261 50	8.921 121	19.219 97	41.408 18
711	505 521	359 425 431	26.664 58	84.320 82	8.925 308	19.228 99	41.427 61
712	506 944	360 944 128	26.683 33	84.380 09	8.929 490	19.238 00	41.447 02
713	508 369	362 467 097	26.702 06	84.439 33	8.933 669	19.247 01	41.466 42
714	509 796	363 994 344	26.720 78	84.498 52	8.937 843	19.256 00	41.485 79
715	511 225	365 525 875	26.739 48	84.557 67	8.942 014	19.264 99	41.505 15
716	512 656	367 061 696	26.758 18	84.616 78	8.946 181	19.273 96	41.524 49
717	514 089	368 601 813	26.776 86	84.675 85	8.950 344	19.282 93	41.543 82
718	515 524	370 146 232	26.795 52	84.734 88	8.954 503	19.291 89	41.563 12
719	516 961	371 694 959	26.814 18	84.793 87	8.958 658	19.300 84	41.582 41
720	518 400	373 248 000	26.832 82	84.852 81	8.962 809	19.309 79	41.601 68
721	519 841	374 805 361	26.851 44	84.911 72	8.966 957	19.318 72	41.620 93
722	521 284	376 367 048	26.870 06	84.970 58	8.971 101	19.327 65	41.640 16
723	522 729	377 933 067	26.888 66	85.029 41	8.975 241	19.336 57	41.659 38
724	524 176	379 503 424	26.907 25	85.088 19	8.979 377	19.345 48	41.678 57
725	525 625	381 078 125	26.925 82	85.146 93	8.983 509	19.354 38	41.697 75
726	527 076	382 657 176	26.944 39	85.205 63	8.987 637	19.363 28	41.716 92
727	528 529	384 240 583	26.962 94	85.264 29	8.991 762	19.372 16	41.736 06
728	529 984	385 828 352	26.981 48	85.322 92	8.995 883	19.381 04	41.755 19
729	531 441	387 420 489	27.000 00	85.381 50	9.000 000	19.389 91	41.774 30
730	532 900	389 017 000	27.018 51	85.440 04	9.004 113	19.398 77	41.793 39
731	534 361	390 617 891	27.037 01	85.498 54	9.008 223	19.407 63	41.812 47
732	535 824	392 223 168	27.055 50	85.557 00	9.012 329	19.416 47	41.831 52
733	537 289	393 832 837	27.073 97	85.615 42	9.016 431	19.425 31	41.850 56
734	538 756	395 446 904	27.092 43	85.673 80	9.020 529	19.434 14	41.869 59
735	540 225	397 065 375	27.110 88	85.732 14	9.024 624	19.442 96	41.888 59
736	541 696	398 688 256	27.129 32	85.790 44	9.028 715	19.451 78	41.907 58
737	543 169	400 315 553	27.147 74	85.848 70	9.032 802	19.460 58	41.926 55
738	544 644	401 947 272	27.166 16	85.906 93	9.036 886	19.469 38	41.945 51
739	546 121	403 583 419	27.184 55	85.965 11	9.040 966	19.478 17	41.964 44
740	547 600	405 224 000	27.202 94	86.023 25	9.045 042	19.486 95	41.983 36
741	549 081	406 869 021	27.221 32	86.081 36	9.049 114	19.495 73	42.002 27
742	550 564	408 518 488	27.239 68	86.139 42	9.053 183	19.504 49	42.021 15
743	552 049	410 172 407	27.258 03	86.197 45	9.057 248	19.513 25	42.040 02
744	553 536	411 830 784	27.276 36	86.255 43	9.061 310	19.522 00	42.058 87
745	555 025	413 493 625	27.294 69	86.313 38	9.065 368	19.530 74	42.077 71
746	556 516	415 160 936	27.313 00	86.371 29	9.069 422	19.539 48	42.096 53
747	558 009	416 832 723	27.331 30	86.429 16	9.073 473	19.548 20	42.115 33
748	559 504	418 508 992	27.349 59	86.486 99	9.077 520	19.556 92	42.134 11
749	561 001	420 189 749	27.367 86	86.544 79	9.081 563	19.565 63	42.152 88

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
750	562 500	421 875 000	27.386 13	86.602 54	9.085 603	19.574 34	42.171 63
751	564 001	423 564 751	27.404 38	86.660 26	9.089 639	19.583 03	42.190 37
752	565 504	425 259 008	27.422 62	86.717 93	9.093 672	19.591 72	42.209 09
753	567 009	426 957 777	27.440 85	86.775 57	9.097 701	19.600 40	42.227 79
754	568 516	428 661 064	27.459 06	86.833 17	9.101 727	19.609 08	42.246 47
755	570 025	430 368 875	27.477 26	86.890 74	9.105 748	19.617 74	42.265 14
756	571 536	432 081 216	27.495 45	86.948 26	9.109 767	19.626 40	42.283 79
757	573 049	433 798 093	27.513 63	87.005 75	9.113 782	19.635 05	42.302 43
758	574 564	435 519 512	27.531 80	87.063 20	9.117 793	19.643 69	42.321 05
759	576 081	437 245 479	27.549 95	87.120 61	9.121 801	19.652 32	42.339 65
760	577 600	438 976 000	27.568 10	87.177 98	9.125 805	19.660 95	42.358 24
761	579 121	440 711 081	27.586 23	87.235 31	9.129 806	19.669 57	42.376 81
762	580 644	442 450 728	27.604 35	87.292 61	9.133 803	19.678 18	42.395 36
763	582 169	444 194 947	27.622 45	87.349 87	9.137 797	19.686 79	42.413 90
764	583 696	445 943 744	27.640 55	87.407 09	9.141 787	19.695 38	42.432 42
765	585 225	447 697 125	27.658 63	87.464 28	9.145 774	19.703 97	42.450 92
766	586 756	449 455 096	27.676 71	87.521 43	9.149 758	19.712 56	42.469 41
767	588 289	451 217 663	27.694 76	87.578 54	9.153 738	19.721 13	42.487 89
768	589 824	452 984 832	27.712 81	87.635 61	9.157 714	19.729 70	42.506 34
769	591 361	454 756 609	27.730 85	87.692 65	9.161 687	19.738 26	42.524 78
770	592 900	456 533 000	27.748 87	87.749 64	9.165 656	19.746 81	42.543 21
771	594 441	458 314 011	27.766 89	87.806 61	9.169 623	19.755 35	42.561 62
772	595 984	460 099 648	27.784 89	87.863 53	9.173 585	19.763 89	42.580 01
773	597 529	461 889 917	27.802 88	87.920 42	9.177 544	19.772 42	42.598 39
774	599 076	463 684 824	27.820 86	87.977 27	9.181 500	19.780 94	42.616 75
775	600 625	465 484 375	27.838 82	88.034 08	9.185 453	19.789 46	42.635 09
776	602 176	467 288 576	27.856 78	88.090 86	9.189 402	19.797 97	42.653 42
777	603 729	469 097 433	27.874 72	88.147 60	9.193 347	19.806 47	42.671 74
778	605 284	470 910 952	27.892 65	88.204 31	9.197 290	19.814 96	42.690 04
779	606 841	472 729 139	27.910 57	88.260 98	9.201 229	19.823 45	42.708 32
780	608 400	474 552 000	27.928 48	88.317 61	9.205 164	19.831 92	42.726 59
781	609 961	476 379 541	27.946 38	88.374 20	9.209 096	19.840 40	42.744 84
782	611 524	478 211 768	27.964 26	88.430 76	9.213 025	19.848 86	42.763 07
783	613 089	480 048 687	27.982 14	88.487 29	9.216 950	19.857 32	42.781 29
784	614 656	481 890 304	28.000 00	88.543 77	9.220 873	19.865 77	42.799 50
785	616 225	483 736 625	28.017 85	88.600 23	9.224 791	19.874 21	42.817 69
786	617 796	485 587 656	28.035 69	88.656 64	9.228 707	19.882 65	42.835 86
787	619 369	487 443 403	28.053 52	88.713 02	9.232 619	19.891 07	42.854 02
788	620 944	489 303 872	28.071 34	88.769 36	9.236 528	19.899 50	42.872 16
789	622 521	491 169 069	28.089 14	88.825 67	9.240 433	19.907 91	42.890 29
790	624 100	493 039 000	28.106 94	88.881 94	9.244 335	19.916 32	42.908 40
791	625 681	494 913 671	28.124 72	88.938 18	9.248 234	19.924 72	42.926 50
792	627 264	496 793 088	28.142 49	88.994 38	9.252 130	19.933 11	42.944 58
793	628 849	498 677 257	28.160 26	89.050 55	9.256 022	19.941 50	42.962 65
794	630 436	500 566 184	28.178 01	89.106 68	9.259 911	19.949 87	42.980 70
795	632 025	502 459 875	28.195 74	89.162 77	9.263 797	19.958 25	42.998 74
796	633 616	504 358 336	28.213 47	89.218 83	9.267 680	19.966 61	43.016 76
797	635 209	506 261 573	28.231 19	89.274 86	9.271 559	19.974 97	43.034 77
798	636 804	508 169 592	28.248 89	89.330 85	9.275 435	19.983 32	43.052 76
799	638 401	510 082 399	28.266 59	89.386 80	9.279 308	19.991 66	43.070 73

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
800	640 000	512 000 000	28.284 27	89.442 72	9.283 178	20.000 00	43.088 69
801	641 601	513 922 401	28.301 94	89.498 60	9.287 044	20.008 33	43.106 64
802	643 204	515 849 608	28.319 60	89.554 45	9.290 907	20.016 65	43.124 57
803	644 809	517 781 627	28.337 25	89.610 27	9.294 767	20.024 97	43.142 49
804	646 416	519 718 464	28.354 89	89.666 05	9.298 624	20.033 28	43.160 39
805	648 025	521 660 125	28.372 52	89.721 79	9.302 477	20.041 58	43.178 28
806	649 636	523 606 616	28.390 14	89.777 50	9.306 328	20.049 88	43.196 15
807	651 249	525 557 943	28.407 75	89.833 18	9.310 175	20.058 16	43.214 00
808	652 864	527 514 112	28.425 34	89.888 82	9.314 019	20.066 45	43.231 85
809	654 481	529 475 129	28.442 93	89.944 43	9.317 860	20.074 72	43.249 67
810	656 100	531 441 000	28.460 50	90.000 00	9.321 698	20.082 99	43.267 49
811	657 721	533 411 731	28.478 06	90.055 54	9.325 532	20.091 25	43.285 29
812	659 344	535 387 328	28.495 61	90.111 04	9.329 363	20.099 50	43.303 07
813	660 969	537 367 797	28.513 15	90.166 51	9.333 192	20.107 75	43.320 84
814	662 596	539 353 144	28.530 69	90.221 95	9.337 017	20.115 99	43.338 59
815	664 225	541 343 375	28.548 20	90.277 35	9.340 839	20.124 23	43.356 33
816	665 856	543 338 496	28.565 71	90.332 72	9.344 657	20.132 45	43.374 06
817	667 489	545 338 513	28.583 21	90.388 05	9.348 473	20.140 67	43.391 77
818	669 124	547 343 432	28.600 70	90.443 35	9.352 286	20.148 89	43.409 47
819	670 761	549 353 259	28.618 18	90.498 62	9.356 095	20.157 10	43.427 15
820	672 400	551 368 000	28.635 64	90.553 85	9.359 902	20.165 30	43.444 81
821	674 041	553 387 661	28.653 10	90.609 05	9.363 705	20.173 49	43.462 47
822	675 684	555 412 248	28.670 54	90.664 22	9.367 505	20.181 68	43.480 11
823	677 329	557 441 767	28.687 98	90.719 35	9.371 302	20.189 86	43.497 73
824	678 976	559 476 224	28.705 40	90.774 45	9.375 096	20.198 03	43.515 34
825	680 625	561 515 625	28.722 81	90.829 51	9.378 887	20.206 20	43.532 94
826	682 276	563 559 976	28.740 22	90.884 54	9.382 675	20.214 36	43.550 52
827	683 929	565 609 283	28.757 61	90.939 54	9.386 460	20.222 52	43.568 09
828	685 584	567 663 552	28.774 99	90.994 51	9.390 242	20.230 66	43.585 64
829	687 241	569 722 789	28.792 36	91.049 44	9.394 021	20.238 80	43.603 18
830	688 900	571 787 000	28.809 72	91.104 34	9.397 796	20.246 94	43.620 71
831	690 561	573 856 191	28.827 07	91.159 20	9.401 569	20.255 07	43.638 22
832	692 224	575 930 368	28.844 41	91.214 03	9.405 339	20.263 19	43.655 72
833	693 889	578 009 537	28.861 74	91.268 83	9.409 105	20.271 30	43.673 20
834	695 556	580 093 704	28.879 06	91.323 60	9.412 869	20.279 41	43.690 67
835	697 225	582 182 875	28.896 37	91.378 33	9.416 630	20.287 51	43.708 12
836	698 896	584 277 056	28.913 66	91.433 04	9.420 387	20.295 61	43.725 56
837	700 569	586 376 253	28.930 95	91.487 70	9.424 142	20.303 70	43.742 99
838	702 244	588 480 472	28.948 23	91.542 34	9.427 894	20.311 78	43.760 41
839	703 921	590 589 719	28.965 50	91.596 94	9.431 642	20.319 86	43.777 81
840	705 600	592 704 000	28.982 75	91.651 51	9.435 388	20.327 93	43.795 19
841	707 281	594 823 321	29.000 00	91.706 05	9.439 131	20.335 99	43.812 56
842	708 964	596 947 688	29.017 24	91.760 56	9.442 870	20.344 05	43.829 92
843	710 649	599 077 107	29.034 46	91.815 03	9.446 607	20.352 10	43.847 27
844	712 336	601 211 584	29.051 68	91.869 47	9.450 341	20.360 14	43.864 60
845	714 025	603 351 125	29.068 88	91.923 88	9.454 072	20.368 18	43.881 91
846	715 716	605 495 736	29.086 08	91.978 26	9.457 800	20.376 21	43.899 22
847	717 409	607 645 423	29.103 26	92.032 60	9.461 525	20.384 24	43.916 51
848	719 104	609 800 192	29.120 44	92.086 92	9.465 247	20.392 26	43.933 78
849	720 801	611 960 049	29.137 60	92.141 20	9.468 966	20.400 27	43.951 05

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
850	722 500	614 125 000	29.154 76	92.195 44	9.472 682	20.408 28	43.968 30
851	724 201	616 295 051	29.171 90	92.249 66	9.476 396	20.416 28	43.985 53
852	725 904	618 470 208	29.189 04	92.303 85	9.480 106	20.424 27	44.002 75
853	727 609	620 650 477	29.206 16	92.358 00	9.483 814	20.432 26	44.019 96
854	729 316	622 835 864	29.223 28	92.412 12	9.487 518	20.440 24	44.037 16
855	731 025	625 026 375	29.240 38	92.466 21	9.491 220	20.448 21	44.054 34
856	732 736	627 222 016	29.257 48	92.520 27	9.494 919	20.456 18	44.071 51
857	734 449	629 422 793	29.274 56	92.574 29	9.498 615	20.464 15	44.088 66
858	736 164	631 628 712	29.291 64	92.628 29	9.502 308	20.472 10	44.105 81
859	737 881	633 839 779	29.308 70	92.682 25	9.505 998	20.480 05	44.122 93
860	739 600	636 056 000	29.325 76	92.736 18	9.509 685	20.488 00	44.140 05
861	741 321	638 277 381	29.342 80	92.790 09	9.513 370	20.495 93	44.157 15
862	743 044	640 503 928	29.359 84	92.843 96	9.517 052	20.503 87	44.174 24
863	744 769	642 735 647	29.376 86	92.897 79	9.520 730	20.511 79	44.191 32
864	746 496	644 972 544	29.393 88	92.951 60	9.524 406	20.519 71	44.208 38
865	748 225	647 214 625	29.410 88	93.005 38	9.528 079	20.527 62	44.225 43
866	749 956	649 461 896	29.427 88	93.059 12	9.531 750	20.535 53	44.242 46
867	751 689	651 714 363	29.444 86	93.112 83	9.535 417	20.543 43	44.259 49
868	753 424	653 972 032	29.461 84	93.166 52	9.539 082	20.551 33	44.276 50
869	755 161	656 234 909	29.478 81	93.220 17	9.542 744	20.559 22	44.293 49
870	756 900	658 503 000	29.495 76	93.273 79	9.546 403	20.567 10	44.310 48
871	758 641	660 776 311	29.512 71	93.327 38	9.550 059	20.574 98	44.327 45
872	760 384	663 054 848	29.529 65	93.380 94	9.553 712	20.582 85	44.344 40
873	762 129	665 338 617	29.546 57	93.434 47	9.557 363	20.590 71	44.361 35
874	763 876	667 627 624	29.563 49	93.487 97	9.561 011	20.598 57	44.378 28
875	765 625	669 921 875	29.580 40	93.541 43	9.564 656	20.606 43	44.395 20
876	767 376	672 221 376	29.597 30	93.594 87	9.568 298	20.614 27	44.412 11
877	769 129	674 526 133	29.614 19	93.648 28	9.571 938	20.622 11	44.429 00
878	770 884	676 836 152	29.631 06	93.701 65	9.575 574	20.629 95	44.445 88
879	772 641	679 151 439	29.647 93	93.755 00	9.579 208	20.637 78	44.462 75
880	774 400	681 472 000	29.664 79	93.808 32	9.582 840	20.645 60	44.479 60
881	776 161	683 797 841	29.681 64	93.861 60	9.586 468	20.653 42	44.496 44
882	777 924	686 128 968	29.698 48	93.914 86	9.590 094	20.661 23	44.513 27
883	779 689	688 465 387	29.715 32	93.968 08	9.593 717	20.669 04	44.530 09
884	781 456	690 807 104	29.732 14	94.021 27	9.597 337	20.676 84	44.546 89
885	783 225	693 154 125	29.748 95	94.074 44	9.600 955	20.684 63	44.563 68
886	784 996	695 506 456	29.765 75	94.127 57	9.604 570	20.692 42	44.580 46
887	786 769	697 864 103	29.782 55	94.180 68	9.608 182	20.700 20	44.597 23
888	788 544	700 227 072	29.799 33	94.233 75	9.611 791	20.707 98	44.613 98
889	790 321	702 595 369	29.816 10	94.286 80	9.615 398	20.715 75	44.630 72
890	792 100	704 969 000	29.832 87	94.339 81	9.619 002	20.723 51	44.647 45
891	793 881	707 347 971	29.849 62	94.392 80	9.622 603	20.731 27	44.664 17
892	795 664	709 732 288	29.866 37	94.445 75	9.626 202	20.739 02	44.680 87
893	797 449	712 121 957	29.883 11	94.498 68	9.629 797	20.746 77	44.697 56
894	799 236	714 516 984	29.899 83	94.551 57	9.633 391	20.754 51	44.714 24
895	801 025	716 917 375	29.916 55	94.604 44	9.636 981	20.762 25	44.730 90
896	802 816	719 323 136	29.933 26	94.657 28	9.640 569	20.769 98	44.747 56
897	804 609	721 734 273	29.949 96	94.710 08	9.644 154	20.777 70	44.764 20
898	806 404	724 150 792	29.966 65	94.762 86	9.647 737	20.785 42	44.780 83
899	808 201	726 572 699	29.983 33	94.815 61	9.651 317	20.793 13	44.797 44

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
900	810 000	729 000 000	30.000 00	94.868 33	9.654 894	20.800 84	44.814 05
901	811 801	731 432 701	30.016 66	94.921 02	9.658 468	20.808 54	44.830 64
902	813 604	733 870 808	30.033 31	94.973 68	9.662 040	20.816 23	44.847 22
903	815 409	736 314 327	30.049 96	95.026 31	9.665 610	20.823 92	44.863 79
904	817 216	738 763 264	30.066 59	95.078 91	9.669 176	20.831 61	44.880 34
905	819 025	741 217 625	30.083 22	95.131 49	9.672 740	20.839 29	44.896 88
906	820 836	743 677 416	30.099 83	95.184 03	9.676 302	20.846 96	44.913 41
907	822 649	746 142 643	30.116 44	95.236 55	9.679 860	20.854 63	44.929 93
908	824 464	748 613 312	30.133 04	95.289 03	9.683 417	20.862 29	44.946 44
909	826 281	751 089 429	30.149 63	95.341 49	9.686 970	20.869 94	44.962 93
910	828 100	753 571 000	30.166 21	95.393 92	9.690 521	20.877 59	44.979 41
911	829 921	756 058 031	30.182 78	95.446 32	9.694 069	20.885 24	44.995 88
912	831 744	758 550 528	30.199 34	95.498 69	9.697 615	20.892 88	45.012 34
913	833 569	761 048 497	30.215 89	95.551 03	9.701 158	20.900 51	45.028 79
914	835 396	763 551 944	30.232 43	95.603 35	9.704 699	20.908 14	45.045 22
915	837 225	766 060 875	30.248 97	95.655 63	9.708 237	20.915 76	45.061 64
916	839 056	768 575 296	30.265 49	95.707 89	9.711 772	20.923 38	45.078 05
917	840 889	771 095 213	30.282 01	95.760 12	9.715 305	20.930 99	45.094 45
918	842 724	773 620 632	30.298 51	95.812 32	9.718 835	20.938 60	45.110 84
919	844 561	776 151 559	30.315 01	95.864 49	9.722 363	20.946 20	45.127 21
920	846 400	778 688 000	30.331 50	95.916 63	9.725 888	20.953 79	45.143 57
921	848 241	781 229 961	30.347 98	95.968 74	9.729 411	20.961 38	45.159 92
922	850 084	783 777 448	30.364 45	96.020 83	9.732 931	20.968 96	45.176 26
923	851 929	786 330 467	30.380 92	96.072 89	9.736 448	20.976 54	45.192 59
924	853 776	788 889 024	30.397 37	96.124 92	9.739 963	20.984 11	45.208 91
925	855 625	791 453 125	30.413 81	96.176 92	9.743 476	20.991 68	45.225 21
926	857 476	794 022 776	30.430 25	96.228 89	9.746 986	20.999 24	45.241 50
927	859 329	796 597 983	30.446 67	96.280 84	9.750 493	21.006 80	45.257 78
928	861 184	799 178 752	30.463 09	96.332 76	9.753 998	21.014 35	45.274 05
929	863 041	801 765 089	30.479 50	96.384 65	9.757 500	21.021 90	45.290 30
930	864 900	804 357 000	30.495 90	96.436 51	9.761 000	21.029 44	45.306 55
931	866 761	806 954 491	30.512 29	96.488 34	9.764 497	21.036 97	45.322 78
932	868 624	809 557 568	30.528 68	96.540 15	9.767 992	21.044 50	45.339 00
933	870 489	812 166 237	30.545 05	96.591 93	9.771 485	21.052 03	45.355 21
934	872 356	814 780 504	30.561 41	96.643 68	9.774 974	21.059 54	45.371 41
935	874 225	817 400 375	30.577 77	96.695 40	9.778 462	21.067 06	45.387 60
936	876 096	820 025 856	30.594 12	96.747 09	9.781 946	21.074 56	45.403 77
937	877 969	822 656 953	30.610 46	96.798 76	9.785 429	21.082 07	45.419 94
938	879 844	825 293 672	30.626 79	96.850 40	9.788 909	21.089 56	45.436 09
939	881 721	827 936 019	30.643 11	96.902 01	9.792 386	21.097 06	45.452 23
940	883 600	830 584 000	30.659 42	96.953 60	9.795 861	21.104 54	45.468 36
941	885 481	833 237 621	30.675 72	97.005 15	9.799 334	21.112 02	45.484 48
942	887 364	835 896 888	30.692 02	97.056 68	9.802 804	21.119 50	45.500 58
943	889 249	838 561 807	30.708 31	97.108 19	9.806 271	21.126 97	45.516 68
944	891 136	841 232 384	30.724 58	97.159 66	9.809 736	21.134 44	45.532 76
945	893 025	843 908 625	30.740 85	97.211 11	9.813 199	21.141 90	45.548 83
946	894 916	846 590 536	30.757 11	97.262 53	9.816 659	21.149 35	45.564 90
947	896 809	849 278 123	30.773 37	97.313 93	9.820 117	21.156 80	45.580 95
948	898 704	851 971 392	30.789 61	97.365 29	9.823 572	21.164 24	45.596 98
949	900 601	854 670 349	30.805 84	97.416 63	9.827 025	21.171 68	45.613 01

SQUARES, CUBES, SQUARE ROOTS, AND CUBE ROOTS

n	n^2	n^3	$\sqrt{n}$	$\sqrt{10n}$	$\sqrt[3]{n}$	$\sqrt[3]{10n}$	$\sqrt[3]{100n}$
950	902 500	857 375 000	30.822 07	97.467 94	9.830 476	21.179 12	45.629 03
951	904 401	860 085 351	30.838 29	97.519 23	9.833 924	21.186 55	45.645 03
952	906 304	862 801 408	38.854 50	97.570 49	9.837 369	21.193 97	45.661 02
953	908 209	865 523 177	38.870 70	97.621 72	9.840 813	21.201 39	45.677 01
954	910 116	868 250 664	30.886 89	97.672 92	9.844 254	21.208 80	45.692 98
955	912 025	870 983 875	30.903 07	97.724 10	9.847 692	21.216 21	45.708 94
956	913 936	873 722 816	30.919 25	97.775 25	9.851 128	21.223 61	45.724 89
957	915 849	876 467 493	30.935 42	97.826 38	9.854 562	21.231 01	45.740 82
958	917 764	879 217 912	30.951 58	97.877 47	9.857 993	21.238 40	45.756 75
959	919 681	881 974 079	30.967 73	97.928 55	9.861 422	21.245 79	45.772 67
960	921 600	884 736 000	30.983 87	97.979 59	9.864 848	21.253 17	45.788 57
961	923 521	887 503 681	31.000 00	98.030 61	9.868 272	21.260 55	45.804 46
962	925 444	890 277 128	31.016 12	98.081 60	9.871 694	21.267 92	45.820 35
963	927 369	893 056 347	31.032 24	98.132 56	9.875 113	21.275 29	45.836 22
964	929 296	895 841 344	31.048 35	98.183 50	9.878 530	21.282 65	45.852 08
965	931 225	898 632 125	31.064 45	98.234 41	9.881 945	21.290 01	45.867 93
966	933 156	901 428 696	31.080 54	98.285 30	9.885 357	21.297 36	45.883 76
967	935 089	904 231 063	31.096 62	98.336 16	9.888 767	21.304 70	45.899 59
968	937 024	907 039 232	31.112 70	98.386 99	9.892 175	21.312 04	45.915 41
969	938 961	909 853 209	31.128 76	98.437 80	9.895 580	21.319 38	45.931 21
970	940 900	912 673 000	31.144 82	98.488 58	9.898 983	21.326 71	45.947 01
971	942 841	915 498 611	31.160 87	98.539 33	9.902 384	21.334 04	45.962 79
972	944 784	918 330 048	31.176 91	98.590 06	9.905 782	21.341 36	45.978 57
973	946 729	921 167 317	31.192 95	98.640 76	9.909 178	21.348 68	45.994 33
974	948 676	924 010 424	31.208 97	98.691 44	9.912 571	21.355 99	46.010 08
975	950 625	926 859 375	31.224 99	98.742 09	9.915 962	21.363 29	46.025 82
976	952 576	929 714 176	31.241 00	98.792 71	9.919 351	21.370 59	46.041 55
977	954 529	932 574 833	31.257 00	98.843 31	9.922 738	21.377 89	46.057 27
978	956 484	935 441 352	31.272 99	98.893 88	9.926 122	21.385 18	46.072 98
979	958 441	938 313 739	31.288 98	98.944 43	9.929 504	21.392 47	46.088 68
980	960 400	941 192 000	31.304 95	98.994 95	9.932 884	21.399 75	46.104 36
981	962 361	944 076 141	31.320 92	99.045 44	9.936 261	21.407 03	46.120 04
982	964 324	946 966 168	31.336 88	99.095 91	9.939 636	21.414 30	46.135 71
983	966 289	949 862 087	31.352 83	99.146 36	9.943 009	21.421 56	46.151 36
984	968 256	952 763 904	31.368 77	99.196 77	9.946 380	21.428 83	46.167 00
985	970 225	955 671 625	31.384 71	99.247 17	9.949 748	21.436 08	46.182 64
986	972 196	958 585 256	31.400 64	99.297 53	9.953 114	21.443 33	46.198 26
987	974 169	961 504 803	31.416 56	99.347 87	9.956 478	21.450 58	46.213 87
988	976 144	964 430 272	31.432 47	99.398 19	9.959 839	21.457 82	46.229 48
989	978 121	967 361 669	31.448 37	99.448 48	9.963 198	21.465 06	46.245 07
990	980 100	970 299 000	31.464 27	99.498 74	9.966 555	21.472 29	46.260 65
991	982 081	973 242 271	31.480 15	99.548 98	9.969 910	21.479 52	46.276 22
992	984 064	976 191 488	31.496 03	99.599 20	9.973 262	21.486 74	46.291 78
993	986 049	979 146 657	31.511 90	99.649 39	9.976 612	21.493 96	46.307 33
994	988 036	982 107 784	31.527 77	99.699 55	9.979 960	21.501 17	46.322 87
995	990 025	985 074 875	31.543 62	99.749 69	9.983 305	21.508 38	46.338 40
996	992 016	988 047 936	31.559 47	99.799 80	9.986 649	21.515 58	46.353 92
997	994 009	991 026 973	31.575 31	99.849 89	9.989 990	21.522 78	46.369 43
998	996 004	994 011 992	31.591 14	99.899 95	9.993 329	21.529 97	46.384 92
999	998 001	997 002 999	31.606 96	99.949 99	9.996 666	21.537 16	46.400 41

Table XIII a

RECIPROCALS, CIRCUMFERENCES, AND AREAS OF CIRCLES

n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
1	1000.000	3.141 593	.785 3982
2	500.000 0	6.283 185	3.141 593
3	333.333 3	9.424 778	7.068 583
4	250.000 0	12.566 37	12.566 37
5	200.000 0	15.707 96	19.634 95
6	166.666 7	18.849 56	28.274 33
7	142.857 1	21.991 15	38.484 51
8	125.000 0	25.132 74	50.265 48
9	111.111 1	28.274 33	63.617 25
10	100.000 0	31.415 93	78.539 82
11	90.909 09	34.557 52	95.033 18
12	83.333 33	37.699 11	113.097 3
13	76.923 08	40.840 70	132.732 3
14	71.428 57	43.982 30	153.938 0
15	66.666 67	47.123 89	176.714 6
16	62.500 00	50.265 48	201.061 9
17	58.823 53	53.407 08	226.980 1
18	55.555 56	56.548 67	254.469 0
19	52.631 58	59.690 26	283.528 7
20	50.000 00	62.831 85	314.159 3
21	47.619 05	65.973 45	346.360 6
22	45.454 55	69.115 04	380.132 7
23	43.478 26	72.256 63	415.475 6
24	41.666 67	75.398 22	452.389 3
25	40.000 00	78.539 82	490.873 9
26	38.461 54	81.681 41	530.929 2
27	37.037 04	84.823 00	572.555 3
28	35.714 29	87.964 59	615.752 2
29	34.482 76	91.106 19	660.519 9
30	33.333 33	94.247 78	706.858 3
31	32.258 06	97.389 37	754.767 6
32	31.250 00	100.531 0	804.247 7
33	30.303 03	103.672 6	855.298 6
34	29.411 76	106.814 2	907.920 3
35	28.571 43	109.955 7	962.112 8
36	27.777 78	113.097 3	1 017.876
37	27.027 03	116.238 9	1 075.210
38	26.315 79	119.380 5	1 134.115
39	25.641 03	122.522 1	1 194.591
40	25.000 00	125.663 7	1 256.637
41	24.390 24	128.805 3	1 320.254
42	23.809 52	131.946 9	1 385.442
43	23.255 81	135.088 5	1 452.201
44	22.727 27	138.230 1	1 520.531
45	22.222 22	141.371 7	1 590.431
46	21.739 13	144.513 3	1 661.903
47	21.276 60	147.654 9	1 734.945
48	20.833 33	150.796 4	1 809.557
49	20.408 16	153.938 0	1 885.741
50	20.000 00	157.079 6	1 963.495
51	19.607 84	160.221 2	2 042.821
52	19.230 77	163.362 8	2 123.717
53	18.867 92	166.504 4	2 206.183
54	18.518 52	169.646 0	2 290.221
55	18.181 82	172.787 6	2 375.829
56	17.857 14	175.929 2	2 463.009
57	17.543 86	179.070 8	2 551.759
58	17.241 38	182.212 4	2 642.079
59	16.949 15	185.354 0	2 733.971
60	16.666 67	188.495 6	2 827.433
61	16.393 44	191.637 2	2 922.467
62	16.129 03	194.778 7	3 019.071
63	15.873 02	197.920 3	3 117.245
64	15.625 00	201.061 9	3 216.991
65	15.384 62	204.203 5	3 318.307
66	15.151 52	207.345 1	3 421.194
67	14.925 37	210.486 7	3 525.652
68	14.705 88	213.628 3	3 631.681
69	14.492 75	216.769 9	3 739.281
70	14.285 71	219.911 5	3 848.451
71	14.084 51	223.053 1	3 959.192
72	13.888 89	226.194 7	4 071.504
73	13.698 63	229.336 3	4 185.387
74	13.513 51	232.477 9	4 300.840
75	13.333 33	235.619 4	4 417.865
76	13.157 89	238.761 0	4 536.460
77	12.987 01	241.902 6	4 656.626
78	12.820 51	245.044 2	4 778.362
79	12.658 23	248.185 8	4 901.670
80	12.500 00	251.327 4	5 026.548
81	12.345 68	254.469 0	5 152.997
82	12.195 12	257.610 6	5 281.017
83	12.048 19	260.752 2	5 410.608
84	11.904 76	263.893 8	5 541.769
85	11.764 71	267.035 4	5 674.502
86	11.627 91	270.177 0	5 808.805
87	11.494 25	273.318 6	5 944.679
88	11.363 64	276.460 2	6 082.123
89	11.235 96	279.601 7	6 221.139
90	11.111 11	282.743 3	6 361.725
91	10.989 01	285.884 9	6 503.882
92	10.869 57	289.026 5	6 647.610
93	10.752 69	292.168 1	6 792.909
94	10.638 30	295.309 7	6 939.778
95	10.526 32	298.451 3	7 088.218
96	10.416 67	301.592 9	7 238.229
97	10.309 28	304.734 5	7 389.811
98	10.204 08	307.876 1	7 542.964
99	10.101 01	311.017 7	7 697.687

RECIPROCALS, CIRCUMFERENCES, AND AREAS OF CIRCLES

n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$	n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
100	10.000 000	314.159 3	7 853.982	150	6.666 667	471.238 9	17 671.46
101	9.900 990	317.300 9	8 011.847	151	6.622 517	474.380 5	17 907.86
102	9.803 922	320.442 5	8 171.282	152	6.578 947	477.522 1	18 145.84
103	9.708 738	323.584 0	8 332.289	153	6.535 948	480.663 7	18 385.39
104	9.615 385	326.725 6	8 494.867	154	6.493 506	483.805 3	18 626.50
105	9.523 810	329.867 2	8 659.015	155	6.451 613	486.946 9	18 869.19
106	9.433 962	333.008 8	8 824.734	156	6.410 256	490.088 5	19 113.45
107	9.345 794	336.150 4	8 992.024	157	6.369 427	493.230 0	19 359.28
108	9.259 259	339.292 0	9 160.884	158	6.329 114	496.371 6	19 606.68
109	9.174 312	342.433 6	9 331.316	159	6.289 308	499.513 2	19 855.65
110	9.090 909	345.575 2	9 503.318	160	6.250 000	502.654 8	20 106.19
111	9.009 009	348.716 8	9 676.891	161	6.211 180	505.796 4	20 358.31
112	8.928 571	351.858 4	9 852.035	162	6.172 840	508.938 0	20 611.99
113	8.849 558	355.000 0	10 028.75	163	6.134 969	512.079 6	20 867.24
114	8.771 930	358.141 6	10 207.03	164	6.097 561	515.221 2	21 124.07
115	8.695 652	361.283 2	10 386.89	165	6.060 606	518.362 8	21 382.46
116	8.620 690	364.424 7	10 568.32	166	6.024 096	521.504 4	21 642.43
117	8.547 009	367.566 3	10 751.32	167	5.988 024	524.646 0	21 903.97
118	8.474 576	370.707 9	10 935.88	168	5.952 381	527.787 6	22 167.08
119	8.403 361	373.849 5	11 122.02	169	5.917 160	530.929 2	22 431.76
120	8.333 333	376.991 1	11 309.73	170	5.882 353	534.070 8	22 698.01
121	8.264 463	380.132 7	11 499.01	171	5.847 953	537.212 3	22 965.83
122	8.196 721	383.274 3	11 689.87	172	5.813 953	540.353 9	23 235.22
123	8.130 081	386.415 9	11 882.29	173	5.780 347	543.495 5	23 506.18
124	8.064 516	389.557 5	12 076.28	174	5.747 126	546.637 1	23 778.71
125	8.000 000	392.699 1	12 271.85	175	5.714 286	549.778 7	24 052.82
126	7.936 508	395.840 7	12 468.98	176	5.681 818	552.920 3	24 328.49
127	7.874 016	398.982 3	12 667.69	177	5.649 718	556.061 9	24 605.74
128	7.812 500	402.123 9	12 867.96	178	5.617 978	559.203 5	24 884.56
129	7.751 938	405.265 5	13 069.81	179	5.586 592	562.345 1	25 164.94
130	7.692 308	408.407 0	13 273.23	180	5.555 556	565.486 7	25 446.90
131	7.633 588	411.548 6	13 478.22	181	5.524 862	568.628 3	25 730.43
132	7.575 758	414.690 2	13 684.78	182	5.494 505	571.769 9	26 015.53
133	7.518 797	417.831 8	13 892.91	183	5.464 481	574.911 5	26 302.20
134	7.462 687	420.973 4	14 102.61	184	5.434 783	578.053 0	26 590.44
135	7.407 407	424.115 0	14 313.88	185	5.405 405	581.194 6	26 880.25
136	7.352 941	427.256 6	14 526.72	186	5.376 344	584.336 2	27 171.63
137	7.299 270	430.398 2	14 741.14	187	5.347 594	587.477 8	27 464.59
138	7.246 377	433.539 8	14 957.12	188	5.319 149	590.619 4	27 759.11
139	7.194 245	436.681 4	15 174.68	189	5.291 005	593.761 0	28 055.21
140	7.142 857	439.823 0	15 393.80	190	5.263 158	596.902 6	28 352.87
141	7.092 199	442.964 6	15 614.50	191	5.235 602	600.044 2	28 652.11
142	7.042 254	446.106 2	15 836.77	192	5.208 333	603.185 8	28 952.92
143	6.993 007	449.247 7	16 060.61	193	5.181 347	606.327 4	29 255.30
144	6.944 444	452.389 3	16 286.02	194	5.154 639	609.469 0	29 559.25
145	6.896 552	455.530 9	16 513.00	195	5.128 205	612.610 6	29 864.77
146	6.849 315	458.672 5	16 741.55	196	5.102 041	615.752 2	30 171.86
147	6.802 721	461.814 1	16 971.67	197	5.076 142	618.893 8	30 480.52
148	6.756 757	464.955 7	17 203.36	198	5.050 505	522.035 3	30 790.75
149	6.711 409	468.097 3	17 436.62	199	5.025 126	625.176 9	31 102.55

RECIPROCALS, CIRCUMFERENCES, AND AREAS OF CIRCLES

n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$	n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
200	5.000 000	628.318 5	31 415.93	250	4.000 000	785.398 2	49 087.39
201	4.975 124	631.460 1	31 730.87	251	3.984 064	788.539 8	49 480.87
202	4.950 495	634.601 7	32 047.39	252	3.968 254	791.681 3	49 875.92
203	4.926 108	637.743 3	32 365.47	253	3.952 569	794.822 9	50 272.55
204	4.901 961	640.884 9	32 685.13	254	3.937 008	797.964 5	50 670.75
205	4.878 049	644.026 5	33 006.36	255	3.921 569	801.106 1	51 070 52
206	4.854 369	647.168 1	33 329.16	256	3.906 250	804.247 7	51 471 85
207	4.830 918	650.309 7	33 653.53	257	3.891 051	807.389 3	51 874.76
208	4.807 692	653.451 3	33 979.47	258	3.875 969	810.530 9	52 279.24
209	4.784 689	656.592 9	34 306.98	259	3.861 004	813.672 5	52 685.29
210	4.761 905	659.734 5	34 636.06	260	3.846 154	816.814 1	53 092.92
211	4.739 336	662.876 0	34 966.71	261	3.831 418	819.955 7	53 502.11
212	4.716 981	666.017 6	35 298.94	262	3.816 794	823.097 3	53 912.87
213	4.694 836	669.159 2	35 632.73	263	3.802 281	826 238 9	54 325.21
214	4.672 897	672.300 8	35 968.09	264	3.787 879	829.380 5	54 739.11
215	4.651 163	675.442 4	36 305.03	265	3.773 585	832.522 1	55 154.59
216	4.629 630	678.584 0	36 643.54	266	3.759 398	835.663 6	55 571.63
217	4.608 295	681.725 6	36 983.61	267	3.745 318	838.805 2	55 990.25
218	4.587 156	684.867 2	37 325.26	268	3.731 343	841.946 8	56 410 44
219	4.566 210	688.008 8	37 668.48	269	3.717 472	845.088 4	56 832.20
220	4.545 455	691.150 4	38 013.27	270	3.703 704	848.230 0	57 255.53
221	4.524 887	694.292 0	38 359.63	271	3.690 037	851.371 6	57 680.43
222	4.504 505	697.433 6	38 707.56	272	3.676 471	854.513 2	58 106.90
223	4.484 305	700.575 2	39 057.07	273	3.663 004	857.654 8	58 534.94
224	4.464 286	703.716 8	39 408.14	274	3.649 635	860.796 4	58 964.55
225	4.444 444	706.858 3	39 760.78	275	3.636 364	863.938 0	59 395.74
226	4.424 779	709.999 9	40 115.00	276	3.623 188	867.079 6	59 828 49
227	4.405 286	713.141 5	40 470.78	277	3.610 108	870.221 2	60 262.82
228	4.385 965	716.283 1	40 828.14	278	3.597 122	873.362 8	60 698.71
229	4.366 812	719.424 7	41 187.07	279	3.584 229	876.504 4	61 136.18
230	4.347 826	722.566 3	41 547.56	280	3.571 429	879.645 9	61 575 22
231	4.329 004	725.707 9	41 909.63	281	3.558 719	882.787 5	62 015 82
232	4.310 345	728.849 5	42 273.27	282	3.546 099	885.929 1	62 458 00
233	4.291 845	731.991 1	42 638.48	283	3.533 569	889.070 7	62 901.75
234	4.273 504	735.132 7	43 005.26	284	3.521 127	892.212 3	63 347.07
235	4.255 319	738.274 3	43 373.61	285	3.508 772	895.353 9	63 793.97
236	4.237 288	741.415 9	43 743.54	286	3.496 503	898.495 5	64 242.43
237	4.219 409	744.557 5	44 115.03	287	3.484 321	901.637 1	64 692.46
238	4.201 681	747.699 1	44 488.09	288	3.472 222	904.778 7	65 144.07
239	4.184 100	750.840 6	44 862.73	289	3.460 208	907.920 3	65 597.24
240	4.166 667	753.982 2	45 238.93	290	3.448 276	911.061 9	66 051.99
241	4.149 378	757.123 8	45 616.71	291	3.436 426	914.203 5	66 508.30
242	4.132 231	760.265 4	45 996.06	292	3.424 658	917.345 1	66 966.19
243	4.115 226	763.407 0	46 376.98	293	3.412 969	920.486 6	67 425.65
244	4.098 361	766.548 6	46 759.47	294	3.401 361	923.628 2	67 886.68
245	4.081 633	769.690 2	47 143.52	295	3.389 831	926.769 8	68 349.28
246	4.065 041	772.831 8	47 529.16	296	3.378 378	929.911 4	68 813.45
247	4.048 583	775.973 4	47 916.36	297	3.367 003	933.053 0	69 279.19
248	4.032 258	779.115 0	48 305.13	298	3.355 705	936.194 6	69 746.50
249	4.016 064	782.256 6	48 695.47	299	3.344 482	939.336 2	70 215.38

RECIPROCALS, CIRCUMFERENCES, AND AREAS OF CIRCLES

n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$	n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
300	3.333 333	942.477 8	70 685.83	350	2.857 143	1 099.557	96 211.28
301	3.322 259	945.619 4	71 157.86	351	2.849 003	1 102.699	96 761.84
302	3.311 258	948.761 0	71 631.45	352	2.840 909	1 105.841	97 313.97
303	3.300 330	951.902 6	72 106.62	353	2.832 861	1 108.982	97 867.68
304	3.289 474	955.044 2	72 583.36	354	2.824 859	1 112.124	98 422.96
305	3.278 689	958.185 8	73 061.66	355	2.816 901	1 115.265	98 979.80
306	3.267 974	961.327 4	73 541.54	356	2.808 989	1 118.407	99 538.22
307	3.257 329	964.468 9	74 022.99	357	2.801 120	1 121.549	100 098.2
308	3.246 753	967.610 5	74 506.01	358	2.793 296	1 124.690	100 659.8
309	3.236 246	970.752 1	74 990.60	359	2.785 515	1 127.832	101 222.9
310	3.225 806	973.893 7	75 476.76	360	2.777 778	1 130.973	101 787.6
311	3.215 434	977.035 3	75 964.50	361	2.770 083	1 134.115	102 353.9
312	3.205 128	980.176 9	76 453.80	362	2.762 431	1 137.257	102 921.7
313	3.194 888	983.318 5	76 944.67	363	2.754 821	1 140.398	103 491.1
314	3.184 713	986.460 1	77 437.12	364	2.747 253	1 143.540	104 062.1
315	3.174 603	989.601 7	77 931.13	365	2.739 726	1 146.681	104 634.7
316	3.164 557	992.743 3	78 426.72	366	2.732 240	1 149.823	105 208.8
317	3.154 574	995.884 9	78 923.88	367	2.724 796	1 152.965	105 784.5
318	3.144 654	999.026 5	79 422.60	368	2.717 391	1 156.106	106 361.8
319	3.134 796	1 002.168	79 922.90	369	2.710 027	1 159.248	106 940.6
320	3.125 000	1 005.310	80 424.77	370	2.702 703	1 162.389	107 521.0
321	3.115 265	1 008.451	80 928.21	371	2.695 418	1 165.531	108 103.0
322	3.105 590	1 011.593	81 433.22	372	2.688 172	1 168.672	108 686.5
323	3.095 975	1 014.734	81 939.80	373	2.680 965	1 171.814	109 271.7
324	3.086 420	1 017.876	82 447.96	374	2.673 797	1 174.956	109 858.4
325	3.076 923	1 021.018	82 957.68	375	2.666 667	1 178.097	110 446.6
326	3.067 485	1 024.159	83 468.97	376	2.659 574	1 181.239	111 036.5
327	3.058 104	1 027.301	83 981.84	377	2.652 520	1 184.380	111 627.9
328	3.048 780	1 030.442	84 496.28	378	2.645 503	1 187.522	112 220.8
329	3.039 514	1 033.584	85 012.28	379	2.638 522	1 190.664	112 815.4
330	3.030 303	1 036.726	85 529.86	380	2.631 579	1 193.805	113 411.5
331	3.021 148	1 039.867	86 049.01	381	2.624 672	1 196.947	114 009.2
332	3.012 048	1 043.009	86 569.73	382	2.617 801	1 200.088	114 608.4
333	3.003 003	1 046.150	87 092.02	383	2.610 966	1 203.230	115 209.3
334	2.994 012	1 049.292	87 615.88	384	2.604 167	1 206.372	115 811.7
335	2.985 075	1 052.434	88 141.31	385	2.597 403	1 209.513	116 415.6
336	2.976 190	1 055.575	88 668.31	386	2.590 674	1 212.655	117 021.2
337	2.967 359	1 058.717	89 196.88	387	2.583 979	1 215.796	117 628.3
338	2.958 580	1 061.858	89 727.03	388	2.577 320	1 218.938	118 237.0
339	2.949 853	1 065.000	90 258.74	389	2.570 694	1 222.080	118 847.2
340	2.941 176	1 068.142	90 792.03	390	2.564 103	1 225.221	119 459.1
341	2.932 551	1 071.283	91 326.88	391	2.557 545	1 228.363	120 072.5
342	2.923 977	1 074.425	91 863.31	392	2.551 020	1 231.504	120 687.4
343	2.915 452	1 077.566	92 401.31	393	2.544 529	1 234.646	121 304.0
344	2.906 977	1 080.708	92 940.88	394	2.538 071	1 237.788	121 922.1
345	2.898 551	1 083.849	93 482.02	395	2.531 646	1 240.929	122 541.7
346	2.890 173	1 086.991	94 024.73	396	2.525 253	1 244.071	123 163.0
347	2.881 844	1 090.133	94 569.01	397	2.518 892	1 247.212	123 785.8
348	2.873 563	1 093.274	95 114.86	398	2.512 563	1 250.354	124 410.2
349	2.865 330	1 096.416	95 662.28	399	2.506 266	1 253.495	125 036.2

RECIPROCALS, CIRCUMFERENCES, AND AREAS OF CIRCLES

n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$	n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
400	2.500 000	1 256.637	125 663.7	450	2.222 222	1 413.717	159 043.1
401	2.493 766	1 259.779	126 292.8	451	2.217 295	1 416.858	159 750.8
402	2.487 562	1 262.920	126 923.5	452	2.212 389	1 420.000	160 460.0
403	2.481 390	1 266.062	127 555.7	453	2.207 506	1 423.141	161 170.8
404	2.475 248	1 269.203	128 189.5	454	2.202 643	1 426.283	161 883.1
405	2.469 136	1 272.345	128 824.9	455	2.197 802	1 429.425	162 597.1
406	2.463 054	1 275.487	129 461.9	456	2.192 982	1 432.566	163 312.6
407	2.457 002	1 278.628	130 100.4	457	2.188 184	1 435.708	164 029.6
408	2.450 980	1 281.770	130 740.5	458	2.183 406	1 438.849	164 748.3
409	2.444 988	1 284.911	131 382.2	459	2.178 649	1 441.991	165 468.5
410	2.439 024	1 288.053	132 025.4	460	2.173 913	1 445.133	166 190.3
411	2.433 090	1 291.195	132 670.2	461	2.169 197	1 448.274	166 913.6
412	2.427 184	1 294.336	133 316.6	462	2.164 502	1 451.416	167 638.5
413	2.421 308	1 297.478	133 964.6	463	2.159 827	1 454.557	168 365.0
414	2.415 459	1 300.619	134 614.1	464	2.155 172	1 457.699	169 093.1
415	2.409 639	1 303.761	135 265.2	465	2.150 538	1 460.841	169 822.7
416	2.403 846	1 306.903	135 917.9	466	2.145 923	1 463.982	170 553.9
417	2.398 082	1 310.044	136 572.1	467	2.141 328	1 467.124	171 286.7
418	2.392 344	1 313.186	137 227.9	468	2.136 752	1 470.265	172 021.0
419	2.386 635	1 316.327	137 885.3	469	2.132 196	1 473.407	172 757.0
420	2.380 952	1 319.469	138 544.2	470	2.127 660	1 476.549	173 494.5
421	2.375 297	1 322.611	139 204.8	471	2.123 142	1 479.690	174 233.5
422	2.369 668	1 325.752	139 866.8	472	2.118 644	1 482.832	174 974.1
423	2.364 066	1 328.894	140 530.5	473	2.114 165	1 485.973	175 716.3
424	2.358 491	1 332.035	141 195.7	474	2.109 705	1 489.115	176 460.1
425	2.352 941	1 335.177	141 862.5	475	2.105 263	1 492.257	177 205.5
426	2.347 418	1 338.318	142 530.9	476	2.100 840	1 495.398	177 952.4
427	2.341 920	1 341.460	143 200.9	477	2.096 436	1 498.540	178 700.9
428	2.336 449	1 344.602	143 872.4	478	2.092 050	1 501.681	179 450.9
429	2.331 002	1 347.743	144 545.5	479	2.087 683	1 504.823	180 202.5
430	2.325 581	1 350.885	145 220.1	480	2.083 333	1 507.964	180 955.7
431	2.320 186	1 354.026	145 896.3	481	2.079 002	1 511.106	181 710.5
432	2.314 815	1 357.168	146 574.1	482	2.074 689	1 514.248	182 466.8
433	2.309 469	1 360.310	147 253.5	483	2.070 393	1 517.389	183 224.8
434	2.304 147	1 363.451	147 934.5	484	2.066 116	1 520.531	183 984.2
435	2.298 851	1 366.593	148 617.0	485	2.061 856	1 523.672	184 745.3
436	2.293 578	1 369.734	149 301.0	486	2.057 613	1 526.814	185 507.9
437	2.288 330	1 372.876	149 986.7	487	2.053 388	1 529.956	186 272.1
438	2.283 105	1 376.018	150 673.9	488	2.049 180	1 533.097	187 037.9
439	2.277 904	1 379.159	151 362.7	489	2.044 990	1 536.239	187 805.2
440	2.272 727	1 382.301	152 053.1	490	2.040 816	1 539.380	188 574.1
441	2.267 574	1 385.442	152 745.0	491	2.036 660	1 542.522	189 344.6
442	2.262 443	1 388.584	153 438.5	492	2.032 520	1 545.664	190 116.6
443	2.257 336	1 391.726	154 133.6	493	2.028 398	1 548.805	190 890.2
444	2.252 252	1 394.867	154 830.3	494	2.024 291	1 551.947	191 665.4
445	2.247 191	1 398.009	155 528.5	495	2.020 202	1 555.088	192 442.2
446	2.242 152	1 401.150	156 228.3	496	2.016 129	1 558.230	193 220.5
447	2.237 136	1 404.292	156 929.6	497	2.012 072	1 561.372	194 000.4
448	2.232 143	1 407.434	157 632.6	498	2.008 032	1 564.513	194 781.9
449	2.227 171	1 410.575	158 337.1	499	2.004 008	1 567.655	195 564.9

RECIPROCALS, CIRCUMFERENCES, AND AREAS OF CIRCLES

n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$	n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
500	2.000 000	1 570.796	196 349.5	550	1.818 182	1 727.876	237 582.9
501	1.996 008	1 573.938	197 135.7	551	1.814 882	1 731.018	238 447.7
502	1.992 032	1 577.080	197 923.5	552	1.811 594	1 734.159	239 314.0
503	1.988 072	1 580.221	198 712.8	553	1.808 318	1 737.301	240 181.8
504	1.984 127	1 583.363	199 503.7	554	1.805 054	1 740.442	241 051.3
505	1.980 198	1 586.504	200 296.2	555	1.801 802	1 743.584	241 922.3
506	1.976 285	1 589.646	201 090.2	556	1.798 561	1 746.726	242 794.8
507	1.972 387	1 592.787	201 885.8	557	1.795 332	1 749.867	243 669.0
508	1.968 504	1 595.929	202 683.0	558	1.792 115	1 753.009	244 544.7
509	1.964 637	1 599.071	203 481.7	559	1.788 909	1 756.150	245 422.0
510	1.960 784	1 602.212	204 282.1	560	1.785 714	1 759.292	246 300.9
511	1.956 947	1 605.354	205 084.0	561	1.782 531	1 762.433	247 181.3
512	1.953 125	1 608.495	205 887.4	562	1.779 359	1 765.575	248 063.3
513	1.949 318	1 611.637	206 692.4	563	1.776 199	1 768.717	248 946.9
514	1.945 525	1 614.779	207 499.1	564	1.773 050	1 771.858	249 832.0
515	1.941 748	1 617.920	208 307.2	565	1.769 912	1 775.000	250 718.7
516	1.937 984	1 621.062	209 117.0	566	1.766 784	1 778.141	251 607.0
517	1.934 236	1 624.203	209 928.3	567	1.763 668	1 781.283	252 496.9
518	1.930 502	1 627.345	210 741.2	568	1.760 563	1 784.425	253 388.3
519	1.926 782	1 630.487	211 555.6	569	1.757 469	1 787.566	254 281.3
520	1.923 077	1 633.628	212 371.7	570	1.754 386	1 790.708	255 175.9
521	1.919 386	1 636.770	213 189.3	571	1.751 313	1 793.849	256 072.0
522	1.915 709	1 639.911	214 008.4	572	1.748 252	1 796.991	256 969.7
523	1.912 046	1 643.053	214 829.2	573	1.745 201	1 800.133	257 869.0
524	1.908 397	1 646.195	215 651.5	574	1.742 160	1 803.274	258 769.8
525	1.904 762	1 649.336	216 475.4	575	1.739 130	1 806.416	259 672.3
526	1.901 141	1 652.478	217 300.8	576	1.736 111	1 809.557	260 576.3
527	1.897 533	1 655.619	218 127.8	577	1.733 102	1 812.699	261 481.8
528	1.893 939	1 658.761	218 956.4	578	1.730 104	1 815.841	262 389.0
529	1.890 359	1 661.903	219 786.6	579	1.727 116	1 818.982	263 297.7
530	1.886 792	1 665.044	220 618.3	580	1.724 138	1 822.124	264 207.9
531	1.883 239	1 668.186	221 451.7	581	1.721 170	1 825.265	265 119.8
532	1.879 699	1 671.327	222 286.5	582	1.718 213	1 828.407	266 033.2
533	1.876 173	1 674.469	223 123.0	583	1.715 266	1 831.549	266 948.2
534	1.872 659	1 677.610	223 961.0	584	1.712 329	1 834.690	267 864.8
535	1.869 159	1 680.752	224 800.6	585	1.709 402	1 837.832	268 782.9
536	1.865 672	1 683.894	225 641.8	586	1.706 485	1 840.973	269 702.6
537	1.862 197	1 687.035	226 484.5	587	1.703 578	1 844.115	270 623.9
538	1.858 736	1 690.177	227 328.8	588	1.700 680	1 847.256	271 546.7
539	1.855 288	1 693.318	228 174.7	589	1.697 793	1 850.398	272 471.1
540	1.851 852	1 696.460	229 022.1	590	1.694 915	1 853.540	273 397.1
541	1.848 429	1 699.602	229 871.1	591	1.692 047	1 856.681	274 324.7
542	1.845 018	1 702.743	230 721.7	592	1.689 189	1 859 823	275 253.8
543	1.841 621	1 705.885	231 573.9	593	1.686 341	1 862.964	276 184.5
544	1.838 235	1 709.026	232 427.6	594	1.683 502	1 866.106	277 116.7
545	1.834 862	1 712.168	233 282.9	595	1.680 672	1 869.248	278 050.6
546	1.831 502	1 715.310	234 139.8	596	1.677 852	1 872.389	278 986.0
547	1.828 154	1 718.451	234 998.2	597	1.675 042	1 875.531	279 923.0
548	1.824 818	1 721.593	235 858.2	598	1.672 241	1 878.672	280 861.5
549	1.821 494	1 724.734	236 719.8	599	1.669 449	1 881.814	281 801.6

RECIPROCALS, CIRCUMFERENCES, AND AREAS OF CIRCLES

n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$	n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
600	1.666 667	1 884.956	282 743.3	650	1.538 462	2 042.035	331 830.7
601	1.663 894	1 888.097	283 686.6	651	1.536 098	2 045.177	332 852.5
602	1.661 130	1 891.239	284 631.4	652	1.533 742	2 048.318	333 875.9
603	1.658 375	1 894.380	285 577.8	653	1.531 394	2 051.460	334 900.8
604	1.655 629	1 897.522	286 525.8	654	1.529 052	2 054.602	335 927.4
605	1.652 893	1 900.664	287 475.4	655	1.526 718	2 057.743	336 955.4
606	1.650 165	1 903.805	288 426.5	656	1.524 390	2 060.885	337 985.1
607	1.647 446	1 906.947	289 379.2	657	1.522 070	2 064.026	339 016.3
608	1.644 737	1 910.088	290 333.4	658	1.519 757	2 067.168	340 049.1
609	1.642 036	1 913.230	291 289.3	659	1.517 451	2 070.310	341 083.5
610	1.639 344	1 916.372	292 246.7	660	1.515 152	2 073.451	342 119.4
611	1.636 661	1 919.513	293 205.6	661	1.512 859	2 076.593	343 157.0
612	1.633 987	1 922.655	294 166.2	662	1.510 574	2 079.734	344 196.0
613	1.631 321	1 925.796	295 128.3	663	1.508 296	2 082.876	345 236.7
614	1.628 664	1 928.938	296 092.0	664	1.506 024	2 086.018	346 278.9
615	1.626 016	1 932.079	297 057.2	665	1.503 759	2 089.159	347 322.7
616	1.623 377	1 935.221	298 024.0	666	1.501 502	2 092.301	348 368.1
617	1.620 746	1 938.363	298 992.4	667	1.499 250	2 095.442	349 415.0
618	1.618 123	1 941.504	299 962.4	668	1.497 006	2 098.584	350 463.5
619	1.615 509	1 944.646	300 933.9	669	1.494 768	2 101.725	351 513.6
620	1.612 903	1 947.787	301 907.1	670	1.492 537	2 104.867	352 565.2
621	1.610 306	1 950.929	302 881.7	671	1.490 313	2 108.009	353 618.5
622	1.607 717	1 954.071	303 858.0	672	1.488 095	2 111.150	354 673.2
623	1.605 136	1 957.212	304 835.8	673	1.485 884	2 114.292	355 729.6
624	1.602 564	1 960.354	305 815.2	674	1.483 680	2 117.433	356 787.5
625	1.600 000	1 963.495	306 796.2	675	1.481 481	2 120.575	357 847.0
626	1.597 444	1 966.637	307 778.7	676	1.479 290	2 123.717	358 908.1
627	1.594 896	1 969.779	308 762.8	677	1.477 105	2 126.858	359 970.8
628	1.592 357	1 972.920	309 748.5	678	1.474 926	2 130.000	361 035.0
629	1.589 825	1 976.062	310 735.7	679	1.472 754	2 133.141	362 100.8
630	1.587 302	1 979.203	311 724.5	680	1.470 588	2 136.283	363 168.1
631	1.584 786	1 982.345	312 714.9	681	1.468 429	2 139.425	364 237.0
632	1.582 278	1 985.487	313 706.9	682	1.466 276	2 142.566	365 307.5
633	1.579 779	1 988.628	314 700.4	683	1.464 129	2 145.708	366 379.6
634	1.577 287	1 991.770	315 695.5	684	1.461 988	2 148.849	367 453.2
635	1.574 803	1 994.911	316 692.2	685	1.459 854	2 151.991	368 528.5
636	1.572 327	1 998.053	317 690.4	686	1.457 726	2 155.133	369 605.2
637	1.569 859	2 001.195	318 690.2	687	1.455 604	2 158.274	370 683.6
638	1.567 398	2 004.336	319 691.6	688	1.453 488	2 161.416	371 763.5
639	1.564 945	2 007.478	320 694.6	689	1.451 379	2 164.557	372 845.0
640	1.562 500	2 010.619	321 699.1	690	1.449 275	2 167.699	373 928.1
641	1.560 062	2 013.761	322 705.2	691	1.447 178	2 170.841	375 012.7
642	1.557 632	2 016.902	323 712.8	692	1.445 087	2 173.982	376 098.9
643	1.555 210	2 020.044	324 722.1	693	1.443 001	2 177.124	377 186.7
644	1.552 795	2 023.186	325 732.9	694	1.440 922	2 180.265	378 276.0
645	1.550 388	2 026.327	326 745.3	695	1.438 849	2 183.407	379 366.9
646	1.547 988	2 029.469	327 759.2	696	1.436 782	2 186.548	380 459.4
647	1.545 595	2 032.610	328 774.7	697	1.434 720	2 189.690	381 553.5
648	1.543 210	2 035.752	329 791.8	698	1.432 665	2 192.832	382 649.1
649	1.540 832	2 038.894	330 810.5	699	1.430 615	2 195.973	383 746.3

RECIPROCALS, CIRCUMFERENCES, AND AREAS OF CIRCLES

n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$	n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
700	1.428 571	2 199.115	384 845.1	750	1.333 333	2 356.194	441 786.5
701	1.426 534	2 202.256	385 945.4	751	1.331 558	2 359.336	442 965.3
702	1.424 501	2 205.398	387 047.4	752	1.329 787	2 362.478	444 145.8
703	1.422 475	2 208.540	388 150.8	753	1.328 021	2 365.619	445 327.8
704	1.420 455	2 211.681	389 255.9	754	1.326 260	2 368.761	446 511.4
705	1.418 440	2 214.823	390 362.5	755	1.324 503	2 371.902	447 696.6
706	1.416 431	2 217.964	391 470.7	756	1.322 751	2 375.044	448 883.3
707	1.414 427	2 221.106	392 580.5	757	1.321 004	2 378.186	450 071.6
708	1.412 429	2 224.248	393 691.8	758	1.319 261	2 381.327	451 261.5
709	1.410 437	2 227.389	394 804.7	759	1.317 523	2 384.469	452 453.0
710	1.408 451	2 230.531	395 919.2	760	1.315 789	2 387.610	453 646.0
711	1.406 470	2 233.672	397 035.3	761	1.314 060	2 390.752	454 840.6
712	1.404 494	2 236.814	398 152.9	762	1.312 336	2 393.894	456 036.7
713	1.402 525	2 239.956	399 272.1	763	1.310 616	2 397.035	457 234.5
714	1.400 560	2 243.097	400 392.8	764	1.308 901	2 400.177	458 433.8
715	1.398 601	2 246.239	401 515.2	765	1.307 190	2 403.318	459 634.6
716	1.396 648	2 249.380	402 639.1	766	1.305 483	2 406.460	460 837.1
717	1.394 700	2 252.522	403 764.6	767	1.303 781	2 409.602	462 041.1
718	1.392 758	2 255.664	404 891.6	768	1.302 083	2 412.743	463 246.7
719	1.390 821	2 258.805	406 020.2	769	1.300 390	2 415.885	464 453.8
720	1.388 889	2 261.947	407 150.4	770	1.298 701	2 419.026	465 662.6
721	1.386 963	2 265.088	408 282.2	771	1.297 017	2 422.168	466 872.9
722	1.385 042	2 268.230	409 415.5	772	1.295 337	2 425.310	468 084.7
723	1.383 126	2 271.371	410 550.4	773	1.293 661	2 428.451	469 298.2
724	1.381 215	2 274.513	411 686.9	774	1.291 990	2 431.593	470 513.2
725	1.379 310	2 277.655	412 824.9	775	1.290 323	2 434.734	471 729.8
726	1.377 410	2 280.796	413 964.5	776	1.288 660	2 437.876	472 947.9
727	1.375 516	2 283.938	415 105.7	777	1.287 001	2 441.017	474 167.6
728	1.373 626	2 287.079	416 248.5	778	1.285 347	2 444.159	475 388.9
729	1.371 742	2 290.221	417 392.8	779	1.283 697	2 447.301	476 611.8
730	1.369 863	2 293.363	418 538.7	780	1.282 051	2 450.442	477 836.2
731	1.367 989	2 296.504	419 686.1	781	1.280 410	2 453.584	479 062.2
732	1.366 120	2 299.646	420 835.2	782	1.278 772	2 456.725	480 289.8
733	1.364 256	2 302.787	421 985.8	783	1.277 139	2 459.867	481 519.0
734	1.362 398	2 305.929	423 138.0	784	1.275 510	2 463.009	482 749.7
735	1.360 544	2 309.071	424 291.7	785	1.273 885	2 466 150	483 982.0
736	1.358 696	2 312.212	425 447.0	786	1.272 265	2 469.292	485 215.8
737	1.356 852	2 315.354	426 603.9	787	1.270 648	2 472.433	486 451.3
738	1.355 014	2 318.495	427 762.4	788	1.269 036	2 475 575	487 688.3
739	1.353 180	2 321.637	428 922.4	789	1.267 427	2 478.717	488 926.9
740	1.351 351	2 324.779	430 084.0	790	1.265 823	2 481.858	490 167.0
741	1.349 528	2 327.920	431 247.2	791	1.264 223	2 485.000	491 408.7
742	1.347 709	2 331.062	432 412.0	792	1.262 626	2 488.141	492 652.0
743	1.345 895	2 334.203	433 578.3	793	1.261 034	2 491.283	493 896.8
744	1.344 086	2 337.345	434 746.2	794	1.259 446	2 494.425	495 143.3
745	1.342 282	2 340.487	435 915.6	795	1.257 862	2 497.566	496 391.3
746	1.340 483	2 343.628	437 086.6	796	1.256 281	2 500.708	497 640.8
747	1.338 688	2 346.770	438 259.2	797	1.254 705	2 503.849	498 892.0
748	1.336 898	2 349.911	439 433.4	798	1.253 133	2 506.991	500 144.7
749	1.335 113	2 353.053	440 609.2	799	1.251 564	2 510.133	501 399.0

RECIPROCALS, CIRCUMFERENCES, AND AREAS OF CIRCLES

n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$	n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
800	1.250 000	2 513.274	502 654.8	850	1.176 471	2 670.354	567 450.2
801	1.248 439	2 516.416	503 912.2	851	1.175 088	2 673.495	568 786.1
802	1.246 883	2 519.557	505 171.2	852	1.173 709	2 676.637	570 123.7
803	1.245 330	2 522.699	506 431.8	853	1.172 333	2 679.779	571 462.8
804	1.243 781	2 525.840	507 693.9	854	1.170 960	2 682.920	572 803.4
805	1.242 236	2 528.982	508 957.6	855	1.169 591	2 686.062	574 145.7
806	1.240 695	2 532.124	510 222.9	856	1.168 224	2 689.203	575 489.5
807	1.239 157	2 535.265	511 489.8	857	1.166 861	2 692.345	576 834.9
808	1.237 624	2 538.407	512 758.2	858	1.165 501	2 695.486	578 181.9
809	1.236 094	2 541.548	514 028.2	859	1.164 144	2 698.628	579 530.4
810	1.234 568	2 544.690	515 299.7	860	1.162 791	2 701.770	580 880.5
811	1.233 046	2 547.832	516 572.9	861	1.161 440	2 704.911	582 232.2
812	1.231 527	2 550.973	517 847.6	862	1.160 093	2 708.053	583 585.4
813	1.230 012	2 554.115	519 123.8	863	1.158 749	2 711.194	584 940.2
814	1.228 501	2 557.256	520 401.7	864	1.157 407	2 714.336	586 296.6
815	1.226 994	2 560.398	521 681.1	865	1.156 069	2 717.478	587 654.5
816	1.225 490	2 563.540	522 962.1	866	1.154 734	2 720.619	589 014.1
817	1.223 990	2 566.681	524 244.6	867	1.153 403	2 723.761	590 375.2
818	1.222 494	2 569.823	525 528.8	868	1.152 074	2 726.902	591 737.8
819	1.221 001	2 572.964	526 814.5	869	1.150 748	2 730.044	593 102.1
820	1.219 512	2 576.106	528 101.7	870	1.149 425	2 733.186	594 467.9
821	1.218 027	2 579.248	529 390.6	871	1.148 106	2 736.327	595 835.2
822	1.216 545	2 582.389	530 681.0	872	1.146 789	2 739.469	597 204.2
823	1.215 067	2 585.531	531 973.0	873	1.145 475	2 742.610	598 574.7
824	1.213 592	2 588.672	533 266.5	874	1.144 165	2 745.752	599 946.8
825	1.212 121	2 591.814	534 561.6	875	1.142 857	2 748.894	601 320.5
826	1.210 654	2 594.956	535 858.3	876	1.141 553	2 752.035	602 695.7
827	1.209 190	2 598.097	537 156.6	877	1.140 251	2 755.177	604 072.5
828	1.207 729	2 601.239	538 456.4	878	1.138 952	2 758.318	605 450.9
829	1.206 273	2 604.380	539 757.8	879	1.137 656	2 761.460	606 830.8
830	1.204 819	2 607.522	541 060.8	880	1.136 364	2 764.602	608 212.3
831	1.203 369	2 610.663	542 365.3	881	1.135 074	2 767.743	609 595.4
832	1.201 923	2 613.805	543 671.5	882	1.133 787	2 770.885	610 980.1
833	1.200 480	2 616.947	544 979.1	883	1.132 503	2 774.026	612 366.3
834	1.199 041	2 620.088	546 288.4	884	1.131 222	2 777.168	613 754.1
835	1.197 605	2 623.230	547 599.2	885	1.129 944	2 780.309	615 143.5
836	1.196 172	2 626.371	548 911.6	886	1.128 668	2 783.451	616 534.4
837	1.194 743	2 629.513	550 225.6	887	1.127 396	2 786.593	617 926.9
838	1.193 317	2 632.655	551 541.1	888	1.126 126	2 789.734	619 321.0
839	1.191 895	2 635.796	552 858.3	889	1.124 859	2 792.876	620 716.7
840	1.190 476	2 638.938	554 176.9	890	1.123 596	2 796.017	622 113.9
841	1.189 061	2 642.079	555 497.2	891	1.122 334	2 799.159	623 512.7
842	1.187 648	2 645.221	556 819.0	892	1.121 076	2 802.301	624 913.0
843	1.186 240	2 648.363	558 142.4	893	1.119 821	2 805.442	626 315.0
844	1.184 834	2 651.504	559 467.4	894	1.118 568	2 808.584	627 718.5
845	1.183 432	2 654.646	560 793.9	895	1.117 318	2 811.725	629 123.6
846	1.182 033	2 657.787	562 122.0	896	1.116 071	2 814.867	630 530.2
847	1.180 638	2 660.929	563 451.7	897	1.114 827	2 818.009	631 938.4
848	1.179 245	2 664.071	564 783.0	898	1.113 586	2 821.150	633 348.2
849	1.177 856	2 667.212	566 115.8	899	1.112 347	2 824.292	634 759.6

RECIPROCALS, CIRCUMFERENCES, AND AREAS OF CIRCLES

n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$	n	$1000/n$	Circum. of circle πn	Area of circle $\frac{1}{4}\pi n^2$
900	1.111 111	2 827.433	636 172.5	950	1.052 632	2 984.513	708 821.8
901	1.109 878	2 830.575	637 587.0	951	1.051 525	2 987.655	710 314.9
902	1.108 647	2 833.717	639 003.1	952	1.050 420	2 990.796	711 809.5
903	1.107 420	2 836.858	640 420.7	953	1.049 318	2 993.938	713 305.7
904	1.106 195	2 840.000	641 839.9	954	1.048 218	2 997.079	714 803.4
905	1.104 972	2 843.141	643 260.7	955	1.047 120	3 000.221	716 302.8
906	1.103 753	2 846.283	644 683.1	956	1.046 025	3 003.363	717 803.7
907	1.102 536	2 849.425	646 107.0	957	1.044 932	3 006.504	719 306.1
908	1.101 322	2 852.566	647 532.5	958	1.043 841	3 009.646	720 810.2
909	1.100 110	2 855.708	648 959.6	959	1.042 753	3 012.787	722 315.8
910	1.098 901	2 858.849	650 388.2	960	1.041 667	3 015.929	723 822.9
911	1.097 695	2 861.991	651 818.4	961	1.040 583	3 019.071	725 331.7
912	1.096 491	2 865.133	653 250.2	962	1.039 501	3 022.212	726 842.0
913	1.095 290	2 868.274	654 683.6	963	1.038 422	3 025.354	728 353.9
914	1.094 092	2 871.416	656 118.5	964	1.037 344	3 028.495	729 867.4
915	1.092 896	2 874.557	657 555.0	965	1.036 269	3 031.637	731 382.4
916	1.091 703	2 877.699	658 993.0	966	1.035 197	3 034.779	732 899.0
917	1.090 513	2 880.840	660 432.7	967	1.034 126	3 037.920	734 417.2
918	1.089 325	2 883.982	661 873.9	968	1.033 058	3 041.062	735 936.9
919	1.088 139	2 887.124	663 316.7	969	1.031 992	3 044.203	737 458.2
920	1.086 957	2 890.265	664 761.0	970	1.030 928	3 047.345	738 981.1
921	1.085 776	2 893.407	666 206.9	971	1.029 866	3 050.486	740 505.6
922	1.084 599	2 896.548	667 654.4	972	1.028 807	3 053.628	742 031.6
923	1.083 424	2 899.690	669 103.5	973	1.027 749	3 056.770	743 559.2
924	1.082 251	2 902.832	670 554.1	974	1.026 694	3 059.911	745 088.4
925	1.081 081	2 905.973	672 006.3	975	1.025 641	3 063.053	746 619.1
926	1.079 914	2 909.115	673 460.1	976	1.024 590	3 066.194	748 151.4
927	1.078 749	2 912.256	674 915.4	977	1.023 541	3 069.336	749 685.3
928	1.077 586	2 915.398	676 372.3	978	1.022 495	3 072.478	751 220.8
929	1.076 426	2 918.540	677 830.8	979	1.021 450	3 075.619	752 757.8
930	1.075 269	2 921.681	679 290.9	980	1.020 408	3 078.761	754 296.4
931	1.074 114	2 924.823	680 752.5	981	1.019 368	3 081.902	755 836.6
932	1.072 961	2 927.964	682 215.7	982	1.018 330	3 085.044	757 378.3
933	1.071 811	2 931.106	683 680.5	983	1.017 294	3 088.186	758 921.6
934	1.070 664	2 934.248	685 146.8	984	1.016 260	3 091.327	760 466.5
935	1.069 519	2 937.389	686 614.7	985	1.015 228	3 094.469	762 012.9
936	1.068 376	2 940.531	688 084.2	986	1.014 199	3 097.610	763 561.0
937	1.067 236	2 943.672	689 555.2	987	1.013 171	3 100.752	765 110.5
938	1.066 098	2 946.814	691 027.9	988	1.012 146	3 103.894	766 661.7
939	1.064 963	2 949.956	692 502.1	989	1.011 122	3 107.035	768 214.4
940	1.063 830	2 953.097	693 977.8	990	1.010 101	3 110.177	769 768.7
941	1.062 699	2 956.239	695 455.2	991	1.009 082	3 113.318	771 324.6
942	1.061 571	2 959.380	696 934.1	992	1.008 065	3 116.460	772 882.1
943	1.060 445	2 962.522	698 414.5	993	1.007 049	3 119.602	774 441.1
944	1.059 322	2 965.663	699 896.6	994	1.006 036	3 122.743	776 001.7
945	1.058 201	2 968.805	701 380.2	995	1.005 025	3 125.885	777 563.8
946	1.057 082	2 971.947	702 865.4	996	1.004 016	3 129.026	779 127.5
947	1.055 966	2 975.088	704 352.1	997	1.003 009	3 132.168	780 692.8
948	1.054 852	2 978.230	705 840.5	998	1.002 004	3 135.309	782 259.7
949	1.053 741	2 981.371	707 330.4	999	1.001 001	3 138.451	783 828.2

Table XIV

NATURAL LOGARITHMS—0.00 to 5.99

N	L	0	1	2	3	4	5	6	7	8	9
0.0	Take tabular value−10		5.395	6.088	6.493	6.781	7.004	7.187	7.341	7.474	7.592
0.1		7.697	7.793	7.880	7.960	8.034	8.103	8.167	8.228	8.285	8.339
0.2		8.391	8.439	8.486	8.530	8.573	8.614	8.653	8.691	8.727	8.762
0.3		8.796	8.829	8.861	8.891	8.921	8.950	8.978	9.006	9.032	9.058
0.4		9.084	9.108	9.132	9.156	9.179	9.201	9.223	9.245	9.266	9.287
0.5		9.307	9.327	9.346	9.365	9.384	9.402	9.420	9.438	9.455	9.472
0.6		9.489	9.506	9.522	9.538	9.554	9.569	9.584	9.600	9.614	9.629
0.7		9.643	9.658	9.671	9.685	9.699	9.712	9.726	9.739	9.752	9.764
0.8		9.777	9.789	9.802	9.814	9.826	9.837	9.849	9.861	9.872	9.883
0.9		9.895	9.906	9.917	9.927	9.938	9.949	9.959	9.970	9.980	9.990
1.0	0.0	0000	0995	1980	2956	3922	4879	5827	6766	7696	8618
1.1		9531	*0436	*1333	*2222	*3103	*3976	*4842	*5700	*6551	*7395
1.2	0.1	8232	9062	9885	*0701	*1511	*2314	*3111	*3902	*4686	*5464
1.3	0.2	6236	7003	7763	8518	9267	*0010	*0748	*1481	*2208	*2930
1.4	0.3	3647	4359	5066	5767	6464	7156	7844	8526	9204	9878
1.5	0.4	0547	1211	1871	2527	3178	3825	4469	5108	5742	6373
1.6		7000	7623	8243	8858	9470	*0078	*0682	*1282	*1879	*2473
1.7	0.5	3063	3649	4232	4812	5389	5962	6531	7098	7661	8222
1.8		8779	9333	9884	*0432	*0977	*1519	*2058	*2594	*3127	*3658
1.9	0.6	4185	4710	5233	5752	6269	6783	7294	7803	8310	8813
2.0		9315	9813	*0310	*0804	*1295	*1784	*2271	*2755	*3237	*3716
2.1	0.7	4194	4669	5142	5612	6081	6547	7011	7473	7932	8390
2.2		8846	9299	9751	*0200	*0648	*1093	*1536	*1978	*2418	*2855
2.3	0.8	3291	3725	4157	4587	5015	5442	5866	6289	6710	7129
2.4		7547	7963	8377	8789	9200	9609	*0016	*0422	*0826	*1228
2.5	0.9	1629	2028	2426	2822	3216	3609	4001	4391	4779	5166
2.6		5551	5935	6317	6698	7078	7456	7833	8208	8582	8954
2.7		9325	9695	*0063	*0430	*0796	*1160	*1523	*1885	*2245	*2604
2.8	1.0	2962	3318	3674	4028	4380	4732	5082	5431	5779	6126
2.9		6471	6815	7158	7500	7841	8181	8519	8856	9192	9527
3.0		9861	*0194	*0526	*0856	*1186	*1514	*1841	*2168	*2493	*2817
3.1	1.1	3140	3462	3783	4103	4422	4740	5057	5373	5688	6002
3.2		6315	6627	6938	7248	7557	7865	8173	8479	8784	9089
3.3		9392	9695	9996	*0297	*0597	*0896	*1194	*1491	*1788	*2083
3.4	1.2	2378	2671	2964	3256	3547	3837	4127	4415	4703	4990
3.5		5276	5562	5846	6130	6413	6695	6976	7257	7536	7815
3.6		8093	8371	8647	8923	9198	9473	9746	*0019	*0291	*0563
3.7	1.3	0833	1103	1372	1641	1909	2176	2442	2708	2972	3237
3.8		3500	3763	4025	4286	4547	4807	5067	5325	5584	5841
3.9		6098	6354	6609	6864	7118	7372	7624	7877	8128	8379
4.0		8629	8879	9128	9377	9624	9872	*0118	*0364	*0610	*0854
4.1	1.4	1099	1342	1585	1828	2070	2311	2552	2792	3031	3270
4.2		3508	3746	3984	4220	4456	4692	4927	5161	5395	5629
4.3		5862	6094	6326	6557	6787	7018	7247	7476	7705	7933
4.4		8160	8387	8614	8840	9065	9290	9515	9739	9962	*0185
4.5	1.5	0408	0630	0851	1072	1293	1513	1732	1951	2170	2388
4.6		2606	2823	3039	3256	3471	3687	3902	4116	4330	4543
4.7		4756	4969	5181	5393	5604	5814	6025	6235	6444	6653
4.8		6862	7070	7277	7485	7691	7898	8104	8309	8515	8719
4.9		8924	9127	9331	9534	9737	9939	*0141	*0342	*0543	*0744
5.0	1.6	0944	1144	1343	1542	1741	1939	2137	2334	2531	2728
5.1		2924	3120	3315	3511	3705	3900	4094	4287	4481	4673
5.2		4866	5058	5250	5441	5632	5823	6013	6203	6393	6582
5.3		6771	6959	7147	7335	7523	7710	7896	8083	8269	8455
5.4		8640	8825	9010	9194	9378	9562	9745	9928	*0111	*0293
5.5	1.7	0475	0656	0838	1019	1199	1380	1560	1740	1919	2098
5.6		2277	2455	2633	2811	2988	3166	3342	3519	3695	3871
5.7		4047	4222	4397	4572	4746	4920	5094	5267	5440	5613
5.8		5786	5958	6130	6302	6473	6644	6815	6985	7156	7326
5.9		7495	7665	7834	8002	8171	8339	8507	8675	8842	9009
N	L	0	1	2	3	4	5	6	7	8	9

NATURAL LOGARITHMS—6.00 to 10.09

N	L	0	1	2	3	4	5	6	7	8	9
6.0	1.7	9176	9342	9509	9675	9840	*0006	*0171	*0336	*0500	*0665
6.1	1.8	0829	0993	1156	1319	1482	1645	1808	1970	2132	2294
6.2		2455	2616	2777	2938	3098	3258	3418	3578	3737	3896
6.3		4055	4214	4372	4530	4688	4845	5003	5160	5317	5473
6.4		5630	5786	5942	6097	6253	6408	6563	6718	6872	7026
6.5		7180	7334	7487	7641	7794	7947	8099	8251	8403	8555
6.6		8707	8858	9010	9160	9311	9462	9612	9762	9912	*0061
6.7	1.9	0211	0360	0509	0658	0806	0954	1102	1250	1398	1545
6.8		1692	1839	1986	2132	2279	2425	2571	2716	2862	3007
6.9		3152	3297	3442	3586	3730	3874	4018	4162	4305	4448
7.0		4591	4734	4876	5019	5161	5303	5445	5586	5727	5869
7.1		6009	6150	6291	6431	6571	6711	6851	6991	7130	7269
7.2		7408	7547	7685	7824	7962	8100	8238	8376	8513	8650
7.3		8787	8924	9061	9198	9334	9470	9606	9742	9877	*0013
7.4	2.0	0148	0283	0418	0553	0687	0821	0956	1089	1223	1357
7.5		1490	1624	1757	1890	2022	2155	2287	2419	2551	2683
7.6		2815	2946	3078	3209	3340	3471	3601	3732	3862	3992
7.7		4122	4252	4381	4511	4640	4769	4898	5027	5156	5284
7.8		5412	5540	5668	5796	5924	6051	6179	6306	6433	6560
7.9		6686	6813	6939	7065	7191	7317	7443	7568	7694	7819
8.0		7944	8069	8194	8318	8443	8567	8691	8815	8939	9063
8.1		9186	9310	9433	9556	9679	9802	9924	*0047	*0169	*0291
8.2	2.1	0413	0535	0657	0779	0900	1021	1142	1263	1384	1505
8.3		1626	1746	1866	1986	2106	2226	2346	2465	2585	2704
8.4		2823	2942	3061	3180	3298	3417	3535	3653	3771	3889
8.5		4007	4124	4242	4359	4476	4593	4710	4827	4943	5060
8.6		5176	5292	5409	5524	5640	5756	5871	5987	6102	6217
8.7		6332	6447	6562	6677	6791	6905	7020	7134	7248	7361
8.8		7475	7589	7702	7816	7929	8042	8155	8267	8380	8493
8.9		8605	8717	8830	8942	9054	9165	9277	9389	9500	9611
9.0		9722	9834	9944	*0055	*0166	*0276	*0387	*0497	*0607	*0717
9.1	2.2	0827	0937	1047	1157	1266	1375	1485	1594	1703	1812
9.2		1920	2029	2138	2246	2354	2462	2570	2678	2786	2894
9.3		3001	3109	3216	3324	3431	3538	3645	3751	3858	3965
9.4		4071	4177	4284	4390	4496	4601	4707	4813	4918	5024
9.5		5129	5234	5339	5444	5549	5654	5759	5863	5968	6072
9.6		6176	6280	6384	6488	6592	6696	6799	6903	7006	7109
9.7		7213	7316	7419	7521	7624	7727	7829	7932	8034	8136
9.8		8238	8340	8442	8544	8646	8747	8849	8950	9051	9152
9.9		9253	9354	9455	9556	9657	9757	9858	9958	*0058	*0158
10.0	2.3	0259	0358	0458	0558	0658	0757	0857	0956	1055	1154
N	L	0	1	2	3	4	5	6	7	8	9

NATURAL LOGARITHMS—10 to 99

N	L	0	1	2	3	4	5	6	7	8	9
1		2.30259	39790	48491	56495	63906	70805	77259	83321	89037	94444
2		99573	*04452	*09104	*13549	*17805	*21888	*25810	*29584	*33220	*36730
3		3.40120	43399	46574	49651	52636	55535	58352	61092	63759	66356
4		68888	71357	73767	76120	78419	80666	82864	85015	87120	89182
5		91202	93183	95124	97029	98898	*00733	*02535	*04305	*06044	*07754
6		4.09434	11087	12713	14313	15888	17439	18965	20469	21951	23411
7		24850	26268	27667	29046	30407	31749	33073	34381	35671	36945
8		38203	39445	40672	41884	43082	44265	45435	46591	47734	48864
9		49981	51086	52179	53260	54329	55388	56435	57471	58497	59512

NATURAL LOGARITHMS

100 to 609

N	L	0	1	2	3	4	5	6	7	8	9
10	4.6	0517	1512	2497	3473	4439	5396	6344	7283	8213	9135
11	4.7	0048	0953	1850	2739	3620	4493	5359	6217	7068	7912
12		8749	9579	*0402	*1218	*2028	*2831	*3628	*4419	*5203	*5981
13	4.8	6753	7520	8280	9035	9784	*0527	*1265	*1998	*2725	*3447
14	4.9	4164	4876	5583	6284	6981	7673	8361	9043	9721	*0395
15	5.0	1064	1728	2388	3044	3695	4343	4986	5625	6260	6890
16		7517	8140	8760	9375	9987	*0595	*1199	*1799	*2396	*2990
17	5.1	3580	4166	4749	5329	5906	6479	7048	7615	8178	8739
18		9296	9850	*0401	*0949	*1494	*2036	*2575	*3111	*3644	*4175
19	5.2	4702	5227	5750	6269	6786	7300	7811	8320	8827	9330
20		9832	*0330	*0827	*1321	*1812	*2301	*2788	*3272	*3754	*4233
21	5.3	4711	5186	5659	6129	6598	7064	7528	7990	8450	8907
22		9363	9816	*0268	*0717	*1165	*1610	*2053	*2495	*2935	*3372
23	5.4	3808	4242	4674	5104	5532	5959	6383	6806	7227	7646
24		8064	8480	8894	9306	9717	*0126	*0533	*0939	*1343	*1745
25	5.5	2146	2545	2943	3339	3733	4126	4518	4908	5296	5683
26		6068	6452	6834	7215	7595	7973	8350	8725	9099	9471
27		9842	*0212	*0580	*0947	*1313	*1677	*2040	*2402	*2762	*3121
28	5.6	3479	3835	4191	4545	4897	5249	5599	5948	6296	6643
29		6988	7332	7675	8017	8358	8698	9036	9373	9709	*0044
30	5.7	0378	0711	1043	1373	1703	2031	2359	2685	3010	3334
31		3657	3979	4300	4620	4939	5257	5574	5890	6205	6519
32		6832	7144	7455	7765	8074	8383	8690	8996	9301	9606
33		9909	*0212	*0513	*0814	*1114	*1413	*1711	*2008	*2305	*2600
34	5.8	2895	3188	3481	3773	4064	4354	4644	4932	5220	5507
35		5793	6079	6363	6647	6930	7212	7493	7774	8053	8332
36		8610	8888	9164	9440	9715	9990	*0263	*0536	*0808	*1080
37	5.9	1350	1620	1889	2158	2426	2693	2959	3225	3489	3754
38		4017	4280	4542	4803	5064	5324	5584	5842	6101	6358
39		6615	6871	7126	7381	7635	7889	8141	8394	8645	8896
40		9146	9396	9645	9894	*0141	*0389	*0635	*0881	*1127	*1372
41	6.0	1616	1859	2102	2345	2587	2828	3069	3309	3548	3787
42		4025	4263	4501	4737	4973	5209	5444	5678	5912	6146
43		6379	6611	6843	7074	7304	7535	7764	7993	8222	8450
44		8677	8904	9131	9357	9582	9807	*0032	*0256	*0479	*0702
45	6.1	0925	1147	1368	1589	1810	2030	2249	2468	2687	2905
46		3123	3340	3556	3773	3988	4204	4419	4633	4847	5060
47		5273	5486	5698	5910	6121	6331	6542	6752	6961	7170
48		7379	7587	7794	8002	8208	8415	8621	8826	9032	9236
49		9441	9644	9848	*0051	*0254	*0456	*0658	*0859	*1060	*1261
50	6.2	1461	1661	1860	2059	2258	2456	2654	2851	3048	3245
51		3441	3637	3832	4028	4222	4417	4611	4804	4998	5190
52		5383	5575	5767	5958	6149	6340	6530	6720	6910	7099
53		7288	7476	7664	7852	8040	8227	8413	8600	8786	8972
54		9157	9342	9527	9711	9895	*0079	*0262	*0445	*0628	*0810
55	6.3	0992	1173	1355	1536	1716	1897	2077	2257	2436	2615
56		2794	2972	3150	3328	3505	3683	3859	4036	4212	4388
57		4564	4739	4914	5089	5263	5437	5611	5784	5957	6130
58		6303	6475	6647	6819	6990	7161	7332	7502	7673	7843
59		8012	8182	8351	8519	8688	8856	9024	9192	9359	9526
60		9693	9859	*0026	*0192	*0357	*0523	*0688	*0853	*1017	*1182
N	L	0	1	2	3	4	5	6	7	8	9

NATURAL LOGARITHMS

600 to 1109

N	L	0	1	2	3	4	5	6	7	8	9
60	6.3	9693	9859	*0026	*0192	*0357	*0523	*0688	*0853	*1017	*1182
61	6.4	1346	1510	1673	1836	1999	2162	2325	2487	2649	2811
62		2972	3133	3294	3455	3615	3775	3935	4095	4254	4413
63		4572	4731	4889	5047	5205	5362	5520	5677	5834	5990
64		6147	6303	6459	6614	6770	6925	7080	7235	7389	7543
65		7697	7851	8004	8158	8311	8464	8616	8768	8920	9072
66		9224	9375	9527	9677	9828	9979	*0129	*0279	*0429	*0578
67	6.5	0728	0877	1026	1175	1323	1471	1619	1767	1915	2062
68		2209	2356	2503	2649	2796	2942	3088	3233	3379	3524
69		3669	3814	3959	4103	4247	4391	4535	4679	4822	4965
70		5108	5251	5393	5536	5678	5820	5962	6103	6244	6386
71		6526	6667	6808	6948	7088	7228	7368	7508	7647	7786
72		7925	8064	8203	8341	8479	8617	8755	8893	9030	9167
73		9304	9441	9578	9715	9851	9987	*0123	*0259	*0394	*0530
74	6.6	0665	0800	0935	1070	1204	1338	1473	1607	1740	1874
75		2007	2141	2274	2407	2539	2672	2804	2936	3068	3200
76		3332	3463	3595	3726	3857	3988	4118	4249	4379	4509
77		4639	4769	4898	5028	5157	5286	5415	5544	5673	5801
78		5929	6058	6185	6313	6441	6568	6696	6823	6950	7077
79		7203	7330	7456	7582	7708	7834	7960	8085	8211	8336
80		8461	8586	8711	8835	8960	9084	9208	9332	9456	9580
81		9703	9827	9950	*0073	*0196	*0319	*0441	*0564	*0686	*0808
82	6.7	0930	1052	1174	1296	1417	1538	1659	1780	1901	2022
83		2143	2263	2383	2503	2623	2743	2863	2982	3102	3221
84		3340	3459	3578	3697	3815	3934	4052	4170	4288	4406
85		4524	4641	4759	4876	4993	5110	5227	5344	5460	5577
86		5693	5809	5926	6041	6157	6273	6388	6504	6619	6734
87		6849	6964	7079	7194	7308	7422	7537	7651	7765	7878
88		7992	8106	8219	8333	8446	8559	8672	8784	8897	9010
89		9122	9234	9347	9459	9571	9682	9794	9906	*0017	*0128
90	6.8	0239	0351	0461	0572	0683	0793	0904	1014	1124	1235
91		1344	1454	1564	1674	1783	1892	2002	2111	2220	2329
92		2437	2546	2655	2763	2871	2979	3087	3195	3303	3411
93		3518	3626	3733	3841	3948	4055	4162	4268	4375	4482
94		4588	4694	4801	4907	5013	5118	5224	5330	5435	5541
95		5646	5751	5857	5961	6066	6171	6276	6380	6485	6589
96		6693	6797	6901	7005	7109	7213	7316	7420	7523	7626
97		7730	7833	7936	8038	8141	8244	8346	8449	8551	8653
98		8755	8857	8959	9061	9163	9264	9366	9467	9568	9669
99		9770	9871	9972	*0073	*0174	*0274	*0375	*0475	*0575	*0675
100	6.9	0776	0875	0975	1075	1175	1274	1374	1473	1572	1672
101		1771	1870	1968	2067	2166	2264	2363	2461	2560	2658
102		2756	2854	2952	3049	3147	3245	3342	3440	3537	3634
103		3731	3828	3925	4022	4119	4216	4312	4409	4505	4601
104		4698	4794	4890	4986	5081	5177	5273	5368	5464	5559
105		5655	5750	5845	5940	6035	6130	6224	6319	6414	6508
106		6602	6697	6791	6885	6979	7073	7167	7261	7354	7448
107		7541	7635	7728	7821	7915	8008	8101	8193	8286	8379
108		8472	8564	8657	8749	8841	8934	9026	9118	9210	9302
109		9393	9485	9577	9668	9760	9851	9942	*0033	*0125	*0216
110	7.0	0307	0397	0488	0579	0670	0760	0851	0941	1031	1121
N	L	0	1	2	3	4	L 5	6	7	8	9

Table XV

VALUES AND LOGARITHMS OF EXPONENTIAL AND HYPERBOLIC FUNCTIONS

x	e^x		e^{-x}	Sinh x		Cosh x		Tanh x
	Value	$\log_{10}$	Value	Value	$\log_{10}$	Value	$\log_{10}$	Value
0.00	1.0000	.00000	1.00000	0.0000	$-\infty$	1.0000	.00000	.00000
0.01	1.0101	.00434	.99005	0.0100	$\bar{2}.00001$	1.0001	.00002	.01000
0.02	1.0202	.00869	.98020	0.0200	$\bar{2}.30106$	1.0002	.00009	.02000
0.03	1.0305	.01303	.97045	0.0300	$\bar{2}.47719$	1.0005	.00020	.02999
0.04	1.0408	.01737	.96079	0.0400	$\bar{2}.60218$	1.0008	.00035	.03998
0.05	1.0513	.02171	.95123	0.0500	$\bar{2}.69915$	1.0013	.00054	.04996
0.06	1.0618	.02606	.94176	0.0600	$\bar{2}.77841$	1.0018	.00078	.05993
0.07	1.0725	.03040	.93239	0.0701	$\bar{2}.84545$	1.0025	.00106	.06989
0.08	1.0833	.03474	.92312	0.0801	$\bar{2}.90355$	1.0032	.00139	.07983
0.09	1.0942	.03909	.91393	0.0901	$\bar{2}.95483$	1.0041	.00176	.08976
0.10	1.1052	.04343	.90484	0.1002	$\bar{1}.00072$	1.0050	.00217	.09967
0.11	1.1163	.04777	.89583	0.1102	$\bar{1}.04227$	1.0061	.00262	.10956
0.12	1.1275	.05212	.88692	0.1203	$\bar{1}.08022$	1.0072	.00312	.11943
0.13	1.1388	.05646	.87809	0.1304	$\bar{1}.11517$	1.0085	.00366	.12927
0.14	1.1503	.06080	.86936	0.1405	$\bar{1}.14755$	1.0098	.00424	.13909
0.15	1.1618	.06514	.86071	0.1506	$\bar{1}.17772$	1.0113	.00487	.14889
0.16	1.1735	.06949	.85214	0.1607	$\bar{1}.20597$	1.0128	.00554	.15865
0.17	1.1853	.07383	.84366	0.1708	$\bar{1}.23254$	1.0145	.00625	.16838
0.18	1.1972	.07817	.83527	0.1810	$\bar{1}.25762$	1.0162	.00700	.17808
0.19	1.2092	.08252	.82696	0.1911	$\bar{1}.28136$	1.0181	.00779	.18775
0.20	1.2214	.08686	.81873	0.2013	$\bar{1}.30392$	1.0201	.00863	.19738
0.21	1.2337	.09120	.81058	0.2115	$\bar{1}.32541$	1.0221	.00951	.20697
0.22	1.2461	.09554	.80252	0.2218	$\bar{1}.34592$	1.0243	.01043	.21652
0.23	1.2586	.09989	.79453	0.2320	$\bar{1}.36555$	1.0266	.01139	.22603
0.24	1.2712	.10423	.78663	0.2423	$\bar{1}.38437$	1.0289	.01239	.23550
0.25	1.2840	.10857	.77880	0.2526	$\bar{1}.40245$	1.0314	.01343	.24492
0.26	1.2969	.11292	.77105	0.2629	$\bar{1}.41986$	1.0340	.01452	.25430
0.27	1.3100	.11726	.76338	0.2733	$\bar{1}.43663$	1.0367	.01564	.26362
0.28	1.3231	.12160	.75578	0.2837	$\bar{1}.45282$	1.0395	.01681	.27291
0.29	1.3364	.12595	.74826	0.2941	$\bar{1}.46847$	1.0423	.01801	.28213
0.30	1.3499	.13029	.74082	0.3045	$\bar{1}.48362$	1.0453	.01926	.29131
0.31	1.3634	.13463	.73345	0.3150	$\bar{1}.49830$	1.0484	.02054	.30044
0.32	1.3771	.13897	.72615	0.3255	$\bar{1}.51254$	1.0516	.02187	.30951
0.33	1.3910	.14332	.71892	0.3360	$\bar{1}.52637$	1.0549	.02323	.31852
0.34	1.4049	.14766	.71177	0.3466	$\bar{1}.53981$	1.0584	.02463	.32748
0.35	1.4191	.15200	.70469	0.3572	$\bar{1}.55290$	1.0619	.02607	.33638
0.36	1.4333	.15635	.69768	0.3678	$\bar{1}.56564$	1.0655	.02755	.34521
0.37	1.4477	.16069	.69073	0.3785	$\bar{1}.57807$	1.0692	.02907	.35399
0.38	1.4623	.16503	.68386	0.3892	$\bar{1}.59019$	1.0731	.03063	.36271
0.39	1.4770	.16937	.67706	0.4000	$\bar{1}.60202$	1.0770	.03222	.37136
0.40	1.4918	.17372	.67032	0.4108	$\bar{1}.61358$	1.0811	.03385	.37995
0.41	1.5068	.17806	.66365	0.4216	$\bar{1}.62488$	1.0852	.03552	.38847
0.42	1.5220	.18240	.65705	0.4325	$\bar{1}.63594$	1.0895	.03723	.39693
0.43	1.5373	.18675	.65051	0.4434	$\bar{1}.64677$	1.0939	.03897	.40532
0.44	1.5527	.19109	.64404	0.4543	$\bar{1}.65738$	1.0984	.04075	.41364
0.45	1.5683	.19543	.63763	0.4653	$\bar{1}.66777$	1.1030	.04256	.42190
0.46	1.5841	.19978	.63128	0.4764	$\bar{1}.67797$	1.1077	.04441	.43008
0.47	1.6000	.20412	.62500	0.4875	$\bar{1}.68797$	1.1125	.04630	.43820
0.48	1.6161	.20846	.61878	0.4986	$\bar{1}.69779$	1.1174	.04822	.44624
0.49	1.6323	.21280	.61263	0.5098	$\bar{1}.70744$	1.1225	.05018	.45422
0.50	1.6487	.21715	.60653	0.5211	$\bar{1}.71692$	1.1276	.05217	.46212

VALUES AND LOGARITHMS OF EXPONENTIAL AND HYPERBOLIC FUNCTIONS

x	e^x		e^{-x}	Sinh x		Cosh x		Tanh x
	Value	$\log_{10}$	Value	Value	$\log_{10}$	Value	$\log_{10}$	Value
0.50	1.6487	.21715	.60653	0.5211	$\bar{1}$.71692	1.1276	.05217	.46212
0.51	1.6653	.22149	.60050	0.5324	$\bar{1}$.72624	1.1329	.05419	.46995
0.52	1.6820	.22583	.59452	0.5438	$\bar{1}$.73540	1.1383	.05625	.47770
0.53	1.6989	.23018	.58860	0.5552	$\bar{1}$.74442	1.1438	.05834	.48538
0.54	1.7160	.23452	.58275	0.5666	$\bar{1}$.75330	1.1494	.06046	.49299
0.55	1.7333	.23886	.57695	0.5782	$\bar{1}$.76204	1.1551	.06262	.50052
0.56	1.7507	.24320	.57121	0.5897	$\bar{1}$.77065	1.1609	.06481	.50798
0.57	1.7683	.24755	.56553	0.6014	$\bar{1}$.77914	1.1669	.06703	.51536
0.58	1.7860	.25189	.55990	0.6131	$\bar{1}$.78751	1.1730	.06929	.52267
0.59	1.8040	.25623	.55433	0.6248	$\bar{1}$.79576	1.1792	.07157	.52990
0.60	1.8221	.26058	.54881	0.6367	$\bar{1}$.80390	1.1855	.07389	.53705
0.61	1.8404	.26492	.54335	0.6485	$\bar{1}$.81194	1.1919	.07624	.54413
0.62	1.8589	.26926	.53794	0.6605	$\bar{1}$.81987	1.1984	.07861	.55113
0.63	1.8776	.27361	.53259	0.6725	$\bar{1}$.82770	1.2051	.08102	.55805
0.64	1.8965	.27795	.52729	0.6846	$\bar{1}$.83543	1.2119	.08346	.56490
0.65	1.9155	.28229	.52205	0.6967	$\bar{1}$.84308	1.2188	.08593	.57167
0.66	1.9348	.28664	.51685	0.7090	$\bar{1}$.85063	1.2258	.08843	.57836
0.67	1.9542	.29098	.51171	0.7213	$\bar{1}$.85809	1.2330	.09095	.58498
0.68	1.9739	.29532	.50662	0.7336	$\bar{1}$.86548	1.2402	.09351	.59152
0.69	1.9937	.29966	.50158	0.7461	$\bar{1}$.87278	1.2476	.09609	.59798
0.70	2.0138	.30401	.49659	0.7586	$\bar{1}$.88000	1.2552	.09870	.60437
0.71	2.0340	.30835	.49164	0.7712	$\bar{1}$.88715	1.2628	.10134	.61068
0.72	2.0544	.31269	.48675	0.7838	$\bar{1}$.89423	1.2706	.10401	.61691
0.73	2.0751	.31703	.48191	0.7966	$\bar{1}$.90123	1.2785	.10670	.62307
0.74	2.0959	.32138	.47711	0.8094	$\bar{1}$.90817	1.2865	.10942	.62915
0.75	2.1170	.32572	.47237	0.8223	$\bar{1}$.91504	1.2947	.11216	.63515
0.76	2.1383	.33006	.46767	0.8353	$\bar{1}$.92185	1.3030	.11493	.64108
0.77	2.1598	.33441	.46301	0.8484	$\bar{1}$.92859	1.3114	.11773	.64693
0.78	2.1815	.33875	.45841	0.8615	$\bar{1}$.93527	1.3199	.12055	.65271
0.79	2.2034	.34309	.45384	0.8748	$\bar{1}$.94190	1.3286	.12340	.65841
0.80	2.2255	.34744	.44933	0.8881	$\bar{1}$.94846	1.3374	.12627	.66404
0.81	2.2479	.35178	.44486	0.9015	$\bar{1}$.95498	1.3464	.12917	.66959
0.82	2.2705	.35612	.44043	0.9150	$\bar{1}$.96144	1.3555	.13209	.67507
0.83	2.2933	.36046	.43605	0.9286	$\bar{1}$.96784	1.3647	.13503	.68048
0.84	2.3164	.36481	.43171	0.9423	$\bar{1}$.97420	1.3740	.13800	.68581
0.85	2.3396	.36915	.42741	0.9561	$\bar{1}$.98051	1.3835	.14099	.69107
0.86	2.3632	.37349	.42316	0.9700	$\bar{1}$.98677	1.3932	.14400	.69626
0.87	2.3869	.37784	.41895	0.9840	$\bar{1}$.99299	1.4029	.14704	.70137
0.88	2.4109	.38218	.41478	0.9981	$\bar{1}$.99916	1.4128	.15009	.70642
0.89	2.4351	.38652	.41066	1.0122	0.00528	1.4229	.15317	.71139
0.90	2.4596	.39087	.40657	1.0265	0.01137	1.4331	.15627	.71630
0.91	2.4843	.39521	.40252	1.0409	.01741	1.4434	.15939	.72113
0.92	2.5093	.39955	.39852	1.0554	.02341	1.4539	.16254	.72590
0.93	2.5345	.40389	.39455	1.0700	.02937	1.4645	.16570	.73059
0.94	2.5600	.40824	.39063	1.0847	.03530	1.4753	.16888	.73522
0.95	2.5857	.41258	.38674	1.0995	.04119	1.4862	.17208	.73978
0.96	2.6117	.41692	.38289	1.1144	.04704	1.4973	.17531	.74428
0.97	2.6379	.42127	.37908	1.1294	.05286	1.5085	.17855	.74870
0.98	2.6645	.42561	.37531	1.1446	.05864	1.5199	.18181	.75307
0.99	2.6912	.42995	.37158	1.1598	.06439	1.5314	.18509	.75736
1.00	2.7183	.43429	.36788	1.1752	.07011	1.5431	.18839	.76159

VALUES AND LOGARITHMS OF EXPONENTIAL AND HYPERBOLIC FUNCTIONS

x	e^x		e^{-x}	Sinh x		Cosh x		Tanh x
	Value	$\log_{10}$	Value	Value	$\log_{10}$	Value	$\log_{10}$	Value
1.00	2.7183	.43429	.36788	1.1752	.07011	1.5431	.18839	.76159
1.01	2.7456	.43864	.36422	1.1907	.07580	1.5549	.19171	.76576
1.02	2.7732	.44298	.36060	1.2063	.08146	1.5669	.19504	.76987
1.03	2.8011	.44732	.35701	1.2220	.08708	1.5790	.19839	.77391
1.04	2.8292	.45167	.35345	1.2379	.09268	1.5913	.20176	.77789
1.05	2.8577	.45601	.34994	1.2539	.09825	1.6038	.20515	.78181
1.06	2.8864	.46035	.34646	1.2700	.10379	1.6164	.20855	.78566
1.07	2.9154	.46470	.34301	1.2862	.10930	1.6292	.21197	.78946
1.08	2.9447	.46904	.33960	1.3025	.11479	1.6421	.21541	.79320
1.09	2.9743	.47338	.33622	1.3190	.12025	1.6552	.21886	.79688
1.10	3.0042	.47772	.33287	1.3356	.12569	1.6685	.22233	.80050
1.11	3.0344	.48207	.32956	1.3524	.13111	1.6820	.22582	.80406
1.12	3.0649	.48641	.32628	1.3693	.13649	1.6956	.22931	.80757
1.13	3.0957	.49075	.32303	1.3863	.14186	1.7093	.23283	.81102
1.14	3.1268	.49510	.31982	1.4035	.14720	1.7233	.23636	.81441
1.15	3.1582	.49944	.31664	1.4208	.15253	1.7374	.23990	.81775
1.16	3.1899	.50378	.31349	1.4382	.15783	1.7517	.24346	.82104
1.17	3.2220	.50812	.31037	1.4558	.16311	1.7662	.24703	.82427
1.18	3.2544	.51247	.30728	1.4735	.16836	1.7808	.25062	.82745
1.19	3.2871	.51681	.30422	1.4914	.17360	1.7957	.25422	.83058
1.20	3.3201	.52115	.30119	1.5095	.17882	1.8107	.25784	.83365
1.21	3.3535	.52550	.29820	1.5276	.18402	1.8258	.26146	.83668
1.22	3.3872	.52984	.29523	1.5460	.18920	1.8412	.26510	.83965
1.23	3.4212	.53418	.29229	1.5645	.19437	1.8568	.26876	.84258
1.24	3.4556	.53853	.28938	1.5831	.19951	1.8725	.27242	.84546
1.25	3.4903	.54287	.28650	1.6019	.20464	1.8884	.27610	.84828
1.26	3.5254	.54721	.28365	1.6209	.20975	1.9045	.27979	.85106
1.27	3.5609	.55155	.28083	1.6400	.21485	1.9208	.28349	.85380
1.28	3.5966	.55590	.27804	1.6593	.21993	1.9373	.28721	.85648
1.29	3.6328	.56024	.27527	1.6788	.22499	1.9540	.29093	.85913
1.30	3.6693	.56458	.27253	1.6984	.23004	1.9709	.29467	.86172
1.31	3.7062	.56893	.26982	1.7182	.23507	1.9880	.29842	.86428
1.32	3.7434	.57327	.26714	1.7381	.24009	2.0053	.30217	.86678
1.33	3.7810	.57761	.26448	1.7583	.24509	2.0228	.30594	.86925
1.34	3.8190	.58195	.26185	1.7786	.25008	2.0404	.30972	.87167
1.35	3.8574	.58630	.25924	1.7991	.25505	2.0583	.31352	.87405
1.36	3.8962	.59064	.25666	1.8198	.26002	2.0764	.31732	.87639
1.37	3.9354	.59498	.25411	1.8406	.26496	2.0947	.32113	.87869
1.38	3.9749	.59933	.25158	1.8617	.26990	2.1132	.32495	.88095
1.39	4.0149	.60367	.24908	1.8829	.27482	2.1320	.32878	.88317
1.40	4.0552	.60801	.24660	1.9043	.27974	2.1509	.33262	.88535
1.41	4.0960	.61236	.24414	1.9259	.28464	2.1700	.33647	.88749
1.42	4.1371	.61670	.24171	1.9477	.28952	2.1894	.34033	.88960
1.43	4.1787	.62104	.23931	1.9697	.29440	2.2090	.34420	.89167
1.44	4.2207	.62538	.23693	1.9919	.29926	2.2288	.34807	.89370
1.45	4.2631	.62973	.23457	2.0143	.30412	2.2488	.35196	.89569
1.46	4.3060	.63407	.23224	2.0369	.30896	2.2691	.35585	.89765
1.47	4.3492	.63841	.22993	2.0597	.31379	2.2896	.35976	.89958
1.48	4.3929	.64276	.22764	2.0827	.31862	2.3103	.36367	.90147
1.49	4.4371	.64710	.22537	2.1059	.32343	2.3312	.36759	.90332
1.50	4.4817	.65144	.22313	2.1293	.32823	2.3524	.37151	.90515

VALUES AND LOGARITHMS OF EXPONENTIAL AND HYPERBOLIC FUNCTIONS

x	e^x		e^{-x}	Sinh x		Cosh x		Tanh x
	Value	$\log_{10}$	Value	Value	$\log_{10}$	Value	$\log_{10}$	Value
1.50	4.4817	.65144	.22313	2.1293	.32823	2.3524	.37151	.90515
1.51	4.5267	.65578	.22091	2.1529	.33303	2.3738	.37545	.90694
1.52	4.5722	.66013	.21871	2.1768	.33781	2.3955	.37939	.90870
1.53	4.6182	.66447	.21654	2.2008	.34258	2.4174	.38334	.91042
1.54	4.6646	.66881	.21438	2.2251	.34735	2.4395	.38730	.91212
1.55	4.7115	.67316	.21225	2.2496	.35211	2.4619	.39126	.91379
1.56	4.7588	.67750	.21014	2.2743	.35686	2.4845	.39524	.91542
1.57	4.8066	.68184	.20805	2.2993	.36160	2.5073	.39921	.91703
1.58	4.8550	.68619	.20598	2.3245	.36633	2.5305	.40320	.91860
1.59	4.9037	.69053	.20393	2.3499	.37105	2.5538	.40719	.92015
1.60	4.9530	.69487	.20190	2.3756	.37577	2.5775	.41119	.92167
1.61	5.0028	.69921	.19989	2.4015	.38048	2.6013	.41520	.92316
1.62	5.0531	.70356	.19790	2.4276	.38518	2.6255	.41921	.92462
1.63	5.1039	.70790	.19593	2.4540	.38987	2.6499	.42323	.92606
1.64	5.1552	.71224	.19398	2.4806	.39456	2.6746	.42725	.92747
1.65	5.2070	.71659	.19205	2.5075	.39923	2.6995	.43129	.92886
1.66	5.2593	.72093	.19014	2.5346	.40391	2.7247	.43532	.93022
1.67	5.3122	.72527	.18825	2.5620	.40857	2.7502	.43937	.93155
1.68	5.3656	.72961	.18637	2.5896	.41323	2.7760	.44341	.93286
1.69	5.4195	.73396	.18452	2.6175	.41788	2.8020	.44747	.93415
1.70	5.4739	.73830	.18268	2.6456	.42253	2.8283	.45153	.93541
1.71	5.5290	.74264	.18087	2.6740	.42717	2.8549	.45559	.93665
1.72	5.5845	.74699	.17907	2.7027	.43180	2.8818	.45966	.93786
1.73	5.6407	.75133	.17728	2.7317	.43643	2.9090	.46374	.93906
1.74	5.6973	.75567	.17552	2.7609	.44105	2.9364	.46782	.94023
1.75	5.7546	.76002	.17377	2.7904	.44567	2.9642	.47191	.94138
1.76	5.8124	.76436	.17204	2.8202	.45028	2.9922	.47600	.94250
1.77	5.8709	.76870	.17033	2.8503	.45488	3.0206	.48009	.94361
1.78	5.9299	.77304	.16864	2.8806	.45948	3.0492	.48419	.94470
1.79	5.9895	.77739	.16696	2.9112	.46408	3.0782	.48830	.94576
1.80	6.0496	.78173	.16530	2.9422	.46867	3.1075	.49241	.94681
1.81	6.1104	.78607	.16365	2.9734	.47325	3.1371	.49652	.94783
1.82	6.1719	.79042	.16203	3.0049	.47783	3.1669	.50064	.94884
1.83	6.2339	.79476	.16041	3.0367	.48241	3.1972	.50476	.94983
1.84	6.2965	.79910	.15882	3.0689	.48698	3.2277	.50889	.95080
1.85	6.3598	.80344	.15724	3.1013	.49154	3.2585	.51302	.95175
1.86	6.4237	.80779	.15567	3.1340	.49610	3.2897	.51716	.95268
1.87	6.4883	.81213	.15412	3.1671	.50066	3.3212	.52130	.95359
1.88	6.5535	.81647	.15259	3.2005	.50521	3.3530	.52544	.95449
1.89	6.6194	.82082	.15107	3.2341	.50976	3.3852	.52959	.95537
1.90	6.6859	.82516	.14957	3.2682	.51430	3.4177	.53374	.95624
1.91	6.7531	.82950	.14808	3.3025	.51884	3.4506	.53789	.95709
1.92	6.8210	.83385	.14661	3.3372	.52338	3.4838	.54205	.95792
1.93	6.8895	.83819	.14515	3.3722	.52791	3.5173	.54621	.95873
1.94	6.9588	.84253	.14370	3.4075	.53244	3.5512	.55038	.95953
1.95	7.0287	.84687	.14227	3.4432	.53696	3.5855	.55455	.96032
1.96	7.0993	.85122	.14086	3.4792	.54148	3.6201	.55872	.96109
1.97	7.1707	.85556	.13946	3.5156	.54600	3.6551	.56290	.96185
1.98	7.2427	.85990	.13807	3.5523	.55051	3.6904	.56707	.96259
1.99	7.3155	.86425	.13670	3.5894	.55502	3.7261	.57126	.96331
2.00	7.3891	.86859	.13534	3.6269	.55953	3.7622	.57544	.96403

VALUES AND LOGARITHMS OF EXPONENTIAL AND HYPERBOLIC FUNCTIONS

x	e^x		e^{-x}	Sinh x		Cosh x		Tanh x
	Value	$\log_{10}$	Value	Value	$\log_{10}$	Value	$\log_{10}$	Value
2.00	7.3891	.86859	.13534	3.6269	.55953	3.7622	.57544	.96403
2.01	7.4633	.87293	.13399	3.6647	.56403	3.7987	.57963	.96473
2.02	7.5383	.87727	.13266	3.7028	.56853	3.8355	.58382	.96541
2.03	7.6141	.88162	.13134	3.7414	.57303	3.8727	.58802	.96609
2.04	7.6906	.88596	.13003	3.7803	.57753	3.9103	.59221	.96675
2.05	7.7679	.89030	.12873	3.8196	.58202	3.9483	.59641	.96740
2.06	7.8460	.89465	.12745	3.8593	.58650	3.9867	.60061	.96803
2.07	7.9248	.89899	.12619	3.8993	.59099	4.0255	.60482	.96865
2.08	8.0045	.90333	.12493	3.9398	.59547	4.0647	.60903	.96926
2.09	8.0849	.90768	.12369	3.9806	.59995	4.1043	.61324	.96986
2.10	8.1662	.91202	.12246	4.0219	.60443	4.1443	.61745	.97045
2.11	8.2482	.91636	.12124	4.0635	.60890	4.1847	.62167	.97103
2.12	8.3311	.92070	.12003	4.1056	.61337	4.2256	.62589	.97159
2.13	8.4149	.92505	.11884	4.1480	.61784	4.2669	.63011	.97215
2.14	8.4994	.92939	.11765	4.1909	.62231	4.3085	.63433	.97269
2.15	8.5849	.93373	.11648	4.2342	.62677	4.3507	.63856	.97323
2.16	8.6711	.93808	.11533	4.2779	.63123	4.3932	.64278	.97375
2.17	8.7583	.94242	.11418	4.3221	.63569	4.4362	.64701	.97426
2.18	8.8463	.94676	.11304	4.3666	.64015	4.4797	.65125	.97477
2.19	8.9352	.95110	.11192	4.4116	.64460	4.5236	.65548	.97526
2.20	9.0250	.95545	.11080	4.4571	.64905	4.5679	.65972	.97574
2.21	9.1157	.95979	.10970	4.5030	.65350	4.6127	.66396	.97622
2.22	9.2073	.96413	.10861	4.5494	.65795	4.6580	.66820	.97668
2.23	9.2999	.96848	.10753	4.5962	.66240	4.7037	.67244	.97714
2.24	9.3933	.97282	.10646	4.6434	.66684	4.7499	.67668	.97759
2.25	9.4877	.97716	.10540	4.6912	.67128	4.7966	.68093	.97803
2.26	9.5831	.98151	.10435	4.7394	.67572	4.8437	.68518	.97846
2.27	9.6794	.98585	.10331	4.7880	.68016	4.8914	.68943	.97888
2.28	9.7767	.99019	.10228	4.8372	.68459	4.9395	.69368	.97929
2.29	9.8749	.99453	.10127	4.8668	.68903	4.9881	.69794	.97970
2.30	9.9742	.99888	.10026	4.9370	.69346	5.0372	.70219	.98010
2.31	10.074	1.00322	.09926	4.9876	.69789	5.0868	.70645	.98049
2.32	10.176	1.00756	.09827	5.0387	.70232	5.1370	.71071	.98087
2.33	10.278	1.01191	.09730	5.0903	.70675	5.1876	.71497	.98124
2.34	10.381	1.01625	.09633	5.1425	.71117	5.2388	.71923	.98161
2.35	10.486	1.02059	.09537	5.1951	.71559	5.2905	.72349	.98197
2.36	10.591	1.02493	.09442	5.2483	.72002	5.3427	.72776	.98233
2.37	10.697	1.02928	.09348	5.3020	.72444	5.3954	.73203	.98267
2.38	10.805	1.03362	.09255	5.3562	.72885	5.4487	.73630	.98301
2.39	10.913	1.03796	.09163	5.4109	.73327	5.5026	.74056	.98335
2.40	11.023	1.04231	.09072	5.4662	.73769	5.5569	.74484	.98367
2.41	11.134	1.04665	.08982	5.5221	.74210	5.6119	.74911	.98400
2.42	11.246	1.05099	.08892	5.5785	.74652	5.6674	.75338	.98431
2.43	11.359	1.05534	.08804	5.6354	.75093	5.7235	.75766	.98462
2.44	11.473	1.05968	.08716	5.6929	.75534	5.7801	.76194	.98492
2.45	11.588	1.06402	.08629	5.7510	.75975	5.8373	.76621	.98522
2.46	11.705	1.06836	.08543	5.8097	.76415	5.8951	.77049	.98551
2.47	11.822	1.07271	.08458	5.8689	.76856	5.9535	.77477	.98579
2.48	11.941	1.07705	.08374	5.9288	.77296	6.0125	.77906	.98607
2.49	12.061	1.08139	.08291	5.9892	.77737	6.0721	.78334	.98635
2.50	12.182	1.08574	.08208	6.0502	.78177	6.1323	.78762	.98661

VALUES AND LOGARITHMS OF EXPONENTIAL AND HYPERBOLIC FUNCTIONS

x	e^x		e^{-x}	Sinh x		Cosh x		Tanh x
	Value	$\log_{10}$	Value	Value	$\log_{10}$	Value	$\log_{10}$	Value
2.50	12.182	1.08574	.08208	6.0502	.78177	6.1323	.78762	.98661
2.51	12.305	1.09008	.08127	6.1118	.78617	6.1931	.79191	.98688
2.52	12.429	1.09442	.08046	6.1741	.79057	6.2545	.79619	.98714
2.53	12.554	1.09877	.07966	6.2369	.79497	6.3166	.80048	.98739
2.54	12.680	1.10311	.07887	6.3004	.79937	6.3793	.80477	.98764
2.55	12.807	1.10745	.07808	6.3645	.80377	6.4426	.80906	.98788
2.56	12.936	1.11179	.07730	6.4293	.80816	6.5066	.81335	.98812
2.57	13.066	1.11614	.07654	6.4946	.81256	6.5712	.81764	.98835
2.58	13.197	1.12048	.07577	6.5607	.81695	6.6365	.82194	.98858
2.59	13.330	1.12482	.07502	6.6274	.82134	6.7024	.82623	.98881
2.60	13.464	1.12917	.07427	6.6947	.82573	6.7690	.83052	.98903
2.61	13.599	1.13351	.07353	6.7628	.83012	6.8363	.83482	.98924
2.62	13.736	1.13785	.07280	6.8315	.83451	6.9043	.83912	.98946
2.63	13.874	1.14219	.07208	6.9008	.83890	6.9729	.84341	.98966
2.64	14.013	1.14654	.07136	6.9709	.84329	7.0423	.84771	.98987
2.65	14.154	1.15088	.07065	7.0417	.84768	7.1123	.85201	.99007
2.66	14.296	1.15522	.06995	7.1132	.85206	7.1831	.85631	.99026
2.67	14.440	1.15957	.06925	7.1854	.85645	7.2546	.86061	.99045
2.68	14.585	1.16391	.06856	7.2583	.86083	7.3268	.86492	.99064
2.69	14.732	1.16825	.06788	7.3319	.86522	7.3998	.86922	.99083
2.70	14.880	1.17260	.06721	7.4063	.86960	7.4735	.87352	.99101
2.71	15.029	1.17694	.06654	7.4814	.87398	7.5479	.87783	.99118
2.72	15.180	1.18128	.06587	7.5572	.87836	7.6231	.88213	.99136
2.73	15.333	1.18562	.06522	7.6338	.88274	7.6991	.88644	.99153
2.74	15.487	1.18997	.06457	7.7112	.88712	7.7758	.89074	.99170
2.75	15.643	1.19431	.06393	7.7894	.89150	7.8533	.89505	.99186
2.76	15.800	1.19865	.06329	7.8683	.89588	7.9316	.89936	.99202
2.77	15.959	1.20300	.06266	7.9480	.90026	8.0106	.90367	.99218
2.78	16.119	1.20734	.06204	8.0285	.90463	8.0905	.90798	.99233
2.79	16.281	1.21168	.06142	8.1098	.90901	8.1712	.91229	.99248
2.80	16.445	1.21602	.06081	8.1919	.91339	8.2527	.91660	.99263
2.81	16.610	1.22037	.06020	8.2749	.91776	8.3351	.92091	.99278
2.82	16.777	1.22471	.05961	8.3586	.92213	8.4182	.92522	.99292
2.83	16.945	1.22905	.05901	8.4432	.92651	8.5022	.92953	.99306
2.84	17.116	1.23340	.05843	8.5287	.93088	8.5871	.93385	.99320
2.85	17.288	1.23774	.05784	8.6150	.93525	8.6728	.93816	.99333
2.86	17.462	1.24208	.05727	8.7021	.93963	8.7594	.94247	.99346
2.87	17.637	1.24643	.05670	8.7902	.94400	8.8469	.94679	.99359
2.88	17.814	1.25077	.05613	8.8791	.94837	8.9352	.95110	.99372
2.89	17.993	1.25511	.05558	8.9689	.95274	9.0244	.95542	.99384
2.90	18.174	1.25945	.05502	9.0596	.95711	9.1146	.95974	.99396
2.91	18.357	1.26380	.05448	9.1512	.96148	9.2056	.96405	.99408
2.92	18.541	1.26814	.05393	9.2437	.96584	9.2976	.96837	.99420
2.93	18.728	1.27248	.05340	9.3371	.97021	9.3905	.97269	.99431
2.94	18.916	1.27683	.05287	9.4315	.97458	9.4844	.97701	.99443
2.95	19.106	1.28117	.05234	9.5268	.97895	9.5791	.98133	.99454
2.96	19.298	1.28551	.05182	9.6231	.98331	9.6749	.98565	.99464
2.97	19.492	1.28985	.05130	9.7203	.98768	9.7716	.98997	.99475
2.98	19.688	1.29420	.05079	9.8185	.99205	9.8693	.99429	.99485
2.99	19.886	1.29854	.05029	9.9177	.99641	9.9680	.99861	.99496
3.00	20.086	1.30288	.04979	10.018	1.00078	10.068	1.00293	.99505

VALUES AND LOGARITHMS OF EXPONENTIAL AND HYPERBOLIC FUNCTIONS

x	e^x		e^{-x}	Sinh x		Cosh x		Tanh x
	Value	$\log_{10}$	Value	Value	$\log_{10}$	Value	$\log_{10}$	Value
3.00	20.086	1.30288	.04979	10.018	1.00078	10.068	1.00293	.99505
3.05	21.115	1.32460	.04736	10.534	1.02259	10.581	1.02454	.99552
3.10	22.198	1.34631	.04505	11.076	1.04440	11.122	1.04616	.99595
3.15	23.336	1.36803	.04285	11.647	1.06620	11.690	1.06779	.99633
3.20	24.533	1.38974	.04076	12.246	1.08799	12.287	1.08943	.99668
3.25	25.790	1.41146	.03877	12.876	1.10977	12.915	1.11108	.99700
3.30	27.113	1.43317	.03688	13.538	1.13155	13.575	1.13273	.99728
3.35	28.503	1.45489	.03508	14.234	1.15332	14.269	1.15439	.99754
3.40	29.964	1.47660	.03337	14.965	1.17509	14.999	1.17605	.99777
3.45	31.500	1.49832	.03175	15.734	1.19685	15.766	1.19772	.99799
3.50	33.115	1.52003	.03020	16.543	1.21860	16.573	1.21940	.99818
3.55	34.813	1.54175	.02872	17.392	1.24036	17.421	1.24107	.99835
3.60	36.598	1.56346	.02732	18.286	1.26211	18.313	1.26275	.99851
3.65	38.475	1.58517	.02599	19.224	1.28385	19.250	1.28444	.99865
3.70	40.447	1.60689	.02472	20.211	1.30559	20.236	1.30612	.99878
3.75	42.521	1.62860	.02352	21.249	1.32733	21.272	1.32781	.99889
3.80	44.701	1.65032	.02237	22.339	1.34907	22.362	1.34951	.99900
3.85	46.993	1.67203	.02128	23.486	1.37081	23.507	1.37120	.99909
3.90	49.402	1.69375	.02024	24.691	1.39254	24.711	1.39290	.99918
3.95	51.935	1.71546	.01925	25.958	1.41427	25.977	1.41459	.99926
4.00	54.598	1.73718	.01832	27.290	1.43600	27.308	1.43629	.99933
4.10	60.340	1.78061	.01657	30.162	1.47946	30.178	1.47970	.99945
4.20	66.686	1.82404	.01500	33.336	1.52291	33.351	1.52310	.99955
4.30	73.700	1.86747	.01357	36.843	1.56636	36.857	1.56652	.99963
4.40	81.451	1.91090	.01227	40.719	1.60980	40.732	1.60993	.99970
4.50	90.017	1.95433	.01111	45.003	1.65324	45.014	1.65335	.99975
4.60	99.484	1.99775	.01005	49.737	1.69668	49.747	1.69677	.99980
4.70	109.95	2.04118	.00910	54.969	1.74012	54.978	1.74019	.99983
4.80	121.51	2.08461	.00823	60.751	1.78355	60.759	1.78361	.99986
4.90	134.29	2.12804	.00745	67.141	1.82699	67.149	1.82704	.99989
5.00	148.41	2.17147	.00674	74.203	1.87042	74.210	1.87046	.99991
5.10	164.02	2.21490	.00610	82.008	1.91389	82.014	1.91389	.99993
5.20	181.27	2.25833	.00552	90.633	1.95729	90.639	1.95731	.99994
5.30	200.34	2.30176	.00499	100.17	2.00074	100.17	2.00074	.99995
5.40	221.41	2.34519	.00452	110.70	2.04415	110.71	2.04417	.99996
5.50	244.69	2.38862	.00409	122.34	2.08758	122.35	2.08760	.99997
5.60	270.43	2.43205	.00370	135.21	2.13101	135.22	2.13103	.99997
5.70	298.87	2.47548	.00335	149.43	2.17444	149.44	2.17445	.99998
5.80	330.30	2.51891	.00303	165.15	2.21787	165.15	2.21788	.99998
5.90	365.04	2.56234	.00274	182.52	2.26130	182.52	2.26131	.99998
6.00	403.43	2.60577	.00248	201.71	2.30473	201.72	2.30474	.99999
6.25	518.01	2.71434	.00193	259.01	2.41331	259.01	2.41331	.99999
6.50	665.14	2.82291	.00150	332.57	2.52188	332.57	2.52189	1.0000
6.75	854.06	2.93149	.00117	427.03	2.63046	427.03	2.63046	1.0000
7.00	1096.6	3.04006	.00091	548.32	2.73903	548.32	2.73903	1.0000
7.50	1808.0	3.25721	.00055	904.02	2.95618	904.02	2.95618	1.0000
8.00	2981.0	3.47436	.00034	1490.5	3.17333	1490.5	3.17333	1.0000
8.50	4914.8	3.69150	.00020	2457.4	3.39047	2457.4	3.39047	1.0000
9.00	8103.1	3.90865	.00012	4051.5	3.60762	4051.5	3.60762	1.0000
9.50	13360.	4.12580	.00007	6679.9	3.82477	6679.9	3.82477	1.0000
10.00	22026.	4.34294	.00005	11013.	4.04191	11013.	4.04191	1.0000

Table XVI

MULTIPLES OF M AND OF 1/M

N	N·M	N	N·M
0	0.00000 000	50	21.71472 410
1	0.43429 448	51	22.14901 858
2	0.86858 896	52	22.58331 306
3	1.30288 345	53	23.01760 754
4	1.73717 793	54	23.45190 202
5	2.17147 241	55	23.88619 650
6	2.60576 689	56	24.32049 099
7	3.04006 137	57	24.75478 547
8	3.47435 586	58	25.18907 995
9	3.90865 034	59	25.62337 443
10	4.34294 482	60	26.05766 891
11	4.77723 930	61	26.49196 340
12	5.21153 378	62	26.92625 788
13	5.64582 826	63	27.36055 236
14	6.08012 275	64	27.79484 684
15	6.51441 723	65	28.22914 132
16	6.94871 171	66	28.66343 581
17	7.38300 619	67	29.09773 029
18	7.81730 067	68	29.53202 477
19	8.25159 516	69	29.96631 925
20	8.68588 964	70	30.40061 373
21	9.12018 412	71	30.83490 822
22	9.55447 860	72	31.26920 270
23	9.98877 308	73	31.70349 718
24	10.42306 757	74	32.13779 166
25	10.85736 205	75	32.57208 614
26	11.29165 653	76	33.00638 062
27	11.72595 101	77	33.44067 511
28	12.16024 549	78	33.87496 959
29	12.59453 998	79	34.30926 407
30	13.02883 446	80	34.74355 855
31	13.46312 894	81	35.17785 303
32	13.89742 342	82	35.61214 752
33	14.33171 790	83	36.04644 200
34	14.76601 238	84	36.48073 648
35	15.20030 687	85	36.91503 096
36	15.63460 135	86	37.34932 544
37	16.06889 583	87	37.78361 993
38	16.50319 031	88	38.21791 441
39	16.93748 479	89	38.65220 889
40	17.37177 928	90	39.08650 337
41	17.80607 376	91	39.52079 785
42	18.24036 824	92	39.95509 234
43	18.67466 272	93	40.38938 682
44	19.10895 720	94	40.82368 130
45	19.54325 169	95	41.25797 578
46	19.97754 617	96	41.69227 026
47	20.41184 065	97	42.12656 474
48	20.84613 513	98	42.56085 923
49	21.28042 961	99	42.99515 371
50	21.71472 410	100	43.42944 819

N	N÷M	N	N÷M
0	0.00000 000	50	115.12925 465
1	2.30258 509	51	117.43183 974
2	4.60517 019	52	119.73442 484
3	6.90775 528	53	122.03700 993
4	9.21034 037	54	124.33959 502
5	11.51292 546	55	126.64218 011
6	13.81551 056	56	128.94476 521
7	16.11809 565	57	131.24735 030
8	18.42068 074	58	133.54993 539
9	20.72326 584	59	135.85252 049
10	23.02585 093	60	138.15510 558
11	25.32843 602	61	140.45769 067
12	27.63102 112	62	142.76027 577
13	29.93360 621	63	145.06286 086
14	32.23619 130	64	147.36544 595
15	34.53877 639	65	149.66803 104
16	36.84136 149	66	151.97061 614
17	39.14394 658	67	154.27320 123
18	41.44653 167	68	156.57578 632
19	43.74911 677	69	158.87837 142
20	46.05170 186	70	161.18095 651
21	48.35428 695	71	163.48354 160
22	50.65687 205	72	165.78612 670
23	52.95945 714	73	168.08871 179
24	55.26204 223	74	170.39129 688
25	57.56462 732	75	172.69388 197
26	59.86721 242	76	174.99646 707
27	62.16979 751	77	177.29905 216
28	64.47238 260	78	179.60163 725
29	66.77496 770	79	181.90422 235
30	69.07755 279	80	184.20680 744
31	71.38013 788	81	186.50939 253
32	73.68272 298	82	188.81197 763
33	75.98530 807	83	191.11456 272
34	78.28789 316	84	193.41714 781
35	80.59047 825	85	195.71973 290
36	82.89306 335	86	198.02231 800
37	85.19564 844	87	200.32490 309
38	87.49823 353	88	202.62748 818
39	89.80081 863	89	204.93007 328
40	92.10340 372	90	207.23265 837
41	94.40598 881	91	209.53524 346
42	96.70857 391	92	211.83782 856
43	99.01115 900	93	214.14041 365
44	101.31374 409	94	216.44299 874
45	103.61632 918	95	218.74558 383
46	105.91891 428	96	221.04816 893
47	108.22149 937	97	223.35075 402
48	110.52408 446	98	225.65333 911
49	112.82666 956	99	227.95592 421
50	115.12925 465	100	230.25850 930

$M = \log_{10} e = .43429\ 44819\ 03251\ 82765$

$\log_{10} n = \log_e n \cdot \log_{10} e = M \log_e n$

$\log_{10} e^x = x \cdot \log_{10} e = x \cdot M.$

$\frac{1}{M} = \log_e 10 = 2.30258\ 50929\ 94045\ 68402$

$\log_e n = \log_{10} n \cdot \log_e 10 = \frac{1}{M} \log_{10} n.$

$\log_e (10^n \cdot x) = \log_e x + n \frac{1}{M}$.

Table XVII

LOGARITHMS OF PRIMES—2 to 997

N	Log N			N	Log N			N	Log N		
2	0.301	029	9957	269	2.429	752	2800	617	2.790	285	1640
3	.477	121	2547	271	.432	969	2909	619	.791	690	6490
5	.698	970	0043	277	.442	479	7691	631	.800	029	3592
7	.845	098	0400	281	.448	706	3199	641	.806	858	0295
11	1.041	392	6852	283	.451	786	4355	643	.808	210	9729
13	1.113	943	3523	293	2.466	867	6204	647	2.810	904	2807
17	.230	448	9214	307	.487	138	3755	653	.814	913	1813
19	.278	753	6010	311	.492	760	3890	659	.818	885	4146
23	.361	727	8360	313	.495	544	3375	661	.820	201	4595
29	.462	397	9979	317	.501	059	2622	673	.828	015	0642
31	1.491	361	6938	331	2.519	827	9938	677	2.830	588	6687
37	.568	201	7241	337	.527	629	9009	683	.834	420	7037
41	.612	783	8567	347	.540	329	4748	691	.839	478	0474
43	.633	468	4556	349	.542	825	4270	701	.845	718	0180
47	.672	097	8579	353	.547	774	7054	709	.850	646	2352
53	1.724	275	8696	359	2.555	094	4486	719	2.856	728	8904
59	.770	852	0116	367	.564	666	0643	727	.861	534	4109
61	.785	329	8350	373	.571	708	8318	733	.865	103	9746
67	.826	074	8027	379	.578	639	2100	739	.868	644	4384
71	.851	258	3487	383	.583	198	7740	743	.870	988	8138
73	1.863	322	8601	389	2.589	949	6013	751	2.875	639	9370
79	.897	627	0913	397	.598	790	5068	757	.879	095	8795
83	.919	078	0924	401	.603	144	3726	761	.881	384	6568
89	.949	390	0066	409	.611	723	3080	769	.885	926	3398
97	.986	771	7343	419	.622	214	0230	773	.888	179	4939
101	2.004	321	3738	421	2.624	282	0958	787	2.895	974	7324
103	.012	837	2247	431	.634	477	2702	797	.901	458	3214
107	.029	383	7777	433	.636	487	8964	809	.907	948	5216
109	.037	426	4979	439	.642	464	5202	811	.909	020	8542
113	.053	078	4435	443	.646	403	7262	821	.914	343	1571
127	2.103	803	7210	449	2.652	246	3410	823	2.915	399	8352
131	.117	271	2957	457	.659	916	2001	827	.917	505	5096
137	.136	720	5672	461	.663	700	9254	829	.918	554	5306
139	.143	014	8003	463	.665	580	9910	839	.923	761	9608
149	.173	186	2684	467	.669	316	8806	853	.930	949	0312
151	2.178	976	9473	479	2.680	335	5134	857	2.932	980	8219
157	.195	899	6524	487	.687	528	9612	859	.933	993	1638
163	.212	187	6044	491	.691	081	4921	863	.936	010	7957
167	.222	716	4711	499	.698	100	5456	877	.942	999	5934
173	.238	046	1031	503	.701	567	9851	881	.944	975	9084
179	2.252	853	0310	509	2.706	717	7823	883	2.945	960	7036
181	.257	678	5749	521	.716	837	7233	887	.947	923	6198
191	.281	033	3672	523	.718	501	6889	907	.957	607	2871
193	.285	557	3090	541	.733	197	2651	911	.959	518	3770
197	.294	466	2262	547	.737	987	3263	919	.963	315	5114
199	2.298	853	0764	557	2.745	855	1952	929	2.968	015	7140
211	.324	282	4553	563	.750	508	3949	937	.971	739	5909
223	.348	304	8630	569	.755	112	2664	941	.973	589	6234
227	.356	025	8572	571	.756	636	1082	947	.976	349	9790
229	.359	835	4823	577	.761	175	8132	953	.979	092	9006
233	2.367	355	9210	587	2.768	638	1012	967	2.985	426	4741
239	.378	397	9009	593	.773	054	6934	971	.987	219	2299
241	.382	017	0426	599	.777	426	8224	977	.989	894	5637
251	.399	673	7215	601	.778	874	4720	983	.992	553	5178
257	.409	933	1233	607	.783	188	6911	991	.996	073	6545
263	2.419	955	7485	613	2.787	460	4745	997	2.998	695	1583

Table XVIII *

COMMON LOGARITHMS OF $\Gamma(n)$

$$\Gamma(n) = \int_0^\infty x^{n-1} \cdot e^{-x}\, dx = \int_0^1 \left[\log \frac{1}{x}\right]^{n-1} dx .$$

n	$\log_{10}\Gamma(n)+10$	n	$\log_{10}\Gamma(n)+10$	n	$\log_{10}\Gamma(n)+10$	n	$\log_{10}\Gamma(n)+10$	n	$\log_{10}\Gamma(n)+10$
1.01	9.9975	1.21	9.9617	1.41	9.9478	1.61	9.9517	1.81	9.9704
1.02	9.9951	1.22	9.9605	1.42	9.9476	1.62	9.9523	1.82	9.9717
1.03	9.9928	1.23	9.9594	1.43	9.9475	1.63	9.9529	1.83	9.9730
1.04	9.9905	1.24	9.9583	1.44	9.9473	1.64	9.9536	1.84	9.9743
1.05	9.9883	1.25	9.9573	1.45	9.9473	1.65	9.9543	1.85	9.9757
1.06	9.9862	1.26	9.9564	1.46	9.9472	1.66	9.9550	1.86	9.9771
1.07	9.9841	1.27	9.9554	1.47	9.9473	1.67	9.9558	1.87	9.9786
1.08	9.9821	1.28	9.9546	1.48	9.9473	1.68	9.9566	1.88	9.9800
1.09	9.9802	1.29	9.9538	1.49	9.9474	1.69	9.9575	1.89	9.9815
1.10	9.9783	1.30	9.9530	1.50	9.9475	1.70	9.9584	1.90	9.9831
1.11	9.9765	1.31	9.9523	1.51	9.9477	1.71	9.9593	1.91	9.9846
1.12	9.9748	1.32	9.9516	1.52	9.9479	1.72	9.9603	1.92	9.9862
1.13	9.9731	1.33	9.9510	1.53	9.9482	1.73	9.9613	1.93	9.9878
1.14	9.9715	1.34	9.9505	1.54	9.9485	1.74	9.9623	1.94	9.9895
1.15	9.9699	1.35	9.9500	1.55	9.9488	1.75	9.9633	1.95	9.9912
1.16	9.9684	1.36	9.9495	1.56	9.9492	1.76	9.9644	1.96	9.9929
1.17	9.9669	1.37	9.9491	1.57	9.9496	1.77	9.9656	1.97	9.9946
1.18	9.9655	1.38	9.9487	1.58	9.9501	1.78	9.9667	1.98	9.9964
1.19	9.9642	1.39	9.9483	1.59	9.9506	1.79	9.9679	1.99	9.9982
1.20	9.9629	1.40	9.9481	1.60	9.9511	1.80	9.9691	2.00	0.0000

$\Gamma(n+1) = n \cdot \Gamma(n), n > 0. \quad \Gamma(2) = \Gamma(1) = 1.$

* See Page 88.

Interpolation

Let $f(x)$ be an analytic function of x. If the values of $f(x)$ are given in a table for a set of values of x separated from one another consecutively by the constant small interval h, the differences between the successive values of the function as tabulated are called *first tabular differences*, the differences of these first differences, *second tabular differences*, etc. The first, second and third tabular differences corresponding to $x = a$ and the tabulated value of $f(a)$ are:

$\Delta_1 \equiv f(a+h) - f(a),$

$\Delta_2 \equiv f(a+2h) - 2 \cdot f(a+h) + f(a),$

$\Delta_3 \equiv f(a+3h) - 3 \cdot f(a+2h) + 3 \cdot f(a+h) - f(a).$

The value of $f(x)$ for $x = a+\delta$, where $\delta = kh$, $0<k<1$, is:

$$f(a+\delta) = f(a) + k \cdot \Delta_1 + \frac{k(k-1)}{2!} \cdot \Delta_2 + \frac{k(k-1)(k-2)}{3!} \cdot \Delta_3 + \cdots.$$

Table XIX

COMPOUND INTEREST*: $(1+r)^n$

Amount of One Dollar Principal at Compound Interest After n Years

n	2%	2½%	3%	3½%	4%	4½%	5%	6%	7%
1	1.0200	1.0250	1.0300	1.0350	1.0400	1.0450	1.0500	1.0600	1.0700
2	1.0404	1.0506	1.0609	1.0712	1.0816	1.0920	1.1025	1.1236	1.1449
3	1.0612	1.0769	1.0927	1.1087	1.1249	1.1412	1.1576	1.1910	1.2250
4	1.0824	1.1038	1.1255	1.1475	1.1699	1.1925	1.2155	1.2625	1.3108
5	1.1041	1.1314	1.1593	1.1877	1.2167	1.2462	1.2763	1.3382	1.4026
6	1.1262	1.1597	1.1941	1.2293	1.2653	1.3023	1.3401	1.4185	1.5007
7	1.1487	1.1887	1.2299	1.2723	1.3159	1.3609	1.4071	1.5036	1.6058
8	1.1717	1.2184	1.2668	1.3168	1.3686	1.4221	1.4775	1.5938	1.7182
9	1.1951	1.2489	1.3048	1.3629	1.4233	1.4861	1.5513	1.6895	1.8385
10	1.2190	1.2801	1.3439	1.4106	1.4802	1.5530	1.6289	1.7908	1.9672
11	1.2434	1.3121	1.3842	1.4600	1.5395	1.6229	1.7103	1.8983	2.1049
12	1.2682	1.3449	1.4258	1.5111	1.6010	1.6959	1.7959	2.0122	2.2522
13	1.2936	1.3785	1.4685	1.5640	1.6651	1.7722	1.8856	2.1329	2.4098
14	1.3195	1.4130	1.5126	1.6187	1.7317	1.8519	1.9799	2.2609	2.5785
15	1.3459	1.4483	1.5580	1.6753	1.8009	1.9353	2.0789	2.3966	2.7590
16	1.3728	1.4845	1.6047	1.7340	1.8730	2.0224	2.1829	2.5404	2.9522
17	1.4002	1.5216	1.6528	1.7947	1.9479	2.1134	2.2920	2.6928	3.1588
18	1.4282	1.5597	1.7024	1.8575	2.0258	2.2085	2.4066	2.8543	3.3799
19	1.4568	1.5987	1.7535	1.9225	2.1068	2.3079	2.5270	3.0256	3.6165
20	1.4859	1.6386	1.8061	1.9898	2.1911	2.4117	2.6533	3.2071	3.8697
21	1.5157	1.6796	1.8603	2.0594	2.2788	2.5202	2.7860	3.3996	4.1406
22	1.5460	1.7216	1.9161	2.1315	2.3699	2.6337	2.9253	3.6035	4.4304
23	1.5769	1.7646	1.9736	2.2061	2.4647	2.7522	3.0715	3.8197	4.7405
24	1.6084	1.8087	2.0328	2.2833	2.5633	2.8760	3.2251	4.0489	5.0724
25	1.6406	1.8539	2.0938	2.3632	2.6658	3.0054	3.3864	4.2919	5.4274
26	1.6734	1.9003	2.1566	2.4460	2.7725	3.1407	3.5557	4.5494	5.8074
27	1.7069	1.9478	2.2213	2.5316	2.8834	3.2820	3.7335	4.8223	6.2139
28	1.7410	1.9965	2.2879	2.6202	2.9987	3.4297	3.9201	5.1117	6.6488
29	1.7758	2.0464	2.3566	2.7119	3.1187	3.5840	4.1161	5.4184	7.1143
30	1.8114	2.0976	2.4273	2.8068	3.2434	3.7453	4.3219	5.7435	7.6123
31	1.8476	2.1500	2.5001	2.9050	3.3731	3.9139	4.5380	6.0881	8.1451
32	1.8845	2.2038	2.5751	3.0067	3.5081	4.0900	4.7649	6.4534	8.7153
33	1.9222	2.2589	2.6523	3.1119	3.6484	4.2740	5.0032	6.8406	9.3253
34	1.9607	2.3153	2.7319	3.2209	3.7943	4.4664	5.2533	7.2510	9.9781
35	1.9999	2.3732	2.8138	3.3336	3.9461	4.6673	5.5160	7.6861	10.6766
36	2.0399	2.4325	2.8983	3.4503	4.1039	4.8774	5.7918	8.1473	11.4239
37	2.0807	2.4933	2.9852	3.5710	4.2681	5.0969	6.0814	8.6361	12.2236
38	2.1223	2.5557	3.0748	3.6960	4.4388	5.3262	6.3855	9.1543	13.0793
39	2.1647	2.6196	3.1670	3.8254	4.6164	5.5659	6.7048	9.7035	13.9948
40	2.2080	2.6851	3.2620	3.9593	4.8010	5.8164	7.0400	10.2857	14.9745
41	2.2522	2.7522	3.3599	4.0978	4.9931	6.0781	7.3920	10.9029	16.0227
42	2.2972	2.8210	3.4607	4.2413	5.1928	6.3516	7.7616	11.5570	17.1443
43	2.3432	2.8915	3.5645	4.3897	5.4005	6.6374	8.1497	12.2505	18.3444
44	2.3901	2.9638	3.6715	4.5433	5.6165	6.9361	8.5572	12.9855	19.6285
45	2.4379	3.0379	3.7816	4.7024	5.8412	7.2482	8.9850	13.7646	21.0025
46	2.4866	3.1139	3.8950	4.8669	6.0748	7.5744	9.4343	14.5905	22.4726
47	2.5363	3.1917	4.0119	5.0373	6.3178	7.9153	9.9060	15.4659	24.0457
48	2.5871	3.2715	4.1323	5.2136	6.5705	8.2715	10.4013	16.3939	25.7289
49	2.6388	3.3533	4.2562	5.3961	6.8333	8.6437	10.9213	17.3775	27.5299
50	2.6916	3.4371	4.3839	5.5849	7.1067	9.0326	11.4674	18.4202	29.4570

*See §18.

Table XX

COMPOUND DISCOUNT *: $1 / (1+r)^n$

Present Value of One Dollar Due at the End of n Years

n	2%	2½%	3%	3½%	4%	4½%	5%	6%	7%
1	.98039	.97561	.97087	.96618	.96154	.95694	.95238	.94340	.93458
2	.96117	.95181	.94260	.93351	.92456	.91573	.90703	.89000	.87344
3	.94232	.92860	.91514	.90194	.88900	.87630	.86384	.83962	.81630
4	.92385	.90595	.88849	.87144	.85480	.83856	.82270	.79209	.76290
5	.90573	.88385	.86261	.84197	.82193	.80245	.78353	.74726	.71299
6	.88797	.86230	.83748	.81350	.79031	.76790	.74622	.70496	.66634
7	.87056	.84127	.81309	.78599	.75992	.73483	.71068	.66506	.62275
8	.85349	.82075	.78941	.75941	.73069	.70319	.67684	.62741	.58201
9	.83676	.80073	.76642	.73373	.70259	.67290	.64461	.59190	.54393
10	.82035	.78120	.74409	.70892	.67556	.64393	.61391	.55839	.50835
11	.80426	.76214	.72242	.68495	.64958	.61620	.58468	.52679	.47509
12	.78849	.74356	.70138	.66178	.62460	.58966	.55684	.49697	.44401
13	.77303	.72542	.68095	.63940	.60057	.56427	.53032	.46884	.41496
14	.75788	.70773	.66112	.61778	.57748	.53997	.50507	.44230	.38782
15	.74301	.69047	.64186	.59689	.55526	.51672	.48102	.41727	.36245
16	.72845	.67362	.62317	.57671	.53391	.49447	.45811	.39365	.33873
17	.71416	.65720	.60502	.55720	.51337	.47318	.43630	.37136	.31657
18	.70016	.64117	.58739	.53836	.49363	.45280	.41552	.35034	.29586
19	.68643	.62553	.57029	.52016	.47464	.43330	.39573	.33051	.27651
20	.67297	.61027	.55368	.50257	.45639	.41464	.37689	.31180	.25842
21	.65978	.59539	.53755	.48557	.43883	.39679	.35894	.29416	.24151
22	.64684	.58086	.52189	.46915	.42196	.37970	.34185	.27751	.22571
23	.63416	.56670	.50669	.45329	.40573	.36335	.32557	.26180	.21095
24	.62172	.55288	.49193	.43796	.39012	.34770	.31007	.24698	.19715
25	.60953	.53939	.47761	.42315	.37512	.33273	.29530	.23300	.18425
26	.59758	.52623	.46369	.40884	.36069	.31840	.28124	.21981	.17220
27	.58586	.51340	.45019	.39501	.34682	.30469	.26785	.20737	.16093
28	.57437	.50088	.43708	.38165	.33348	.29157	.25509	.19563	.15040
29	.56311	.48866	.42435	.36875	.32065	.27902	.24295	.18456	.14056
30	.55207	.47674	.41199	.35628	.30832	.26700	.23138	.17411	.13137
31	.54125	.46511	.39999	.34423	.29646	.25550	.22036	.16425	.12277
32	.53063	.45377	.38834	.33259	.28506	.24450	.20987	.15496	.11474
33	.52023	.44270	.37703	.32134	.27409	.23397	.19987	.14619	.10723
34	.51003	.43191	.36604	.31048	.26355	.22390	.19035	.13791	.10022
35	.50003	.42137	.35538	.29998	.25342	.21425	.18129	.13011	.09366
36	.49022	.41109	.34503	.28983	.24367	.20503	.17266	.12274	.08754
37	.48061	.40107	.33498	.28003	.23430	.19620	.16444	.11580	.08181
38	.47119	.39128	.32523	.27056	.22529	.18775	.15661	.10924	.07646
39	.46195	.38174	.31575	.26141	.21662	.17967	.14915	.10306	.07146
40	.45289	.37243	.30656	.25257	.20829	.17193	.14205	.09722	.06678
41	.44401	.36335	.29763	.24403	.20028	.16453	.13528	.09172	.06241
42	.43530	.35448	.28896	.23578	.19257	.15744	.12884	.08653	.05833
43	.42677	.34584	.28054	.22781	.18517	.15066	.12270	.08163	.05451
44	.41840	.33740	.27237	.22010	.17805	.14417	.11686	.07701	.05095
45	.41020	.32917	.26444	.21266	.17120	.13796	.11130	.07265	.04761
46	.40215	.32115	.25674	.20547	.16461	.13202	.10600	.06854	.04450
47	.39427	.31331	.24926	.19852	.15828	.12634	.10095	.06466	.04159
48	.38654	.30567	.24200	.19181	.15219	.12090	.09614	.06100	.03887
49	.37896	.29822	.23495	.18532	.14634	.11569	.09156	.05755	.03632
50	.37153	.29094	.22811	.17905	.14071	.11071	.08720	.05429	.03395

* See §20.

Table XXI

AMOUNT OF AN ANNUITY*

Amount of an Annuity of One Dollar per Year after n Years

n	2%	2½%	3%	3½%	4%	4½%	5%	6%	7%
1	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
2	2.0200	2.0250	2.0300	2.0350	2.0400	2.0450	2.0500	2.0600	2.0700
3	3.0604	3.0756	3.0909	3.1062	3.1216	3.1370	3.1525	3.1836	3.2149
4	4.1216	4.1525	4.1836	4.2149	4.2465	4.2782	4.3101	4.3746	4.4399
5	5.2040	5.2563	5.3091	5.3625	5.4163	5.4707	5.5256	5.6371	5.7507
6	6.3081	6.3877	6.4684	6.5502	6.6330	6.7169	6.8019	6.9753	7.1533
7	7.4343	7.5474	7.6625	7.7794	7.8983	8.0192	8.1420	8.3938	8.6540
8	8.5830	8.7361	8.8923	9.0517	9.2142	9.3800	9.5491	9.8975	10.2598
9	9.7546	9.9545	10.1591	10.3685	10.5828	10.8021	11.0266	11.4913	11.9780
10	10.9497	11.2034	11.4639	11.7314	12.0061	12.2882	12.5779	13.1808	13.8164
11	12.1687	12.4835	12.8078	13.1420	13.4864	13.8412	14.2068	14.9716	15.7836
12	13.4121	13.7956	14.1920	14.6020	15.0258	15.4640	15.9171	16.8699	17.8885
13	14.6803	15.1404	15.6178	16.1130	16.6268	17.1599	17.7130	18.8821	20.1406
14	15.9739	16.5190	17.0863	17.6770	18.2919	18.9321	19.5986	21.0151	22.5505
15	17.2934	17.9319	18.5989	19.2957	20.0236	20.7841	21.5786	23.2760	25.1290
16	18.6393	19.3802	20.1569	20.9710	21.8245	22.7193	23.6575	25.6725	27.8881
17	20.0121	20.8647	21.7616	22.7050	23.6975	24.7417	25.8404	28.2129	30.8402
18	21.4123	22.3863	23.4144	24.4997	25.6454	26.8551	28.1324	30.9057	33.9990
19	22.8406	23.9460	25.1169	26.3572	27.6712	29.0636	30.5390	33.7600	37.3790
20	24.2974	25.5447	26.8704	28.2797	29.7781	31.3714	33.0660	36.7856	40.9955
21	25.7833	27.1833	28.6765	30.2695	31.9692	33.7831	35.7193	39.9927	44.8652
22	27.2990	28.8629	30.5368	32.3289	34.2480	36.3034	38.5052	43.3923	49.0057
23	28.8450	30.5844	32.4529	34.4604	36.6179	38.9370	41.4305	46.9958	53.4361
24	30.4219	32.3490	34.4265	36.6665	39.0826	41.6892	44.5020	50.8156	58.1767
25	32.0303	34.1578	36.4593	38.9499	41.6459	44.5652	47.7271	54.8645	63.2490
26	33.6709	36.0117	38.5530	41.3131	44.3117	47.5706	51.1135	59.1564	68.6765
27	35.3443	37.9120	40.7096	43.7591	47.0842	50.7113	54.6691	63.7058	74.4838
28	37.0512	39.8598	42.9309	46.2906	49.9676	53.9933	58.4026	68.5281	80.6977
29	38.7922	41.8563	45.2189	48.9108	52.9663	57.4230	62.3227	73.6398	87.3465
30	40.5681	43.9027	47.5754	51.6227	56.0849	61.0071	66.4388	79.0582	94.4608
31	42.3794	46.0003	50.0027	54.4295	59.3283	64.7524	70.7608	84.8017	102.0730
32	44.2270	48.1503	52.5028	57.3345	62.7015	68.6662	75.2988	90.8898	110.2182
33	46.1116	50.3540	55.0778	60.3412	66.2095	72.7562	80.0638	97.3432	118.9334
34	48.0338	52.6129	57.7302	63.4532	69.8579	77.0303	85.0670	104.1838	128.2588
35	49.9945	54.9282	60.4621	66.6740	73.6522	81.4966	90.3203	111.4348	138.2369
36	51.9944	57.3014	63.2759	70.0076	77.5983	86.1640	95.8363	119.1209	148.9135
37	54.0343	59.7339	66.1742	73.4579	81.7022	91.0413	101.6281	127.2681	160.3374
38	56.1149	62.2273	69.1594	77.0289	85.9703	96.1382	107.7095	135.9042	172.5610
39	58.2372	64.7830	72.2342	80.7249	90.4091	101.4644	114.0950	145.0585	185.6403
40	60.4020	67.4026	75.4013	84.5503	95.0255	107.0303	120.7998	154.7620	199.6351
41	62.6100	70.0876	78.6633	88.5095	99.8265	112.8467	127.8398	165.0477	214.6096
42	64.8622	72.8398	82.0232	92.6074	104.8196	118.9248	135.2318	175.9505	230.6322
43	67.1595	75.6608	85.4839	96.8486	110.0124	125.2764	142.9933	187.5076	247.7765
44	69.5027	78.5523	89.0484	101.2383	115.4129	131.9138	151.1430	199.7580	266.1209
45	71.8927	81.5161	92.7199	105.7817	121.0294	138.8500	159.7002	212.7435	285.7493
46	74.3306	84.5540	96.5015	110.4840	126.8706	146.0982	168.6852	226.5081	306.7518
47	76.8172	87.6679	100.3965	115.3510	132.9454	153.6726	178.1194	241.0986	329.2244
48	79.3535	90.8596	104.4084	120.3883	139.2632	161.5879	188.0254	256.5645	353.2701
49	81.9406	94.1311	108.5406	125.6018	145.8337	169.8594	198.4267	272.9584	378.9990
50	84.5794	97.4843	112.7969	130.9979	152.6671	178.5030	209.3480	290.3359	406.5289

*See §23.

Table XXII

PRESENT VALUE OF AN ANNUITY*

Present Value of One Dollar per Year for n Years

n	2%	2½%	3%	3½%	4%	4½%	5%	6%	7%
1	.9804	.9756	.9709	.9662	.9615	.9569	.9524	.9434	.9346
2	1.9416	1.9274	1.9135	1.8997	1.8861	1.8727	1.8594	1.8334	1.8080
3	2.8839	2.8560	2.8286	2.8016	2.7751	2.7490	2.7232	2.6730	2.6243
4	3.8077	3.7620	3.7171	3.6731	3.6299	3.5875	3.5460	3.4651	3.3872
5	4.7135	4.6458	4.5797	4.5151	4.4518	4.3900	4.3295	4.2124	4.1002
6	5.6014	5.5081	5.4172	5.3286	5.2421	5.1579	5.0757	4.9173	4.7665
7	6.4720	6.3494	6.2303	6.1145	6.0021	5.8927	5 7864	5.5824	5.3893
8	7.3255	7.1701	7.0197	6.8740	6.7327	6.5959	6.4632	6.2098	5.9713
9	8.1622	7.9709	7.7861	7.6077	7.4353	7.2688	7.1078	6.8017	6.5152
10	8.9826	8.7521	8.5302	8.3166	8.1109	7.9127	7.7217	7.3601	7.0236
11	9.7868	9.5142	9.2526	9.0016	8.7605	8.5289	8.3064	7.8869	7.4987
12	10.5753	10.2578	9.9540	9.6633	9.3851	9.1186	8.8633	8.3838	7.9427
13	11.3484	10.9832	10.6350	10.3027	9.9856	9.6829	9.3936	8.8527	8.3577
14	12.1062	11.6909	11.2961	10.9205	10.5631	10.2228	9.8986	9.2950	8.7455
15	12.8493	12.3814	11.9379	11.5174	11.1184	10.7395	10.3797	9.7122	9.1079
16	13.5777	13.0550	12.5611	12.0941	11.6523	11.2340	10.8378	10.1059	9.4466
17	14.2919	13.7122	13.1661	12.6513	12.1657	11.7072	11.2741	10.4773	9.7632
18	14.9920	14.3534	13.7535	13.1897	12.6593	12.1600	11.6896	10.8276	10.0591
19	15.6785	14.9789	14.3238	13.7098	13.1339	12.5933	12.0853	11.1581	10.3356
20	16.3514	15.5892	14.8775	14.2124	13.5903	13.0079	12.4622	11.4699	10.5940
21	17.0112	16.1845	15.4150	14.6980	14.0292	13.4047	12.8212	11.7641	10.8355
22	17.6580	16.7654	15.9369	15.1671	14.4511	13.7844	13.1630	12.0416	11.0612
23	18.2922	17.3321	16.4436	15.6204	14.8568	14.1478	13.4886	12.3034	11.2722
24	18.9139	17.8850	16.9355	16.0584	15.2470	14.4955	13.7986	12.5504	11.4693
25	19.5235	18.4244	17.4131	16.4815	15.6221	14.8282	14.0939	12.7834	11.6536
26	20.1210	18.9506	17.8768	16.8904	15.9828	15.1466	14.3752	13.0032	11.8258
27	20.7069	19.4640	18.3270	17.2854	16.3296	15.4513	14.6430	13.2105	11.9867
28	21.2813	19.9649	18.7641	17.6670	16.6631	15.7429	14.8981	13.4062	12.1371
29	21.8444	20.4535	19.1885	18.0358	16.9837	16.0219	15.1411	13.5907	12.2777
30	22.3965	20.9303	19.6004	18.3920	17.2920	16.2889	15.3725	13.7648	12.4090
31	22.9377	21.3954	20.0004	18.7363	17.5885	16.5444	15.5928	13.9291	12.5318
32	23.4683	21.8492	20.3888	19.0689	17.8736	16.7889	15.8027	14.0840	12.6466
33	23.9886	22.2919	20.7658	19.3902	18.1476	17.0229	16.0025	14.2302	12.7538
34	24.4986	22.7238	21.1318	19.7007	18.4112	17.2468	16.1929	14.3681	12.8540
35	24.9986	23.1452	21.4872	20.0007	18.6646	17.4610	16.3742	14.4982	12.9477
36	25.4888	23.5563	21.8323	20.2905	18.9083	17.6660	16.5469	14.6210	13.0352
37	25.9695	23.9573	22.1672	20.5705	19.1426	17.8622	16.7113	14.7368	13.1170
38	26.4406	24.3486	22.4925	20.8411	19.3679	18.0500	16.8679	14.8460	13.1935
39	26.9026	24.7303	22.8082	21.1025	19.5845	18.2297	17.0170	14.9491	13.2649
40	27.3555	25.1028	23.1148	21.3551	19.7928	18.4016	17.1591	15.0463	13.3317
41	27.7995	25.4661	23.4124	21.5991	19.9931	18.5661	17.2944	15.1380	13.3941
42	28.2348	25.8206	23.7014	21.8349	20.1856	18.7236	17.4232	15.2245	13.4524
43	28.6616	26.1664	23.9819	22.0627	20.3708	18.8742	17.5459	15.3062	13.5070
44	29.0800	26.5038	24.2543	22.2828	20.5488	19.0184	17.6628	15.3832	13.5579
45	29.4902	26.8330	24.5187	22.4955	20.7200	19.1563	17.7741	15.4558	13.6055
46	29.8923	27.1542	24.7754	22.7009	20.8847	19.2884	17.8801	15.5244	13.6500
47	30.2866	27.4675	25.0247	22.8994	21.0429	19.4147	17.9810	15.5890	13.6910
48	30.6731	27.7732	25.2667	23.0912	21.1951	19.5356	18.0772	15.6500	13.7305
49	31.0521	28.0714	25.5017	23.2766	21.3415	19.6513	18.1687	15.7076	13.7668
50	31.4236	28.3623	25.7298	23.4556	21.4822	19.7620	18.2559	15.7619	13.8007

* See §24.

Table XXIII LOGARITHMS FOR INTEREST COMPUTATIONS

r	1 + r	log (1 + r)
½ %	1.005	00216 60617 56508
1 %	1.010	00432 13737 82643
1½ %	1.015	00646 60422 49232
2 %	1.020	00860 01717 61918
2½ %	1.025	01072 38653 91773
3 %	1.030	01283 72247 05172
3½ %	1.035	01494 03497 92937
4 %	1.040	01703 33392 98780
4½ %	1.045	01911 62904 47073
5 %	1.050	02118 92990 69938

r	1 + r	log (1 + r)
5½ %	1.055	02325 24596 33711
6 %	1.060	02530 58652 64770
6½ %	1.065	02734 96077 74757
7 %	1.070	02938 37776 85210
7½ %	1.075	03140 84642 51624
8 %	1.080	03342 37554 86950
8½ %	1.085	03542 97381 84548
9 %	1.090	03742 64979 40624
9½ %	1.095	03941 41191 76137
10 %	1.100	04139 26851 58225

The amount A of principal P at compound interest after n years is: $A = P(1 + r)^n$.
The present value P of an amount A due at end of n years is: $P = A/(1 + r)^n$.

Table XXIV AMERICAN EXPERIENCE MORTALITY TABLE

x	l_x	d_x	q_x	p_x
10	100 000	749	0.007 490	0.992 510
11	99 251	746	0.007 516	0.992 484
12	98 505	743	0.007 543	0.992 457
13	97 762	740	0.007 569	0.992 431
14	97 022	737	0.007 596	0.992 404
15	96 285	735	0.007 634	0.992 366
16	95 550	732	0.007 661	0.992 339
17	94 818	729	0.007 688	0.992 312
18	94 089	727	0.007 727	0.992 273
19	93 362	725	0.007 765	0.992 235
20	92 637	723	0.007 805	0.992 195
21	91 914	722	0.007 855	0.992 145
22	91 192	721	0.007 906	0.992 094
23	90 471	720	0.007 958	0.992 042
24	89 751	719	0.008 011	0.991 989
25	89 032	718	0.008 065	0.991 935
26	88 314	718	0.008 130	0.991 870
27	87 596	718	0.008 197	0.991 803
28	86 878	718	0.008 264	0.991 736
29	86 160	719	0.008 345	0.991 655
30	85 441	720	0.008 427	0.991 573
31	84 721	721	0.008 510	0.991 490
32	84 000	723	0.008 607	0.991 393
33	83 277	726	0.008 718	0.991 282
34	82 551	729	0.008 831	0.991 169
35	81 822	732	0.008 946	0.991 054
36	81 090	737	0.009 089	0.990 911
37	80 353	742	0.009 234	0.990 766
38	79 611	749	0.009 408	0.990 592
39	78 862	756	0.009 586	0.990 414
40	78 106	765	0.009 794	0.990 206
41	77 341	774	0.010 008	0.989 992
42	76 567	785	0.010 252	0.989 748
43	75 782	797	0.010 517	0.989 483
44	74 985	812	0.010 829	0.989 171
45	74 173	828	0.011 163	0.988 837
46	73 345	848	0.011 562	0.988 438
47	72 497	870	0.012 000	0.988 000
48	71 627	896	0.012 509	0.987 491
49	70 731	927	0.013 106	0.986 894
50	69 804	962	0.013 781	0.986 219
51	68 842	1 001	0.014 541	0.985 459
52	67 841	1 044	0.015 389	0.984 611
53	66 797	1 091	0.016 333	0.983 667
54	65 706	1 143	0.017 396	0.982 604
55	64 563	1 199	0.018 571	0.981 429
56	63 364	1 260	0.019 885	0.980 115
57	62 104	1 325	0.021 335	0.978 665
58	60 779	1 394	0.022 936	0.977 064
59	59 385	1 468	0.024 720	0.975 280
60	57 917	1 546	0.026 693	0.973 307
61	56 371	1 628	0.028 880	0.971 120
62	54 743	1 713	0.031 292	0.968 708
63	53 030	1 800	0.033 943	0.966 057
64	51 230	1 889	0.036 873	0.963 127
65	49 341	1 980	0.040 129	0.959 871
66	47 361	2 070	0.043 707	0.956 293
67	45 291	2 158	0.047 647	0.952 353
68	43 133	2 243	0.052 002	0.947 998
69	40 890	2 321	0.056 762	0.943 238
70	38 569	2 391	0.061 993	0.938 007
71	36 178	2 448	0.067 665	0.932 335
72	33 730	2 487	0.073 733	0.926 267
73	31 243	2 505	0.080 178	0.919 822
74	28 738	2 501	0.087 028	0.912 972
75	26 237	2 476	0.094 371	0.905 629
76	23 761	2 431	0.102 311	0.897 689
77	21 330	2 369	0.111 064	0.888 936
78	18 961	2 291	0.120 827	0.879 173
79	16 670	2 196	0.131 734	0.868 266
80	14 474	2 091	0.144 466	0.855 534
81	12 383	1 964	0.158 605	0.841 395
82	10 419	1 816	0.174 297	0.825 703
83	8 603	1 648	0.191 561	0.808 439
84	6 955	1 470	0.211 359	0.788 641
85	5 485	1 292	0.235 552	0.764 448
86	4 193	1 114	0.265 681	0.734 319
87	3 079	933	0.303 020	0.696 980
88	2 146	744	0.346 692	0.653 308
89	1 402	555	0.395 863	0.604 137
90	847	385	0.454 545	0.545 455
91	462	246	0.532 468	0.467 532
92	216	137	0.634 259	0.365 741
93	79	58	0.734 177	0.265 823
94	21	18	0.857 143	0.142 857
95	3	3	1.000 000	0.000 000

Based on 100,000 living at age 10.

x = age, l_x = number living, d_x = number of deaths,
q_x = yearly probability of dying, p_x = yearly probability of living.

Table XXV. LOGARITHMS OF FACTORIAL n.

n	$\log n!$	n	$\log n!$	n	$\log n!$	n	$\log n!$
		50	64.48307	100	157.97000	150	262.75689
1	0.00000	51	66.19064	101	159.97432	151	264.93587
2	0.30103	52	67.90665	102	161.98293	152	267.11771
3	0.77815	53	69.63092	103	163.99576	153	269.30241
4	1.38021	54	71.36332	104	166.01280	154	271.48993
5	2.07918	55	73.10368	105	168.03399	155	273.68026
6	2.85733	56	74.85187	106	170.05929	156	275.87338
7	3.70243	57	76.60774	107	172.08867	157	278.06928
8	4.60552	58	78.37117	108	174.12210	158	280.26794
9	5.55976	59	80.14202	109	176.15952	159	282.46934
10	6.55976	60	81.92017	110	178.20092	160	284.67346
11	7.60116	61	83.70550	111	180.24624	161	286.88028
12	8.68034	62	85.49790	112	182.29546	162	289.08980
13	9.79428	63	87.29724	113	184.34854	163	291.30198
14	10.94041	64	89.10342	114	186.40544	164	293.51683
15	12.11650	65	90.91633	115	188.46614	165	295.73431
16	13.32062	66	92.73587	116	190.53060	166	297.95442
17	14.55107	67	94.56195	117	192.59878	167	300.17714
18	15.80634	68	96.39446	118	194.67067	168	302.40245
19	17.08509	69	98.23331	119	196.74621	169	304.63033
20	18.38612	70	100.07840	120	198.82539	170	306.86078
21	19.70834	71	101.92966	121	200.90818	171	309.09378
22	21.05077	72	103.78700	122	202.99454	172	311.32931
23	22.41249	73	105.65032	123	205.08444	173	313.56735
24	23.79271	74	107.51955	124	207.17787	174	315.80790
25	25.19065	75	109.39461	125	209.27478	175	318.05094
26	26.60562	76	111.27543	126	211.37515	176	320.29645
27	28.03698	77	113.16192	127	213.47895	177	322.54443
28	29.48414	78	115.05401	128	215.58616	178	324.79485
29	30.94654	79	116.95164	129	217.69675	179	327.04770
30	32.42366	80	118.85473	130	219.81069	180	329.30297
31	33.91502	81	120.76321	131	221.92796	181	331.56065
32	35.42017	82	122.67703	132	224.04854	182	333.82072
33	36.93869	83	124.59610	133	226.17239	183	336.08317
34	38.47016	84	126.52038	134	228.29949	184	338.34799
35	40.01423	85	128.44980	135	230.42983	185	340.61516
36	41.57054	86	130.38430	136	232.56337	186	342.88468
37	43.13874	87	132.32382	137	234.70009	187	345.15652
38	44.71852	88	134.26830	138	236.83997	188	347.43067
39	46.30959	89	136.21769	139	238.98298	189	349.70714
40	47.91165	90	138.17194	140	241.12911	190	351.98589
41	49.52443	91	140.13098	141	243.27833	191	354.26692
42	51.14768	92	142.09476	142	245.43062	192	356.55022
43	52.78115	93	144.06325	143	247.58595	193	358.83578
44	54.42460	94	146.03638	144	249.74432	194	361.12358
45	56.07781	95	148.01410	145	251.90568	195	363.41362
46	57.74057	96	149.99637	146	254.07004	196	365.70587
47	59.41267	97	151.98314	147	256.23735	197	368.00034
48	61.09391	98	153.97437	148	258.40762	198	370.29701
49	62.78410	99	155.97000	149	260.58080	199	372.59586

FACTORIALS and THEIR RECIPROCALS

n	$n!$	n	$n!$
1	1	11	39916800
2	2	12	479001600
3	6	13	6227020800
4	24	14	87178291200
5	120	15	1307674368000
6	720	16	20922789888000
7	5040	17	355687428096000
8	40320	18	6402373705728000
9	362880	19	121645100408832000
10	3628800	20	2432902008176640000

n	$1/n!$	n	$1/n!$
1	1.	11	$.25052\times10^{-7}$
2	0.5	12	$.20877\times10^{-8}$
3	.16667	13	$.16059\times10^{-9}$
4	$.41667\times10^{-1}$	14	$.11471\times10^{-10}$
5	$.83333\times10^{-2}$	15	$.76472\times10^{-12}$
6	$.13889\times10^{-2}$	16	$.47795\times10^{-13}$
7	$.19841\times10^{-3}$	17	$.28115\times10^{-14}$
8	$.24802\times10^{-4}$	18	$.15619\times10^{-15}$
9	$.27557\times10^{-5}$	19	$.82206\times10^{-17}$
10	$.27557\times10^{-6}$	20	$.41103\times10^{-18}$

Table XXVa. BINOMIAL COEFFICIENTS

n	$\binom{n}{0}$	$\binom{n}{1}$	$\binom{n}{2}$	$\binom{n}{3}$	$\binom{n}{4}$	$\binom{n}{5}$	$\binom{n}{6}$	$\binom{n}{7}$	$\binom{n}{8}$	$\binom{n}{9}$	$\binom{n}{10}$
0	1										
1	1	1									
2	1	2	1								
3	1	3	3	1							
4	1	4	6	4	1						
5	1	5	10	10	5	1					
6	1	6	15	20	15	6	1				
7	1	7	21	35	35	21	7	1			
8	1	8	28	56	70	56	28	8	1		
9	1	9	36	84	126	126	84	36	9	1	
10	1	10	45	120	210	252	210	120	45	10	1
11	1	11	55	165	330	462	462	330	165	55	11
12	1	12	66	220	495	792	924	792	495	220	66
13	1	13	78	286	715	1287	1716	1716	1287	715	286
14	1	14	91	364	1001	2002	3003	3432	3003	2002	1001
15	1	15	105	455	1365	3003	5005	6435	6435	5005	3003
16	1	16	120	560	1820	4368	8008	11440	12870	11440	8008
17	1	17	136	680	2380	6188	12376	19448	24310	24310	19448
18	1	18	153	816	3060	8568	18564	31824	43758	48620	43758
19	1	19	171	969	3876	11628	27132	50388	75582	92378	92378
20	1	20	190	1140	4845	15504	38760	77520	125970	167960	184756

$${}_nC_m = \binom{n}{m} = \frac{n!}{[(n-m)!\,m!]} = \binom{n}{n-m}, \binom{n}{0} = 1.$$

$$(p+q)^n = p^n + \binom{n}{1} p^{n-1}q + \ldots + \binom{n}{s} p^s q^t + \ldots + q^n, \; s + t = n.$$

PROBABILITY

Let p = probability of an event e in one trial, and q = probability of failure of e. The probability that, in n trials, the event e will occur exactly $(n-t)$ times is $\binom{n}{t} p^{n-t} q^t$. The probability that an event e will happen at least r times in n trials is $\sum_{t=0}^{t=n-r} \binom{n}{t} p^{n-t} q^t$; at most r times in n trials is $\sum_{t=n-r}^{t=n} \binom{n}{t} p^{n-t} q^t$.

In a *point binomial*, $(p+q)^n$, distribution, the mean number of favorable events is np; the mean number of unfavorable events is nq; the *standard deviation* is $\sigma = \sqrt{pqn}$; and $a_3 = (p-q)/\sigma$. The *mean deviation from the mean* $= MD$ is $\sigma\sqrt{2/\pi} = 0.7979\,\sigma$; the *semi-quartile deviation from the mean* $= 0.6745\,\sigma = 0.845\,MD$.

The probability that a deviation of an individual measure from the average lies between $y = -a$ and $y = a$ is

$$\frac{1}{\sqrt{\pi}} \int_{y=-a}^{y=a} h e^{-h^2y^2} dy = \frac{1}{\sigma\sqrt{2\pi}} \int_{y=-a}^{y=a} e^{-\frac{y^2}{2\sigma^2}} dy = \frac{1}{\sqrt{2\pi}} \int_{x=-b}^{x=b} e^{-\frac{x^2}{2}} dx,$$

where $x = hy\sqrt{2}$, $b = ha\sqrt{2}$, and $\sigma = 1/h\sqrt{2}$; h is called the *modulus of precision* and σ the *standard (quadratic mean) deviation.*

Table XXV b

PROBABILITY FUNCTIONS

$$\tfrac{1}{2}(1+\alpha) = \int_{-\infty}^{x} \Phi(x)\,dx = \text{Area under } \Phi(x) \text{ from } -\infty \text{ to } x,$$

$$\alpha = \int_{-x}^{x} \Phi(x)dx, \qquad \Phi(x) = \frac{1}{\sqrt{2\pi}} e^{\frac{-x^2}{2}} = \text{Normal function.}$$

$\Phi^{(2)}(x) = (x^2-1)\ \Phi(x)$ = Second derivative of $\Phi(x)$.
$\Phi^{(3)}(x) = (3x-x^3)\ \Phi(x)$ = Third derivative of $\Phi(x)$.
$\Phi^{(4)}(x) = (x^4-6x^2+3)\ \Phi(x)$ = Fourth derivative of $\Phi(x)$.

x	$\frac{1}{2}(1+\alpha)$	$\Phi(x)$	$\Phi^{(2)}(x)$	$\Phi^{(3)}(x)$	$\Phi^{(4)}(x)$	x	$\frac{1}{2}(1+\alpha)$	$\Phi(x)$	$\Phi^{(2)}(x)$	$\Phi^{(3)}(x)$	$\Phi^{(4)}(x)$
0.00	.5000	.3989	−.3989	.0000	1.1968	0.50	.6915	.3521	−.2641	.4841	.5501
0.01	.5040	.3989	−.3989	.0120	1.1965	0.51	.6950	.3503	−.2592	.4895	.5279
0.02	.5080	.3989	−.3987	.0239	1.1956	0.52	.6985	.3485	−.2543	.4947	.5056
0.03	.5120	.3988	−.3984	.0359	1.1941	0.53	.7019	.3467	−.2493	.4996	.4831
0.04	.5160	.3986	−.3980	.0478	1.1920	0.54	.7054	.3448	−.2443	.5043	.4605
0.05	.5199	.3984	−.3975	.0597	1.1894	0.55	.7088	.3429	−.2392	.5088	.4378
0.06	.5239	.3982	−.3968	.0716	1.1861	0.56	.7123	.3410	−.2341	.5131	.4150
0.07	.5279	.3980	−.3960	.0834	1.1822	0.57	.7157	.3391	−.2289	.5171	.3921
0.08	.5319	.3977	−.3951	.0952	1.1778	0.58	.7190	.3372	−.2238	.5209	.3691
0.09	.5359	.3973	−.3941	.1070	1.1727	0.59	.7224	.3352	−.2185	.5245	.3461
0.10	.5398	.3970	−.3930	.1187	1.1671	0.60	.7257	.3332	−.2133	.5278	.3231
0.11	.5438	.3965	−.3917	.1303	1.1609	0.61	.7291	.3312	−.2080	.5309	.3000
0.12	.5478	.3961	−.3904	.1419	1.1541	0.62	.7324	.3292	−.2027	.5338	.2770
0.13	.5517	.3956	−.3889	.1534	1.1468	0.63	.7357	.3271	−.1973	.5365	.2539
0.14	.5557	.3951	−.3873	.1648	1.1389	0.64	.7389	.3251	−.1919	.5389	.2309
0.15	.5596	.3945	−.3856	.1762	1.1304	0.65	.7422	.3230	−.1865	.5411	.2078
0.16	.5636	.3939	−.3838	.1874	1.1214	0.66	.7454	.3209	−.1811	.5431	.1849
0.17	.5675	.3932	−.3819	.1986	1.1118	0.67	.7486	.3187	−.1757	.5448	.1620
0.18	.5714	.3925	−.3798	.2097	1.1017	0.68	.7517	.3166	−.1702	.5463	.1391
0.19	.5753	.3918	−.3777	.2206	1.0911	0.69	.7549	.3144	−.1647	.5476	.1164
0.20	.5793	.3910	−.3754	.2315	1.0799	0.70	.7580	.3123	−.1593	.5486	.0937
0.21	.5832	.3902	−.3730	.2422	1.0682	0.71	.7611	.3101	−.1538	.5495	.0712
0.22	.5871	.3894	−.3706	.2529	1.0560	0.72	.7642	.3079	−.1483	.5501	.0487
0.23	.5910	.3885	−.3680	.2634	1.0434	0.73	.7673	.3056	−.1428	.5504	.0265
0.24	.5948	.3876	−.3653	.2737	1.0302	0.74	.7704	.3034	−.1373	.5506	.0043
0.25	.5987	.3867	−.3625	.2840	1.0165	0.75	.7734	.3011	−.1318	.5505	−.0176
0.26	.6026	.3857	−.3596	.2941	1.0024	0.76	.7764	.2989	−.1262	.5502	−.0394
0.27	.6064	.3847	−.3566	.3040	0.9878	0.77	.7794	.2966	−.1207	.5497	−.0611
0.28	.6103	.3836	−.3535	.3138	0.9727	0.78	.7823	.2943	−.1153	.5490	−.0825
0.29	.6141	.3825	−.3504	.3235	0.9572	0.79	.7852	.2920	−.1098	.5481	−.1037
0.30	.6179	.3814	−.3471	.3330	0.9413	0.80	.7881	.2897	−.1043	.5469	−.1247
0.31	.6217	.3802	−.3437	.3423	0.9250	0.81	.7910	.2874	−.0988	.5456	−.1455
0.32	.6255	.3790	−.3402	.3515	0.9082	0.82	.7939	.2850	−.0934	.5440	−.1660
0.33	.6293	.3778	−.3367	.3605	0.8910	0.83	.7967	.2827	−.0880	.5423	−.1862
0.34	.6331	.3765	−.3330	.3693	0.8735	0.84	.7995	.2803	−.0825	.5403	−.2063
0.35	.6368	.3752	−.3293	.3779	0.8556	0.85	.8023	.2780	−.0771	.5381	−.2260
0.36	.6406	.3739	−.3255	.3864	0.8373	0.86	.8051	.2756	−.0718	.5358	−.2455
0.37	.6443	.3726	−.3216	.3947	0.8186	0.87	.8078	.2732	−.0664	.5332	−.2646
0.38	.6480	.3712	−.3176	.4028	0.7996	0.88	.8106	.2709	−.0611	.5305	−.2835
0.39	.6517	.3697	−.3135	.4107	0.7803	0.89	.8133	.2685	−.0558	.5276	−.3021
0.40	.6554	.3683	−.3094	.4184	0.7607	0.90	.8159	.2661	−.0506	.5245	−.3203
0.41	.6591	.3668	−.3059	.4259	0.7408	0.91	.8186	.2637	−.0453	.5212	−.3383
0.42	.6628	.3653	−.3008	.4332	0.7206	0.92	.8212	.2613	−.0401	.5177	−.3559
0.43	.6664	.3637	−.2965	.4403	0.7001	0.93	.8238	.2589	−.0350	.5140	−.3731
0.44	.6700	.3621	−.2920	.4472	0.6793	0.94	.8264	.2565	−.0299	.5102	−.3901
0.45	.6736	.3605	−.2875	.4539	0.6583	0.95	.8289	.2541	−.0248	.5062	−.4066
0.46	.6772	.3589	−.2830	.4603	0.6371	0.96	.8315	.2516	−.0197	.5021	−.4228
0.47	.6808	.3572	−.2783	.4666	0.6156	0.97	.8340	.2492	−.0147	.4978	−.4387
0.48	.6844	.3555	−.2736	.4727	0.5940	0.98	.8365	.2468	−.0098	.4933	−.4541
0.49	.6879	.3538	−.2689	.4785	0.5721	0.99	.8389	.2444	−.0049	.4887	−.4692

PROBABILITY FUNCTIONS

x	$\frac{1}{2}(1+\alpha)$	$\Phi(x)$	$\Phi^{(2)}(x)$	$\Phi^{(3)}(x)$	$\Phi^{(4)}(x)$	x	$\frac{1}{2}(1+\alpha)$	$\Phi(x)$	$\Phi^{(2)}(x)$	$\Phi^{(3)}(x)$	$\Phi^{(4)}(x)$
1.00	.8413	.2420	.0000	.4839	−.4839	1.50	.9332	.1295	.1619	.1457	−.7043
1.01	.8438	.2396	.0048	.4790	−.4983	1.51	.9345	.1276	.1633	.1387	−.6994
1.02	.8461	.2371	.0096	.4740	−.5122	1.52	.9357	.1257	.1647	.1317	−.6942
1.03	.8485	.2347	.0143	.4688	−.5257	1.53	.9370	.1238	.1660	.1248	−.6888
1.04	.8508	.2323	.0190	.4635	−.5389	1.54	.9382	.1219	.1672	.1180	−.6831
1.05	.8531	.2299	.0236	.4580	−.5516	1.55	.9394	.1200	.1683	.1111	−.6772
1.06	.8554	.2275	.0281	.4524	−.5639	1.56	.9406	.1182	.1694	.1044	−.6710
1.07	.8577	.2251	.0326	.4467	−.5758	1.57	.9418	.1163	.1704	.0977	−.6646
1.08	.8599	.2227	.0371	.4409	−.5873	1.58	.9429	.1145	.1714	.0911	−.6580
1.09	.8621	.2203	.0414	.4350	−.5984	1.59	.9441	.1127	.1722	.0846	−.6511
1.10	.8643	.2179	.0458	.4290	−.6091	1.60	.9452	.1109	.1730	.0781	−.6441
1.11	.8665	.2155	.0500	.4228	−.6193	1.61	.9463	.1092	.1738	.0717	−.6368
1.12	.8686	.2131	.0542	.4166	−.6292	1.62	.9474	.1074	.1745	.0654	−.6293
1.13	.8708	.2107	.0583	.4102	−.6386	1.63	.9484	.1057	.1751	.0591	−.6216
1.14	.8729	.2083	.0624	.4038	−.6476	1.64	.9495	.1040	.1757	.0529	−.6138
1.15	.8749	.2059	.0664	.3973	−.6561	1.65	.9505	.1023	.1762	.0468	−.6057
1.16	.8770	.2036	.0704	.3907	−.6643	1.66	.9515	.1006	.1766	.0408	−.5975
1.17	.8790	.2012	.0742	.3840	−.6720	1.67	.9525	.0989	.1770	.0349	−.5891
1.18	.8810	.1989	.0780	.3772	−.6792	1.68	.9535	.0973	.1773	.0290	−.5806
1.19	.8830	.1965	.0818	.3704	−.6861	1.69	.9545	.0957	.1776	.0233	−.5720
1.20	.8849	.1942	.0854	.3635	−.6926	1.70	.9554	.0940	.1778	.0176	−.5632
1.21	.8869	.1919	.0890	.3566	−.6986	1.71	.9564	.0925	.1779	.0120	−.5542
1.22	.8888	.1895	.0926	.3496	−.7042	1.72	.9573	.0909	.1780	.0065	−.5452
1.23	.8907	.1872	.0960	.3425	−.7094	1.73	.9582	.0893	.1780	.0011	−.5360
1.24	.8925	.1849	.0994	.3354	−.7141	1.74	.9591	.0878	.1780	−.0042	−.5267
1.25	.8944	.1826	.1027	.3282	−.7185	1.75	.9599	.0863	.1780	−.0094	−.5173
1.26	.8962	.1804	.1060	.3210	−.7224	1.76	.9608	.0848	.1778	−.0146	−.5079
1.27	.8980	.1781	.1092	.3138	−.7259	1.77	.9616	.0833	.1777	−.0196	−.4983
1.28	.8997	.1758	.1123	.3065	−.7291	1.78	.9625	.0818	.1774	−.0245	−.4887
1.29	.9015	.1736	.1153	.2992	−.7318	1.79	.9633	.0804	.1772	−.0294	−.4789
1.30	.9032	.1714	.1182	.2918	−.7341	1.80	.9641	.0790	.1769	−.0341	−.4692
1.31	.9049	.1691	.1211	.2845	−.7361	1.81	.9649	.0775	.1765	−.0388	−.4593
1.32	.9066	.1669	.1239	.2771	−.7376	1.82	.9656	.0761	.1761	−.0433	−.4494
1.33	.9082	.1647	.1267	.2697	−.7388	1.83	.9664	.0748	.1756	−.0477	−.4395
1.34	.9099	.1626	.1293	.2624	−.7395	1.84	.9671	.0734	.1751	−.0521	−.4295
1.35	.9115	.1604	.1319	.2550	−.7399	1.85	.9678	.0721	.1746	−.0563	−.4195
1.36	.9131	.1582	.1344	.2476	−.7400	1.86	.9686	.0707	.1740	−.0605	−.4095
1.37	.9147	.1561	.1369	.2402	−.7396	1.87	.9693	.0694	.1734	−.0645	−.3995
1.38	.9162	.1539	.1392	.2328	−.7389	1.88	.9699	.0681	.1727	−.0685	−.3894
1.39	.9177	.1518	.1415	.2254	−.7378	1.89	.9706	.0669	.1720	−.0723	−.3793
1.40	.9192	.1497	.1437	.2180	−.7364	1.90	.9713	.0656	.1713	−.0761	−.3693
1.41	.9207	.1476	.1459	.2107	−.7347	1.91	.9719	.0644	.1705	−.0797	−.3592
1.42	.9222	.1456	.1480	.2033	−.7326	1.92	.9726	.0632	.1697	−.0832	−.3492
1.43	.9236	.1435	.1500	.1960	−.7301	1.93	.9732	.0620	.1688	−.0867	−.3392
1.44	.9251	.1415	.1519	.1887	−.7274	1.94	.9738	.0608	.1679	−.0900	−.3292
1.45	.9265	.1394	.1537	.1815	−.7243	1.95	.9744	.0596	.1670	−.0933	−.3192
1.46	.9279	.1374	.1555	.1742	−.7209	1.96	.9750	.0584	.1661	−.0964	−.3093
1.47	.9292	.1354	.1572	.1670	−.7172	1.97	.9756	.0573	.1651	−.0994	−.2994
1.48	.9306	.1334	.1588	.1599	−.7132	1.98	.9761	.0562	.1641	−.1024	−.2895
1.49	.9319	.1315	.1604	.1528	−.7089	1.99	.9767	.0551	.1630	−.1052	−.2797

The sum of those terms of $(p+q)^n \equiv \sum_{t=0}^{n} \binom{n}{t} p^{n-t} q^t$, $p+q=1$, in which t ranges from a to b, inclusive, a and b being integers, $(a \leqq t \leqq b)$, is (if n is large enough) approximately

$$\int_{x_1}^{x_2} \phi(x)\,dx + \left[\frac{q-p}{6\sigma}\phi^{(2)}(x) + \frac{1}{24}\left(\frac{1}{\sigma^2} - \frac{6}{n}\right)\phi^{(3)}(x)\right]_{x_1}^{x_2},$$

where $x_1 = (a - \frac{1}{2} - qn)/\sigma$, $x_2 = (b + \frac{1}{2} - qn)/\sigma$.

PROBABILITY FUNCTIONS

x	$\frac{1}{2}(1+\alpha)$	$\Phi(x)$	$\Phi^{(2)}(x)$	$\Phi^{(3)}(x)$	$\Phi^{(4)}(x)$	x	$\frac{1}{2}(1+\alpha)$	$\Phi(x)$	$\Phi^{(2)}(x)$	$\Phi^{(3)}(x)$	$\Phi^{(4)}(x)$
2.00	.9772	.0540	.1620	−.1080	−.2700	2.50	.9938	.0175	.0920	−.1424	.0800
2.01	.9778	.0529	.1609	−.1106	−.2603	2.51	.9940	.0171	.0906	−.1416	.0836
2.02	.9783	.0519	.1598	−.1132	−.2506	2.52	.9941	.0167	.0892	−.1408	.0871
2.03	.9788	.0508	.1586	−.1157	−.2411	2.53	.9943	.0163	.0878	−.1399	.0905
2.04	.9793	.0498	.1575	−.1180	−.2316	2.54	.9945	.0158	.0864	−.1389	.0937
2.05	.9798	.0488	.1563	−.1203	−.2222	2.55	.9946	.0154	.0850	−.1380	.0968
2.06	.9803	.0478	.1550	−.1225	−.2129	2.56	.9948	.0151	.0836	−.1370	.0998
2.07	.9808	.0468	.1538	−.1245	−.2036	2.57	.9949	.0147	.0823	−.1360	.1027
2.08	.9812	.0459	.1526	−.1265	−.1945	2.58	.9951	.0143	.0809	−.1350	.1054
2.09	.9817	.0449	.1513	−.1284	−.1854	2.59	.9952	.0139	.0796	−.1339	.1080
2.10	.9821	.0440	.1500	−.1302	−.1765	2.60	.9953	.0136	.0782	−.1328	.1105
2.11	.9826	.0431	.1487	−.1320	−.1676	2.61	.9955	.0132	.0769	−.1317	.1129
2.12	.9830	.0422	.1474	−.1336	−.1588	2.62	.9956	.0129	.0756	−.1305	.1152
2.13	.9834	.0413	.1460	−.1351	−.1502	2.63	.9957	.0126	.0743	−.1294	.1173
2.14	.9838	.0404	.1446	−.1366	−.1416	2.64	.9959	.0122	.0730	−.1282	.1194
2.15	.9842	.0395	.1433	−.1380	−.1332	2.65	.9960	.0119	.0717	−.1270	.1213
2.16	.9846	.0387	.1419	−.1393	−.1249	2.66	.9961	.0116	.0705	−.1258	.1231
2.17	.9850	.0379	.1405	−.1405	−.1167	2.67	.9962	.0113	.0692	−.1245	.1248
2.18	.9854	.0371	.1391	−.1416	−.1086	2.68	.9963	.0110	.0680	−.1233	.1264
2.19	.9857	.0363	.1377	−.1426	−.1006	2.69	.9964	.0107	.0668	−.1220	.1279
2.20	.9861	.0355	.1362	−.1436	−.0927	2.70	.9965	.0104	.0656	−.1207	.1293
2.21	.9864	.0347	.1348	−.1445	−.0850	2.71	.9966	.0101	.0644	−.1194	.1306
2.22	.9868	.0339	.1333	−.1453	−.0774	2.72	.9967	.0099	.0632	−.1181	.1317
2.23	.9871	.0332	.1319	−.1460	−.0700	2.73	.9968	.0096	.0620	−.1168	.1328
2.24	.9875	0325	.1304	−.1467	−.0626	2.74	.9969	.0093	.0608	−.1154	.1338
2.25	.9878	.0317	.1289	−.1473	−.0554	2.75	.9970	.0091	.0597	−.1141	.1347
2.26	.9881	.0310	.1275	−.1478	−.0484	2.76	.9971	.0088	.0585	−.1127	.1356
2.27	.9884	.0303	.1260	−.1483	−.0414	2.77	.9972	.0086	.0574	−.1114	.1363
2.28	.9887	.0297	.1245	−.1486	−.0346	2.78	.9973	.0084	.0563	−.1100	.1369
2.29	.9890	.0290	.1230	−.1490	−.0279	2.79	.9974	.0081	.0552	−.1087	.1375
2.30	.9893	.0283	.1215	−.1492	−.0214	2.80	.9974	.0079	.0541	−.1073	.1379
2.31	.9896	.0277	.1200	−.1494	−.0150	2.81	.9975	.0077	.0531	−.1059	.1383
2.32	.9898	.0270	.1185	−.1495	−.0088	2.82	.9976	.0075	.0520	−.1045	.1386
2.33	.9901	.0264	.1170	−.1496	−.0027	2.83	.9977	.0073	.0510	−.1031	.1389
2.34	.9904	.0258	.1155	−.1496	.0033	2.84	.9977	.0071	.0500	−.1017	.1390
2.35	.9906	.0252	.1141	−.1495	.0092	2.85	.9978	.0069	.0490	−.1003	.1391
2.36	.9909	.0246	.1126	−.1494	.0149	2.86	.9979	.0067	.0480	−.0990	.1391
2.37	.9911	.0241	.1111	−.1492	.0204	2.87	.9979	.0065	.0470	−.0976	.1391
2.38	.9913	.0235	.1096	−.1490	.0258	2.88	.9980	.0063	.0460	−.0962	.1389
2.39	.9916	.0229	.1081	−.1487	.0311	2.89	.9981	.0061	.0451	−.0948	.1388
2.40	.9918	.0224	.1066	−.1483	.0362	2.90	.9981	.0060	.0441	−.0934	.1385
2.41	.9920	.0219	.1051	−.1480	.0412	2.91	.9982	.0058	.0432	−.0920	.1382
2.42	.9922	.0213	.1036	−.1475	.0461	2.92	.9982	.0056	.0423	−.0906	.1378
2.43	.9925	.0208	.1022	−.1470	.0508	2.93	.9983	.0055	.0414	−.0893	.1374
2.44	.9927	.0203	.1007	−.1465	.0554	2.94	.9984	.0053	.0405	−.0879	.1369
2.45	.9929	.0198	.0992	−.1459	.0598	2.95	.9984	.0051	.0396	−.0865	.1364
2.46	.9931	.0194	.0978	−.1453	.0641	2.96	.9985	.0050	.0388	−.0852	.1358
2.47	.9932	.0189	.0963	−.1446	.0683	2.97	.9985	.0048	.0379	−.0838	.1352
2.48	.9934	.0184	.0949	−.1439	.0723	2.98	.9986	.0047	.0371	−.0825	.1345
2.49	.9936	.0180	.0935	−.1432	.0762	2.99	.9986	.0046	.0363	−.0811	.1337

The sum of the first $(t+1)$ terms of

$(p+q)^n \equiv \sum_{t=0}^{n} \binom{n}{t} p^{n-t} q^t$, $p+q=1$, is approximately,

$$\int_x^\infty \phi(x)\,dx + \frac{q-p}{6\sigma}\,\phi^{(2)}(x) - \frac{1}{24}\left(\frac{1}{\sigma^2} - \frac{6}{n}\right)\phi^{(3)}(x),$$

where $x = (s - \frac{1}{2} - np)/\sigma$, $s = n - t$. The sum of the last $(s+1)$ terms is approximately

$$\int_x^\infty \phi(x)\,dx - \frac{q-p}{6\sigma}\,\phi^{(2)}(x) - \frac{1}{24}\left(\frac{1}{\sigma^2} - \frac{6}{n}\right)\phi^{(2)}(x),$$

where $x = (t - \frac{1}{2} - nq)/\sigma$.

PROBABILITY FUNCTIONS

x	$\frac{1}{2}(1+\alpha)$	$\Phi(x)$	$\Phi^{(2)}(x)$	$\Phi^{(3)}(x)$	$\Phi^{(4)}(x)$	x	$\frac{1}{2}(1+\alpha)$	$\Phi(x)$	$\Phi^{(2)}(x)$	$\Phi^{(3)}(x)$	$\Phi^{(4)}(x)$
3.00	.9987	.0044	.0355	−.0798	.1330	3.50	.9998	.0009	.0098	−.0283	.0694
3.01	.9987	.0043	.0347	−.0785	.1321	3.51	.9998	.0008	.0095	−.0276	.0681
3.02	.9987	.0042	.0339	−.0771	.1313	3.52	.9998	.0008	.0093	−.0269	.0669
3.03	.9988	.0040	.0331	−.0758	.1304	3.53	.9998	.0008	.0090	−.0262	.0656
3.04	.9988	.0039	.0324	−.0745	.1294	3.54	.9998	.0008	.0087	−.0256	.0643
3.05	.9989	.0038	.0316	−.0732	.1285	3.55	.9998	.0007	.0085	−.0249	.0631
3.06	.9989	.0037	.0309	−.0720	.1275	3.56	.9998	.0007	.0082	−.0243	.0618
3.07	.9989	.0036	.0302	−.0707	.1264	3.57	.9998	.0007	.0080	−.0237	.0606
3.08	.9990	.0035	.0295	−.0694	.1254	3.58	.9998	.0007	.0078	−.0231	.0594
3.09	.9990	.0034	.0288	−.0682	.1243	3.59	.9998	.0006	.0075	−.0225	.0582
3.10	.9990	.0033	.0281	−.0669	.1231	3.60	.9998	.0006	.0073	−.0219	.0570
3.11	.9991	.0032	.0275	−.0657	.1220	3.61	.9999	.0006	.0071	−.0214	.0559
3.12	.9991	.0031	.0268	−.0645	.1208	3.62	.9999	.0006	.0069	−.0208	.0547
3.13	.9991	.0030	.0262	−.0633	.1196	3.63	.9999	.0006	.0067	−.0203	.0536
3.14	.9992	.0029	.0256	−.0621	.1184	3.64	.9999	.0005	.0065	−.0198	.0524
3.15	.9992	.0028	.0249	−.0609	.1171	3.65	.9999	.0005	.0063	−.0192	.0513
3.16	.9992	.0027	.0243	−.0598	.1159	3.66	.9999	.0005	.0061	−.0187	.0502
3.17	.9992	.0026	.0237	−.0586	.1146	3.67	.9999	.0005	.0059	−.0182	.0492
3.18	.9993	.0025	.0232	−.0575	.1133	3.68	.9999	.0005	.0057	−.0177	.0481
3.19	.9993	.0025	.0226	−.0564	.1120	3.69	.9999	.0004	.0056	−.0173	.0470
3.20	.9993	.0024	.0220	−.0552	.1107	3.70	.9999	.0004	.0054	−.0168	.0460
3.21	.9993	.0023	.0215	−.0541	.1093	3.71	.9999	.0004	.0052	−.0164	.0450
3.22	.9994	.0022	.0210	−.0531	.1080	3.72	.9999	.0004	.0051	−.0159	.0440
3.23	.9994	.0022	.0204	−.0520	.1066	3.73	.9999	.0004	.0049	−.0155	.0430
3.24	.9994	.0021	.0199	−.0509	.1053	3.74	.9999	.0004	.0048	−.0150	.0420
3.25	.9994	.0020	.0194	−.0499	.1039	3.75	.9999	.0004	.0046	−.0146	.0410
3.26	.9994	.0020	.0189	−.0488	.1025	3.76	.9999	.0003	.0045	−.0142	.0401
3.27	.9995	.0019	.0184	−.0478	.1011	3.77	.9999	.0003	.0043	−.0138	.0392
3.28	.9995	.0018	.0180	−.0468	.0997	3.78	.9999	.0003	.0042	−.0134	.0382
3.29	.9995	.0018	.0175	−.0458	.0983	3.79	.9999	.0003	.0041	−.0131	.0373
3.30	.9995	.0017	.0170	−.0449	.0969	3.80	.9999	.0003	.0039	−.0127	.0365
3.31	.9995	.0017	.0166	−.0439	.0955	3.81	.9999	.0003	.0038	−.0123	.0356
3.32	.9996	.0016	.0162	−.0429	.0941	3.82	.9999	.0003	.0037	−.0120	.0347
3.33	.9996	.0016	.0157	−.0420	.0927	3.83	.9999	.0003	.0036	−.0116	.0339
3.34	.9996	.0015	.0153	−.0411	.0913	3.84	.9999	.0003	.0034	−.0113	.0331
3.35	.9996	.0015	.0149	−.0402	.0899	3.85	.9999	.0002	.0033	−.0110	.0323
3.36	.9996	.0014	.0145	−.0393	.0885	3.86	.9999	.0002	.0032	−.0107	.0315
3.37	.9996	.0014	.0141	−.0384	.0871	3.87	1.0000	.0002	.0031	−.0104	.0307
3.38	.9996	.0013	.0138	−.0376	.0857	3.88	1.0000	.0002	.0030	−.0100	.0299
3.39	.9997	.0013	.0134	−.0367	.0843	3.89	1.0000	.0002	.0029	−.0098	.0292
3.40	.9997	.0012	.0130	−.0359	.0829	3.90	1.0000	.0002	.0028	−.0095	.0284
3.41	.9997	.0012	.0127	−.0350	.0815	3.91	1.0000	.0002	.0027	−.0092	.0277
3.42	.9997	.0012	.0123	−.0342	.0801	3.92	1.0000	.0002	.0026	−.0089	.0270
3.43	.9997	.0011	.0120	−.0334	.0788	3.93	1.0000	.0002	.0026	−.0086	.0263
3.44	.9997	.0011	.0116	−.0327	.0774	3.94	1.0000	.0002	.0025	−.0084	.0256
3.45	.9997	.0010	.0113	−.0319	.0761	3.95	1.0000	.0002	.0024	−.0081	.0250
3.46	.9997	.0010	.0110	−.0311	.0747	3.96	1.0000	.0002	.0023	−.0079	.0243
3.47	.9997	.0010	.0107	−.0304	.0734	3.97	1.0000	.0002	.0022	−.0076	.0237
3.48	.9998	.0009	.0104	−.0297	.0721	3.98	1.0000	.0001	.0022	−.0074	.0230
3.49	.9998	.0009	.0101	−.0290	.0707	3.99	1.0000	.0001	.0021	−.0072	.0224

4.00	1.0000	.0001	.0020	−.0070	.0218	4.50	1.0000	.0000	.0003	−.0012	.0047
4.05	1.0000	.0001	.0017	−.0059	.0190	4.55	1.0000	.0000	.0003	−.0010	.0039
4.10	1.0000	.0001	.0014	−.0051	.0165	4.60	1.0000	.0000	.0002	−.0009	.0033
4.15	1.0000	.0001	.0012	−.0043	.0143	4.65	1.0000	.0000	.0002	−.0007	.0027
4.20	1.0000	.0001	.0010	−.0036	.0123	4.70	1.0000	.0000	.0001	−.0006	.0023
4.25	1.0000	.0001	.0008	−.0031	.0105	4.75	1.0000	.0000	.0001	−.0005	.0019
4.30	1.0000	.0000	.0007	−.0026	.0090	4.80	1.0000	.0000	.0001	−.0004	.0016
4.35	1.0000	.0000	.0006	−.0022	.0077	4.85	1.0000	.0000	.0001	−.0003	.0013
4.40	1.0000	.0000	.0005	−.0018	.0065	4.90	1.0000	.0000	.0001	−.0003	.0011
4.45	1.0000	.0000	.0004	−.0015	.0055	4.95	1.0000	.0000	.0000	−.0002	.0009

Table XXV c

FACTORS FOR COMPUTING PROBABLE ERRORS

n	$\frac{1}{\sqrt{n}}$	$\frac{1}{\sqrt{n(n-1)}}$	$\frac{.6745}{\sqrt{n-1}}$	$\frac{.6745}{\sqrt{n(n-1)}}$	$\frac{.8453}{n\sqrt{n-1}}$	$\frac{.8453}{\sqrt{n(n-1)}}$
2	.707 107	.707 107	.6745	.4769	.4227	.5978
3	.577 350	.408 248	.4769	.2754	.1993	.3451
4	.500 000	.288 675	.3894	.1947	.1220	.2440
5	.447 214	.223 607	.3372	.1508	.0845	.1890
6	.408 248	.182 574	.3016	.1231	.0630	.1543
7	.377 964	.154 303	.2754	.1041	.0493	.1304
8	.353 553	.133 631	.2549	.0901	.0399	.1130
9	.333 333	.117 851	.2385	.0795	.0332	.0996
10	.316 228	.105 409	.2248	.0711	.0282	.0891
11	.301 511	.095 346	.2133	.0643	.0243	.0806
12	.288 675	.087 039	.2034	.0587	.0212	.0736
13	.277 350	.080 064	.1947	.0540	.0188	.0677
14	.267 261	.074 125	.1871	.0500	.0167	.0627
15	.258 199	.069 007	.1803	.0465	.0151	.0583
16	.250 000	.064 550	.1742	.0435	.0136	.0546
17	.242 536	.060 634	.1686	.0409	.0124	.0513
18	.235 702	.057 166	.1636	.0386	.0114	.0483
19	.229 416	.054 074	.1590	.0365	.0105	.0457
20	.223 607	.051 299	.1547	.0346	.0097	.0434
21	.218 218	.048 795	.1508	.0329	.0090	.0412
22	.213 201	.046 524	.1472	.0314	.0084	.0393
23	.208 514	.044 455	.1438	.0300	.0078	.0376
24	.204 124	.042 563	.1406	.0287	.0073	.0360
25	.200 000	.040 825	.1377	.0275	.0069	.0345
26	.196 116	.039 223	.1349	.0265	.0065	.0332
27	.192 450	.037 743	.1323	.0255	.0061	.0319
28	.188 982	.036 370	.1298	.0245	.0058	.0307
29	.185 695	.035 093	.1275	.0237	.0055	.0297
30	.182 574	.033 903	.1252	.0229	.0052	.0287
31	.179 605	.032 791	.1231	.0221	.0050	.0277
32	.176 777	.031 750	.1211	.0214	.0047	.0268
33	.174 078	.030 773	.1192	.0208	.0045	.0260
34	.171 499	.029 854	.1174	.0201	.0043	.0252
35	.169 031	.028 989	.1157	.0196	.0041	.0245
36	.166 667	.028 172	.1140	.0190	.0040	.0238
37	.164 399	.027 400	.1124	.0185	.0038	.0232
38	.162 221	.026 669	.1109	.0180	.0037	.0225
39	.160 128	.025 976	.1094	.0175	.0035	.0220
40	.158 114	.025 318	.1080	.0171	.0034	.0214
41	.156 174	.024 693	.1066	.0167	.0033	.0209
42	.154 303	.024 098	.1053	.0163	.0031	.0204
43	.152 499	.023 531	.1041	.0159	.0030	.0199
44	.150 756	.022 990	.1029	.0155	.0029	.0194
45	.149 071	.022 473	.1017	.0152	.0028	.0190
46	.147 442	.021 979	.1005	.0148	.0027	.0186
47	.145 865	.021 507	.0994	.0145	.0027	.0182
48	.144 338	.021 054	.0984	.0142	.0026	.0178
49	.142 857	.020 620	.0974	.0139	.0025	.0174

The *probable error* of a single observation in a series of n measures, $t_1, t_2, \ldots, t_n$, the arithmetic mean of which is m, is

$$e = \frac{0.6745}{\sqrt{n-1}}\sqrt{(m-t_1)^2 + (m-t_2)^2 + \ldots + (m-t_n)^2};$$

the probable error of the mean is

$$E = \frac{0.6745}{\sqrt{n(n-1)}}\sqrt{(m-t_1)^2 + (m-t_2)^2 + \ldots + (m-t_n)^2}.$$

FACTORS FOR COMPUTING PROBABLE ERRORS

n	$\frac{1}{\sqrt{n}}$	$\frac{1}{\sqrt{n(n-1)}}$	$\frac{.6745}{\sqrt{n-1}}$	$\frac{.6745}{\sqrt{n(n-1)}}$	$\frac{.8453}{n\sqrt{n-1}}$	$\frac{.8453}{\sqrt{n(n-1)}}$
50	.141 421	.020 203	.0964	.0136	.0024	.0171
51	.140 028	.019 803	.0954	.0134	.0023	.0167
52	.138 675	.019 418	.0945	.0131	.0023	.0164
53	.137 361	.019 048	.0935	.0129	.0022	.0161
54	.136 083	.018 692	.0927	.0126	.0022	.0158
55	.134 840	.018 349	.0918	.0124	.0021	.0155
56	.133 631	.018 019	.0910	.0122	.0020	.0152
57	.132 453	.017 700	.0901	.0119	.0020	.0150
58	.131 306	.017 392	.0893	.0117	.0019	.0147
59	.130 189	.017 095	.0886	.0115	.0019	.0145
60	.129 099	.016 807	.0878	.0113	.0018	.0142
61	.128 037	.016 529	.0871	.0112	.0018	.0140
62	.127 000	.016 261	.0864	.0110	.0018	.0138
63	.125 988	.016 001	.0857	.0108	.0017	.0135
64	.125 000	.015 749	.0850	.0106	.0017	.0133
65	.124 035	.015 504	.0843	.0105	.0016	.0131
66	.123 091	.015 268	.0837	.0103	.0016	.0129
67	.122 169	.015 038	.0830	.0101	.0016	.0127
68	.121 268	.014 815	.0824	.0100	.0015	.0125
69	.120 386	.014 599	.0818	.0099	.0015	.0123
70	.119 523	.014 389	.0812	.0097	.0015	.0122
71	.118 678	.014 185	.0806	.0096	.0014	.0120
72	.117 851	.013 986	.0801	.0094	.0014	.0118
73	.117 041	.013 793	.0795	.0093	.0014	.0117
74	.116 248	.013 606	.0789	.0092	.0013	.0115
75	.115 470	.013 423	.0784	.0091	.0013	.0113
76	.114 708	.013 245	.0779	.0089	.0013	.0112
77	.113 961	.013 072	.0773	.0088	.0013	.0111
78	.113 228	.012 904	.0769	.0087	.0012	.0109
79	.112 509	.012 739	.0764	.0086	.0012	.0108
80	.111 803	.012 579	.0759	.0085	.0012	.0106
81	.111 111	.012 423	.0754	.0084	.0012	.0105
82	.110 432	.012 270	.0749	.0083	.0012	.0104
83	.109 764	.012 121	.0745	.0082	.0011	.0103
84	.109 109	.011 976	.0740	.0081	.0011	.0101
85	.108 465	.011 835	.0736	.0080	.0011	.0100
86	.107 833	.011 696	.0732	.0079	.0011	.0099
87	.107 211	.011 561	.0727	.0078	.0011	.0098
88	.106 600	.011 429	.0723	.0077	.0010	.0097
89	.106 000	.011 300	.0719	.0076	.0010	.0096
90	.105 409	.011 173	.0715	.0075	.0010	.0094
91	.104 828	.011 050	.0711	.0075	.0010	.0093
92	.104 257	.010 929	.0707	.0074	.0010	.0092
93	.103 695	.010 811	.0703	.0073	.0010	.0091
94	.103 142	.010 695	.0699	.0072	.0009	.0090
95	.102 598	.010 582	.0696	.0071	.0009	.0089
96	.102 062	.010 471	.0692	.0071	.0009	.0089
97	.101 535	.010 363	.0688	.0070	.0009	.0088
98	.101 015	.010 257	.0685	.0069	.0009	.0087
99	.100 504	.010 152	.0681	.0069	.0009	.0086
100	.100 000	.010 050	.0678	.0068	.0008	.0085

Approximate values of e and E are

$$e = 0.8453 \frac{\sum_{i=1}^{n} d_i}{\sqrt{n(n-1)}}, \quad E = 0.8453 \frac{\sum_{i=1}^{n} d_i}{n\sqrt{n-1}},$$

where $\sum_{i=1}^{n} d_i$ is the sum of the deviations $d_i = |t_i - m|$.

Table XXVI

COMPLETE ELLIPTIC INTEGRALS, K AND E, FOR DIFFERENT VALUES OF THE MODULUS, k

$$K = \int_0^{\frac{\pi}{2}} \frac{dx}{\sqrt{1-k^2\sin^2 x}}; \quad E = \int_0^{\frac{\pi}{2}} \sqrt{1-k^2\sin^2 x} \cdot dx$$

$\sin^{-1}k$	K	E
0°	1.5708	1.5708
1	1.5709	1.5707
2	1.5713	1.5703
3	1.5719	1.5697
4	1.5727	1.5689
5	1.5738	1.5678
6	1.5751	1.5665
7	1.5767	1.5649
8	1.5785	1.5632
9	1.5805	1.5611
10	1.5828	1.5589
11	1.5854	1.5564
12	1.5882	1.5537
13	1.5913	1.5507
14	1.5946	1.5476
15	1.5981	1.5442
16	1.6020	1.5405
17	1.6061	1.5367
18	1.6105	1.5326
19	1.6151	1.5283
20	1.6200	1.5238
21	1.6252	1.5191
22	1.6307	1.5141
23	1.6365	1.5090
24	1.6426	1.5037
25	1.6490	1.4981
26	1.6557	1.4924
27	1.6627	1.4864
28	1.6701	1.4803
29	1.6777	1.4740
30	1.6858	1.4675
31	1.6941	1.4608
32	1.7028	1.4539
33	1.7119	1.4469
34	1.7214	1.4397
35	1.7312	1.4323
36	1.7415	1.4248
37	1.7522	1.4171
38	1.7633	1.4092
39	1.7748	1.4013
40	1.7868	1.3931
41	1.7992	1.3849
42	1.8122	1.3765
43	1.8256	1.3680
44	1.8396	1.3594
45	1.8541	1.3506
46	1.8691	1.3418
47	1.8848	1.3329
48	1.9011	1.3238
49	1.9180	1.3147

$\sin^{-1}k$	K	E
50°	1.9356	1.3055
51	1.9539	1.2963
52	1.9729	1.2870
53	1.9927	1.2776
54	2.0133	1.2681
55	2.0347	1.2587
56	2.0571	1.2492
57	2.0804	1.2397
58	2.1047	1.2301
59	2.1300	1.2206
60	2.1565	1 2111
61	2.1842	1.2015
62	2.2132	1.1921
63	2.2435	1.1826
64	2.2754	1.1732
65	2.3088	1.1638
65.5	2.3261	1.1592
66.0	2.3439	1.1546
66.5	2.3622	1.1499
67.0	2.3809	1.1454
67.5	2.4001	1.1408
68.0	2.4198	1.1362
68.5	2.4401	1.1317
69.0	2.4610	1.1273
69.5	2.4825	1.1228
70.0	2.5046	1.1184
70.5	2.5273	1.1140
71.0	2.5507	1.1096
71.5	2.5749	1.1053
72.0	2.5998	1.1011
72.5	2.6256	1.0968
73.0	2.6521	1.0927
73.5	2.6796	1.0885
74.0	2.7081	1.0844
74.5	2.7375	1.0804
75.0	2.7681	1.0764
75.5	2.7998	1.0725
76.0	2.8327	1.0686
76.5	2.8669	1.0648
77.0	2.9026	1.0611
77.5	2.9397	1.0574
78.0	2.9786	1.0538
78.5	3.0192	1.0502
79.0	3.0617	1.0468
79.5	3.1064	1.0434
80.0	3.1534	1.0401
80.2	3.1729	1.0388
80.4	3.1928	1.0375
80.6	3.2132	1.0363
80.8	3.2340	1.0350

$\sin^{-1}k$	K	E
81°.0	3.2553	1.0338
81.2	3.2771	1.0326
81.4	3.2995	1.0313
81.6	3.3223	1.0302
81.8	3.3458	1.0290
82.0	3.3699	1.0278
82.2	3.3946	1.0267
82.4	3.4199	1.0256
82.6	3.4460	1.0245
82.8	3.4728	1.0234
83.0	3.5004	1.0223
83.2	3.5288	1.0213
83.4	3.5581	1.0202
83.6	3.5884	1.0192
83.8	3.6196	1.0182
84.0	3.6519	1.0172
84.2	3.6853	1.0163
84.4	3.7198	1.0153
84.6	3.7557	1.0144
84.8	3.7930	1.0135
85.0	3.8317	1.0127
85.2	3.8721	1.0118
85.4	3.9142	1.0110
85.6	3.9583	1.0102
85.8	4.0044	1.0094
86.0	4.0528	1.0087
86.2	4.1037	1.0079
86.4	4.1574	1.0072
86.6	4.2142	1.0065
86.8	4.2744	1.0059
87.0	4.3387	1.0053
87.2	4.4073	1.0047
87.4	4.4812	1.0041
87.6	4.5619	1.0036
87.8	4.6477	1.0031
88.0	4.7427	1.0026
88.2	4.8479	1.0022
88.4	4.9654	1.0017
88.6	5.0988	1.0014
88.8	5.2527	1.0010
89.0	5.4349	1.0008
89.1	5.5402	1.0006
89.2	5.6579	1.0005
89.3	5.7914	1.0005
89.4	5.9455	1.0003
89.5	6.1278	1.0002
89.6	6.3504	1.0001
89.7	6.6385	1.0001
89.8	7.0440	1.0000
89.9	7.7371	1.0000

Table XXVI.

LOGARITHMS OF TRIGONOMETRIC FUNCTIONS

Deg.	Log Rad	Log Sin	Log Cos	Log Tan	Log Ctn	Log Sec	Log Csc		
0	.....	.....	10.0000	.....	.....	0.0000	.....	0.1961	90
1	8.2419	8.2419	9.9999	8.2419	1.7581	0.0001	1.7581	0.1913	89
2	8.5429	8.5428	9.9997	8.5431	1.4569	0.0003	1.4572	0.1864	88
3	8.7190	8.7188	9.9994	8.7194	1.2806	0.0006	1.2812	0.1814	87
4	8.8439	8.8436	9.9989	8.8446	1.1554	0.0011	1.1564	0.1764	86
5	8.9408	8.9403	9.9983	8.9420	1.0580	0.0017	1.0597	0.1713	85
6	9.0200	9.0192	9.9976	9.0216	0.9784	0.0024	0.9808	0.1662	84
7	9.0870	9.0859	9.9968	9.0891	0.9109	0.0032	0.9141	0.1610	83
8	9.1450	9.1436	9.9958	9.1478	0.8522	0.0042	0.8564	0.1557	82
9	9.1961	9.1943	9.9946	9.1997	0.8003	0.0054	0.8057	0.1504	81
10	9.2419	9.2397	9.9934	9.2463	0.7537	0.0066	0.7603	0.1450	80
11	9.2833	9.2806	9.9919	9.2887	0.7113	0.0081	0.7194	0.1395	79
12	9.3211	9.3179	9.9904	9.3275	0.6725	0.0096	0.6821	0.1340	78
13	9.3558	9.3521	9.9887	9.3634	0.6366	0.0113	0.6479	0.1284	77
14	9.3880	9.3837	9.9869	9.3968	0.6032	0.0131	0.6163	0.1227	76
15	9.4180	9.4130	9.9849	9.4281	0.5719	0.0151	0.5870	0.1169	75
16	9.4460	9.4403	9.9828	9.4575	0.5425	0.0172	0.5597	0.1111	74
17	9.4723	9.4659	9.9806	9.4853	0.5147	0.0194	0.5341	0.1052	73
18	9.4971	9.4900	9.9782	9.5118	0.4882	0.0218	0.5100	0.0992	72
19	9.5206	9.5126	9.9757	9.5370	0.4630	0.0243	0.4874	0.0931	71
20	9.5429	9.5341	9.9730	9.5611	0.4389	0.0270	0.4659	0.0870	70
21	9.5641	9.5543	9.9702	9.5842	0.4158	0.0298	0.4457	0.0807	69
22	9.5843	9.5736	9.9672	9.6064	0.3936	0.0328	0.4264	0.0744	68
23	9.6036	9.5919	9.9640	9.6279	0.3721	0.0360	0.4081	0.0680	67
24	9.6221	9.6093	9.9607	9.6486	0.3514	0.0393	0.3907	0.0614	66
25	9.6398	9.6259	9.9573	9.6687	0.3313	0.0427	0.3741	0.0548	65
26	9.6569	9.6418	9.9537	9.6882	0.3118	0.0463	0.3582	0.0481	64
27	9.6732	9.6570	9.9499	9.7072	0.2928	0.0501	0.3430	0.0412	63
28	9.6890	9.6716	9.9459	9.7257	0.2743	0.0541	0.3284	0.0343	62
29	9.7042	9.6856	9.9418	9.7438	0.2562	0.0582	0.3144	0.0272	61
30	9.7190	9.6990	9.9375	9.7614	0.2386	0.0625	0.3010	0.0200	60
31	9.7332	9.7118	9.9331	9.7788	0.2212	0.0669	0.2882	0.0127	59
32	9.7470	9.7242	9.9284	9.7958	0.2042	0.0716	0.2758	0.0053	58
33	9.7604	9.7361	9.9236	9.8125	0.1875	0.0764	0.2639	9.9978	57
34	9.7734	9.7476	9.9186	9.8290	0.1710	0.0814	0.2524	9.9901	56
35	9.7859	9.7586	9.9134	9.8452	0.1548	0.0866	0.2414	9.9822	55
36	9.7982	9.7692	9.9080	9.8613	0.1387	0.0920	0.2308	9.9743	54
37	9.8101	9.7795	9.9023	9.8771	0.1229	0.0977	0.2205	9.9662	53
38	9.8217	9.7893	9.8965	9.8928	0.1072	0.1035	0.2107	9.9579	52
39	9.8329	9.7989	9.8905	9.9084	0.0916	0.1095	0.2011	9.9494	51
40	9.8439	9.8081	9.8843	9.9238	0.0762	0.1157	0.1919	9.9408	50
41	9.8547	9.8169	9.8778	9.9392	0.0608	0.1222	0.1831	9.9321	49
42	9.8651	9.8255	9.8711	9.9544	0.0456	0.1289	0.1745	9.9231	48
43	9.8753	9.8338	9.8641	9.9697	0.0303	0.1359	0.1662	9.9140	47
44	9.8853	9.8418	9.8569	9.9848	0.0152	0.1431	0.1582	9.9046	46
45	9.8951	9.8495	9.8495	0.0000	0.0000	0.1505	0.1505	9.8951	45
		Log Cos	Log Sin	Log Ctn	Log Tan	Log Csc	Log Sec	Log Rad	Deg.

Table XXVIII

NATURAL TRIGONOMETRIC FUNCTIONS

Deg.	Rad	Sin	Cos	Tan	Ctn	Sec	Csc		
0	0.0000	0.0000	1.0000	0.0000	.....	1.0000	.....	1.5708	90
1	0.0175	0.0175	0.9998	0.0175	57.290	1.0002	57.299	1.5533	89
2	0.0349	0.0349	0.9994	0.0349	28.636	1.0006	28.654	1.5359	88
3	0.0524	0.0523	0.9986	0.0524	19.081	1.0014	19.107	1.5184	87
4	0.0698	0.0698	0.9976	0.0699	14.301	1.0024	14.336	1.5010	86
5	0.0873	0.0872	0.9962	0.0875	11.430	1.0038	11.474	1.4835	85
6	0.1047	0.1045	0.9945	0.1051	9.5144	1.0055	9.5668	1.4661	84
7	0.1222	0.1219	0.9925	0.1228	8.1443	1.0075	8.2055	1.4486	83
8	0.1396	0.1392	0.9903	0.1405	7.1154	1.0098	7.1853	1.4312	82
9	0.1571	0.1564	0.9877	0.1584	6.3138	1.0125	6.3925	1.4137	81
10	0.1745	0.1736	0.9848	0.1763	5.6713	1.0154	5.7588	1.3963	80
11	0.1920	0.1908	0.9816	0.1944	5.1446	1.0187	5.2408	1.3788	79
12	0.2094	0.2079	0.9781	0.2126	4.7046	1.0223	4.8097	1.3614	78
13	0.2269	0.2250	0.9744	0.2309	4.3315	1.0263	4.4454	1.3439	77
14	0.2443	0.2419	0.9703	0.2493	4.0108	1.0306	4.1336	1.3265	76
15	0.2618	0.2588	0.9659	0.2679	3.7321	1.0353	3.8637	1.3090	75
16	0.2793	0.2756	0.9613	0.2867	3.4874	1.0403	3.6280	1.2915	74
17	0.2967	0.2924	0.9563	0.3057	3.2709	1.0457	3.4203	1.2741	73
18	0.3142	0.3090	0.9511	0.3249	3.0777	1.0515	3.2361	1.2566	72
19	0.3316	0.3256	0.9455	0.3443	2.9042	1.0576	3.0716	1.2392	71
20	0.3491	0.3420	0.9397	0.3640	2.7475	1.0642	2.9238	1.2217	70
21	0.3665	0.3584	0.9336	0.3839	2.6051	1.0711	2.7904	1.2043	69
22	0.3840	0.3746	0.9272	0.4040	2.4751	1.0785	2.6695	1.1868	68
23	0.4014	0.3907	0.9205	0.4245	2.3559	1.0864	2.5593	1.1694	67
24	0.4189	0.4067	0.9135	0.4452	2.2460	1.0946	2.4586	1.1519	66
25	0.4363	0.4226	0.9063	0.4663	2.1445	1.1034	2.3662	1.1345	65
26	0.4538	0.4384	0.8988	0.4877	2.0503	1.1126	2.2812	1.1170	64
27	0.4712	0.4540	0.8910	0.5095	1.9626	1.1223	2.2027	1.0996	63
28	0.4887	0.4695	0.8829	0.5317	1.8807	1.1326	2.1301	1.0821	62
29	0.5061	0.4848	0.8746	0.5543	1.8040	1.1434	2.0627	1.0647	61
30	0.5236	0.5000	0.8660	0.5774	1.7321	1.1547	2.0000	1.0472	60
31	0.5411	0.5150	0.8572	0.6009	1.6643	1.1666	1.9416	1.0297	59
32	0.5585	0.5299	0.8480	0.6249	1.6003	1.1792	1.8871	1.0123	58
33	0.5760	0.5446	0.8387	0.6494	1.5399	1.1924	1.8361	0.9948	57
34	0.5934	0.5592	0.8290	0.6745	1.4826	1.2062	1.7883	0.9774	56
35	0.6109	0.5736	0.8192	0.7002	1.4281	1.2208	1.7434	0.9599	55
36	0.6283	0.5878	0.8090	0.7265	1.3764	1.2361	1.7013	0.9425	54
37	0.6458	0.6018	0.7986	0.7536	1.3270	1.2521	1.6616	0.9250	53
38	0.6632	0.6157	0.7880	0.7813	1.2799	1.2690	1.6243	0.9076	52
39	0.6807	0.6293	0.7771	0.8098	1.2349	1.2868	1.5890	0.8901	51
40	0.6981	0.6428	0.7660	0.8391	1.1918	1.3054	1.5557	0.8727	50
41	0.7156	0.6561	0.7547	0.8693	1.1504	1.3250	1.5243	0.8552	49
42	0.7330	0.6691	0.7431	0.9004	1.1106	1.3456	1.4945	0.8378	48
43	0.7505	0.6820	0.7314	0.9325	1.0724	1.3673	1.4663	0.8203	47
44	0.7679	0.6947	0.7193	0.9657	1.0355	1.3902	1.4396	0.8029	46
45	0.7854	0.7071	0.7071	1.0000	1.0000	1.4142	1.4142	0.7854	45
		Cos	Sin	Ctn	Tan	Csc	Sec	Rad	Deg.

Table XXIX

FOUR-PLACE LOGARITHMS

N	L. 0	1	2	3	4	5	6	7	8	9	Proportional Parts 1	2	3	4	5
10	0000	0043	0086	0128	0170	0212	0253	0294	0334	0374	4	8	12	17	21
11	0414	0453	0492	0531	0569	0607	0645	0682	0719	0755	4	8	11	15	19
12	0792	0828	0864	0899	0934	0969	1004	1038	1072	1106	3	7	10	14	17
13	1139	1173	1206	1239	1271	1303	1335	1367	1399	1430	3	6	10	13	16
14	1461	1492	1523	1553	1584	1614	1644	1673	1703	1732	3	6	9	12	15
15	1761	1790	1818	1847	1875	1903	1931	1959	1987	2014	3	6	8	11	14
16	2041	2068	2095	2122	2148	2175	2201	2227	2253	2279	3	5	8	11	13
17	2304	2330	2355	2380	2405	2430	2455	2480	2504	2529	2	5	7	10	12
18	2553	2577	2601	2625	2648	2672	2695	2718	2742	2765	2	5	7	9	12
19	2788	2810	2833	2856	2878	2900	2923	2945	2967	2989	2	4	7	9	11
20	3010	3032	3054	3075	3096	3118	3139	3160	3181	3201	2	4	6	8	11
21	3222	3243	3263	3284	3304	3324	3345	3365	3385	3404	2	4	6	8	10
22	3424	3444	3464	3483	3502	3522	3541	3560	3579	3598	2	4	6	8	10
23	3617	3636	3655	3674	3692	3711	3729	3747	3766	3784	2	4	6	7	9
24	3802	3820	3838	3856	3874	3892	3909	3927	3945	3962	2	4	5	7	9
25	3979	3997	4014	4031	4048	4065	4082	4099	4116	4133	2	4	5	7	9
26	4150	4166	4183	4200	4216	4232	4249	4265	4281	4298	2	3	5	7	8
27	4314	4330	4346	4362	4378	4393	4409	4425	4440	4456	2	3	5	6	8
28	4472	4487	4502	4518	4533	4548	4564	4579	4594	4609	2	3	5	6	8
29	4624	4639	4654	4669	4683	4698	4713	4728	4742	4757	1	3	4	6	7
30	4771	4786	4800	4814	4829	4843	4857	4871	4886	4900	1	3	4	6	7
31	4914	4928	4942	4955	4969	4983	4997	5011	5024	5038	1	3	4	5	7
32	5051	5065	5079	5092	5105	5119	5132	5145	5159	5172	1	3	4	5	7
33	5185	5198	5211	5224	5237	5250	5263	5276	5289	5302	1	3	4	5	7
34	5315	5328	5340	5353	5366	5378	5391	5403	5416	5428	1	2	4	5	6
35	5441	5453	5465	5478	5490	5502	5514	5527	5539	5551	1	2	4	5	6
36	5563	5575	5587	5599	5611	5623	5635	5647	5658	5670	1	2	4	5	6
37	5682	5694	5705	5717	5729	5740	5752	5763	5775	5786	1	2	4	5	6
38	5798	5809	5821	5832	5843	5855	5866	5877	5888	5899	1	2	3	5	6
39	5911	5922	5933	5944	5955	5966	5977	5988	5999	6010	1	2	3	4	5
40	6021	6031	6042	6053	6064	6075	6085	6096	6107	6117	1	2	3	4	5
41	6128	6138	6149	6160	6170	6180	6191	6201	6212	6222	1	2	3	4	5
42	6232	6243	6253	6263	6274	6284	6294	6304	6314	6325	1	2	3	4	5
43	6335	6345	6355	6365	6375	6385	6395	6405	6415	6425	1	2	3	4	5
44	6435	6444	6454	6464	6474	6484	6493	6503	6513	6522	1	2	3	4	5
45	6532	6542	6551	6561	6571	6580	6590	6599	6609	6618	1	2	3	4	5
46	6628	6637	6646	6656	6665	6675	6684	6693	6702	6712	1	2	3	4	5
47	6721	6730	6739	6749	6758	6767	6776	6785	6794	6803	1	2	3	4	5
48	6812	6821	6830	6839	6848	6857	6866	6875	6884	6893	1	2	3	4	5
49	6902	6911	6920	6928	6937	6946	6955	6964	6972	6981	1	2	3	4	4
50	6990	6998	7007	7016	7024	7033	7042	7050	7059	7067	1	2	3	3	4
51	7076	7084	7093	7101	7110	7118	7126	7135	7143	7152	1	2	3	3	4
52	7160	7168	7177	7185	7193	7202	7210	7218	7226	7235	1	2	3	3	4
53	7243	7251	7259	7267	7275	7284	7292	7300	7308	7316	1	2	2	3	4
54	7324	7332	7340	7348	7356	7364	7372	7380	7388	7396	1	2	2	3	4
N	L. 0	1	2	3	4	5	6	7	8	9	1	2	3	4	5

FOUR-PLACE LOGARITHMS

N	L. 0	1	2	3	4	5	6	7	8	9	Proportional parts 1	2	3	4	5
55	7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4
56	7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4
57	7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	1	2	3	4
58	7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4
59	7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4
60	7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4
61	7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	2	3	3
62	7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	3
63	7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	3
64	8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3
65	8129	8136	8142	3149	8156	8162	8169	8176	8182	8189	1	1	2	3	3
66	8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3
67	8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	3
68	8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	3
69	8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	3	3
70	8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	3	3
71	8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	3	3
72	8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	3	3
73	8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3
74	8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3
75	8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3
76	8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3
77	8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3
78	8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3
79	8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3
80	9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3
81	9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3
82	9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3
83	9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3
84	9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3
85	9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	2	2	3
86	9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	2	2	3
87	9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	1	1	2	2	3
88	9445	9450	9455	9460	9465	9469	9474	9479	9484	9489	0	1	1	2	2
89	9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2
90	9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2
91	9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0	1	1	2	2
92	9638	9643	9647	9652	9657	9661	9666	9671	9675	9680	0	1	1	2	2
93	9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0	1	1	2	2
94	9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0	1	1	2	2
95	9777	9782	9786	9791	9795	9800	9805	9809	9814	9818	0	1	1	2	2
96	9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0	1	1	2	2
97	9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2
98	9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0	1	1	2	2
99	9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2
N	L. 0	1	2	3	4	5	6	7	8	9	1	2	3	4	5

Table XXX

FOUR-PLACE ANTILOGARITHMS

N	A. 0	1	2	3	4	5	6	7	8	9	Proportional parts 1	2	3	4	5
.00	1000	1002	1005	1007	1009	1012	1014	1016	1019	1021	0	0	1	1	1
.01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	0	0	1	1	1
.02	1047	1050	1052	1054	1057	1059	1062	1064	1067	1069	0	0	1	1	1
.03	1072	1074	1076	1079	1081	1084	1086	1089	1091	1094	0	0	1	1	1
.04	1096	1099	1102	1104	1107	1109	1112	1114	1117	1119	0	1	1	1	1
.05	1122	1125	1127	1130	1132	1135	1138	1140	1143	1146	0	1	1	1	1
.06	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	0	1	1	1	1
.07	1175	1178	1180	1183	1186	1189	1191	1194	1197	1199	0	1	1	1	1
.08	1202	1205	1208	1211	1213	1216	1219	1222	1225	1227	0	1	1	1	1
.09	1230	1233	1236	1239	1242	1245	1247	1250	1253	1256	0	1	1	1	1
.10	1259	1262	1265	1268	1271	1274	1276	1279	1282	1285	0	1	1	1	1
.11	1288	1291	1294	1297	1300	1303	1306	1309	1312	1315	0	1	1	1	2
.12	1318	1321	1324	1327	1330	1334	1337	1340	1343	1346	0	1	1	1	2
.13	1349	1352	1355	1358	1361	1365	1368	1371	1374	1377	0	1	1	1	2
.14	1380	1384	1387	1390	1393	1396	1400	1403	1406	1409	0	1	1	1	2
.15	1413	1416	1419	1422	1426	1429	1432	1435	1439	1442	0	1	1	1	2
.16	1445	1449	1452	1455	1459	1462	1466	1469	1472	1476	0	1	1	1	2
.17	1479	1483	1486	1489	1493	1496	1500	1503	1507	1510	0	1	1	1	2
.18	1514	1517	1521	1524	1528	1531	1535	1538	1542	1545	0	1	1	1	2
.19	1549	1552	1556	1560	1563	1567	1570	1574	1578	1581	0	1	1	1	2
.20	1585	1589	1592	1596	1600	1603	1607	1611	1614	1618	0	1	1	1	2
.21	1622	1626	1629	1633	1637	1641	1644	1648	1652	1656	0	1	1	1	2
.22	1660	1663	1667	1671	1675	1679	1683	1687	1690	1694	0	1	1	2	2
.23	1698	1702	1706	1710	1714	1718	1722	1726	1730	1734	0	1	1	2	2
.24	1738	1742	1746	1750	1754	1758	1762	1766	1770	1774	0	1	1	2	2
.25	1778	1782	1786	1791	1795	1799	1803	1807	1811	1816	0	1	1	2	2
.26	1820	1824	1828	1832	1837	1841	1845	1849	1854	1858	0	1	1	2	2
.27	1862	1866	1871	1875	1879	1884	1888	1892	1897	1901	0	1	1	2	2
.28	1905	1910	1914	1919	1923	1928	1932	1936	1941	1945	0	1	1	2	2
.29	1950	1954	1959	1963	1968	1972	1977	1982	1986	1991	0	1	1	2	2
.30	1995	2000	2004	2009	2014	2018	2023	2028	2032	2037	0	1	1	2	2
.31	2042	2046	2051	2056	2061	2065	2070	2075	2080	2084	0	1	1	2	2
.32	2089	2094	2099	2104	2109	2113	2118	2123	2128	2133	0	1	1	2	2
.33	2138	2143	2148	2153	2158	2163	2168	2173	2178	2183	0	1	1	2	2
.34	2188	2193	2198	2203	2208	2213	2218	2223	2228	2234	1	1	2	2	3
.35	2239	2244	2249	2254	2259	2265	2270	2275	2280	2286	1	1	2	2	3
.36	2291	2296	2301	2307	2312	2317	2323	2328	2333	2339	1	1	2	2	3
.37	2344	2350	2355	2360	2366	2371	2377	2382	2388	2393	1	1	2	2	3
.38	2399	2404	2410	2415	2421	2427	2432	2438	2443	2449	1	1	2	2	3
.39	2455	2460	2466	2472	2477	2483	2489	2495	2500	2506	1	1	2	2	3
.40	2512	2518	2523	2529	2535	2541	2547	2553	2559	2564	1	1	2	2	3
.41	2570	2576	2582	2588	2594	2600	2606	2612	2618	2624	1	1	2	2	3
.42	2630	2636	2642	2649	2655	2661	2667	2673	2679	2685	1	1	2	2	3
.43	2692	2698	2704	2710	2716	2723	2729	2735	2742	2748	1	1	2	2	3
.44	2754	2761	2767	2773	2780	2786	2793	2799	2805	2812	1	1	2	3	3
.45	2818	2825	2831	2838	2844	2851	2858	2864	2871	2877	1	1	2	3	3
.46	2884	2891	2897	2904	2911	2917	2924	2931	2938	2944	1	1	2	3	3
.47	2951	2958	2965	2972	2979	2985	2992	2999	3006	3013	1	1	2	3	3
.48	3020	3027	3034	3041	3048	3055	3062	3069	3076	3083	1	1	2	3	3
.49	3090	3097	3105	3112	3119	3126	3133	3141	3148	3155	1	1	2	3	4
N	A. 0	1	2	3	4	5	6	7	8	9	1	2	3	4	5

FOUR-PLACE ANTILOGARITHMS

N	A. 0	1	2	3	4	5	6	7	8	9	Proportional Parts 1	2	3	4	5
.50	3162	3170	3177	3184	3192	3199	3206	3214	3221	3228	1	1	2	3	4
.51	3236	3243	3251	3258	3266	3273	3281	3289	3296	3304	1	1	2	3	4
.52	3311	3319	3327	3334	3342	3350	3357	3365	3373	3381	1	1	2	3	4
.53	3388	3396	3404	3412	3420	3428	3436	3443	3451	3459	1	2	2	3	4
.54	3467	3475	3483	3491	3499	3508	3516	3524	3532	3540	1	2	2	3	4
.55	3548	3556	3565	3573	3581	3589	3597	3606	3614	3622	1	2	2	3	4
.56	3631	3639	3648	3656	3664	3673	3681	3690	3698	3707	1	2	2	3	4
.57	3715	3724	3733	3741	3750	3758	3767	3776	3784	3793	1	2	3	3	4
.58	3802	3811	3819	3828	3837	3846	3855	3864	3873	3882	1	2	3	3	4
.59	3890	3899	3908	3917	3926	3936	3945	3954	3963	3972	1	2	3	4	5
.60	3981	3990	3999	4009	4018	4027	4036	4046	4055	4064	1	2	3	4	5
.61	4074	4083	4093	4102	4111	4121	4130	4140	4150	4159	1	2	3	4	5
.62	4169	4178	4188	4198	4207	4217	4227	4236	4246	4256	1	2	3	4	5
.63	4266	4276	4285	4295	4305	4315	4325	4335	4345	4355	1	2	3	4	5
.64	4365	4375	4385	4395	4406	4416	4426	4436	4446	4457	1	2	3	4	5
.65	4467	4477	4487	4498	4508	4519	4529	4539	4550	4560	1	2	3	4	5
.66	4571	4581	4592	4603	4613	4624	4634	4645	4656	4667	1	2	3	4	5
.67	4677	4688	4699	4710	4721	4732	4742	4753	4764	4775	1	2	3	4	5
.68	4786	4797	4808	4819	4831	4842	4853	4864	4875	4887	1	2	3	5	6
.69	4898	4909	4920	4932	4943	4955	4966	4977	4989	5000	1	2	3	5	6
.70	5012	5023	5035	5047	5058	5070	5082	5093	5105	5117	1	2	3	5	6
.71	5129	5140	5152	5164	5176	5188	5200	5212	5224	5236	1	2	4	5	6
.72	5248	5260	5272	5284	5297	5309	5321	5333	5346	5358	1	2	4	5	6
.73	5370	5383	5395	5408	5420	5433	5445	5458	5470	5483	1	3	4	5	6
.74	5495	5508	5521	5534	5546	5559	5572	5585	5598	5610	1	3	4	5	6
.75	5623	5636	5649	5662	5675	5689	5702	5715	5728	5741	1	3	4	5	7
.76	5754	5768	5781	5794	5808	5821	5834	5848	5861	5875	1	3	4	5	7
.77	5888	5902	5916	5929	5943	5957	5970	5984	5998	6012	1	3	4	5	7
.78	6026	6039	6053	6067	6081	6095	6109	6124	6138	6152	1	3	4	6	7
.79	6166	6180	6194	6209	6223	6237	6252	6266	6281	6295	1	3	4	6	7
.80	6310	6324	6339	6353	6368	6383	6397	6412	6427	6442	1	3	4	6	7
.81	6457	6471	6486	6501	6516	6531	6546	6561	6577	6592	2	3	5	6	8
.82	6607	6622	6637	6653	6668	6683	6699	6714	6730	6745	2	3	5	6	8
.83	6761	6776	6792	6808	6823	6839	6855	6871	6887	6902	2	3	5	6	8
.84	6918	6934	6950	6966	6982	6998	7015	7031	7047	7063	2	3	5	7	8
.85	7079	7096	7112	7129	7145	7161	7178	7194	7211	7228	2	3	5	7	8
.86	7244	7261	7278	7295	7311	7328	7345	7362	7379	7396	2	3	5	7	8
.87	7413	7430	7447	7464	7482	7499	7516	7534	7551	7568	2	4	5	7	9
.88	7586	7603	7621	7638	7656	7674	7691	7709	7727	7745	2	4	5	7	9
.89	7762	7780	7798	7816	7834	7852	7870	7889	7907	7925	2	4	6	7	9
.90	7943	7962	7980	7998	8017	8035	8054	8072	8091	8110	2	4	6	7	9
.91	8128	8147	8166	8185	8204	8222	8241	8260	8279	8299	2	4	6	8	9
.92	8318	8337	8356	8375	8395	8414	8433	8453	8472	8492	2	4	6	8	10
.93	8511	8531	8551	8570	8590	8610	8630	8650	8670	8690	2	4	6	8	10
.94	8710	8730	8750	8770	8790	8810	8831	8851	8872	8892	2	4	6	8	10
.95	8913	8933	8954	8974	8995	9016	9036	9057	9078	9099	2	4	6	8	10
.96	9120	9141	9162	9183	9204	9226	9247	9268	9290	9311	2	4	6	9	11
.97	9333	9354	9376	9397	9419	9441	9462	9484	9506	9528	2	4	6	9	11
.98	9550	9572	9594	9616	9638	9661	9683	9705	9727	9750	2	4	7	9	11
.99	9772	9795	9817	9840	9863	9886	9908	9931	9954	9977	2	5	7	9	11
N	A. 0	1	2	3	4	5	6	7	8	9	1	2	3	4	5

Mathematical Symbols and Abbreviations

$+$	Plus or Positive
$-$	Minus or Negative
$\pm$	Plus or minus Positive or negative
$\mp$	Minus or plus Negative or positive
$\times$ or $\cdot$	Multiplied by
$\div$ or $:$	Divided by
$=$ or $::$	Equals, as
$\neq$, $\doteq$	Does not equal
$\fallingdotseq$	Equals approximately Congruent
$>$	Greater than
$<$	Less than
$\geqq$	Greater than or equal to
$\leqq$	Less than or equal to
$\backsim$	Similar to
$\therefore$	Therefore
$\sqrt{\ }$	Square root
$\sqrt[n]{\ }$	nth root
a^n	nth power of a
log or $\log_{10}$	Common logarithm Briggsian "
ln or $\log_e$ or log	Natural logarithm Hyperbolic " Napierian "
e or ϵ	Base (2.718) of natural system of logarithms
π	Pi (3.1416)
$\angle$	Angle
$\perp$	Perpendicular to
$\parallel$	Parallel to
a°	a degrees (angle)
a'	a minutes (angle) a prime
a''	a seconds (angle) a second a double-prime
a'''	a third a triple-prime
a_n	a sub n
sin	Sine
cos	Cosine
tan	Tangent
cot or ctn	Cotangent
sec	Secant
csc	Cosecant
vers	Versed sine
covers	Coversed sine
exsec	Exsecant
$\sin^{-1}a$ or arc sin a	Anti-sine a Angle whose sine is a Inverse sine a
sinh	Hyperbolic sine
cosh	Hyperbolic cosine
tanh	Hyperbolic tangent
$\sinh^{-1}a$ or arc sinh a	Anti-hyperbolic sine a Angle whose hyperbolic sine is a
$P(x,y)$	Rect. coörd. of point P
$P(r, \theta)$	Polar coörd. of point P
$f(x), F(x)$ or $\Phi(x)$	Function of x
Δy	Increment of y
$\doteq$ or $\rightarrow$	Approaches as a limit
Σ	Summation of
∞	Infinity
dy	Differential of y
$\frac{dy}{dx}$ or $f'(x)$	Derivative of $y=f(x)$ with respect to x
$\frac{d^2y}{dx^2}$ or $f''(x)$	Second deriv. of $y=f(x)$ with respect to x
$\frac{d^ny}{dx^n}$ or $f^{(n)}(x)$	nth deriv. of $y = f(x)$ with respect to x
$\frac{\partial z}{\partial x}$	Partial derivative of z with respect to x
$\frac{\partial^2 z}{\partial x\,\partial y}$	Second partial deriv. of z with respect to y and x
$\int$	Integral of
$\int_a^b$	Integral between the limits a and b
j or i	Imaginary quantity $(\sqrt{-1})$, $i^2=-1$
$x=a+jb$	Symbolic vector notation
$n!=1\cdot2\cdot3\cdots n$	

Greek Alphabet

A	α	Alpha	N	ν	Nu
B	β	Beta	Ξ	ξ	Xi
Γ	γ	Gamma	O	o	Omicron
Δ	δ	Delta	Π	π	Pi
E	ϵ	Epsilon	P	ρ	Rho
Z	ζ	Zeta	Σ	σ	Sigma
H	η	Eta	T	τ	Tau
Θ	θ	Theta	Y	υ	Upsilon
I	ι	Iota	Φ	ϕ	Phi
K	κ	Kappa	X	χ	Chi
Λ	λ	Lambda	Ψ	ψ	Psi
M	μ	Mu	Ω	ω	Omega

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